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Chapter 1 : Programmable LED Controller | eBay

PLC handbook - Practical guide to programmable logic controllers (photo credit: calendrierdelascience.com) They are designed for multiple arrangements of digital and analog inputs and outputs with extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact.

Overview[edit] PLC system in a rack, left-to-right: Programs to control machine operation are typically stored in battery-backed-up or non-volatile memory. Before the PLC, control, sequencing, and safety interlock logic for manufacturing automobiles was mainly composed of relays , cam timers , drum sequencers , and dedicated closed-loop controllers. Since these could number in the hundreds or even thousands, the process for updating such facilities for the yearly model change-over was very time consuming and expensive, as electricians needed to individually rewire the relays to change their operational characteristics. When digital computers became available, being general-purpose programmable devices, they were soon applied to control sequential and combinatorial logic in industrial processes. However these early computers required specialist programmers and stringent operating environmental control for temperature, cleanliness, and power quality. To meet these challenges the PLC was developed with several key attributes. It would tolerate the shop-floor environment, it would support discrete bit-form input and output in an easily extensible manner, it would not require years of training to use, and it would permit its operation to be monitored. Since many industrial processes have timescales easily addressed by millisecond response times, modern fast, small, reliable electronics greatly facilitate building reliable controllers, and performance could be traded off for reliability. The winning proposal came from Bedford Associates of Bedford, Massachusetts. Modicon, which stood for modular digital controller. One of the people who worked on that project was Dick Morley , who is considered to be the "father" of the PLC. It was presented to Modicon by GM , when the unit was retired after nearly twenty years of uninterrupted service. Modicon used the 84 moniker at the end of its product range until the made its appearance. The automotive industry is still one of the largest users of PLCs. In a parallel development Odo Josef Struger is sometimes known as the "father of the programmable logic controller" as well. These PLCs were programmed in " ladder logic ", which strongly resembles a schematic diagram of relay logic. This program notation was chosen to reduce training demands for the existing technicians. Other early PLCs used a form of instruction list programming, based on a stack-based logic solver. Another method is state logic , a very high-level programming language designed to program PLCs based on state transition diagrams. Many early PLCs did not have accompanying programming terminals that were capable of graphical representation of the logic, and so the logic was instead represented as a series of logic expressions in some version of Boolean format , similar to Boolean algebra. As programming terminals evolved, it became more common for ladder logic to be used, for the aforementioned reasons and because it was a familiar format used for electro-mechanical control panels. Newer formats such as state logic and Function Block which is similar to the way logic is depicted when using digital integrated logic circuits exist, but they are still not as popular as ladder logic. A primary reason for this is that PLCs solve the logic in a predictable and repeating sequence, and ladder logic allows the programmer the person writing the logic to see any issues with the timing of the logic sequence more easily than would be possible in other formats. Programming[edit] Early PLCs, up to the mids, were programmed using proprietary programming panels or special-purpose programming terminals , which often had dedicated function keys representing the various logical elements of PLC programs. Programs were stored on cassette tape cartridges. Facilities for printing and documentation were minimal due to lack of memory capacity. The oldest PLCs used non-volatile magnetic core memory. More recently, PLCs are programmed using application software on personal computers, which now represent the logic in graphic form instead of character symbols. The programming software allows entry and editing of the ladder-style logic. In some software packages, it is also possible to view and edit the program in function block diagrams, sequence flow charts and structured text. Generally the software provides functions for debugging and troubleshooting the PLC software, for example, by highlighting portions of the logic to show current status during operation or via simulation. The software will upload and download the PLC program,

for backup and restoration purposes. In some models of programmable controller, the program is transferred from a personal computer to the PLC through a programming board which writes the program into a removable chip such as an EPROM. Functionality[edit] The functionality of the PLC has evolved over the years to include sequential relay control, motion control, process control , distributed control systems , and networking. The data handling, storage, processing power, and communication capabilities of some modern PLCs are approximately equivalent to desktop computers. Desktop computer controllers have not been generally accepted in heavy industry because the desktop computers run on less stable operating systems than do PLCs, and because the desktop computer hardware is typically not designed to the same levels of tolerance to temperature, humidity, vibration, and longevity as the processors used in PLCs. Operating systems such as Windows do not lend themselves to deterministic logic execution, with the result that the controller may not always respond to changes of input status with the consistency in timing expected from PLCs. Desktop logic applications find use in less critical situations, such as laboratory automation and use in small facilities where the application is less demanding and critical, because they are generally much less expensive than PLCs. Discrete inputs are given a unique address, and a PLC instruction can test if the input state is on or off. Just as a series of relay contacts perform a logical AND function, not allowing current to pass unless all the contacts are closed, so a series of "examine if on" instructions will energize its output storage bit if all the input bits are on. Similarly, a parallel set of instructions will perform a logical OR. In an electro-mechanical relay wiring diagram, a group of contacts controlling one coil is called a "rung" of a "ladder diagram ", and this concept is also used to describe PLC logic. Some models of PLC limit the number of series and parallel instructions in one "rung" of logic. The output of each rung sets or clears a storage bit, which may be associated with a physical output address or which may be an "internal coil" with no physical connection. Such internal coils can be used, for example, as a common element in multiple separate rungs. Unlike physical relays, there is usually no limit to the number of times an input, output or internal coil can be referenced in a PLC program. Some PLCs enforce a strict left-to-right, top-to-bottom execution order for evaluating the rung logic. This is different from electro-mechanical relay contacts, which in a sufficiently complex circuit may either pass current left-to-right or right-to-left, depending on the configuration of surrounding contacts. The elimination of these "sneak paths" is either a bug or a feature, depending on programming style. More advanced instructions of the PLC may be implemented as functional blocks, which carry out some operation when enabled by a logical input and which produce outputs to signal, for example, completion or errors, while manipulating variable internally that may not correspond to discrete logic. Timers and counters[edit] The main function of a timer is to keep an output on for a specific length of time. A good example of this is a garage light, where you want power to be cut off after 2 minutes so as to give someone time to go into the house. A Delay-OFF timer activates immediately when turned on, counts down from a programmed time before cutting off, and is cleared when the enabling input is off. A Delay-ON timer is activated by input and starts accumulating time, counts up to a programmed time before cutting off, and is cleared when the enabling input is turned off. A Delay-ON-Retentive timer is activated by input and starts accumulating time, retains the accumulated value even if the ladder-logic rung goes false, and can be reset only by a RESET contact. Counters are primarily used for counting items such as cans going into a box on an assembly line. This is important because once something is filled to its max the item needs to be moved on so something else can be filled. Up counters count up to the preset value, turn on the CTU CounT Up output when the preset value is reached, and are cleared upon receiving a reset. Down counters count down from a preset value, turns on the CTD CounT Down output when 0 is reached, and are cleared upon reset. These small devices are typically made in a common physical size and shape by several manufacturers, and branded by the makers of larger PLCs to fill out their low end product range. Most of these have 8 to 12 discrete inputs, 4 to 8 discrete outputs, and up to 2 analog inputs. Size is usually about 4" wide, 3" high, and 3" deep. Most have a small plug for connecting via RS or RS to a personal computer so that programmers can use simple Windows applications for programming instead of being forced to use the tiny LCD and push-button set for this purpose. Unlike regular PLCs that are usually modular and greatly expandable, the PLRs are usually not modular or expandable, but their price can be two orders of magnitude less than a PLC, and they still offer robust design

and deterministic execution of the logics. Features[edit] Control panel with PLC grey elements in the center. The unit consists of separate elements, from left to right; power supply , controller, relay units for in- and output Control panel with a PLC user interface for thermal oxidizer regulation. PLC input can include simple digital elements such as limit switches , analog variables from process sensors such as temperature and pressure , and more complex data such as that from positioning or machine vision systems. Scan time[edit] A PLC program generally loops i. The program then runs from its first instruction rung down to the last rung. Excessively long scan times may mean the response of the PLC to changing inputs or process conditions is too slow to be useful. As PLCs became more advanced, methods were developed to change the sequence of ladder execution, and subroutines were implemented. Precision timing modules, or counter modules for use with shaft encoders , are used where the scan time would be too long to reliably count pulses or detect the sense of rotation of an encoder. This allows even a relatively slow PLC to still interpret the counted values to control a machine, as the accumulation of pulses is done by a dedicated module that is unaffected by the speed of program execution on the PLC. Process of a scan cycle[edit] There are 5 main steps in a scan cycle:

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Chapter 4 : Programmable logic controller - Wikipedia

Programmable controllers have become the primary automation method for many industries, and applications, providing accurate, reliable, easily-modified control. In addition to discrete and process functions, PLCs have evolved to perform complex tasks such as motion, data logging, web server access and email.

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