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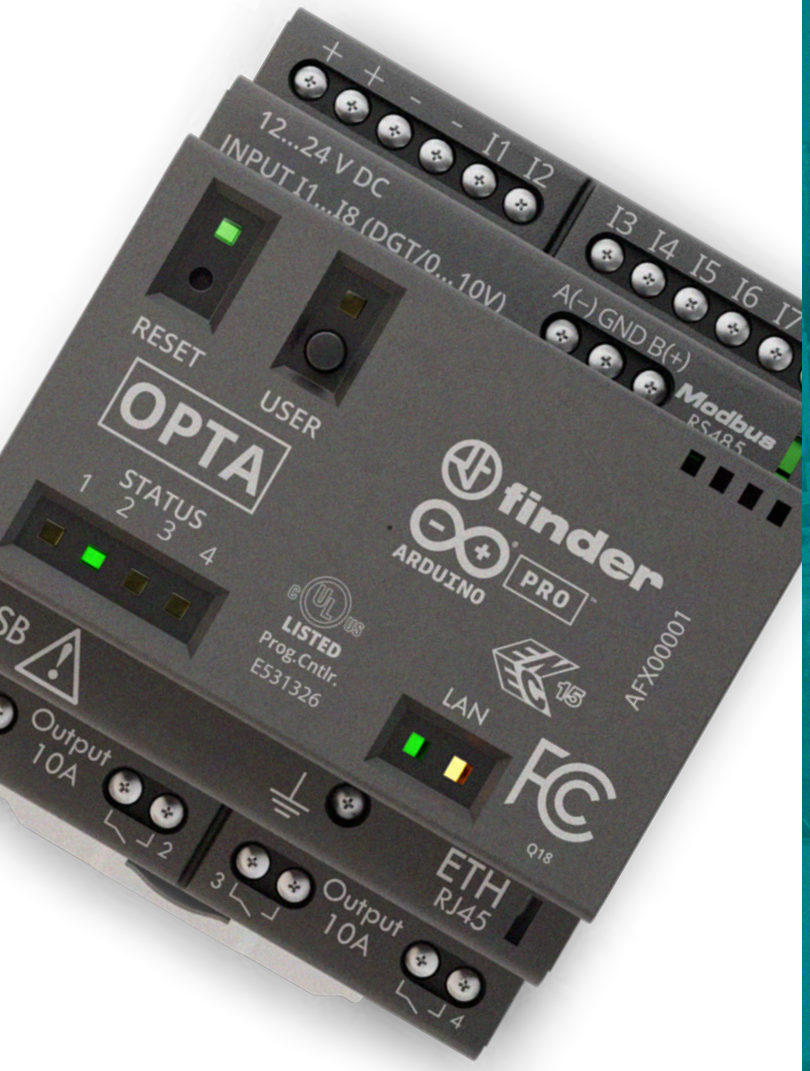

Unlocking the Potential of the Arduino Opta Micro PLC in HMI Applications

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The **Arduino® Opta®** is a micro-programmable logic controller (PLC) designed to meet the needs of the Industrial Internet of Things (IIoT). Easily configured using Arduino's own PLC integrated development environment (PLC IDE), the Opta can be integrated into industrial sensors, controls, and hardware and can be used with intuitive human-machine interfaces (HMIs) that will enhance safety, boost productivity, and optimize process performance.

The Role of Micro PLCs in Today's Industrial Environment

Micro PLCs are becoming more common in industrial, agricultural, manufacturing, and large commercial environments. The small PLCs, including the Arduino Opta, can be programmed to take on specialized roles, controlling a few key process parameters without needing an extensive and complicated control system. Small feedback loops, sensor data collection, automated control, robotic motion, and other applications are prime micro PLC usage candidates.

While a micro PLC does not have the processing capability of a full-scale PLC, a micro PLC still can perform decentralized tasks on the edges of the network. Instead of thinking of a micro PLC as a scaled-down PLC, think of it as a way to optimize resources. The micro PLC is typically programmed for a few specialized tasks, freeing up large and powerful devices or computer processing time for more complex tasks.

One of the primary advantages of a micro PLC is its ability to separate tasks that do not need to be controlled through the central automation system. This eases integration and troubleshooting efforts; why risk taking down the entire automation system because a few servo controls need to be adjusted in one factory area?

In manufacturing and industrial applications, micro PLCs have been used in packaging, machine tending, object manipulation, assembly, and other similar tasks.

Outside of manufacturing, these small controllers have been used to manage temperature in heating, ventilation, and air conditioning (HVAC) controls in homes, greenhouses, and livestock shelters. They have also been implemented as lighting control based on occupancy in commercial office buildings, stairwells, and grocery store coolers.

Many operations can be turned over to a micro PLC in virtually any facility. Shifting control from a central PLC to a distributed control network has many advantages in terms of flexibility and efficiency.

What is the Arduino Opta Micro PLC?

The **Arduino® Opta®** is a micro PLC that can perform many process control decisions at the edge of the automation network without remaining isolated from the central control system. It is not designed to replace complicated central control systems; rather, it is designed to remove some of the computing load for simplicity and quick control decisions.

The Opta is equipped with a STM32H747XI dual-core Arm® Cortex®-M7 +M4 MCU processor, which makes faster computations, floating points, digital signal processing, and real-time data analysis possible. All of these are required for machine learning (ML) and artificial intelligence (AI) algorithms. This moves some of the ML/AI computing load from the central control system to the edge of the automation network.

Integration of Arduino Opta Micro PLC with HMIs

An important benefit of the Opta micro PLC is that engineers can quickly program it to interface with human-machine interfaces. HMIs can be used to monitor real-time production status, drive dashboards that record and display critical process data, and provide input for operators to interact with equipment. While the Opta itself is not the HMI, it can be used to collect and display the data used by the HMI.

The ability to quickly deploy an HMI can increase operator safety and reduce the chances of process excursions. It allows data to be displayed at the right place and time, meaning operators can glance at a display to determine whether a process is behaving as expected or not. Furthermore, with the IoT capabilities inherent in the Arduino Opta, data can be ported to the cloud – including the **Arduino Cloud**, of course – and viewed by a control room; from there, technicians can focus only on processing anomalies and troubleshooting.

The Opta can be used in energy-saving applications as well. As a micro PLC, it is well-suited to control the lighting in a room based on occupancy, time of day, and other variables. With commercially available sensors such as those in **Arduino Pro's Nicla family**, the Opta can be at the heart of a control system able to turn on lights or operate window-shade controls to minimize energy usage while maintaining an appropriate and safe light level. This concept could be applied to other processes, such as compressors, coolant pumps, fans, and other relay-driven controls.

How to Configure the Arduino Opta Micro PLC with an HMI

Arduino partner Weintek USA developed a **video** that walks users through the steps to connect its HMI to an Opta micro PLC.

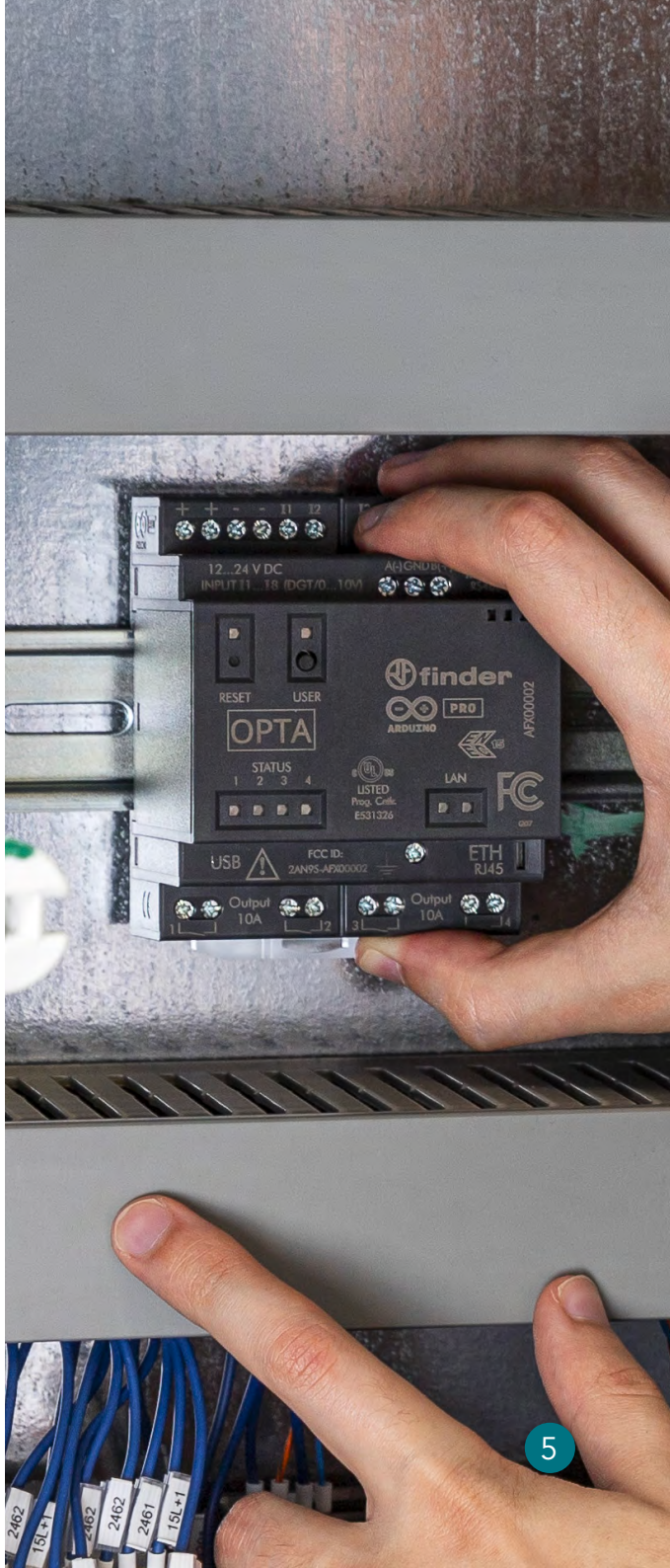
First, the hardware configuration, such as the serial port number, is used in the initial setup in the PLC IDE. This sets up the port for downloading the runtime to the Opta.

From there, Modbus TCP parameters and network settings are set up, and the variables are defined, allowing the Opta to communicate with the HMI.

Next, the user can write the code selecting a language (among the IEC 61131-3 languages) and develop the application. Testing can be performed in the PLC IDE before deploying it to physical hardware. Troubleshooting and debugging can save time, which is a key advantage of the PLC IDE.

Finally, engineers can deploy code to the hardware. Further testing is used to refine the code.

To dive deeper, enroll in ACE-120: Weintek HMI Essentials with Arduino Opta by Arduino Academy!



Programming the Arduino Opta

The Opta can be programmed using the PLC IDE with any of five IEC 61131-3 languages, including ladder logic diagram (LD) and function block diagram (FBD), or through the Arduino language, using the Arduino IDE. This programming environment also includes numerous libraries, existing code (Arduino sketches), and modules that can speed up program development.

Sharing variables allows us to quickly integrate the code written with the IEC 61131-3 languages with Arduino sketches. In this way, a programmer who may have learned one or two of the languages can quickly create, maintain, and modify code for use in the Opta micro PLC.

Versions and Connectivity

Three models are available based on the connectivity method: Ethernet, RS-485, and WiFi/Bluetooth. The Opta Lite has USB C and Ethernet programming capabilities, the Opta 485 adds RS-485 half-duplex capability, and the Opta WiFi includes WiFi capability as well. These options allow Modbus and TCP-based communications protocols to be used, making them easier to integrate into existing hardware.

All three of these versions can be integrated with **Arduino Cloud** and can interface with AWS and Azure third-party platforms. All data can be viewed using intuitive and familiar real-time dashboards.

The Opta includes built-in, industry-leading security measures to keep data secure. The X.509 security standard ensures that data transmitted and received from the cloud will go only to its intended recipient. In true modern development fashion, the software is constantly being upgraded as new threats to cybersecurity are developed.

The Arduino PLC IDE

The Arduino PLC IDE is a self-contained environment for developing Arduino Opta control code. It can use Arduino Sketches, any of the numerous code libraries, and interface all five common PLC languages. The use of shared variables in the PLC IDE makes it easy to move data between devices and to the cloud using any of the five common PLC languages. Furthermore, it is free, and a large online community is contributing a variety of code libraries and other resources to help even the beginning programmer deploy applications quickly.

Besides helping the programmer write code, the Arduino PLC IDE has a built-in debugger for finding programmatic errors before deploying them to hardware. This drastically simplifies troubleshooting and unplanned downtime of industrial equipment.

For more information, check out the **Arduino PLC IDE guide.**

I/O Expansions to Opta

Three expansion modules are available for the Opta, giving the engineer more flexibility and more capability for custom applications.

There are two digital modules: the Opta Ext D1608S and the Opta Ext D1608E. The primary difference between the two is the type of relays they can interface. The “S” model can drive eight solid-state relays with 24 VDC at 3 A each, while the “E” model can drive eight electromechanical relays with 250 VAC at 6 A each. Both modules are otherwise similar, adding 16 inputs that are programmable

as digital (0-24 VDC) or analog (0-24 V). Furthermore, as many as five of these modules can be mixed and matched, all connected to a single Opta micro PLC.

Besides the digital relays, there is also the Opta Ext A0602, an analog I/O module. This module is programmable to handle 0-10 V or 0 to 25 mA signals and a Pt100 Resistance Temperature Device (RTD) for measuring temperature.

To find out more, **check out the dedicated page** on the Arduino website.

Configuring Modbus RTU on Opta using PLC IDE

Modbus RTU, a serial communication protocol, can be easily configured and deployed on Opta hardware using the PLC IDE. There are several key steps to follow when using Modbus.

First, the Opta is assigned a role – Remote Terminal Unit (RTU), Client, or Server. Also, vital communication parameters are set at this stage (baud rate, parity, etc.). Status variables are defined, or the Modbus node and all devices are configured.

Second, the important variables can be set instead of complicated programming during setup and configuration. From there, the PLC code handles the Modbus data transfer between these variables and, thus, between devices.

Finally, the system is operational. The programmer should have a good grasp of the process and predict the expected results so that the program can be modified as needed.

Ultimately, the PLC IDE is designed to make this process easier to learn, easier to deploy, and easier to troubleshoot. For more detailed information on how to configure Modbus RTU on Opta, check out the **Modbus setup guide.**

It's Easy to Get Started with Opta

The **Arduino® Opta®** micro PLC is a versatile yet compact controller that can be applied to many processes in industrial or manufacturing settings. In particular, the ability to interact intuitively with HMIs can allow technicians to view process variables and manipulate controls without extensive, specialized training. The Arduino Academy even offers an online **Arduino Opta Essentials Course (ACE-100)** that includes all the PLC basics required to get started.

For more information about how the Arduino Opta Micro PLC can optimize process control in your facility, please **contact Arduino.**

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