Open-Source Agility Meets Industrial-Grade Toughness

P1AM-100 CPU
$52.00 C++ UL-certified CPU that combines open source control with AutomationDirect industrial I/O

Open-source MKR shields
Generic and Arduino-brand shields including DIY modules

AutomationDirect industrial I/O, shields, and power supplies
- Power Supplies
- Industrial-grade Shields
- Discrete I/O Modules
- Analog/Temperature I/O Modules
- Relay I/O Modules
- Specialty I/O Modules

P1AM-100 CPU
A rugged open-source CPU that's compatible with the MKRZero Arduino and seamlessly bridges standard 3rd-party shields with AutomationDirect industrial PLC I/O

For the latest prices, please check AutomationDirect.com.
MAKER IN...INDUSTRIAL OUT

Reducing the risk of open source
With the growing popularity of single-board controllers and the risks involved with implementing them in industrial applications, it was apparent that our industry needed an open-source controller that would hold up in the most extreme conditions. Produced in conjunction with FACTS Engineering, the ProductivityOpen controller (P1AM-100) is just that as it combines the best of both worlds - Maker ingenuity coupled with our Productivity controller family’s proven reliability.

WHAT’S INSIDE:
Productivity1000 industrial I/O interface
The I/O interface chipset supports the full suite of Productivity1000 I/O expansion modules, including:
• Discrete
• Analog
• Temperature
• Relay
• High-speed Input
• PWM

Open source at heart (Arduino-compatible)
The processor circuit of the P1AM-100 is designed to mimic the Arduino MKRZero microcontroller. By doing this, the P1AM-100 is able to recognize most available Arduino MKR format shields, and/or all of the industrially-hardened Productivity shields, and can utilize most Arduino sketch programs found on open-source websites. Using the same IDE, the P1AM-100 is programmed using C++ code, or you can use the ProductivityBlocks graphical programming interface to quickly code the controller to operate your application.

Industrial power supply stage
The robust power supply filtering stage produces a regulated 5VDC output from a 24VDC input, isolating the CPU and I/O power. To generate the 24VDC input, use any of the field-proven Productivity1000 industrial power supplies or supply your own using the terminal block connection.

Open source sample code available
UL61010 listed for industrial applications
Expandable I/O with over 216 points using right-side I/O modules and left-side shields
Compatible with Productivity1000 I/O modules (also UL61010)
Industrial-grade shields for Ethernet, GPIO and prototyping
ProductivityBlocks, intuitive block programming software
2 year warranty

For the latest prices, please check AutomationDirect.com.
Open source the Productivity way!

What is “open source”?

The term “open source” is used to describe a program or software created by one developer that is available to be used and/or modified in any way by other developers and users without licensing fees, royalties due, or restrictions on the use of the source code. This is sometimes referred to as “copyleft” as opposed to “copyright”. Open source has evolved to also include hardware, shared schematics and PCB production files that are often readily available to anyone. This type of shared development has spawned an enormous “Maker” community. Numerous Maker sites can be found online with a vast collection of simple, helpful and most of all reusable, DIY projects.

The microcontrollers used to run these DIY programs are inexpensive, small and typically consist of a single integrated circuit containing a processor, memory and I/O. A brand of single-board microcontrollers that has become one of the most well-known is the Arduino.

What is Arduino?

Arduino products were originally created for students without backgrounds in electronics or computer programming. Arduino consists of a family of single programmable circuit boards and the IDE (Integrated Development Environment) that uses a streamlined version of C++ to write and upload code to the boards. Many pre-configured circuit boards, called “shields”, are available to expand the functionality of the Arduino controller. These shields can provide Ethernet, WiFi, GPS, LCD displays, and motor controls, among others, by simply “stacking” or connecting the shields to the Arduino controller board.

Avoid the ticking time bomb

The open-source concept is favored heavily by hobbyists and students, but recently the industrial controls industry has also taken notice, partly due to the extremely attractive price tag. Industrial applications using “off-the-shelf” Arduinos have begun to show up but there is a risk with installing these single-board controllers in industrial environments. Many of these controllers are not field tested and in most instances are just downtime waiting to happen. Vibration, noise, and temperature fluctuations can have a negative effect on consumer-grade microcontrollers, causing unexpected equipment failures and costly production shutdowns. In these types of harsh applications, you need a controller designed to survive - you need the ProductivityOpen!

Open-source communities

Sharing of ideas and finding innovative ways to solve complex problems is facilitated by open-source communities and the websites dedicated to them. Sites like MakerPro and GitHub allow hobbyists and professionals to work together to create interesting solutions for difficult or everyday problems.

“A simple DIY automatic pet feeder I made using a single board controller I got from Amazon.”

“I could use the pet feeder code to create an automatic pig feeder on my farm...

...But I need a controller that can survive the extremely hot Texas summers.”

“I could alter the feeder code to automatically feed ingredients into a mixing tank...

...But I need a controller that can handle the plant’s harsh environment.”

Industrial-Grade CPU (Arduino-Compatible)

$49

www.automationdirect.com/Productivity

mPRA-5 ProductivityOpen Overview

For the latest prices, please check AutomationDirect.com
**Things to consider when choosing between a PLC and Maker controller**

**For the PLC’ers:**
Let’s be honest, a $49 CPU is definitely something worthy of a closer look. But for those coming from a strictly PLC background there are some things to be aware of. Besides the obvious difference of programming methods (C++ vs. Ladder Logic) there are some other functional differences that also need to be addressed and we’ve included them in the table below.

**For the Makers:**
Those of you who are very familiar with open-source controllers, like the Arduino, may be wondering what an industrial controller could provide. Besides the ruggedness and survivability, there are many other benefits as well, some of which are covered in the table below.

<table>
<thead>
<tr>
<th><strong>Industrial Controller Comparison</strong></th>
<th><strong>P1AM-100 (CPU (Arduino-compatible))</strong></th>
<th><strong>P1-540 (PLC CPU)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming language</td>
<td>ProductivityBlocks, Other Community</td>
<td>Ladder Logic</td>
</tr>
<tr>
<td>Development environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Form factor</td>
<td>Productivity1000</td>
<td>Productivity1000</td>
</tr>
<tr>
<td>Right-side expansion (I/O modules)</td>
<td>Productivity1000</td>
<td>Productivity1000</td>
</tr>
<tr>
<td>Left-side expansion (shields)</td>
<td>P1AM Family, Arduino MKR form factor shields</td>
<td>N/A</td>
</tr>
<tr>
<td>Interfaces</td>
<td>USB Programming, Arduino MKR expansion bus</td>
<td>USB Programming + RS232/485 + Ethernet</td>
</tr>
<tr>
<td>CPU toggle switch</td>
<td>User controlled</td>
<td>Run/Stop system controlled</td>
</tr>
<tr>
<td>User LED</td>
<td>User controlled</td>
<td>System controlled</td>
</tr>
<tr>
<td>Memory: project memory</td>
<td>256kB flash</td>
<td>50,000kB</td>
</tr>
<tr>
<td>Memory: data retentive</td>
<td>N/A</td>
<td>500kB</td>
</tr>
<tr>
<td>Memory: removable media</td>
<td>µSD</td>
<td>µSD</td>
</tr>
<tr>
<td>3rd party expansion</td>
<td>Yes, using Arduino MKR expansion bus</td>
<td>N/A</td>
</tr>
<tr>
<td>Project stored on CPU</td>
<td>Yes, optionally</td>
<td></td>
</tr>
<tr>
<td>I/O update control</td>
<td>Typically immediately within program instructions</td>
<td>Typically at beginning/end of scan loop</td>
</tr>
<tr>
<td>GUI FW updates</td>
<td>Controlled by Arduino.cc</td>
<td>Ugraded by user</td>
</tr>
<tr>
<td>Board and library updates</td>
<td>Auto update based on user settings</td>
<td>Manual SW/FW updates from AutomationDirect.com</td>
</tr>
<tr>
<td>IDE updates</td>
<td>Arduino IDE from Arduino.cc and others</td>
<td>Productivity Suite Software from AutomationDirect.com</td>
</tr>
<tr>
<td>Community sharing</td>
<td>Open source; community driven sharing of programs and support</td>
<td>N/A</td>
</tr>
<tr>
<td>Online/runtime edits</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>Auto-configured I/O</td>
<td>N/A</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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**For the latest prices, please check AutomationDirect.com.**
Proven hardware that won’t let you down

Power Supplies
Productivity1000 power supplies provide 16 or 26 W of output power with VDC or VAC input options.
- P1-00DC - 12-24 VDC input with 24VDC, 0.67 A, 20 mA output.
- P1-00AC - 100-290 VAC or 125VDC input with 24VDC, 0.67 A, 16W output.
- P1-02AC - 100-240 VAC or 125VDC input with 24VDC, 0.8 A, 26W output.

NOTE: You can use your own 24VDC power supply by wiring directly to the P1AM-100 CPU power terminals.

Discrete I/O Modules
Discrete input, output and combo input/output modules are available in 8 or 16-point versions with various DC/AC voltage ranges.
- P1-08DR - Input Module: 2-channel, 0-10 VDC, 12-bit resolution
- P1-08DO - Output Module: 2-channel, 0-20 mA in, 12-bit resolution
- P1-16DO - Output Module: 8-channel, 0-20 mA output

Relay I/O Modules
Relay output modules support devices that operate with voltages up to 240VAC or 24VDC.
- P1-08TRS - Output Module 8-pt, 6-24 VAC/VDC, 0.67 A, 20 mA output
- P1-16TR - Output Module 16-pt, 6-24 VAC/VDC, 1.3 A, 20 mA output
- P1-16DO - Output Module 8-channel, 0-20 mA output, 16-bit resolution

Analog/Temperature I/O Modules
Analog input and output modules are available to monitor and control pressure, temperature, flow, level or any other process signal your application requires.
- P1-04DAL - 1 - Output Module: 4-channel, 0-10 VDC, 12-bit resolution
- P1-04ADL - 1 - Input Module: 4-channel, 0-10 VDC, 13-bit resolution
- P1-04ADL2DAL - 1 - Combo Module: 4-channel, 0-10 VDC in, 4-channel, 0-10 VDC out

Specialty I/O Modules
Specialty modules are designed to perform specific functions.
- P1-04PWM - Pulse Modulation Output Module, 4) 0-20 kHz pulse modulated outputs, 0-100% duty cycle
- P1-04SIM - Input Simulator Module, 8-pt
- P1-04AD - Input Module: 4-channel, 0-10 VDC, 13-bit resolution
- P1-04ULA - Input Module: 4-channel, ±5VDC, ±10VDC, 0-5 VDC, 0-20 mA, 16-bit resolution

Industrial-grade Shields
ProductivityOpen industrial shields are rated for harsh duty and can add needed functionality to the P1AM-100 CPU.
- P1AM-ETH: Ethernet Module, provides a single 10/100 Mbps Ethernet connection
- P1AM-GPIO: MKR-pins Extension Shield, subset of pins routed to front-facing 18-pin terminal block

Interactive Hardware Configurator Tool
Use the interactive configurator tool on our website to quickly configure your ProductivityOpen system to your specifications. Simply choose the power supply, I/O modules and shields you require with the connection options you prefer and send the selected ports right to the shopping cart.
4 expansion options for maximum versatility

The P1AM-100 CPU is designed to reliably take open-source control into the industrial realm. But we didn't stop with just the CPU. We've also engineered a collection of industrial shields that can add needed functionality to the controller. Options including Ethernet can easily be added to the left side of the CPU. Readily-available Arduino shields can also be added to that side if needed. On the right side of the CPU, you can expand the system with low-cost Productivity1000 discrete, analog and specialty I/O modules. Up to 240 discrete I/O points are possible on the right-side, with virtually unlimited I/O on the left.

It's your choice to select any configuration that meets your needs:

1. 100% industrial
   Ensure that all aspects of your open-source controller are protected from harsh environments with industrially-rated power supplies, shields, CPU and I/O modules.

2. Industrial Maker
   Got a specific Arduino shield you want to use in your process? That’s perfectly okay with the ProductivityOpen controller. Simply attach any compatible Arduino shield(s)* to the left side of the CPU and use Productivity1000 industrially-hardened I/O modules to give your controller added protection from field equipment.

3. The jack of all trades
   You can mix and match any combination of compatible open Arduino shields* and industrially-rated ProductivityOpen shields to achieve the control you’re looking for. The ProductivityOpen controller has been designed to provide the utmost flexibility to satisfy both Makers and industry professionals.

   *Use discretion, since many of the consumer-grade Arduino shields are not suitable for industrial applications.

4. DIY all the way
   Build custom electronic circuits and interfaces for your control system with our proto board. The P1AM-PROTO is a generic perf board with 100mil thru-holes for your own prototype designs.

Click below or go to http://go2adr.com/hardwarevid to view Check out all of the hardware options in this video
Tested, tested, and tested again to ensure quality

Why should UL have all the fun?
FACTS Engineering, our development and manufacturing partner for Productivity controllers, takes product reliability very seriously. When developing new control products like the P1AM-100, FACTS thoroughly tests them in house to validate their longevity. Once the product has been through FACTS’ rigorous testing, there’s really no doubt they’ll be certified by UL.

FACTS has many in-house testing stations at their facility in New Port Richey, FL, including a shake table and temperature chamber that they use to ensure your controller continues to perform, no matter how harsh the environment, well beyond the purchase.

Getting started is easy with our convenient starter kits!
Our starter kits provide everything needed to get you on your way. CPU, industrial shields, industrial I/O modules, power cables and more are all included with the P1AM-START1 kit. The P1AM-START2 is a lower-cost starter kit without industrial shields and includes CPU, industrial I/O, power supply, etc., perfect for those wanting to learn more about open-source control.

Order yours today and get it fast with our FREE two-day shipping!

The P1AM-100 open-source controller is designed to survive where others fail and we guarantee it with a two-year warranty!

What’s in the P1AM-START1?
A kit for the devoted Maker:
- (1) P1AM-100 CPU
- (1) P1AM-ETH Ethernet shield
- (1) P1AM-GPIO MKR-pins extension shield
- (1) P1-4ADDL20AL-1 analog combo module
- (1) PSL-24-030 power supply
- (1) USB-CBL-AMICB6 programming cable
- (1) 3-wire power cable
- (1) P2-RTB terminal block
- (1) P1-10RTB terminal block

What’s in the P1AM-START2?
A kit for the PLC’er wanting to learn Arduino:
- (1) P1AM-100 CPU
- (1) P1-08TRS relay output module
- (1) P1-08SIM simulator input module
- (1) P1-4ADL20AL-1 analog combo module
- (1) PSL-24-030 power supply
- (1) USB-CBL-AMICB6 programming cable
- (1) 3-wire power cable
- (1) P2-RTB terminal block
Exceeding the needs of an ever-changing industry

As industry changes, we are there for you!

Let's face it, with technology, change is constant. New advancements and techniques are always on the horizon and one major shift we see today is in controller programming. Ladder Logic is still a very popular programming method but other methods, like C++ programming, are making big inroads into industrial automation thanks to low-cost microcontrollers like the Arduino. But keeping up with industry trends doesn't mean you have to sacrifice system integrity.

The P1AM-100 provides the C++ programming environment you want with the industrially-hardened hardware you need.

Arduino IDE
- download here -

For use with: Windows®, Mac®, Linux®

The Arduino IDE is a C++ programming environment used for writing and compiling source code for Arduino-based controllers. The IDE contains a text editor for code writing, an output/message area, a small toolbar for common functions and a menu bar. It also has a Monitor and Graphing output window which helps with debugging your project.

Programs written using the Arduino IDE are called sketches. You can download previously-created sketches from the Arduino community-at-large for "code-in-an-instant" or create your own using C++ or the super-easy ProductivityBlocks interface.

ProductivityBlocks

Based on the ArduBlock concept, ProductivityBlocks is a graphical programming interface and add-on to the Arduino IDE. If you have ever programmed with C++, you know how tedious it can be hunting down the dreaded syntax error like a missing semicolon or bracket. ProductivityBlocks helps you build your sketch program by dragging and dropping interlocking blocks; the associated C++ is generated for you. ProductivityBlocks works with either MAC or PC systems offering custom blocks that use terminology common to industrial controller functions so their purpose is easily understood. Many are customized for Productivity1000 I/O modules, ProductivityOpen CPU and shields, and creates an easier interface for coding that will save you time and debugging headaches.

It's completely free, will save you tons of development time and is perfect for our loyal Apple® customers.

Give ProductivityBlocks a try today!

Using the Arduino IDE:
See how to program your ProductivityOpen CPU using the Arduino IDE

Click image or go to http://go2adc.com/firstsketch to view

ProductivityBlocks Interface
- download here -

For use with: Windows®, Mac®

For the latest prices, please check AutomationDirect.com.
Tons of helpful resources available anytime

AutomationDirect Community

Our technical/community forum at www.go2adc.com/P1AM is the place to go for help with your P1AM-100 project. There you will find:

- Links to our GitHub repositories - Library, Board Support and Mechanical
- Arduino IDE install link
- ProductivityBlocks interface download
- Links to numerous helpful videos
- Most of all, ideas and advice from over 29,000 industry professionals with various backgrounds and expertise.

Arduino IDE
- download here -

For use with:
Windows®
Mac®
Linux®

AutomationDirect Community

forum with 29,000 members and growing!

www.go2adc.com/P1AM

Our online store at www.automationdirect.com has all of the product information you need. Specifications, agency approvals, inserts, manuals, 3D CAD files and more can be found here 24/7/365.

CAD files, photos, helpful How-to videos are all here 24/7/365
“But what can I do with it?”

The short answer is, “Whatever you can think of”. The P1AM-100 is a blank canvas and if you have the know-how, you can make it do almost anything. On the other hand, if you don’t have much experience with C++, there may be a program already written that will do what you need. That’s the beauty of open source - many times what you want to do has already been done. Make it a simple data logger with an Excel interface, incorporate a Modbus TCP server for C-more and other HMIs, or make it a pick-and-place controller on a production line, it’s completely up to you and your imagination!

Any job, any industry
- Simple data logging
- IIoT functions
- Pick and place applications
- Temperature and humidity monitoring
- Greenhouse automation
- HVAC control
- Car wash systems
- Water treatment facilities
- Package/material handling
- Generator switchgear
- Lighting control
- The possibilities are ENDLESS!

Use it as a simple data logger
Use it to display critical information
Use it throughout your process for reliable monitoring and control

Mixing
Unloading
Filling
Capping
Packaging

For the latest prices, please check AutomationDirect.com.
Don’t take chances with maintenance costs

The cost of maintenance can quickly destroy your investment returns and your sleep! When it comes to using a consumer-grade single-board microcontroller in an industrial environment, some say “So what if it breaks, I’ll just replace it with another inexpensive microcontroller.” While that may be an option, adding to your maintenance costs is never a winning scenario.

It’s believed that up to 20% of plant operating expense is maintenance-related. That’s a good chunk and planning ahead to add to that percentage isn’t a good idea. Besides the cost of replacement parts and the labor needed, you’ll also have to consider the possibility of pulling valuable resources away from other projects, the increased probability of a failure during peak production hours, having to keep a large inventory of replacement parts on hand, and if any domino effect will occur from the failure - meaning how will the machine/system react and will other components fail as a result?

When you look at the big picture, it’s apparent that the “I’ll just swap it when it breaks” method can turn out to be quite costly. And although a consumer-grade microcontroller’s initial cost is very attractive, the savings in maintenance and downtime that you get with an industrial microcontroller blows the initial $30-or-so price difference out of the water!

**EXAMPLE:** You work for a package delivery service, and at your sorting facility you need to purchase an inexpensive controller to fire a single diverter arm that is feeding the new outbound conveyor. Let’s see what could happen in this industrial environment with the P1AM-100 vs. a consumer-grade microcontroller...
Consumer-grade controllers have their place, but the harsh conditions of the industrial world is not one of them. So ask yourself this simple question, when it comes to your and your company’s reputation,

Would you rather:

A low-cost open-source controller built specifically for the industrial automation field by engineers with over 25 years of service to that field, with a sound product support structure and helpful resources that will be there for you now and in the future?

CONSUMER-GRADE SHIELDS
CONSUMER-GRADE MICROCONTROLLER
CONSUMER-GRADE OPEN/C++ CPU

OR

A low-cost open-source controller that is intended for classrooms and hobby projects, with no long-term product support or decades of experience servicing the needs of automation professionals?

INDUSTRIAL-GRADE SHIELDS
INDUSTRIAL-GRADE OPEN/C++ CPU
INDUSTRIAL-GRADE PRODUCTIVITY 1000 I/O MODULES

Open Productivity

2 YEAR WARRANTY

$49

Industrial-Grade CPU (Arduino-Compatible)

www.automationdirect.com/ProductivityOpen

1-800-633-0405