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INDUSTRIAL AUTOMATION WITH PLC

BLOCK DIAGRAM OF PLC

Programmable Logic Controller - PLC

PLC stands for programmable logic control. It is a computer designed to be used in the industry. It controls the different processes and is programmed According to the operational requirement of that process.

Several industries utilize a sequential industrial process that is respective in nature. For such processes industries have to depend upon use of relays, stepping drum, timers and controls considerable difficulties experienced in reprogramming necessitated due to change in the nature of production. Often the whole system has to be scrapped and a redesign is required.

To overcome these problems PLC control system was introduced. The PLC can be described as a control ladder comprising a sequence program. PLC sequence program consists of normally open and normally closed contacts connected in parallel or in series. It also has relay coils, which turns ON and OFF as the state of these contacts change.

PLC Programmable Logic Concept:

A programmable logic controller is a microprocessor based programming technique, which is used to perform many functions in industrial process. The programmable logic controller operates similarly to the ordinary controller. But in this system different operation are performed by software. If we want to change the program it is only needed to change the program in the software. PLC takes input instructions in the form of a ladder diagram or computer software instructions.

These instructions are decoded in the CPU and the CPU provides differed signals to control or to operate many devices of the system.

When these devices change their position or cause to change controlled variable. A sample of controlled variable is given to CPU indicate that change in controlled variable has been eliminated. PLC basically consists of a ladder network, which is performed according to the requirements of the system.

Basic Parts of PLC:

A typical block diagram of PLC is shown in Fig. as clear from fig PLC consists of the following basic parts.

1. CPU (Central processing unit)
2. Programming device
3. Input & output module

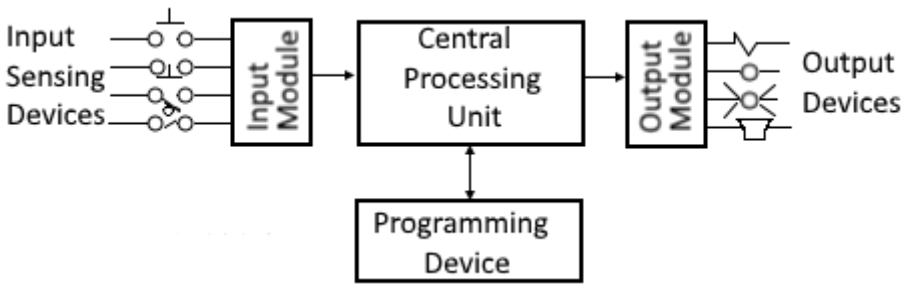

Fig: PLC Block Diagram

Central Processing Unit:

The central processing unit is the heart of the PLC system. The CPU is a microprocessor-based control system that replaces central relays, counters, timers and sequencers. A processor appears only once in a PLC and it can be either a one-bit or a word processor. One bit processors are adequate for dealing with logic operations. PLCs with word processors are used when processing text and numerical data, calculations, gauging, controlling and recording, as well as the simple processing of signals in binary code is required.

The principle of operation of the CPU can be briefly described as follow.

The CPU accepts (reads) input data from various sensing devices, executes the user program from memory and sends appropriate output commands to control devices. A direct current (DC) power source is required to produce the low-level voltage used by the processor and I/O modules. This power supply can be housed in the CPU unit or maybe a separately mounted unit, depending on the PLC system manufacturers. The CPU contains various electrical parts and receptacles for connecting the cables that go to the other units as well as to operational key switches.

Typical operation key switch positions are.

1. **Off:** The system cannot be run or programmed.
2. **Run:** Allow the system to run, but no program alterations can be made.
3. **Program:** Disables the output and allows creating modifying, and deleting of programs.

Input & Output Modules of PLC:

Input/output modules are used for interfacing between input devices (e.g. start and stop pushbuttons, sensors, limited switch, selector switch) and microprocessor. And also used for interfacing between output devices (e.g electrical heater, lights, solenoid valve, relays, buzzer, fan) and microprocessor. The input information is transferred to the processor through the input module and output information from the processor to load is transformed through the output module.

The input/output module use for providing the isolation between input devices and process. And also to provide isolation from processor to output devices. For isolation modules use the optocoupler.

Input devices such as pushbuttons, limited switches, sensors and selector switches are hard-wired to terminals on the input modules. Output devices such as small motor, motor starters, solenoid valves, and indicator lights are hard-wired to the output modules.

Input interface modules accept signals from the machine or process devices (e.g. 220V AC) and convert them into signals (e.g. 5VDC) that can be used by the controller, or processor output interface modules converts controller or processor signals (e.g. 5VDC) into external signals (e.g 220 v AC) used to control the machine or process.

The simplified circuit and block diagram of input modules is shown in fig. input modules perform four basic tasks in the PLC system.

1. They sense when the signal is received from the sensor on the input of the machine
2. They convert the input voltage to the correct voltage level for the PLC
3. They isolate PLC from fluctuation in the input signal voltage or current.
4. In end, they send the signal to the PLC.

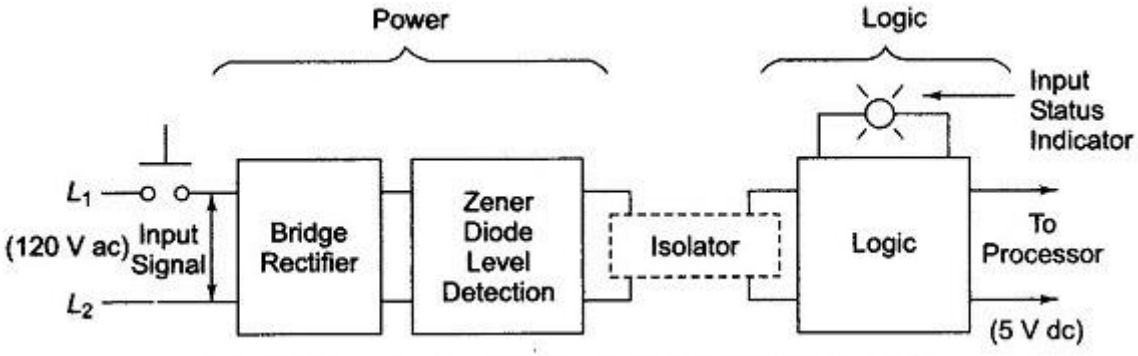

Fig: PLC Input Module Block Diagram

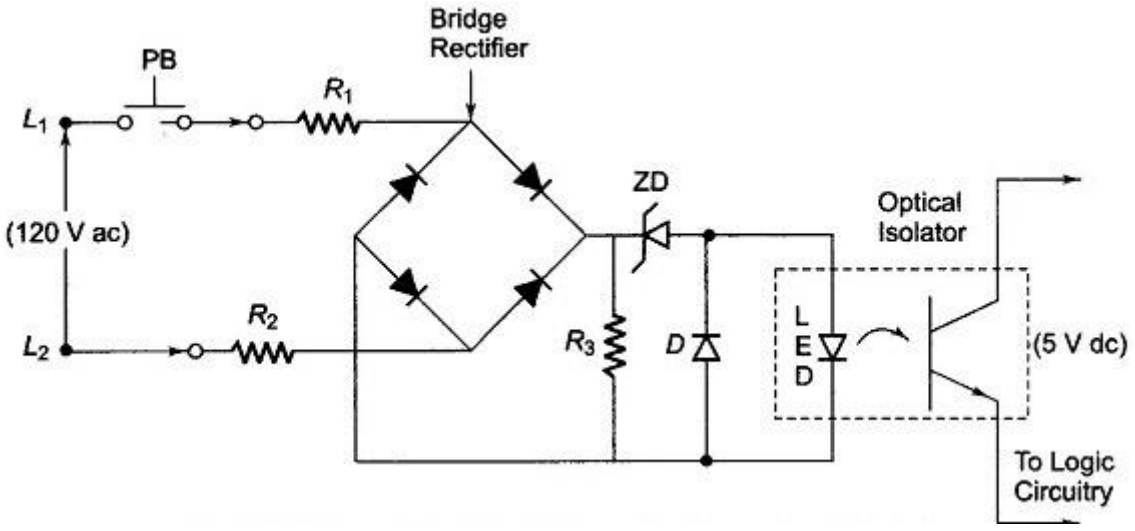

Fig: PLC Input Module Circuit Diagram

It is clear from the above figure that the input module is consists of two sections one is the power section while the other is a logical section, which is electrically isolated from each other. When the push button is closed 220V AC is applied to the bridge rectifier, through resistors R1 & R2. The rectifier converts AC Signal into DC signal and Zener diode ZD gives low voltage to the LED. When light from LED strikes the phototransistor it becomes in the conduction region and gives DC voltage to the processor. An optical isolator also helps to reduce the effects of electrical noise, which can produce an error.

PLC Output Module:

The output module is used for interfacing between output load and processor, the output modules have a function similar to that of the input modules except in reverse order.

The fig has shown the block and circuit diagram of the output module. It consists of two sections, one is the logic section second is the power section.

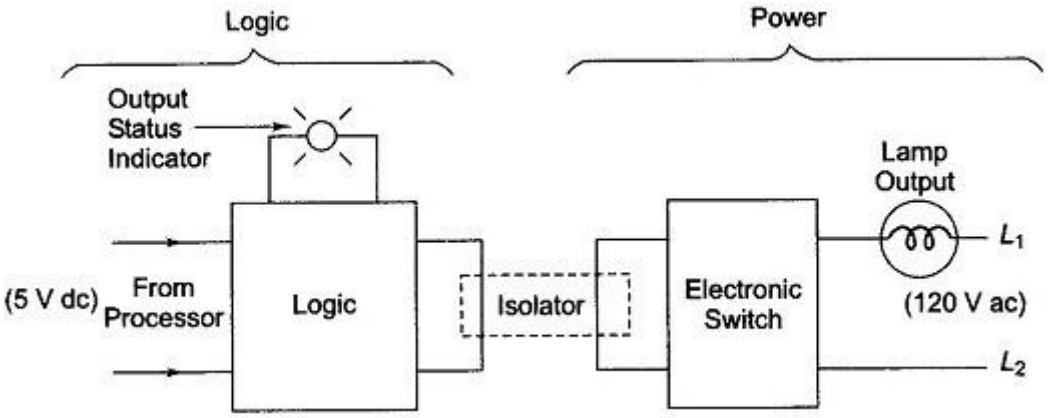

Fig: PLC Output Module Block Diagram

When the logic high signal comes from the processor the LED is on & the light strikes the phototransistor. Which become in the conduction region & give a triggering pulse at the gate of Triac. The trial conducts-and load lamp is energized through it as clear from fig.

The interfacing is providing by an optocoupler (LED, Phototransistor) as in the input module.

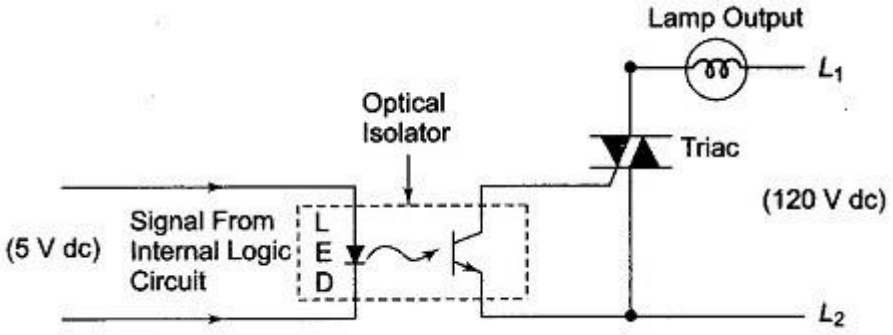

Fig: PLC Isolated Circuit Diagram

Programming device (Keyboard Monitor):

The keyboard and monitor are used for programming a PLC. The data is inter in the PLC processor with the help of the Keyboard in the form of a ladder diagram. This ladder diagram can be seen on the monitor screen. The programmer can communicate with the PLC processor with help of programming devices. The programming unit communicates with the processor if PLC via

a serial or parallel data communication link. The personal computer can be used for programming PLC if it has the required software.

Microprocessor-Based PLC Control System

The Figure shows the block diagram of the microprocessor-based control system. Data acquisition system (DAS) takes information signals from a sensor which is in the form of analog and changes them into a digital value that can be read in and processed by the microprocessor. A keyboard and display in the system allow the user to set-point values, read the current values of process variables, and issue commands. Relays, D/A converters,

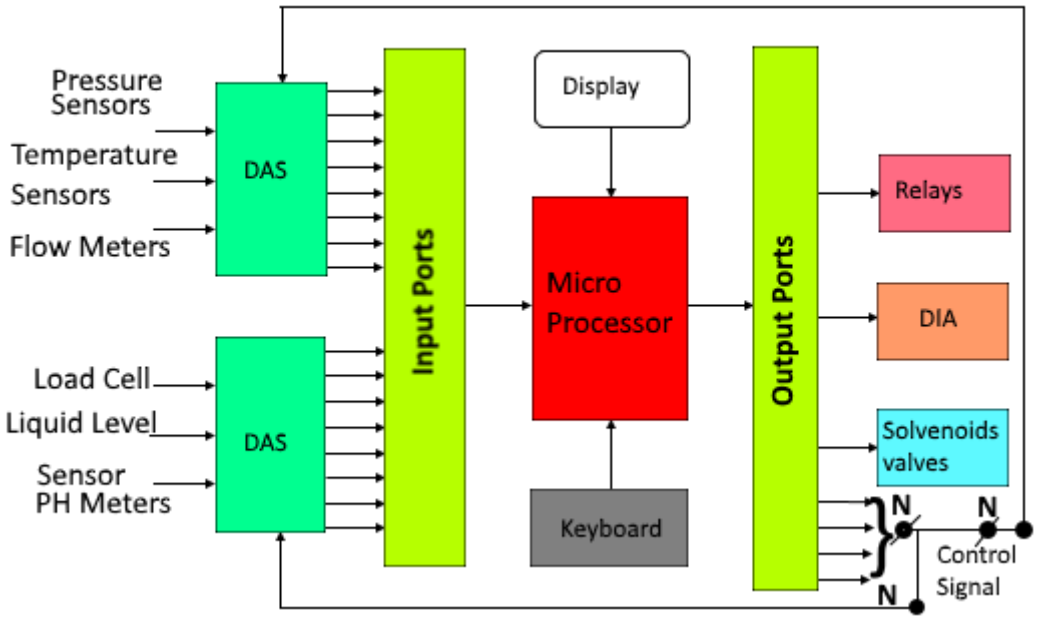

Fig: PLC Microprocessor Based Control System Block Diagram

Solenoid valves and other actuators are used to control process variables under program direction. A programmable timer in the system determines the rate at which control loops are serviced.

Microprocessor-based control systems range from a small Programmable controller that might be used to control a machine on the Factory floor to large computers used to control an entire fractionating column in an oil refinery.