

Product Focus: Programmable Logic Controllers

What can a PLC do for you?

Programmable Logic Controllers (PLCs) have been around for over 50 years and have become the go-to control choice for automation projects worldwide. Used in a multitude of applications including assembly line control, food processing and packaging, luxury yacht automation, and even amusement park rides, PLCs are everywhere. The benefits provided by today's low-cost PLCs (CLICK PLCs start at \$69) easily outweigh their expense, making them a must-have for modern-day production processes.

PLC Benefits

- 1. Utmost flexibility: PLCs have high processing speeds and can carry out complex functions including arithmetic, pulse tracking, condition monitoring, etc. They can also manage many inputs and outputs simultaneously, allowing one PLC to control and monitor many processes at once. Many changes needed to the process can be handled via the software, requiring no rewiring of components.
- 2. Longer life and reliability: PLCs are designed to handle the harsh industrial world and are constructed with solid state components, so there are no moving parts that can wear out over time and fail.
- 3. Easier troubleshooting: PLCs provide many diagnostic tools to help isolate malfunctions quickly, and replacing parts is much less time consuming than systems with hard wired control.
- 4. Less real estate required: PLCs have become more compact with many micro versions available today. The smaller form factors free up a lot of panel space compared to older control systems.
- 5. Energy savings: Modern-day PLCs consume a fraction of the energy required by their electromechanical relay control counterparts.







9 Helpful Steps for Specifying PLCs

As with any engineering decision, it's always best to put it on paper first to see the "big picture". The same holds true when choosing the most effective controller for your application. This choice depends on a number of factors and the following steps serve as a checklist of things to consider when determining programmable logic controller requirements. Listed are the most important areas to consider when choosing a control system and can help determine your system needs.

Step 1. Proposed System

Determine whether your system is new or existing. Will your system be installed from scratch or are there existing products already installed? The rest of your system will need to be compatible with new components.

Why this is important:

Certain controller products may not be compatible with others. Making sure your existing products are compatible with any new products you are researching will save you time and money.

Step 2. Environmental Issues

Consider any environmental issues that will affect your application (temperature, dust, vibration, codes specific to your facility, etc.)

Why this is important:

Certain environments may affect the operation of a controller. For example, typical controllers have an operating temperature of 0-55 degrees Celsius (32-130 degrees F). If your application will include any extreme environmental conditions, or you have specific codes at your facility that must be met, you will need to either research products that meet those specifications or design the installation to meet requirements.

Step 3. Discrete Devices

Determine how many discrete devices your system will have and which types (AC, DC, etc.) are needed. *Why this is important:*

The number and type of devices your system will include is directly linked to the amount of I/O that will be necessary for your system. You will need to choose a controller that supports your I/O count requirements and has modules that support your signal types.

Step 4. Analog Devices

Determine how many analog devices your system will have and which types (voltage, current, temperature, etc.) are needed. *Why this is important:*

Same as with discrete devices, the number and type of devices your system will include is directly linked to the amount of I/O that will be necessary for your system. You will need to choose a controller that supports your I/O count requirements and has modules that support your signal types.

Step 5. Specialty Modules or Features

Determine whether your system will require any specialty features. Will your application require high-speed counting or positioning? What about data logging, a real-time clock, or other specialty feature?

Why this is important:

Specialty functions are not necessarily available in all controller CPUs or in standard I/O modules. Understanding the special functions your system may perform will help you determine which CPU to choose and whether or not you will need to purchase additional specialty modules.

Step 6. CPU Requirements

Determine the type of CPU you will need. How much memory will your system require? How many devices will your system have (determines data memory)? How large is your program estimated to be, and what types of instructions will your program include (determines program memory)? How fast a scan time do you need?

Why this is important:

Data memory refers to the amount of memory needed for dynamic data manipulation and storage in the system. For example, counter and timer instructions typically use data memory to store setpoints, current values, and other internal flags. If the application requires historical data retention, such as measured device values over a long period of time, the size of the data tables required may determine the CPU model you choose.

Program memory is the amount of memory needed to store the sequence of program instructions that have been selected to perform the application. Each type of instruction requires a specific amount of program memory. Applications that are basically sequential in nature can rely on the I/O device rule of thumb to estimate program memory (5 words of program memory for each discrete device and 25 words for each analog device); complex applications will be more difficult to judge.

If scan time is important in your application, consider the CPU processor speed as well as instruction execution speed. Some CPUs are faster at Boolean logic but slower with data handling instructions. If special functions such as PID are required, the CPU you select may make those functions easier to perform.

Step 7. I/O Locations

Determine where your I/O will be located. Will your system require only local I/O, or both local and remote I/O locations? *Why this is important:*

If subsystems will be needed at long distances from the CPU, you will need a controller that supports remote I/O. You will also have to determine if the remote distances and speeds supported will be adequate for your application. Ethernet-connected I/O hardware is becoming one of the more popular communication standards. This I/O may also be referred to as distributed I/O, and may require a particular protocol, such as Modbus.

Step 8. Communications

Determine your communication requirements. Will your system be communicating to other networks, systems or field devices?

Why this is important:

Communication ports (other than the programming port) are not always included with a controller.

Knowing your system communication requirements will help you choose a CPU that supports your communication requirements, or additional communication modules if necessary.

Step 9. Programming

Determine your programming requirements: Does your application require only traditional programming instructions, or are special instructions necessary? Do you prefer fixed memory addressing or tag name based control? Which programming language are you accustomed to?

Why this is important:

Certain controllers may not support every type of instruction. You will need to choose a model that supports all instructions that you may need for a specific application. For example, built-in PID functions are much easier to use than writing your own code to perform closed-loop process control. Typical instructions such as timers, counters, etc., are available in most controllers. Also, many variations exist when it comes to the programming language (ladder logic, structured text, etc.) and memory addressing (fixed or tag name based). Choose the programming package that you are most comfortable with and that will offer the most ease-of-use when developing, troubleshooting and maintaining.

Something to Consider: Open-source Control

With the growing popularity of low-cost single-board controllers and the "Maker" communities that support them, it was only natural for them to find their way into the industrial realm. Off-the-shelf single-board controllers are intended for hobbyists and students but the automation industry needs an open-source controller that can handle extreme conditions. The ProductivityOpen controller (P1AM-100) is an industrial open-source controller designed for harsh environments that is programmed using C++ code for utmost controller customization.







Do-more PLCs starting at **\$197**

The Do-more PLC family has one of the most advanced instruction sets in the market and many other tools/ features to help you tackle complex applications.

Productivity Series CPU starting at **\$180**

The Productivity PLC family offers the utmost versatility in both hardware and software. This scalable PLC line will easily conform to large systems with tons of I/O or smaller/segmented systems using limited I/O. With tag name programming, device integration that includes GS drives, Protos X field I/O and others, and a few WOW factors, like onboard analog module data displays, Productivity PLCs are a perfect fit for almost any application.

SIMPLE CONTROL

The CLICK micro-brick PLC (starting at just \$69.00, with FREE easy-to-use programming software) is by far the most practical PLC for the smallest of applications and the perfect tool for beginners.





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www.vacuumtechnology.com For over 30 years Vacuum Technology Incorporated has focused on developing practical, affordable, and custom-tailored solutions for industrial vacuum/leak testing applications worldwide.

"We found the CLICK PLC from AutomationDirect to be a reliable, easyto-use, I/O interface for our machines. We replaced our bulky, aging, relay circuit boards and ribbon cable PC connections with smaller, more affordable, Ethernetcapable CLICK PLCs. Besides their PLCs, AutomationDirect's fast, same-day shipping and easy ordering are an added plus for us." - Jesus Chavez

www.AutomationDirect.com I-800



ADVANCED CONTROL (fixed memory addressing)

The Do-more! PLC control technology was developed to efficiently tackle complex applications. This PLC series, with its numerous hardware and software features, provides an extensive toolbox to help you master the most demanding projects.

Do more with advanced applications including:

- Waste water treatment
- Stepper/servo control systems
- Simple to mid-range motion control
- Electrical switchgear applications
- HVAC /chiller tower control
- Precision valve control
- Object positioning
- Building automation
- Bar code systems

lloT/Big Data applications Data logging Protocol conversion

Modbus RTU to TCP conversion

www.do-more.com

Do-more BRX PLCs STRONG POINTS:

- Motion control
- Built-in high speed I/O
- PWM outputs
- Email with attachments
- Robust Instruction set
- Data file management
- MQTT(S)/HTTP(S)/FTP
 protocols

- Rest API
- Embedded webserver
- PLC simulator
- Security
- User-defined structures
- Embedded video help



Robust instruction set

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🔶 Favorites	
Contact	
Coil/Bit Output	
Analog/Process	
Date/Time/Calendar	
Ethernet Softwara	
File System	
Hardware/Device	
High Speed/Axis	
AXCAM - Axis Electronic Camming	
AXCONFIG - Axis Configuration	
AXFOLLOW - Axis Position Following with Offset	
AXGEAR - Axis Electronic Gearing	
AXHOME - Axis Perform Home Search	
AXJOG - Axis Jog Mode	
AXPOSSCRV - Axis Move to Position Using S-Curve	
AXPOSTRAP - Axis Move to Position Using Trapezoid	
AXRSTFAULT - Reset Axis Limit Fault	
AXSETPROP - Set Axis Properties	
AXVEL - Axis Set Velocity Mode	
TDODECFG - Deconfigure Table Driven Output	
TDOPLS - Load Programmable Limit Switch Table for Table Driven Output	
TDOPRESET - Load Preset Table for Table Driven Output	
Math	_
Misc/Data Manipulation	
Program Control	
Program-Looping	
Protocol-Custom/ASCII	
Protocol-Standard	Т
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FREE advanced programming software with powerful development tools and over 200 instructions

Timer/Counter/Drum

James Catlett Plant Manager Chemence

C2 3 X 5 C 5 7 5 5 C 0 1 2 3

"AutomationDirect's low prices and free support keep us coming back. Their automation products are exactly whatwe need to get the job done and the new BRX PLC, with its motion capabilities and built-in analog, is perfect for our packaging lines." - James Catlett



www.chemence.com

Chemence is the only industrial, consumer, and medical cyanoacrylate manufacturer in the US.

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Productivity^{Series}. **ADVANCED CONTROL** (tag name memory addressing)

The Productivity family of PLCs is our most versatile family. Each series offers different I/O capacities but all use the same programming software, allowing you to easily scale your control hardware up or down depending on the application. The ProductivitySuite software provides versatile programming with tag name addressing that has no predefined memory structure.

Great for any application including:

- Waste water treatment
- Stepper/servo control systems
- Precision package tracking and sorting
- Bottling applications
- Electrical switchgear applications
- HVAC /chiller tower control
- Car wash systems
- Industrial oven control

Communication-heavy or diverse applications

Productivity PLCs STRONG POINTS: • Web server/mobile access

- Tag name memory
- Large I/O count
- Hot-swappable I/O modules
- Multiple built-in communication options
- ABS certified modules
- High level of integration

Productivity 1000, CPU only \$204

- 4 built-in comm ports: micro USB, Serial RS-485, Serial RS-232, Ethernet 10/100Mbps
- · Data logging up to 32GB on a microSD card (sold separately)
- Slim, stackable, super compact design

Productivity 2000, CPU only \$276

- 5 built-in comm ports: (1) plug-andplay USB programming port, (1) general purpose Ethernet 10/100Mbps port, (1) remote I/O Ethernet 10/100Mbps port and (2) serial ports
- Data logging up to 32GB on a microSD card (sold separately)
- Programmable 4-line OLED message display on CPU for system status and tag data readouts

- Add up to 8 I/O modules for a total of 128 discrete I/O points or 32 analog I/O channels
- Choose from spring clamp, screw terminal or the popular ZipLink wiring solution for your I/O wiring needs



- OLED displays on select analog modules for real-time, no meter required measurements
- Up to 480 local I/O points and 4,320 total I/O through remote expansion
- 29 discrete, analog and specialty I/O modules including high-speed



www.productivityplc.com

Productivity3000°,......... CPU starting at only \$589

- Up to 7 built-in comm ports: USB programming port, micro USB, Serial RS-485, Serial RS-232, general purpose Ethernet 10/100Mbps port, remote I/O Ethernet 10/100Mbps
- Programmable 4-line LCD message display on CPU for system status and tag data readouts
- LCD displays on all analog modules
- Support for local expansion and remote I/O bases, up to 59,840 I/O points
- 39 discrete, analog and specialty I/O modules including high-speed
- ABS certified



ADVANCED **ALL-PURPOSE CONTROL** EXTREME VERSATILITY FOR THE WIDEST RANGE OF **APPLICATIONS**

Database sharing (great for

• Two-dimensional data arrays

Scalable hardware options

SCADA/HMIs)

• Data displays

(sorting/tracking)

Robust instruction set



MIMX Find Min Max Values SCL Scale (Linear) SRR Shift/Rotate Array

H NO Contact (NO) [TGC] Toggle Coil

Contacts

5ई Compare Contact (CMP) ₭ NC Contact (NC) 北 NC Edge Contact (NCE) HH NO Contact (NO) HI NO Edge Contact (NOE) Coils

ALM Alarm RVG Average CHG Change of Value MIMX Find Min Max Values LALM Learn Alarm LIM Limit Value RMP Ramp GEN Ramp Generator SCL Scale (Linear) SCLN Scale (Non Linear) SUM Selected Summation SW Switch

Application Functions Array Functions Counters/Timers Communications 🗄 📃 Data Handling Drum Sequencers High Speed I/O Functions HOME Find Home PST Preset Table PLS Programmable Limit Switch **REG** Registration SPOS Set Position SMOU Simple Move

IMOIL Valacity Mayo

FREE

Software

Todd Timpa Special Projects Manager CTC Crushing

"We recently upgraded our entire plant from a hardwired, manually-controlled operation to a PI C-controlled one using the Productivity2000 and C-more HMIs from AutomationDirect. These products have performed remarkably well in the quarry's harsh environment and have provided the simplicity. reliability and efficiency we were looking for." - Todd Timpa **Brandon Sembrick** Flectrician **CTC** Crushing



CTC Crushing, an IMPACT family company, supplies quality sand, gravel and specialty rock products to the Las Vegas and Boulder City, NV areas. They've been responsibly mining and crushing native rock for 20 years and are experts in aggregate production.

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Still unsure which PLC is for you? Let us help.

When it comes to deciding which one of our PLCs is the one for your application, we want to help. Our online interactive PLC selector tool can help get you on the right path to the right PLC. Simply choose the type and amount of I/O, the type of communication, and any hardware or software requirements. The tool will then display the suitable PLC families for your selections, along with overview videos, cost comparisons, and feature listings.

FREE online PLC selector: http://go2adc.com/select-plc

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Programmable Controllers	Ethernet	0	EtherNet/IP U		 Supports up to 143 	discrete I/O points.
Pushbuttons / Switches / Indicators	E Serial 0		Modbus TCP		 Supports up to 54 Supports up to 3 a 	inalog channels. Irial ports.
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And don't forget, our tech support group is available at 1(800) 633-0405 to answer any questions you may have about the capabilities of our many PLC products.

Feature	Do-more BRX	Productivity2000	CLICK
Motion Control	(250kHz pulse in/out with axis/ coordinated control)	(1MHz pulse in/out)	
PID	(with trending and auto-tuning)	(with trending and auto-tuning)	(with trending and auto-tuning; Ethernet models only)
Max PID Loops	Only limited by memory	Only limited by memory	8 loops
Built-in Communications Ports	Up to 3 built in (including POM interchangeable port): RS232/485 serial port; Optional Ethernet port; POM Slot port options: USB, RS232, RS232 w/ Flow Control, RS422, RS485 or Ethernet	5 built in: USB, RS-232, RS-485, Ethernet, Remote I/O with integrated GS drives, remote slaves and Protos X field I/O systems	Up to 3 built in: RS-232, RS485 and/or Ethernet
Built-in Port Speeds	Ethernet: 10/100 Mbps Serial: up to 115.2k baud	Ethernet: 10/100 Mbps Serial: up to 115.2k baud	Ethernet: 10/100 Mbps Serial: up to 115.2k baud
Communications Protocols	Modbus RTU Master/Slave, Modbus TCP, TCP/IP, EtherNet/IP, MQTT/MQTTS, HTTP/ HTTPS, FTP, SMTP, SNTP, DHCP, Ethernet remote I/O, K-sequence Slave	Modbus RTU Master/Slave, Modbus TCP, ASCII In/out, TCP/IP, UDP/IP EtherNet/IP, Ethernet remote I/O, ProNET, Custom	Modbus RTU Master/Slave, Modbus TCP, EtherNet/IP, ASCII In/out
Email	(allows data file attachments)	(allows data file attachments)	
Data Displays		(CPU module status and patented analog module data displays)	
Data Logging	(1MB Internal RAM + 32GB MicroSD option)	(32GB MicroSD option)	
Data File Management	(12 specific instructions for file handling)		
Built-in Web Server/Mohile			

This chart lists some common careabouts for our most popular PLC series

Feature	Do-more BRX	Productivity2000	CLICK
Built-in Web Server/Mobile Access	(Web server)	(Web server and mobile app)	
Max Local Discrete/Analog I/O	292 discrete I/O points and 134 analog channels	480 discrete I/O points 240 analog channels	142 discrete I/O points or 54 analog channels
Max Local High-speed I/O	146 high-speed I/O channels at up to 250kHz using built-in DC I/O and HSIO1/2 modules or 64 channels at up to 2MHz with the HSIO4	30 high-speed I/O channels at up to 1MHz using additional modules	8 inputs / 6 counters at up to 100kHz using built-in DC inputs
Remote Expansion	Up to 247 remote I/O bases (using MBIO controller) and up to 16 Scanner/Client Explicit EtherNet/IP connections	Up to eight remote I/O base groups and up to 32 scanner/client Ethernet connections	
Auto-configured I/O	 ✓ 	v	 ✓
Integrated VFD, VPN & field I/O support		v	
Max User Memory	1.89 MB	50 MB	16 KB
Programming Environment	Fixed memory addressing; ladder logic with fill- in-the-blank function blocks, stage sequencing	Tag name addressing; ladder logic with fill-in- the-blank function blocks	Fixed memory addressing; ladder logic with fill-in-the-blank function blocks
Instruction Set	200+ instructions	80+ instructions	21 instructions
Structure Data Types	(user defined)	(user defined)	
Data Arrays	1D	1D/2D	1D
Code Blocks	Programs/Subroutines/Tasks/Interrupts	Tasks	Subroutines/Interrupts
Project Simulator	 ✓ 	V	
Rest API	 ✓ 		
Pulse Width Modulated Outputs	 ✓ 		
Security	OS/Project/Communication	Project	Project
Onboard Help	Extensive help file with embedded videos and video library	Extensive help file	Help file with video links

FREE software and FREE technical support all our PLCS!











INDUSTRIAL OPEN-SOURCE CONTROL

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.

Industrial-Grade

CPU (Arduino-Compatible)

RESET 14 + TX 13 + RX 12 SCL 11 SDA 10 MISC 9 SCK

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.

The P1AM-100 CPU is a blank canvas and with the right know-how, you can make it do almost anything:

- Simple data logging
- IIoT functions
- Pick and place
- Greenhouse automation
- HVAC control
- Water treatment processes
- Package/material handling
- Generator switchgear
- Lighting control
- The possibilities are ENDLESS!

The Productivity®Open UL/CE-certified open-source CPU mimics the Arduino® MKRZero microcontroller, seamlessly supporting both standard 3rd-party MKR shields and industrial PLC I/O.

Productivity Open

With the ProductivityOpen platform you get all the great features of a standard Arduino plus the added

+

power and reliability of an industrial controller.

- Open-source sample code
 available
- C++ programming
- Add-on shields for product optimization
- Low cost controller

- Industrialized power supply for EMI and ESD protection
- UL61010 listed for industrial applications
- Expandable I/O with over 240 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



Program the ProductivityOpen CPU using the Arduino IDE (C++) or the ProductivityBlocks graphical programming interface to quickly code the P1AM-100 controller for your application. Based on the ArduBlock concept, ProductivityBlocks is a graphical programming interface and add-on to the Arduino IDE. ProductivityBlocks helps you build your sketch program by dragging and dropping interlocking blocks; the associated C++ is generated for you!

www.automationdirect.com/P1AM

The gap between plant-floor systems and frontoffice operations is closing at a rapid pace. Data sharing between logistics, accounting, maintenance, production, and other departments provides "big-picture" oversight, which results in better planning, reduced waste, and higher efficiency.

Modern-day PLCs, like the Do-more! BRX, have adapted to the demand for higher-level data exchange. BRX has advanced data logging and communication features, including an embedded Rest API and native MQTT(S) protocols, that allow it to easily take on the role of an edge device gathering, refining and delivering control system data to upstream IT collection and BIG DATA analysis programs.





Must-have lloT Protocols

FTP Protocol

With the growing number of IIoT platforms and cloud computing services, BRX controllers utilize the industry-standard MQTT(S) and FTP protocols to seamlessly integrate with asset management/IIoT platforms including Microsoft Azure[®] and IBM Watson[®].

Embedded Web Server

With BRX's embedded Web server, you can instantly access system status, diagnostic information, and monitor memory usage from any Internet-ready device.

Rest API

The integrated Rest API and secure HTTPS protocol allow BRX to work with flow control tools like Node-RED[®] in order to supply high-level IT systems with the plant-floor data they need.



AutomationDirect.com has been a leader in providing affordable, quality industrial control products to the U.S. and Canada for more than two and a half decades.

As a privately-held efficiently run company, we take pride in serving our customers the way they want to be served - honestly and fairly. We do everything we can to accomplish this day in and day out.



- Honest up-front pricing (no gimmicks)
- Quick delivery order today, it ships fast!
- FREE tech support top-rated by customers in surveys and reviews
- FREE shipping on orders over \$49