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Micro PLCs versus Programmable Relays

Micro PLCs have greatly improved their price/performance ratio over the last few years, making them the right choice for more applications as compared to programmable relays.

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The line between programmable relays and micro PLCs has moved to a much lower price point over the last few years, making a micro PLC a better option for controlling many small to medium size machines. Micro PLCs are no more expensive nor difficult to use than programmable relays in these applications, and the required training is about the same, as is the programming effort.

Programmable relays shine in situations where the application is simple and fixed, with little or no changes required, and where a limited local operator interface is required. In these applications, a programmable relay will be lower cost than a micro PLC and a separate operator interface. Although control functions and features are limited, they include debouncing an input signal, time delays before turning on an output, pulse duration outputs, and others.

Programmable relays used to provide a significant advantage in applications with just four to eight inputs and four to eight outputs, but this has changed as micro PLCs have declined in price and increased in capabilities. In the past, many users would only consider a step up to a micro PLC if more complex logic was required, but this assumption is no longer correct.

Micro PLCs, such as the **CLICK from AutomationDirect** have many advantages for use in automated machines and processes, which will be briefly discussed in this white paper. A short definition of a micro PLCs and programmable relays will also be provided. The bottom line: a micro PLC should be used in all but the simplest applications due to a host of advantages as compared to a programmable relay.

What is a Micro PLC?

The use of newer technology in micro PLCs has created a very compact, less expensive PLC with the price/performance ratio required to move into what was once exclusively programmable relay territory. Several of the advantages of a micro PLC over a programmable relay are listed in Table 1.

Table 1: Advantages of a Micro PLC
- Expandability
- Better price/performance ratio
- More communication options
- Easy to add full-featured operator interface
- Easier to create advanced programs

AutomationDirect's CLICK PLC will be used to illustrate these advantages, although some other micro PLCs share some of the same attributes (Figure 1).
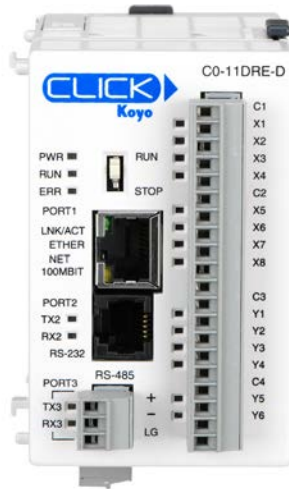

Figure 1: This CLICK Micro PLC has built-in I/O and communication options, making it suitable for use in a wide variety of applications.

The CLICK comes in a variety of models with built-in I/O and removable terminal blocks for easy wiring. Additional modules can be added to expand I/O if needed. The CLICK CPUs include different combinations of discrete and analog inputs and discrete and analog outputs. It can be expanded to a total of 142 discrete I/O or 54 analog channels (Figure 2). The CLICK starts at a cost of $69, a price point common for many programmable relays, while delivering much more functionality and flexibility.

Figure 2: The CLICK Micro PLC can expand up to a total of 142 discrete I/O or 54 analog channels using 24 different digital and analog modules, including AC, DC, relay, thermocouple and RTD for more complex applications.

The CLICK includes various communication options and models with a real-time clock. Built-in communication can include a 10/100 Mbps multipurpose Ethernet port for networking and control. This port can be used to program the PLC, network it or

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control Ethernet-enabled devices—using Modbus TCP.
Other communication options in micro PLCs include RS-232 communications ports for programming, or for configuring MODBUS RTU or ASCII protocols. RS-485 communication is also available.

These communication options enable easy connection to a wide variety of operator interface terminals (OITs), such as AutomationDirect's C-more or C-more Micro. Whether serial or Ethernet is used, the connection is simple, and can quickly provide extensive text and graphical display features on a touch screen much larger than found on programmable relays. The CLICK CPU can also power the C-more Micro from the serial connection alleviating the need for additional power wiring.

The CLICK micro PLC includes only 21 instructions, suitable for most small to medium size applications, which makes it easy to program. The limited instruction set reduces training needs, and the PC-based programming software is free.

A micro PLC provides a more scalable solution than a programmable relay, providing room for future expansion. As a machine is updated or improved, more advanced programming and additional I/O can be added to a micro PLC, while the limits of programmable relays are often quickly reached. Both a micro PLC and a programmable relay can often provide a control solution at reasonable cost, but the future benefits of using a PLC should be considered.

What is a Programmable Relay?

A programmable relay is a small device that includes several inputs and outputs providing relay, timer and counter functions in a single unit. Most programmable relays include a small amount of I/O, but some include over 20 discrete inputs and outputs, as well as up to eight analog inputs and eight analog outputs.

Programmable relays often include a built-in LCD display, such as 6 lines and 20 characters per line, to display the program, variables and configuration. Also included are function keys and buttons on the front face of the relay for navigation; entering and editing the program and parameters; and starting, stopping and configuring the device.

These built-in displays have distinct limitations. Knowledge of the actual application and the variables, using a cheat sheet, are often required as the display provides little information.

Although programmable relays provide simple installation, minimal wiring and user-friendly programming—micro PLCs can make the same claim. Either option works well in small to medium size automation applications. Both are small controllers that can automate functions such as simple sequences based on time or events, time-delays, counters, and relay logic or relay replacement.

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Training Requirements

A common misconception with programmable relays is that no training is required to learn how to program it, but this is simply not true for all but the most basic applications. Once more than a few I/O points are needed, the coding complexity for a programmable relay is very similar to a micro PLC when using PC-based programming software. And the option of coding a programmable relay from its built-in display is simply not practical for all but the most basic applications.

When programmable relays start to move into micro PLC territory in terms of I/O points and functionality, complexity increases along with cost. Training requirements for programming and implementation become similar, with no advantage to either platform.

A review of three of the more popular high-end programmable relays found two of the manuals to be about 200 to 250 pages in length, with the third at over 550 pages. This third programmable relay required almost 200 more pages for a user manual as well, for a total of almost 750 pages. Each of these three programmable relays cost more than a CLICK micro PLC, and did not include the features, functions and capabilities listed in Table 1.

Of course, the **CLICK micro PLC has a User Manual** as well, and it's just under 300 pages. This manual includes a step-by-step quick start guide, all hardware specifications for the controller and expansion discrete and analog, installation and wiring, communication, maintenance and troubleshooting information. And, if you need help selecting CLICK PLC components, there is an AutomationDirect **configuration tool** to configure and order the hardware.

A very simple programmable relay, specifically a timer relay, with an octal base, dip switches and a potentiometer to select function modes and time, includes only a 4-page user manual, so it is easy to use. If an application requires only a single, heavy-duty SPDT electro-mechanical output relay with on-delay, off-delay or interval output, this type device is a good choice (Figure 3).

Figure 3: This Fuji Timer Relay is a cost-effective solution for applications requiring only a single timer output function.

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With either a micro PLC and all but the simplest programmable relay, some training will be required, and users will have to read the manual. In the case of the CLICK PLC, it is likely that the 24-page quick-start guide will get most users up and running quickly. For those who need more training or have questions, there is free a 30-day training certificate included with each CLICK CPU purchased, as well as award-winning technical support available from AutomationDirect.

On-Board Programming

Most programmable relays promote the fact that the device can be programmed using the built-in front panel display of the relay, so there's no need for PC-based programming software. While this is technically true, it is not simple to enter a program, parameters and configuration using a display and buttons not much bigger than a pack of matches.

It is still necessary to enter contacts and coils, link them together and insert rungs. If possible with the selected programmable relay, comments should be added to ease understanding of the control logic. Some programmable relays even use function blocks that are even more difficult to see and use.

Viewing ladder logic or function block programming on a small LCD display on a programmable relay mounted to control panel in an enclosure located at knee level is not practical for most. Interpreting the screen symbols, with no descriptors, requires training or reading the manual. Add to that some complexity in the control logic, and the capability of coding a programmable relay via its built-in display disappears quickly in most applications.

In many cases, understanding or remembering what buttons to press to access or edit the program or modify parameters can require many steps. Users must typically position a curser using navigation keys to access a menu; hold a program, parameter or shift key to access a function or parameter to edit the value; accept it; exit edit mode; and return to run mode. These functions and capabilities, while built-in to a programmable relay's display, are available with a much better user experience using PC-based programming software.

Programming Details

Both programmable relays and micro PLCs can be programmed using PC-based software. Depending on the controller, the programming software will be either available via a free download, or can be purchased for a low price. With either device, it will take time to be efficient with the programming software.

Both PLC and programmable relay software provides the tools to program the hardware to meet the application requirements, and both include extensive online programming help files. In the CLICK's case, the PLC programming software can be downloaded for free, or purchased on CD. Users will find the CLICK programming software simple, with a practical instruction set available to get the program created and running quickly, and the **help files** are extensive.

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With the basic instructions and documentation available with the CLICK micro PLCs, training is not needed, but it is available. Once the PLC is installed and wired, a quick start guide can lead the user through the nine steps required to create a program shown in Table 2.

Table 2 – Nine Steps to Create a Micro PLC Program
1. Download and install the free programming software on a PC
2. Launch the programming software
3. Create a project (program)
4. Compile and save the project
5. Apply power to the PLC
6. Establish PC to PLC communication
7. Download the project to the PLC
8. Place PLC in run mode
9. Test project using PC software's data view monitor

In this CLICK example, following the instructions in about 24-pages of a well-laid-out chapter in the manual, it is possible to quickly learn how to create, compile and transfer a ladder logic project to a CLICK PLC, and then run and test the project. While the quick start shows how to add relay contacts and coils to ladder logic to turn on an output, there are additional instructions available for the CLICK PLC. Details about other instructions are available in the programming software's online help topics.

Don't Forget the Documentation
With a programmable relay, a program can also be entered with PC programming software and downloaded to the device. As discussed, the programmable relay's basic, built-in operator interface could also be used for programming. But while programming using the front panel seems convenient, it can provide a quick path to confusion.

It is difficult to follow programming using the small display built-in. It is also nearly impossible to document the program without using the PC. The next time the programmable relay program needs editing, it can be difficult to follow existing programming unless it is saved to a PC and accessed with the appropriate programming software, just as with a micro PLC.

On the other hand, the CLICK micro PLC has sufficient memory for the ladder program and on-board documentation. Using this feature, program software and associated documentation including comments, tag names, rung descriptions, etc. can be stored on-board the CLICK micro PLC. This eliminates the need to maintain the documentation externally, especially useful when the program is lost, or it is being edited using a different PC in the future.

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Conclusion

A micro PLC is a better solution than a programmable relay for simple to moderate machine control applications. A programmable relay should be chosen when the application is very simple and will never be changed, and when the local operator interface display is sufficient and required.

Due to recent technical developments, micro PLCs are no longer just relay and timer replacers, but can replace programmable relays in many applications. It should be clear from the examples given above that it is incorrect to think that a micro PLC solution is more expensive than a programmable relay. In fact, a CLICK micro PLC will cost less up front in all but the simplest applications. It is also not true that the PLC will take more time to program and will require more training (Figure 4).

Figure 4: A CLICK micro PLC is often a better choice than a programmable relay for all but the simplest and most basic applications.

For those who think a micro PLC would be overkill and might choose a programmable relay instead, AutomationDirect suggests a close look at their **CLICK micro PLC**. It's the better and less expensive solution in many applications, and it's well suited for future expansion.

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