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Foreword

Since 1968, with the introduction of the first Modicon programmable logic controller, PLCs have been the driving force behind all of industrial automation. PLCs are notable for having several important characteristics. First, and perhaps most importantly, is their ability to connect to control and signaling devices on the factory floor. Also, they are designed to be modular in order to fit a variety of design requirements. Finally, they are traditionally programmed with languages that mimic electrical control diagrams.

In this book, we will explore four critical elements of every PLC hardware system: the CPU, the power supply, the modules for input and output connections, and the communication ports that link the PLC with the rest of the factory. Although each PLC has its own unique characteristics, there are many common elements that users will recognize across all makes and models.

Our team has compiled this book thanks to generous hardware contributions from several industrial PLC manufacturers, both for physical bench tests and for product images. The content is exclusively written and edited by our own engineering and editorial team at Control.com, and we hope that you will find it to be practical as you continue your journey of understanding in electrical control systems.



David Peterson

Director of Engineering Content at Control.com



The Components of a PLC

A **programmable logic controller**, or PLC, is an industrial computer designed to handle the everyday operation of machines. The primary tasks of a PLC are to receive signals from buttons and sensors, quickly process these signals, and then provide the proper outputs with absolute reliability.

The shapes, sizes, and colors of PLCs vary wildly across manufacturers and product lines. However, there are four key components that are found within nearly every PLC:

1. The central processing unit (CPU).
2. The power supply unit (PSU).
3. Input/output (I/O) modules.
4. Communication and networking ports.

This ebook will provide a detailed look at the types, functions, and connections of each of these components.



All PLCs share some common elements: (left-to-right) a power supply, communication modules, the CPU, and I/O modules.

The CPU

All of the components inside a PLC are critical to its function. However, none is more important than the **central processing unit (CPU)**. It is responsible for executing the logical instructions that make up the "programmable" part of a programmable logic controller PLC.

The CPU acts much like the processor inside any computer, executing the program and communicating with external devices. However, a PLC CPU is far simpler and will rarely match the performance of even the lowest-end modern laptop. Although both a PC CPU and a PLC CPU execute instructions that are core to the function of the computer, the difference in installation context calls for extremely different execution strategies.

What Does a PLC CPU Actually Do?

To run a process, a CPU must accomplish several distinct tasks, all of which are closely related to each other:

- Communicate with the engineer's programming computer to receive the program.
- Transmit data across the backplane between various PLC modules.
- Scan and update the table of current values from all I/O modules.
- Calculate the result of each line of code.
- Update the table of values to be sent to the output modules.

Loading and executing a program sets this CPU apart from a traditional computer in a very important way. For most PCs, general users would refer to the operating system (OS), like Windows, macOS, or Linux, as the background system that loads and runs programs and provides the user interface.

A PLC CPU cannot install and run software applications, nor does it provide a user interface that can be connected to a mouse or keyboard.

Instead, the system running inside a PLC is what is known as a **runtime environment**. This means that it is limited to executing lines of machine code and interacting with the power supply and hardware modules (the I/O modules). The PLC itself does not contain the programming environment in which the user can design and compile the code.

For user code design, each manufacturer creates their own **integrated development environment (IDE)**, like Rockwell's Studio 5000, Siemens's TIA Portal, or



Be sure to choose wisely: even the most powerful CPU is useless if it cannot connect with the proper port and protocol.

Beckhoff's TwinCAT. Some manufacturers are adopting more open IDEs like CODESYS. The steps for PLC code creation are:

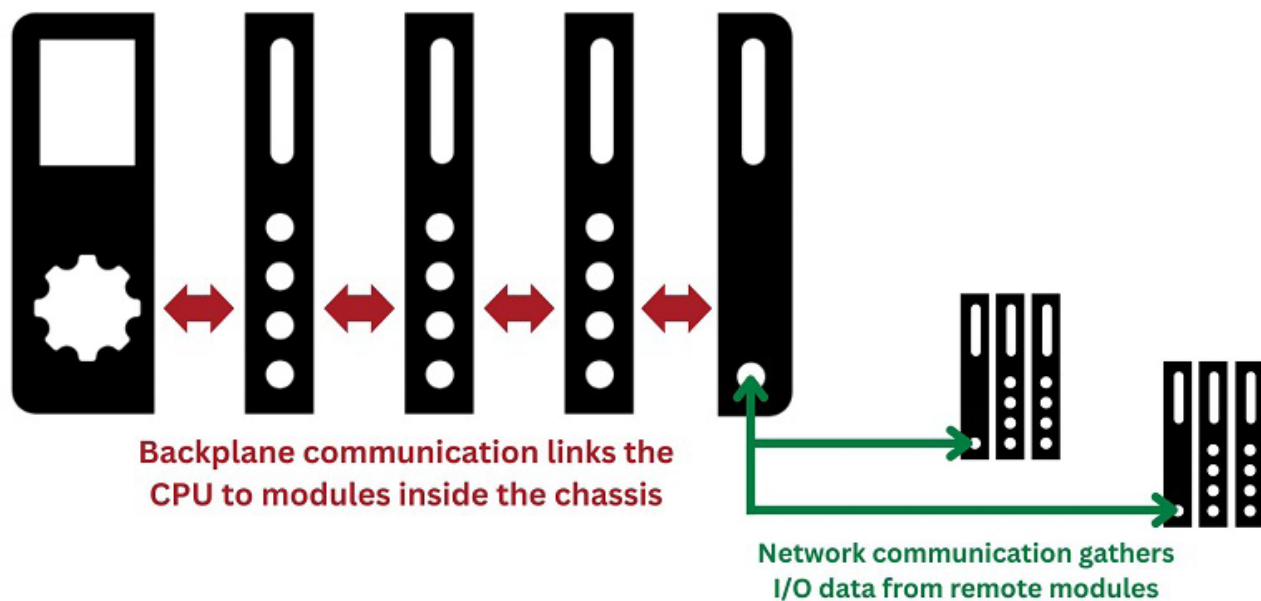
1. The IDE is installed on the engineer's PC.
2. A new project is created.
3. The project code is written, including all programs, routines, and tag definitions.
4. The project is compiled and downloaded to the PLC through either an Ethernet (or PROFINET, EtherCAT, etc.) or serial (usually USB) interface.

These days, there is an increasing popularity of an evolved version of the PLC that incorporates both the runtime and the OS onto the same device, side-by-side. Examples include Beckhoff's embedded PCs or the PLCnext from Phoenix Contact. These allow the familiarity of programming in typical IEC 61131 languages, while also allowing the IDE and many other OS-based apps to be installed directly onto the PLC itself. Typically called an industrial PC (IPC), they are different enough in operation that they will not be covered in this book.

How Does a PLC Communicate with I/O Devices?

On a modular PLC, the CPU plugs in side-by-side along with all of the other modules in the PLC. The metal pins in this plug serve to connect all of the modules with a single, high-speed communication channel called a **backplane**.

Backplane communication ensures that all **input/output (I/O)** information is transmitted between the CPU and the I/O modules. The backplane also handles data transmission between the CPU and any communication modules that network with remote devices.



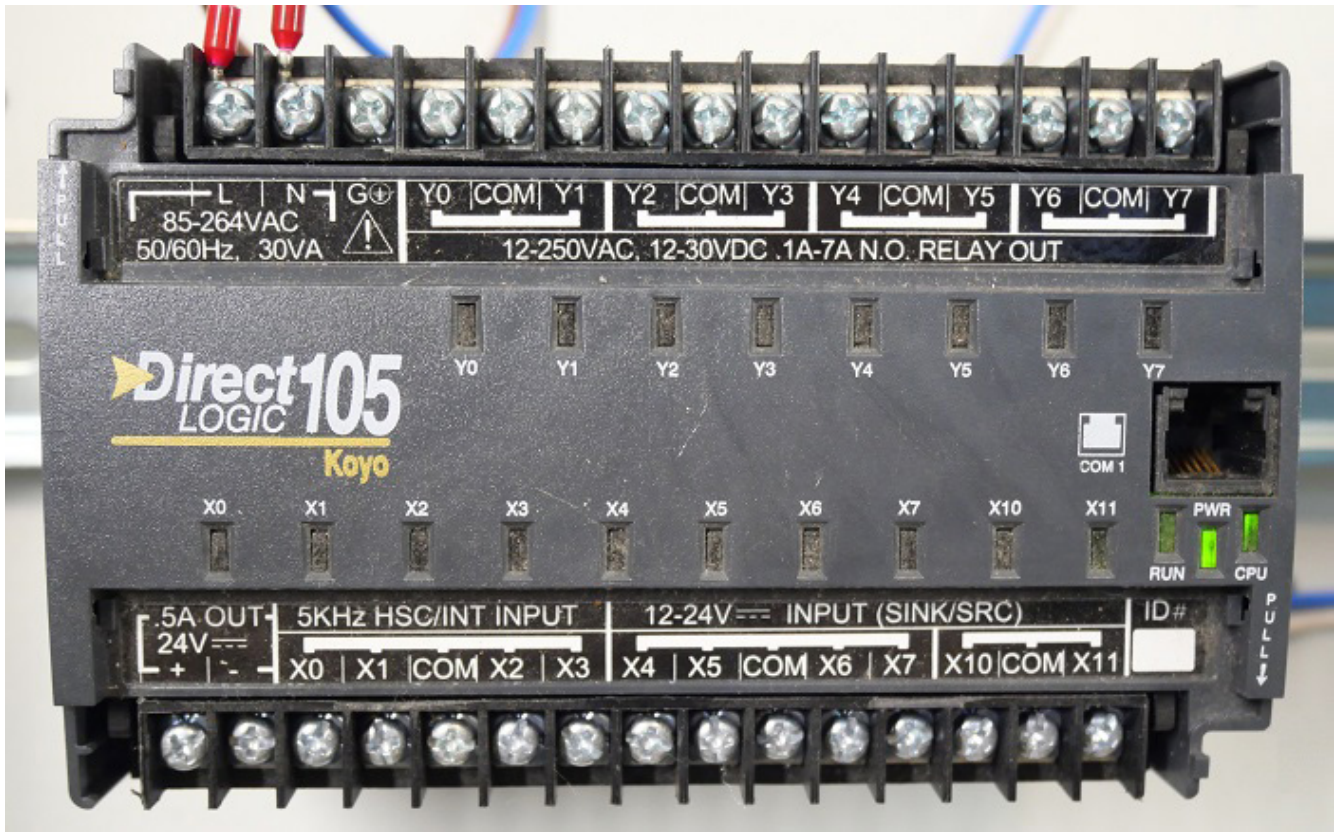
Backplane communication ensures that all data, even remote data, can reach the CPU module.

Backplane connections take the form of multi-pin headers with small wires designed to supply functional power to the modules but not to provide power for the field devices. This will be discussed more on

page 12. The backplane's transmit (Tx) and receive (Rx) data lines can rapidly scan many modules in a very short time. Depending on the manufacturer, these data lines may use a form of proprietary serial communication or a high-speed EtherCAT connection.

Some smaller, brick-style PLCs have a fixed number of I/O points built directly into the PLC alongside the CPU, but these models still require a data connection between the CPU and the I/O points.

The CPU scans all input and output points for current I/O status as rapidly as possible and places those values in a dedicated table of values in the CPU's memory.



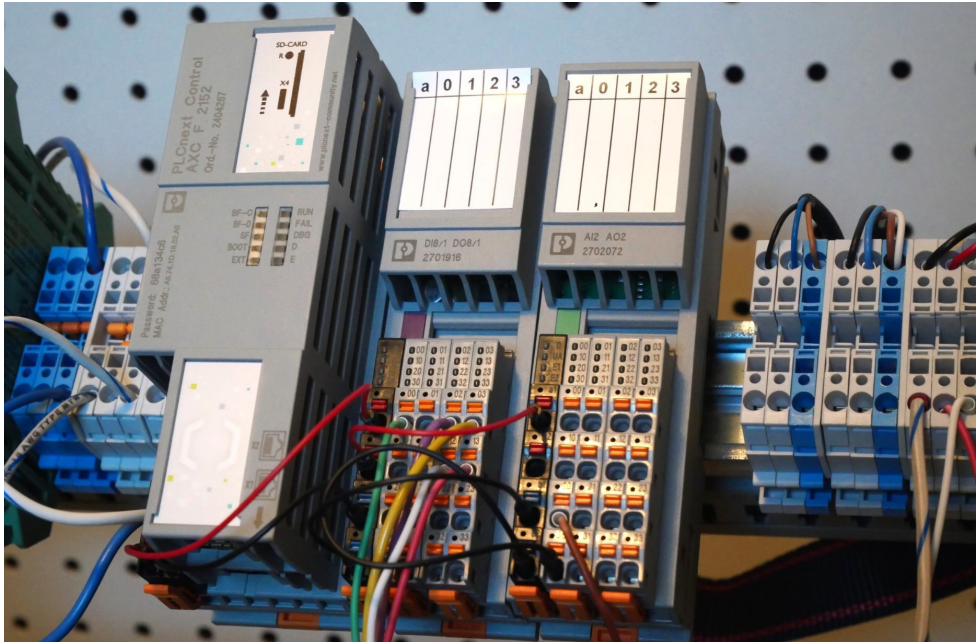
This brick-style PLC has 10x inputs and 8x outputs built into the unit, but the CPU still needs to communicate with these I/O terminals.

The lines of code are scanned and evaluated one at a time while a temporary table of output values is populated. As soon as the last line is scanned, that output table is sent to the output modules, each one updating based on its address and position in the table. Due to this, the output terminals do not update the instant a line changes from false to true—it only appears that way because the PLC scan cycle is very short.

The Most Important PLC CPU Specs

Unlike normal computers, no PLC manufacturer touts the processing speed or the RAM capacity of their latest processor.

The clock speed of a PLC is not the information that's important. Instead, the execution time of instructions is the most reliable way to gauge PLC effectiveness. Bits, integers, and floating points—each of these data types demands a different amount of dedicated processor time when they are involved in calculations. Product datasheets give this information freely, allowing a programmer to estimate the amount of time it will take for a full scan between the reading of inputs and the writing of outputs.



Higher-end PLCs have better processors that allow faster scan cycles with more instructions. This allows them to manage longer programs with more I/O points than smaller PLCs.

The calculation time of each operation in μs or ms is the important detail, not the clock speed in GHz. And, since each program is different, there is no way to provide a spec on each user's cycle time.

As for program storage, a PLC doesn't need to be burdened with a 500 GB external solid-state drive. Unlike a computer, which stores images, videos, and programs by the dozens, several lines of text code, similar to a notepad file, are the only things being stored. Since even the largest .txt files are several MB at most, a PLC's storage size is far less important compared to other types of computational devices. Instead, PLC manufacturers focus on making hardware and performance highly reliable. This is why well-maintained PLCs will often operate for many decades, while normal PC performance will begin to deteriorate after only a few years of use.

A common spec for program storage space is less than 1 GB; only the most massive industrial processes will come close to this size. Some PLCs also allow expansion memory.

What's the Best CPU for a PLC?

The most appropriate CPU for a given PLC should have the following:

1. **A communication protocol compatible with the programming PC.** When buying an older PLC CPU with an RS-232 programming interface, it is vital to have the cable and software to match it.

2. **Enough memory to hold the program.** A discussion with the manufacturer will likely clarify precisely how much memory will be necessary, but if the process is fairly small, 100 MB is likely more than enough.
3. **I/O capability.** Each CPU is rated by the maximum number of I/O signals that can be connected to the system. This number is based on the design of the machine that is being controlled.
4. **Low cycle time for system reliability.** Discuss with the manufacturer to get an idea of how many I/O points and how many instructions will likely be needed in order to ensure a low delay between input data and output commands.

Choosing the right PLC CPU requires a delicate balance of knowing the necessary specs while being prepared for the projects of the future. But with these guidelines and with the help of the manufacturer, it will be much easier to make well-informed and money-saving decisions when installing future PLCs or upgrading current models.

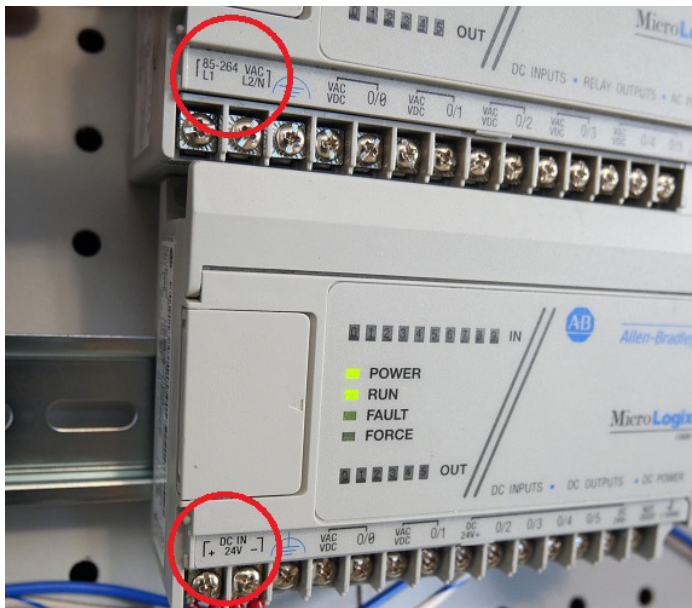
The Power Supply Unit

Power supplies are an integral part of electronic devices. Most devices have some form of conversion from line voltage down to an appropriate voltage and frequency. Cell phones have wall outlet chargers, PCs have an ATX supply, and industrial control cabinets almost always contain a DIN-rail mounted 24-volt DC (VDC) supply.

PLCs also need a supply of electricity, but there are many different ways this can be accomplished.

PLC Power Supply Types

Throughout the world of electronics, the power supply is an important device that receives incoming AC line voltage and converts it down to an appropriate DC voltage for the system. Of all utilized voltages, 24 V is the most common for industrial control systems.



These two similar PLC models have different supply inputs: AC on the top model and DC on the bottom. Note the deeper size of the AC supply model.

There are four main schemes of power delivery for PLCs. The power input connections may either be built **directly** into the CPU or attached as a **module**. And, in both of these cases, there are options for accepting either **AC** or **DC** voltage.

Built-in Power Supply Units for AC

Small PLCs, like ones that contain all of the I/O points on the main unit, often have power conversion built right in. These are recognized by the **AC line voltage names** printed on the terminals: most commonly **L** and **N**, or **L1** and **L2**.

Occasionally, a PLC may directly accept a higher AC voltage, like 240 VAC. However, extreme care must be taken, as this level of voltage will immediately destroy a PLC that is only designed for 120 volts.

One advantage of these AC input systems is that they can be installed with no other power delivery equipment. They also usually contain

their own 24 VDC output for a few field I/O devices (although the 24 VDC output won't deliver very much current). All in all, it's a great solution when a small automation system is necessary that also avoids the footprint and cost of extra parts.

Built-in Power Supply Units for DC

Small brick-style PLCs, as well as some of the smaller modular PLCs, might also accept a direct delivery of DC voltage from an external power supply into the CPU. At first glance, they appear almost identical to AC input models, but there are two main distinguishing features.

First, the printed labels next to the terminals will be different, showing **DC+** and **DC-** instead of L and N. This may seem to be a simple and obvious difference, but the reality is that too many PLCs have been destroyed by the careless swapping of one device with one that seems 100% identical. It is imperative to read every label carefully.

Second, while AC-powered PLCs contain their own embedded 24 VDC output, the PLCs that already require DC will likely not have these terminals. This will be discussed more on [page 15](#), but it's important to be aware that if two terminals on the PLC being replaced showed a DC output, but they are missing or labeled **NC** on the new model, there's a good chance it's a different model or design of PLC.



Two models of PLCs with AC inputs and a built-in 24 VDC output.

If a PLC lacks a DC output, why would a user prefer this over a similar AC model that also provides the needed 24 VDC? The advantage comes in scenarios that require more current (output power) than those built-in supplies can offer.

A system might have motor contactors and solenoid valves that demand more power. A single well-chosen DIN rail power supply can feed the PLC and all connected I/O devices. In addition, a single AC supply input reduces the number of distribution terminal blocks and electrical hazards in the cabinet.

Modular Power Supply Units for AC

For larger PLCs, the power supply is usually separate from the CPU. The power supply is attached to the backplane chassis or an expansion pin header on the left or right side of the CPU module.

This configuration resembles those with a built-in AC supply, but the manufacturer will offer several different power output modules. For an expansive PLC with **over a dozen modules**, it may be necessary to spend more money to purchase a larger power supply, but it's beneficial to keep the power supply separate from the CPU. This also allows for upgrading without a significant additional cost.

These modular AC power supply modules will be similarly marked with L and N or L1 and L2. They might have options for either 120 or 240 VAC. As with built-in AC supplies, it is common to find a DC output also built into these power supply units.

By providing various modular options, a custom PLC configuration can be easily designed with sufficient power for all modules, while also allowing a number of options for the rest of the chassis.

Power supplies built into PLCs provide far less flexibility and are suitable only for small automation systems.



Two modular power supplies, one requiring DC (left) and one clearly marked for AC (right).

A modular power supply requiring a 24 VDC input.

Modular Power Supply Units for DC

This final method of supplying power to PLC modules provides the flexibility of selecting one large external DC power supply for the entire system. Modular DC power supplies provide power to the entire PLC through the connections on the backplane. These modular DC power supplies will be clearly marked for DC+ and DC-.

It is important to note that the PLC power supply, whether modular or embedded into the CPU, **only** powers the CPU and the operation of the modules. **It will not power the output terminals** (loads) or the input devices (sensors and switches). How, then, are those field devices powered?

Field I/O Power Supply

Even if a PLC is powered up with green lights on all modules, power isn't automatically given at the I/O terminal. The backplane supplies the power to operate the module, but it will not supply the power that drives the field devices like relays, solenoids, or motor starters. These devices require more power than the backplane can provide.

A DC power supply must be used, whether external or built-in, to route the +24 VDC and 0 VDC to the common terminals of the I/O modules. It's also important to **understand how sourcing and sinking modules work**. Many people have experienced a situation where the PLC program appeared to be working, but the I/O signals failed to register at the PLC due to the common power or ground not completing the circuit to the power supply.

Providing Power to PLCs

It's hard to say which part of a PLC is most important, but it's indisputable that insufficient power delivery will only result in failure. Take the time to ensure that every PLC and automation system has the right type and size of power supply to ensure sufficient power.

Input/Output Modules

Out of all the sub-system components that make up a PLC, I/O modules are usually the favorite among engineers who specialize in physical devices and wiring. That's not to say I/O modules are inherently simple or easy to use; in fact, it can be one of the most confusing parts of a PLC.

I/O modules represent the connection interface between digital computation and real-world input and output devices. Any workplace or facility that uses a PLC will almost certainly interface with physical input and output devices.

What Can I Connect to a PLC I/O Module?

What is categorized as an input is fairly broad. Virtually any switch or push-button with mechanical contacts can be connected to a PLC, provided that both sides of the contact are connected with the correct wiring. Hypothetically, a PLC could connect to anything from a massive disconnect switch down to a tiny tactile surface-mount PCB switch. However, since PLCs are mainly used for machine control, they will usually connect to the 22 mm diameter buttons and switches that populate pedestal and cabinet-mounted operator panels.

Sensors provide feedback about the performance of the system and are therefore among the devices most often connected to PLCs. Many sensors have a solid-state construction, so they can only provide one kind of voltage output to a PLC. If the sensor is designed for 10-30 VDC or 120 VAC, then it's perfect for a PLC. On the other hand, some sensors are made for lower voltages. To use these, the sensor will need a special low-voltage input or a way to amplify the output up to 12-24 volts.

The types of outputs, or loads, also vary in form and function. If something can be switched ON and OFF, then it's also a likely candidate to be connected to a PLC. Common examples of this are lights, relays, solenoid switches, and valves. The voltage rating of the connected device doesn't usually matter, as output modules can handle virtually any voltage. If the device runs from a pulsed output, like a motor drive, or even a variable signal (like volume or speed), then an appropriate PLC output will be reasonably easy to locate.

What kinds of I/O modules exist, and how can we differentiate between I/O varieties?

PLC Input Module Types

The following are selected examples of the most common PLC input module types. Some companies may manufacture specialized modules that do not appear on this list.

DC Input Modules

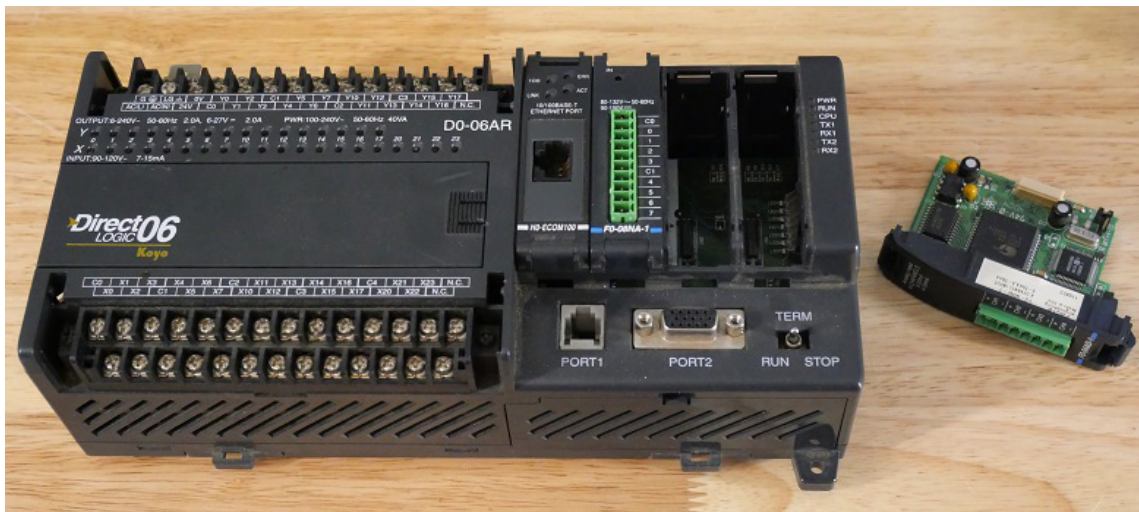
DC input modules respond to a limited range of voltage, usually 12 to 24 or only 24 V. Although the common product label is simply "DC," these modules are discrete, meaning that they can only accept signals that are on or off. They can be **sourcing or sinking**, terms which refer to the polarity of the current passing through the terminals. The number of terminals on a single DC input module can vary from 4 up to 32 in some high-density models. These are widely used for switches and sensors.

Analog Input Modules

Analog inputs can be voltage (0-10 V, usually), current (4-20 mA, usually), or configurable to work either way. They can provide isolated inputs or return to a common ground, so it's important to work with signal integrity experts to know which variation is best. The number of terminals in these analog input modules most commonly ranges from 2 to 8.

AC Input Modules

Many switches and sensors handle AC voltage, with a common example being the light switches in the average home. It would be expensive to convert each signal to a 24 VDC output, so the solution is an input module for 120 VAC signals. These modules require one common neutral connection, creating a sinking-style module. Manufacturers rarely (if ever) opt for the sourcing style of AC input, which would place a live 120 VAC on each terminal. While models are available for 24 or 240 VAC, the most common configuration by far is 120 VAC. This type of module usually contains between 8 and 16 terminals.



Some fixed I/O PLCs also include add-on module slots.

High-Speed Input Modules

High-speed input modules are similar to DC inputs, but the electronics are optimized to accept rapid input pulses. These high-speed modules typically connect to encoders and external controllers that deliver a rapid **pulse-width (PWM) or pulse train output** signal that must be accurately measured. In most cases, a high-speed input can still accept standard DC inputs with no problem. Most motion systems only control a small number of axes, so these modules usually contain fewer inputs, with 2 or 4 inputs being most common on a single module.

TTL Input Modules

This acronym stands for “transistor-transistor logic.” This kind of module typically interfaces with the 3.3 to 5.0 V levels used by the digital I/O of an embedded computer in a peripheral device. TTL input modules are fairly uncommon in modern PLCs, since these peripheral communication functions have largely been replaced by network protocols or level-shifters that efficiently convert signals to the industry standard 24 V. These modules usually have 8 to 16 terminals.

PLC Output Module Types

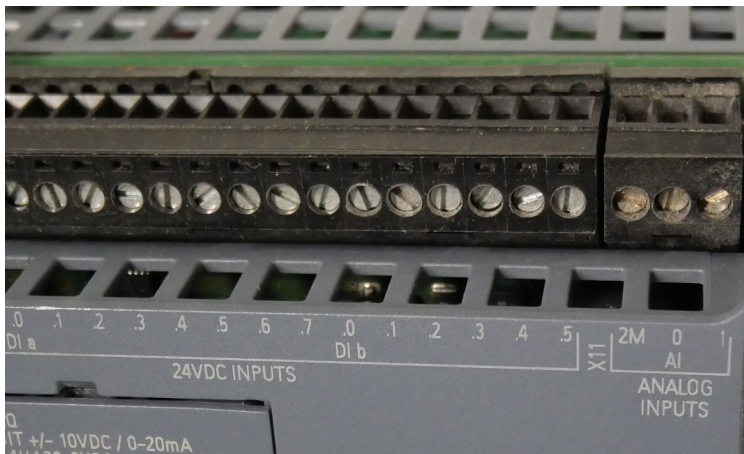
Output signals are quite similar to inputs, except that the PLC is the device emitting the signal. But not everything about outputs and their interaction with a PLC is identical.

DC Output Modules

These modules typically power 24 VDC devices. They are available in both sourcing and sinking configurations, and feature between 4 and 32 terminals.

Relay Output Modules

Relays are very flexible since they can handle both DC and AC voltages. They are slower to respond than DC output modules, and they don't last as long. However, they can handle far more current. Some modules only provide the normally open (N.O.) outputs, while others provide access to both N.O. and normally closed (N.C.) outputs. There are typically between 4 and 16 terminals in a relay output.



Analog inputs alongside DC inputs.



The high-density connections of a 32-terminal digital input module.

Analog Output

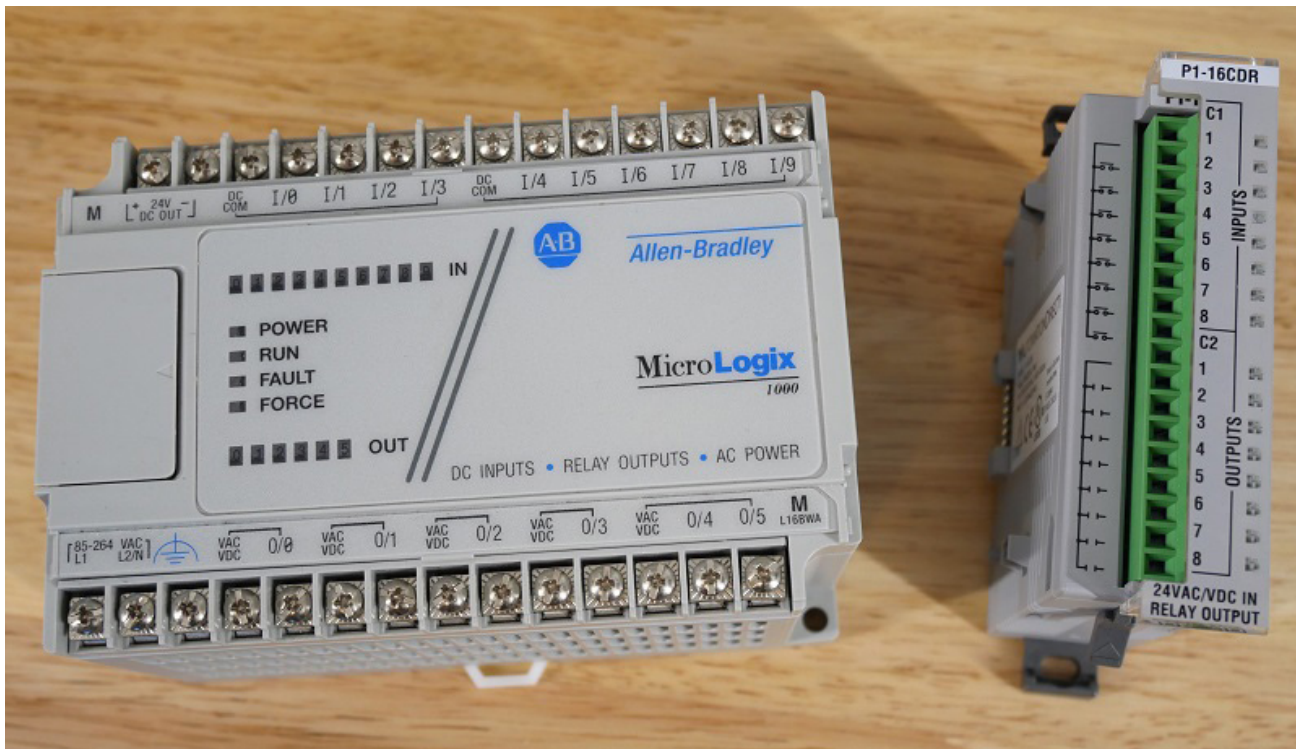
Analog outputs can deliver either voltage or current signals. Since most inter-device signals are sent over a communication protocol, analog outputs aren't as common as inputs. These modules have between 2 and 8 terminals.

AC (TRIAC) Output

While relay modules can handle some AC loads, any switching that requires high speeds and a long service life requires some kind of solid-state switch. The TRIAC is a solid-state device specifically designed for AC loads, and they are usually limited to 120 VAC loads. But care must be taken with TRIACs because **troubleshooting can be particularly tricky**. These modules typically range from 8 to 16 output terminals.

Custom I/O Modules

While the above examples constitute a majority of all the modules used in running systems today, be aware that nearly anyone can create a custom module. It's quite possible to come across models with slight variations or even an entirely new type of module. Because of this, it's important to pay close attention to the details outlined in any tech document or specification sheet, follow all wiring diagrams, and, when possible, learn from engineers who have worked with unfamiliar modules.



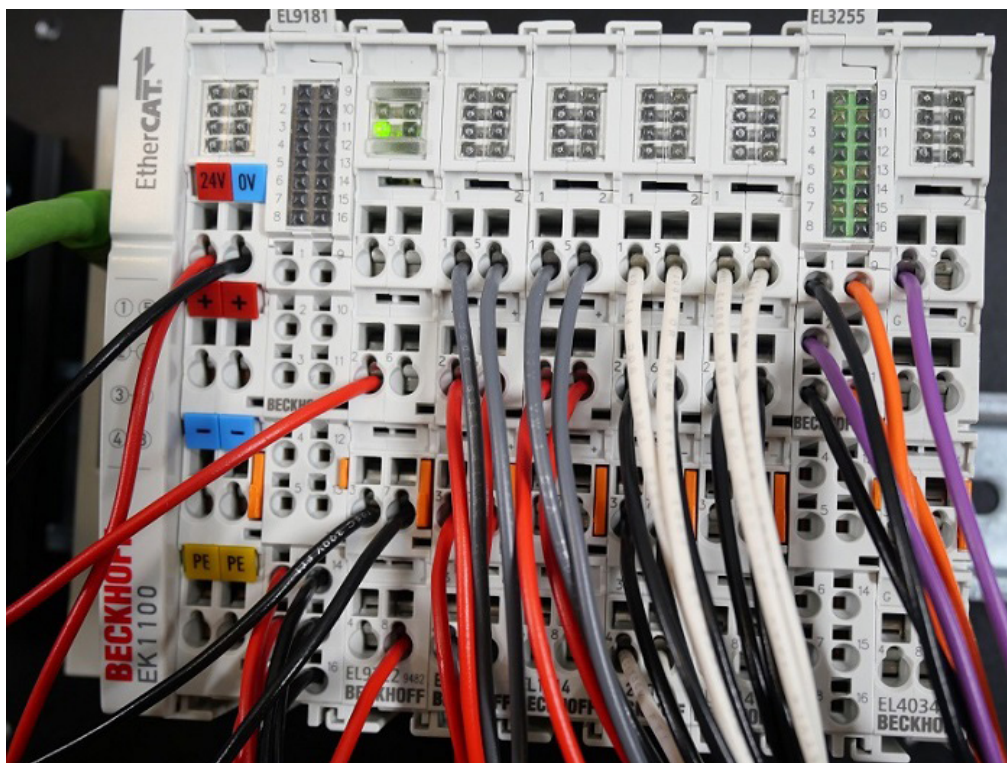
Relay outputs in the same unit as digital inputs—they can be mixed-and-matched.

Communication Modules

Communication modules, which are also called networking modules by some manufacturers, add new ways to engage with equipment, making these advanced modules the final building block of the modern PLC system. These modules provide an industry-standard network connection to the outside world, transforming traditional PLCs into process automation controllers (PACs), a modern variation on the traditional PLC.

Communication Systems in PLCs

Similar to the I/O and power supply modules, communication ports are frequently embedded directly into the CPU module, but they may also be installed as add-on modules to expand the system for greater flexibility.



A wide variety of I/O modules can be found in a single unit.

Programming Interface

In some PLCs, a distinction must be made between programming and networking. Sometimes, both of these functions are accomplished through the same interface port. However, a dedicated programming port usually takes one of two forms: USB or DB9.

A USB port (usually a **type B, mini, micro, or type C**) is a point-to-point connection used in PLCs exclusively for the downloading and uploading of programs to the host IDE computer. Although extremely simple and reliable, it requires the computer to be physically located within a few feet of the control cabinet when the PLC needs to be modified or monitored.

A 9-pin DB9 serial interface is an alternative to a USB port and is most often seen on slightly older equipment. One cannot immediately assume that a DB9 port is limited to programming because the port can also be configured for the common RS-232 interface for communication systems like Modbus RTU. Since a DB9 is also a point-to-point interface, it's not seen on large networks. Another variation of the DB9 connector is a 6-pin RJ11, which looks like a narrow version of a CAT5/6 RJ45 connector.

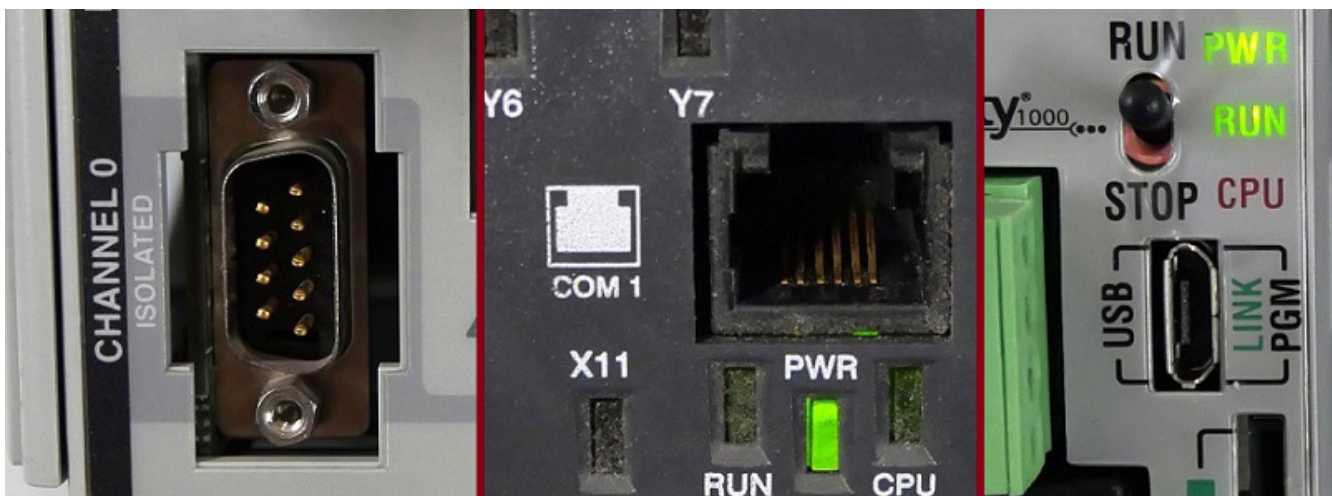
Built-in Network Interfaces

Most CPU modules have at least one network port built directly into the controller. Most smaller PLCs, especially older ones, might only have one connection for a simple HMI connection. Most modern PLCs include multiple built-in network ports as the cost of the technology decreases, while the need to interconnect with various systems becomes more critical.

These built-in ports usually provide physical access to one or more of the following protocols or standards:

- Ethernet
- EtherCAT
- PROFINET
- RS-485
- RS-232

Ethernet and PROFINET use an RJ45 plug, common to all familiar Ethernet networks. An RS-232 connection may appear as a 9-pin DB9 serial termination or simple screw terminals. In some cases, the



Three common PC serial communication ports: DB9 (left), RJ11 (center), and micro USB (right).

RS-232 port may be integrated directly into the simpler 4-wire harness shared with the RS-485 port, and the user selects the required standard from within the programming software.

RS-232 is the only communication protocol that is restricted to a single point-to-point connection. This limits its functionality in networking, but it's still commonly found on legacy equipment.

Ethernet, PROFINET, and RS-485 networks are multi-drop, meaning they can communicate with many devices using unique addresses. RS-485 is an older standard, and is now commonly used to link across Modbus, PROFIBUS, and other proprietary networks, such as Data Highway (DH485) from Allen-Bradley.



Several different serial network port options. The PLC on the left contains Port 1 for the programming interface and Port 2 for RS-232/422/485. The module on the right contains a port for RS-232 and a separate screw terminal header for RS-422/485.

Industrial Ethernet and PROFINET are variations of the original Ethernet standard. Most large companies tend to pick one of the two protocols and procure their equipment appropriately. However, since the physical port is the same for both standards, some PLCs allow for running a controller as a scanner or host with either of the protocols—sometimes even simultaneously. Despite that versatility, companies with an automation process that relies on many brands and generations of equipment all talking to the same controller are better off selecting specific modules that can be dedicated to each task.

Network Interface Modules

PLC manufacturers usually adopt one of two different strategies:

1. The CPU module contains most of the possible PLC communications elements.
2. The CPU is left very basic, and add-on cards are used to support network drops.

The second strategy is more typical for large systems with more than 2-3 networks within the factory setup.

Modules compatible with the previously-mentioned systems are easily obtained, but there are many other communication module variations. Let's look at a few of these.

Fiber Optic Modules

Fiber optic systems use light to transmit a protocol (usually Ethernet) over a glass or plastic cable that reflects the light internally. They support tremendous data rates over long distances as compared to slow, resistive copper. Since PLCs are built to control smaller machine assemblies with relatively slow data rates and traditional connectors, it's rare to find a CPU with fiber built directly in. If the need arises for a fiber optic interface, the user could choose to add a fiber optic module to the chassis. However, as technology advances, industrial systems keep collecting more data and are capable of controlling

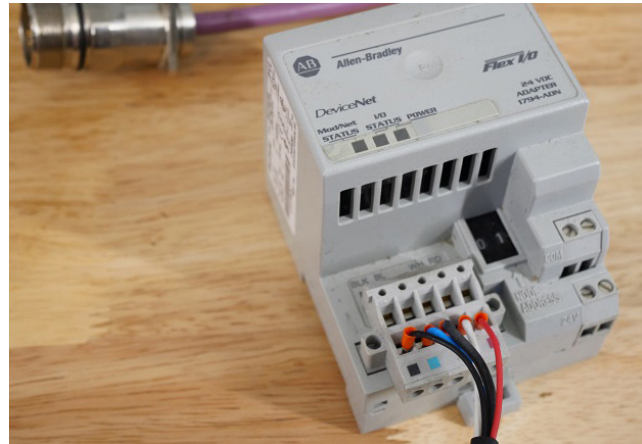
larger machines, so it is likely that fiber optic ports may become a more standard connection option in the future.

EtherCAT Modules

This protocol, founded by Beckhoff Automation, is a higher-speed variant of Ethernet, specifically for control automation technologies (hence the name CAT). Due to the high data rate, this protocol is increasingly common for time-sensitive data transfer and motion control. Many controllers now include EtherCAT as an embedded protocol.



For this PLC, the CPU is limited to only programming, leaving the networking task to add-on modules as needed. This PLC, the CPU is limited to only programming, leaving the networking task to add-on modules as needed.



This DeviceNet module (actually for a field I/O system) uses the round-style cable distributed into a multi-pin header.

DeviceNet Modules

This network, built from CAN technology, was founded by Allen-Bradley but has been transferred to open-source for wider integration. It uses a flat or round multi-conductor cable.

HART Modules

The Highway-Addressable Remote Transducer (HART) digital protocol rides on a 4-20 mA analog signal. This allows HART devices to be installed into an existing analog system. However, HART requires a dedicated module; a simple analog out module cannot translate HART protocol signals.

IO-Link Modules

The increasingly popular IO-Link protocol allows data and configuration along a normal M12 cable. One major advantage of these IO-Link networks is that they allow older discrete I/O devices to connect to the same hubs and switches as the smart IO-Link devices—a great capability for field-level flexibility.

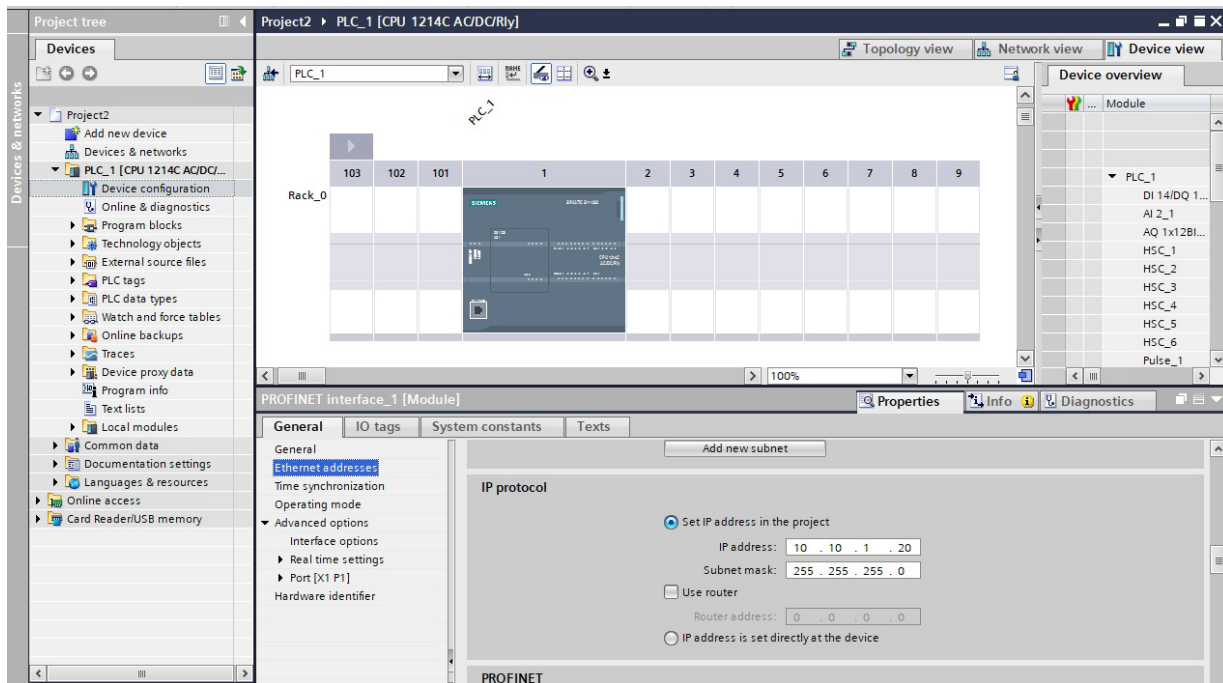
These and many other protocols can be found in modules and embedded in the CPU for specialty applications.



These IO-Link sensors, hub, and M12 cable are just a few of the possible devices that can connect to an IO-Link module.

Installing and Configuring a Communication Module

The installation process is very similar across all models of PLC. Modular cards fit into the chassis or connect with a wiring harness. The IDE always contains a hardware manager that can read the configuration of all connected modules and networks if an online connection is established. New devices and network nodes can always be manually added offline.



Example of a software interface (Siemens TIA Portal) for configuring the built-in or modular communication port.

The first step in configuring a module is to establish an online connection with the controller, either by USB or with a direct Ethernet connection. Locate the communication module in the hardware manager and open the properties. Input the proper network address for the port and download the project to the

controller. The communication module should now be able to scan its network for compatible devices like motor drives, robots, or HMIs. Note that the exact steps vary according to the IDE, but the process will always follow this same progression of steps.

Troubleshooting PLC Communication Systems

Network troubleshooting can be particularly troublesome and is usually far more difficult than troubleshooting I/O signals. High-speed data cannot be traced with simple handheld tools. In addition, the applications are far more software-dependent than, for example, discrete on/off updates. But as controllers become more capable of handling many tasks, they must be flexible enough to communicate with a lot of equipment. This is where network protocols become a necessity.

Online or in-person classes, both from OEMs and from independent sources, can be a great way to learn from professionals who share similar backgrounds. These experienced professionals understand industry pain points and can often explain systems in a way that helps engineers feel comfortable and ready to embrace future challenges and innovations.



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