Session One

•AUTOMATION & PLC

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Controlling and Monitoring Industry

Programmable Logic Controller

Definitions of PLC

The first PLC Construction
by General Motors in 1968

Programmable logic controller (PLC).
Programmable controller (PC).

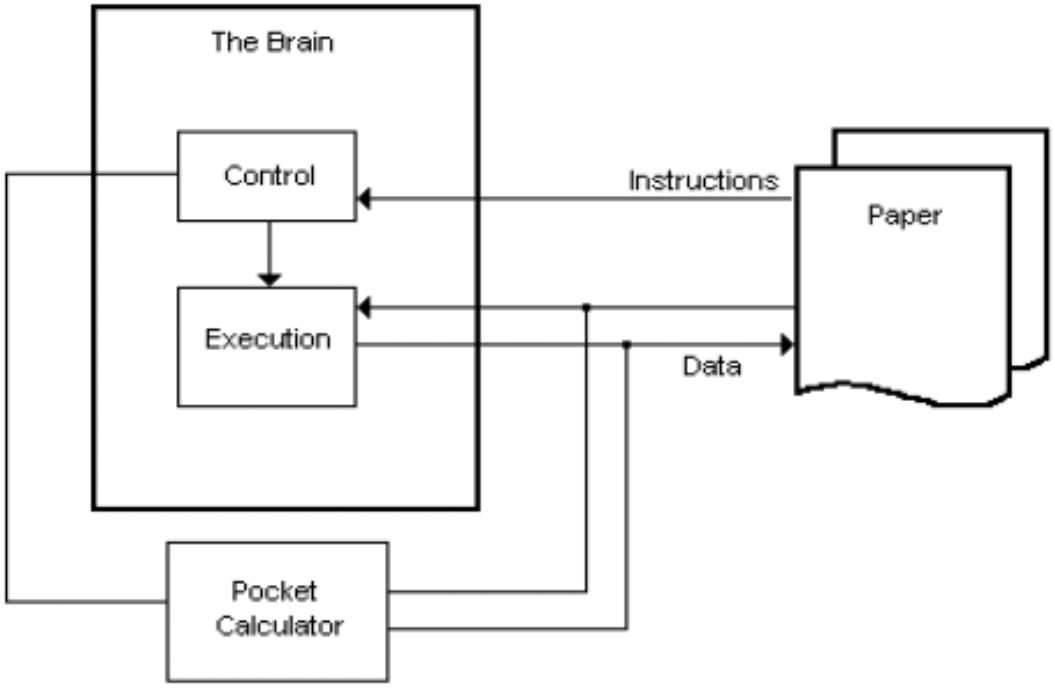
- **1974** Multiprocessing PLC
  - Logic, timer/counter, data move, arithmetic
  - 12k memory, 1024 input and output

Programmable Logic Controller

- PLCs are easy to program and install
- The speed with which internal times operate is much faster than conventional time delay relay systems
- Access to PLCs could be restricted or protected
- PLCs have the advantage of problem-solving capabilities, over any other type of control system
- PLCs are usually designed with communication capabilities that allow to interface with local or remote computer systems or operator.
- PLCs are extremely reliable

Programmable Logic Controller

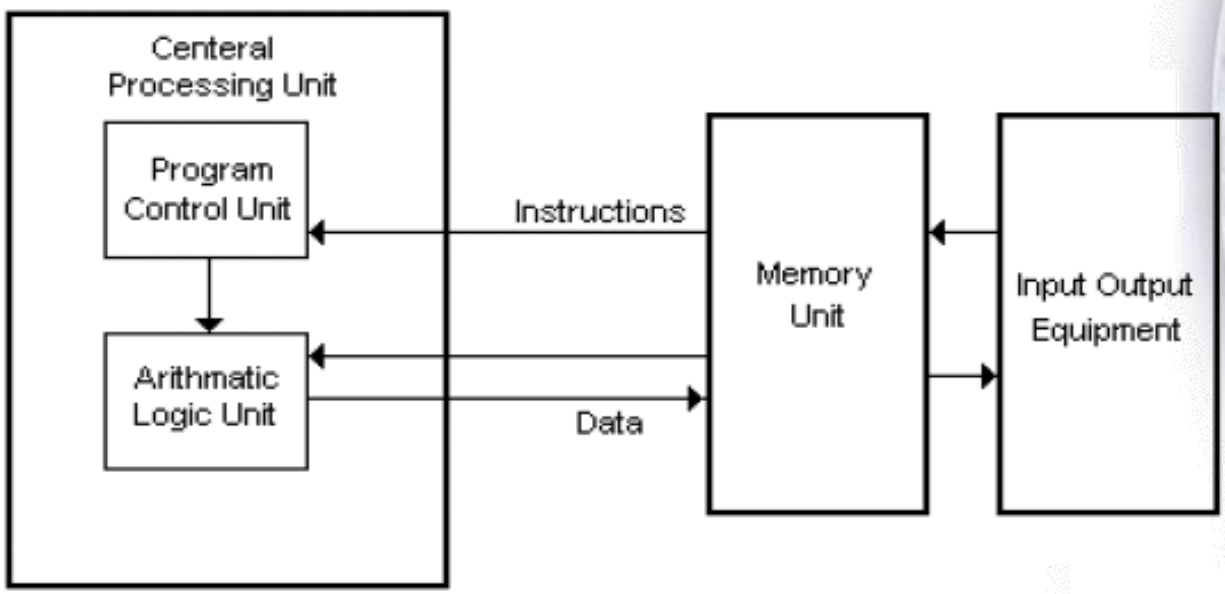
- Function of input output data & Instructions of HC



THE MAIN COMPONENTS OF A HUMAN COMPUTATION

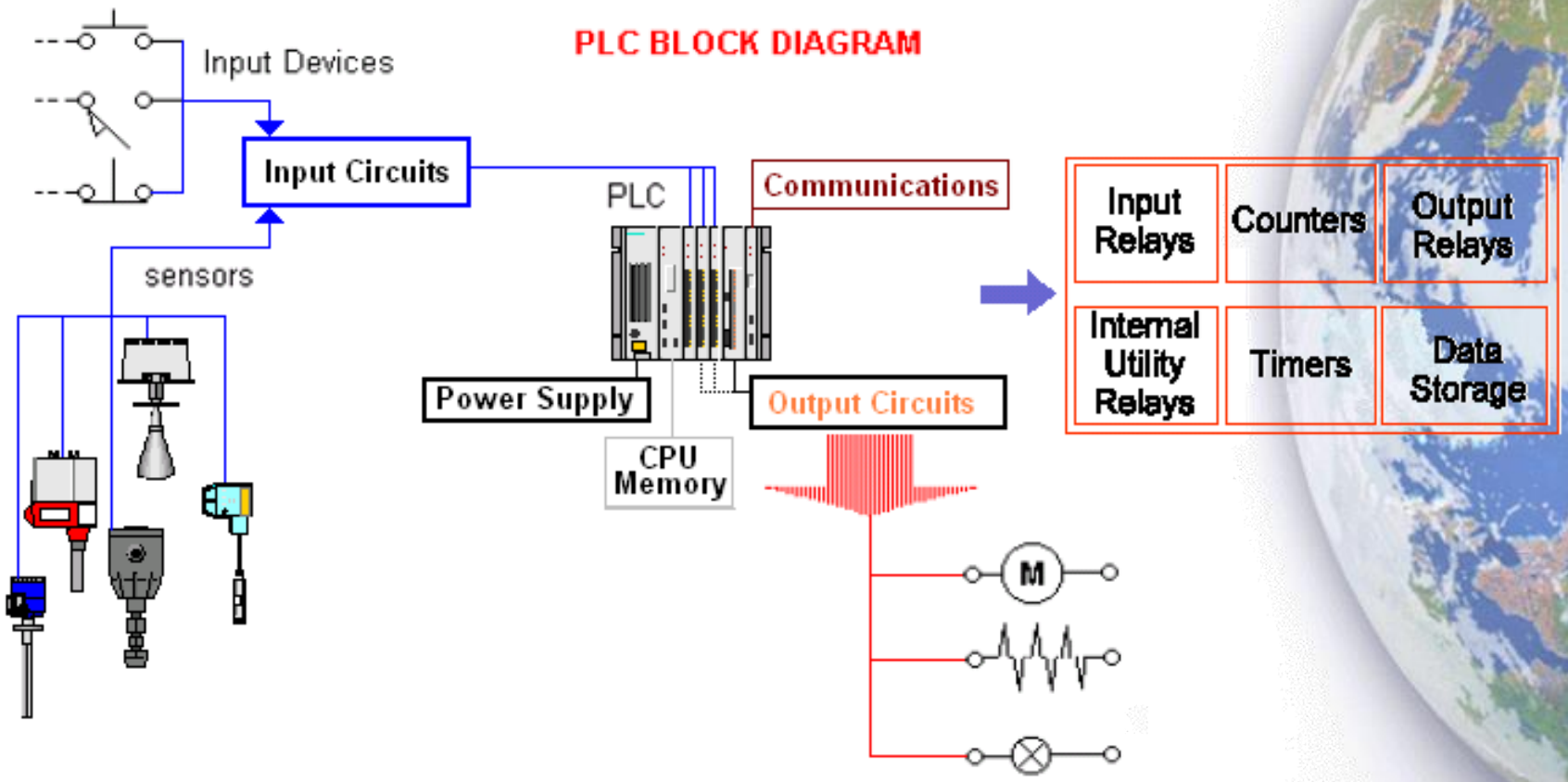
Programmable Logic Controller

- The main Components of the Machine Computing

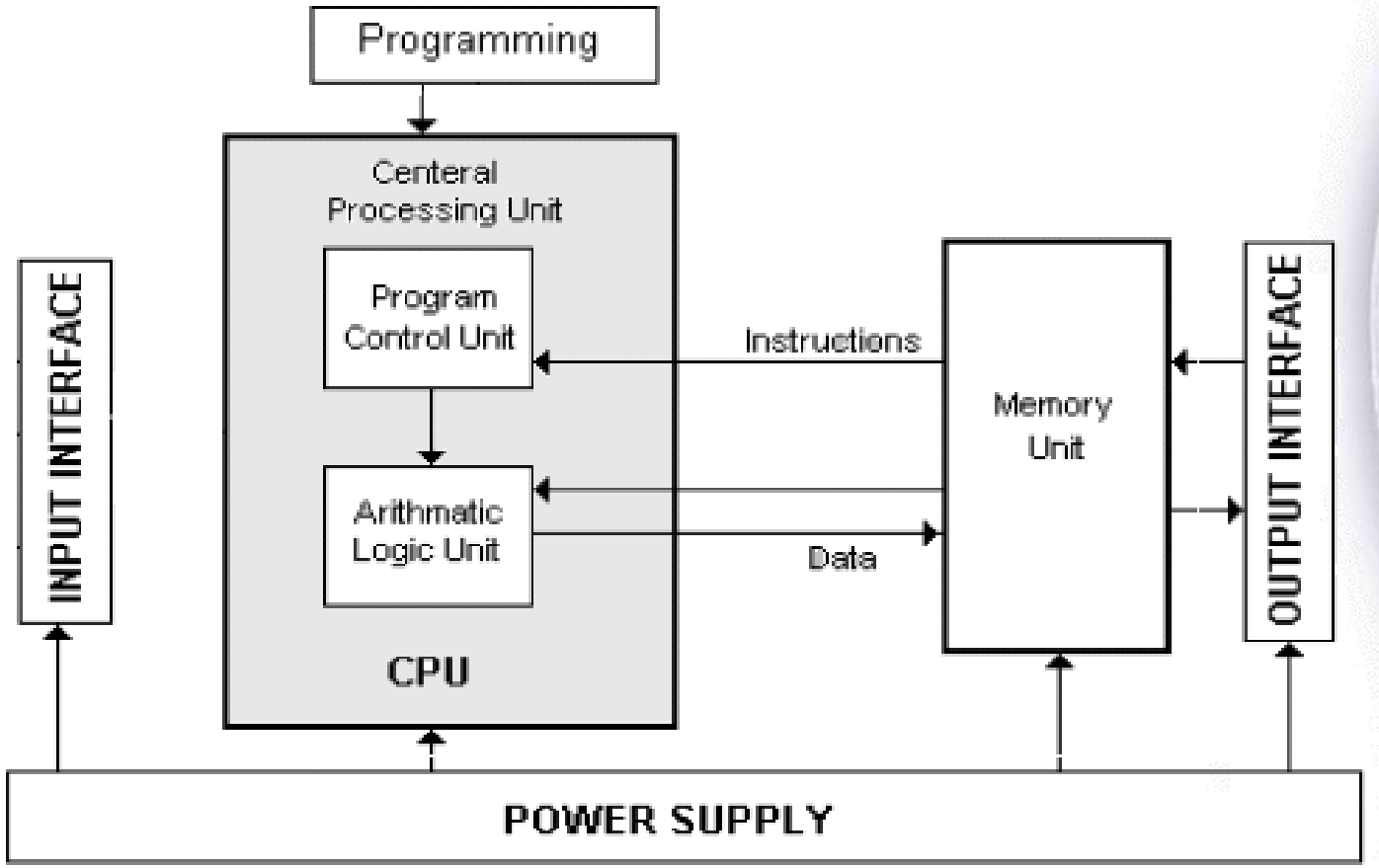


MACHINE COMPUTING

Programmable Logic Controller

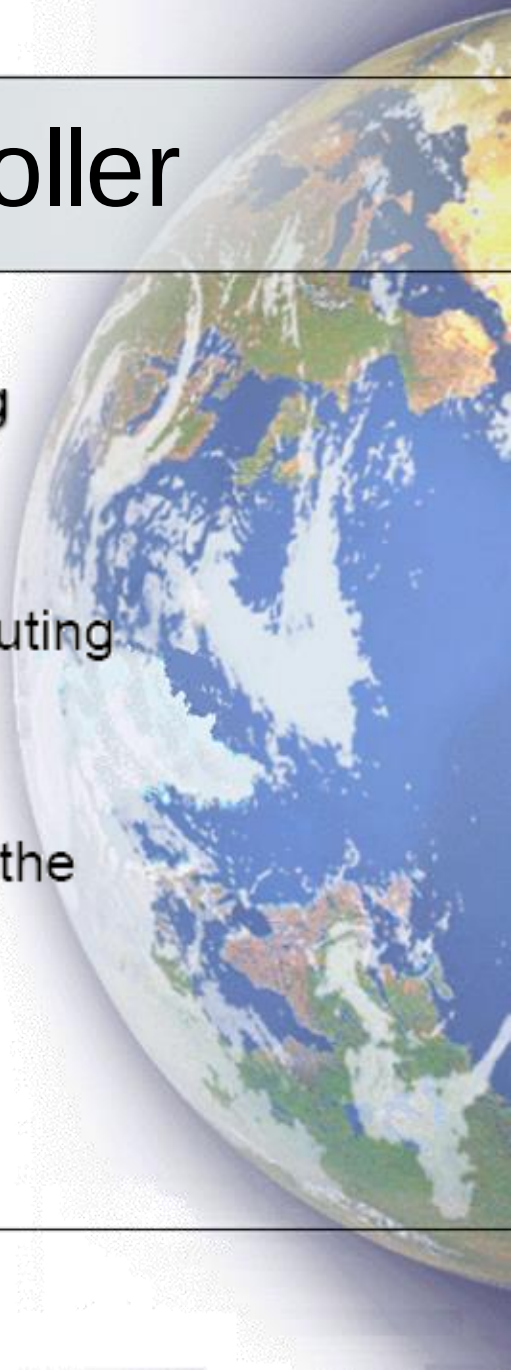


Programmable Logic Controller



Programmable Logic Controller

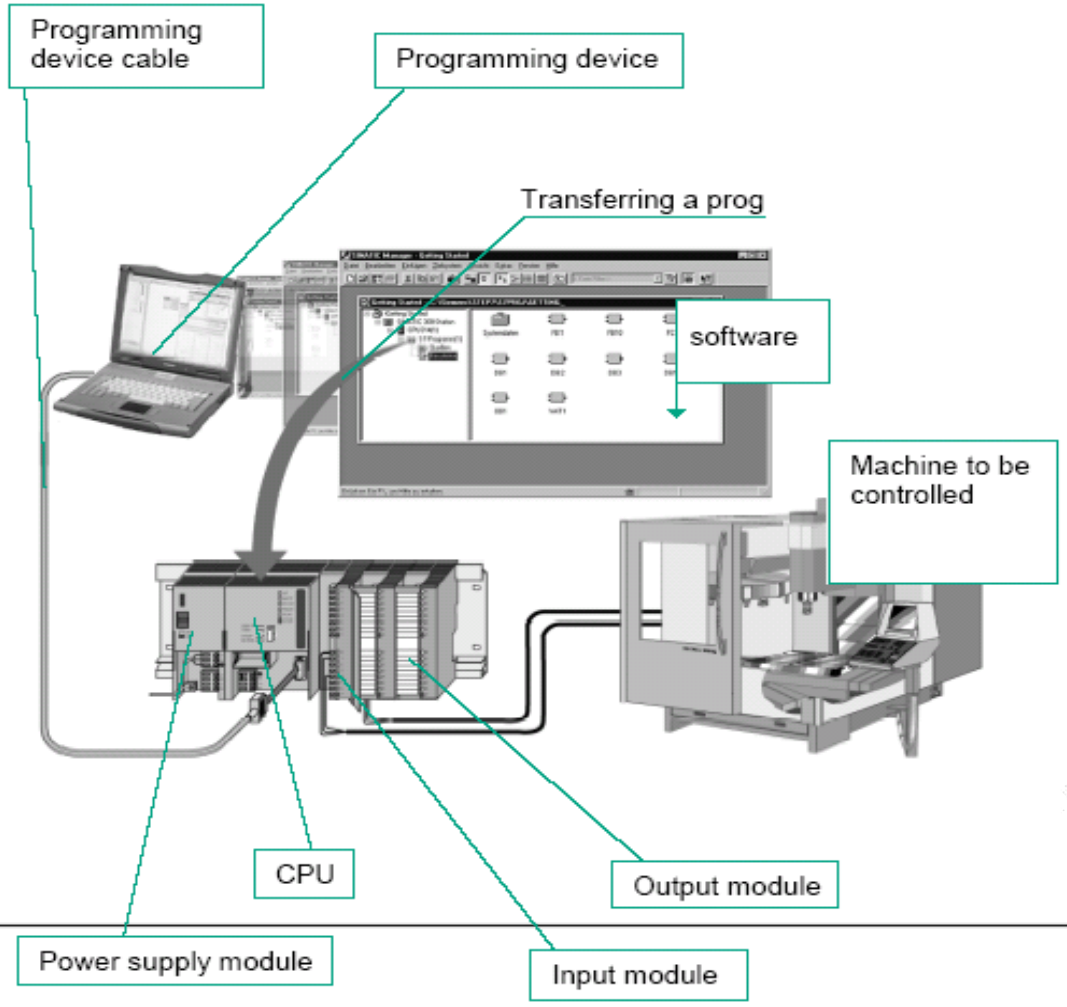
- Consequently, every PLC must have the following components:
  - A Processor Capable of interpreting and executing programs.
  - A Memory for Storing Programs and Data
  - A Means of Transferring information between the Memory and the Processor.
  - And between the PLC and the Outside World



Programmable Logic Controller

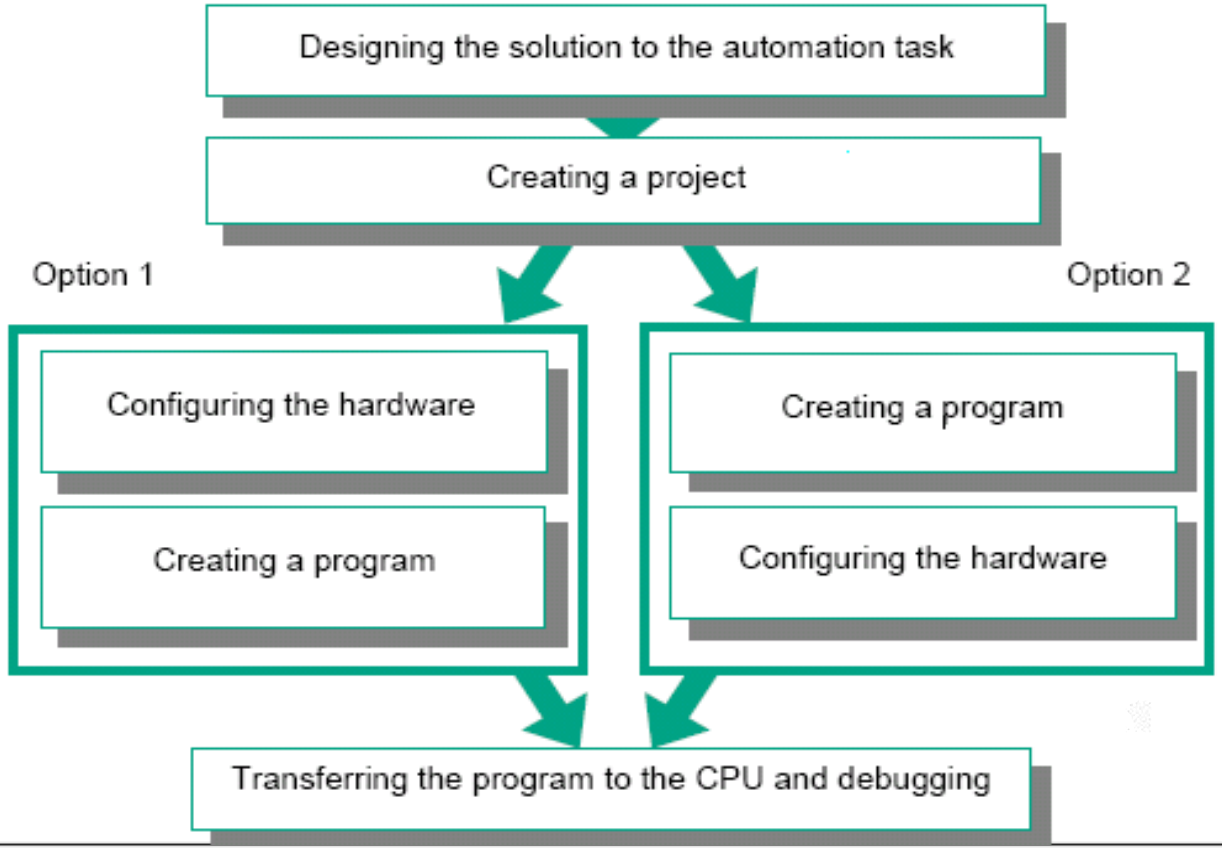
- The Input Interface
- The Output Interface
- The CPU and MEMORY
- The Power Supply
- The Program
- The Programming Languages
- The Programming Device, or Programming Terminal

Programmable Logic Controller

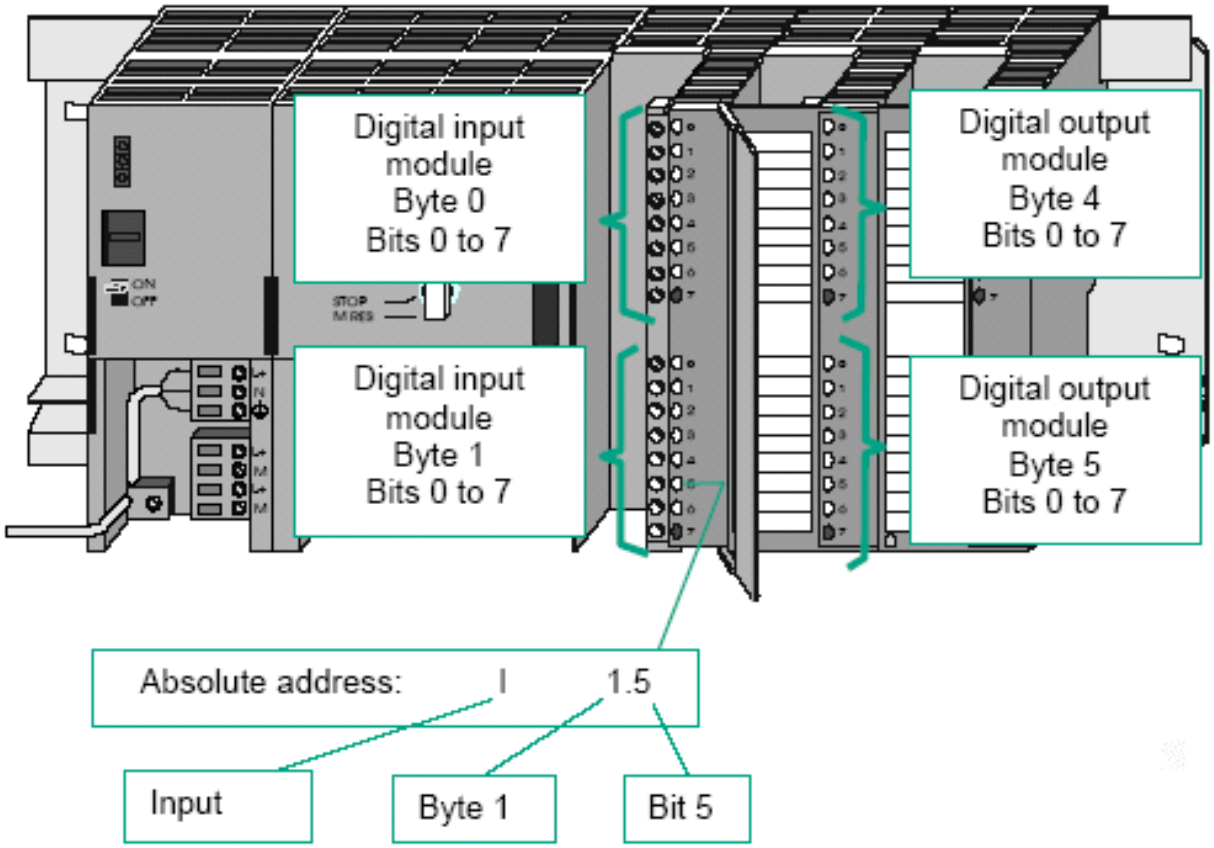


Programmable Logic Controller

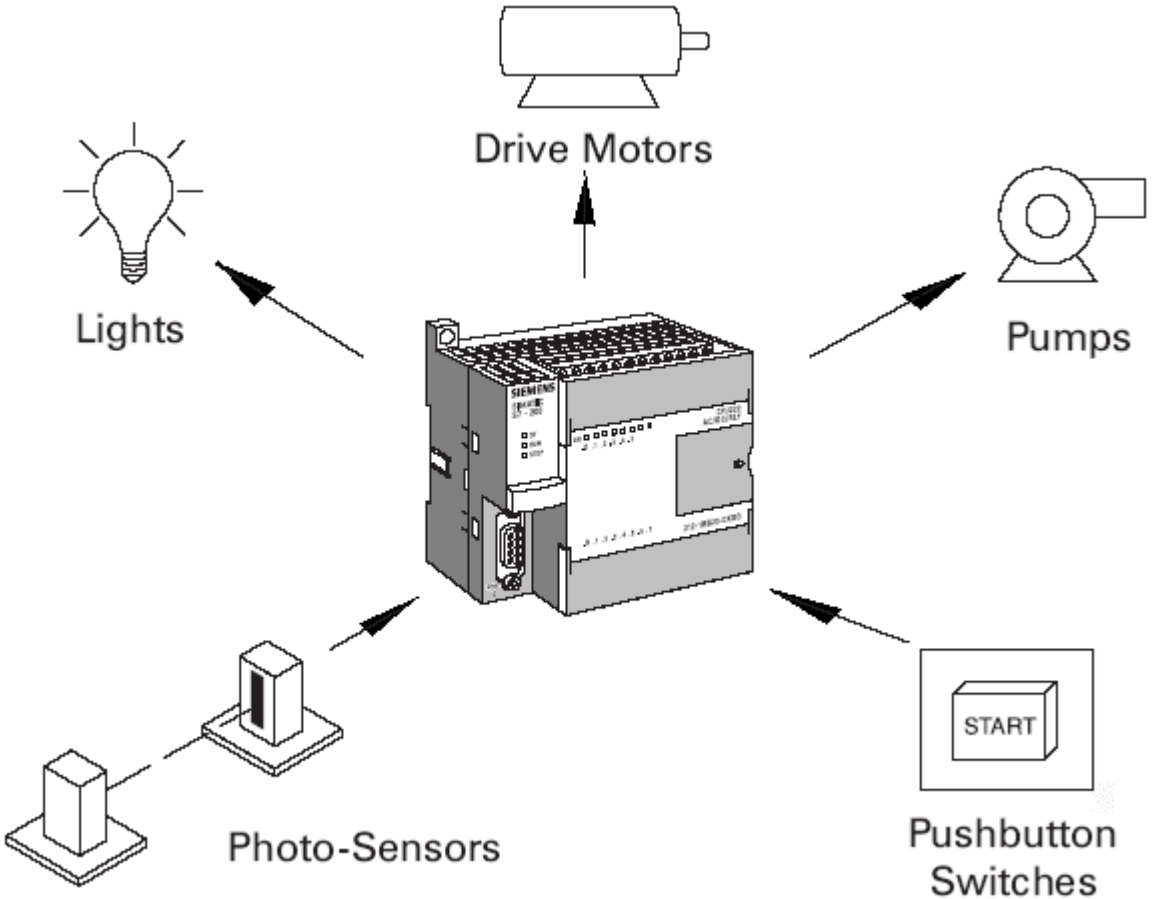
Basic Procedure projects can be created in different orders.



Programmable Logic Controller



Programmable Logic Controller



Programmable Logic Controller

PLCs consist of

- input modules or points
- a Central Processing Unit (CPU)
- and output modules or points

Programmable Logic Controller

An input

accepts a variety of digital or analog signals from various field devices (sensors) and converts them into a logic signal that can be used by the CPU.

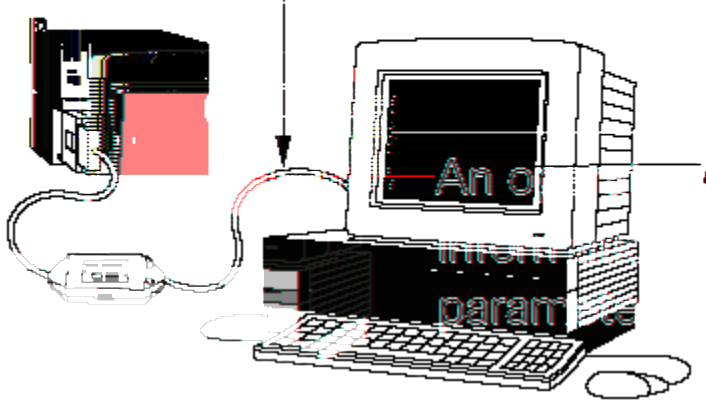
The CPU makes decisions and executes control instructions based on program instructions in memory.

Output modules

convert control instructions from the CPU into a digital or analog signal that can be used to control various field devices (actuators).

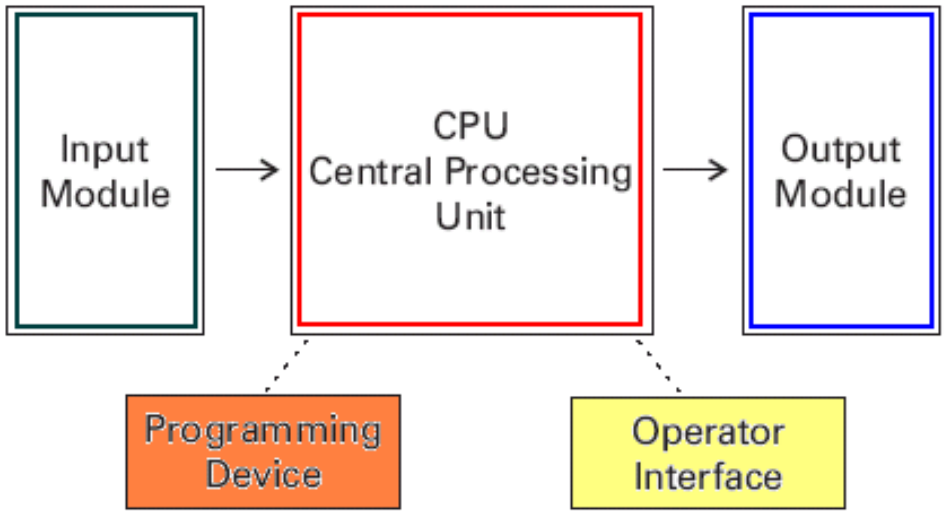
Programmable Logic Controller

A programming device is used to input the desired instructions. These instructions determine what the PLC will do for a specific input.



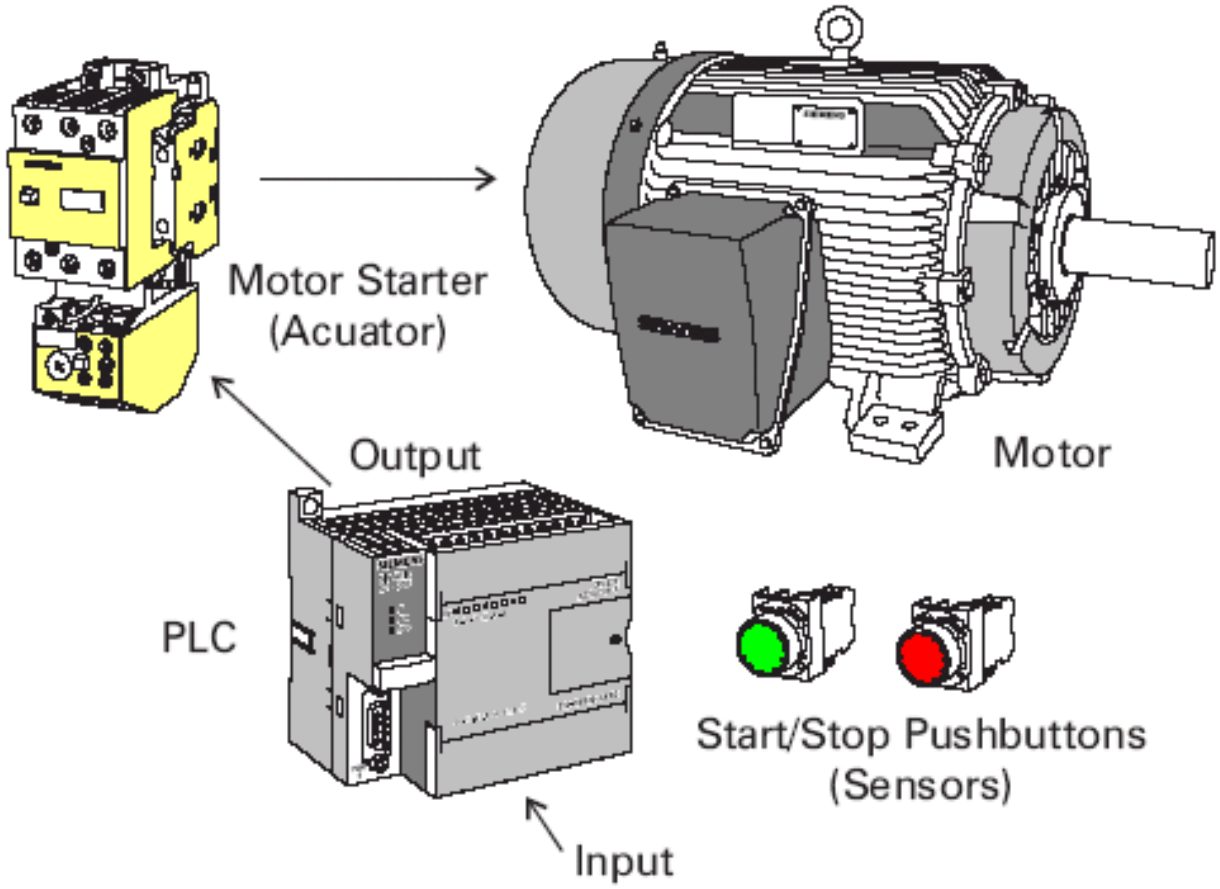
An operator interface device allows process information to be displayed and new control parameters to be entered.

Programmable Logic Controller

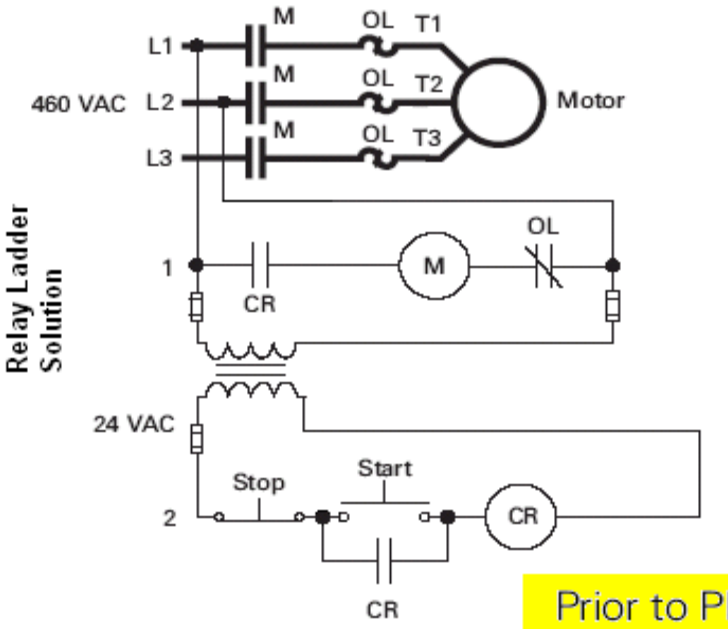


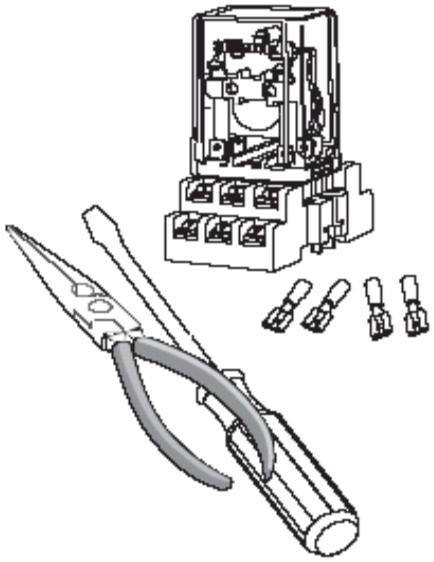
Pushbuttons (sensors), in this simple example, connected to PLC inputs, can be used to start and stop a motor connected to a PLC through a motor starter (actuator).

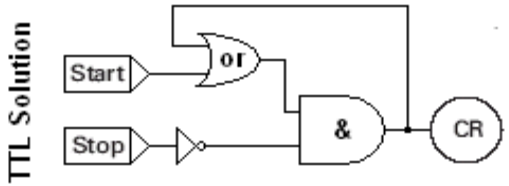
Programmable Logic Controller



Programmable Logic Controller







Prior to PLCs,

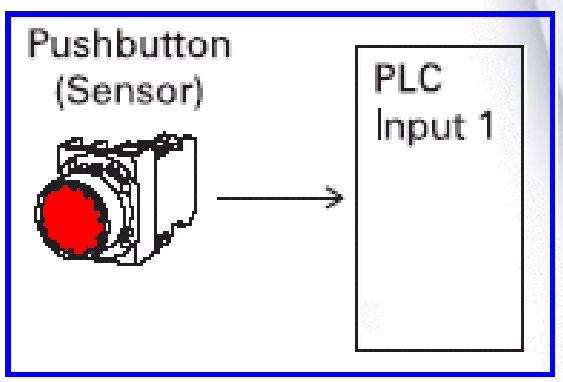
Circuit diagrams had to be designed, electrical components specified and installed, and wiring lists created.

This is often referred to as hard-wired control.

Programmable Logic Controller

A sensor

is a device that converts a physical condition into an electrical signal for use by the PLC. Sensors are connected to the input of a PLC. A pushbutton is one example of a sensor that is connected to the PLC input. An electrical signal is sent from the pushbutton to the PLC indicating the conditon (open/closed) of the pushbutton contacts.

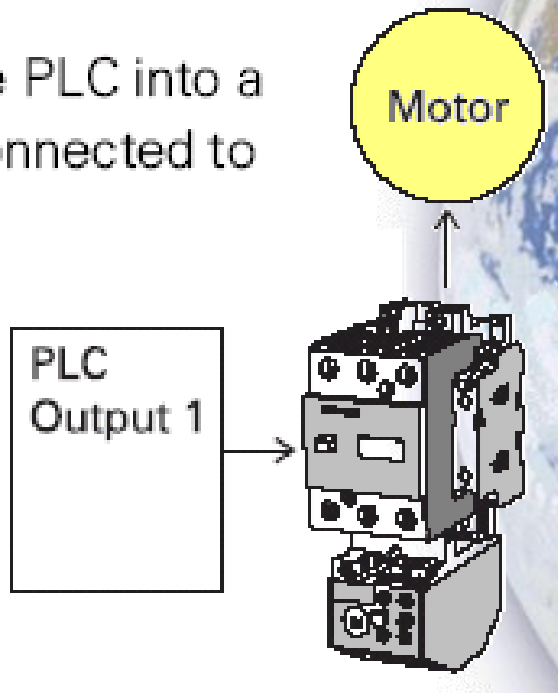


Programmable Logic Controller

Actuators

convert an electrical signal from the PLC into a physical condition. Actuators are connected to the PLC output.

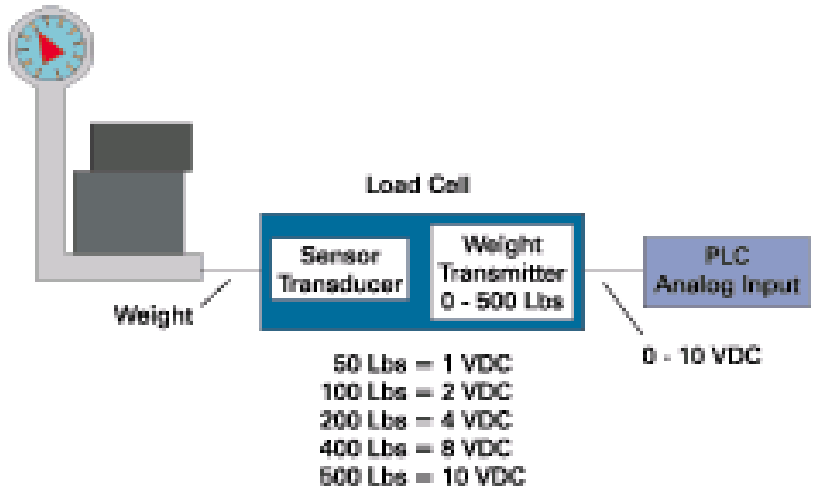
A motor starter is one example of an actuator that is connected to the PLC output. Depending on the output PLC signal the motor starter will either start or stop the motor.



Programmable Logic Controller

Analog Input

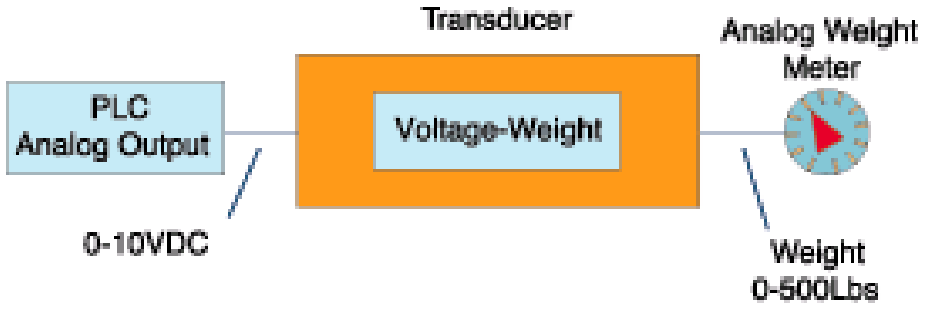
An input to a system that can continuously vary over a range of current or voltage such as 4 to 20 milliamps or 0 to 10 volts.



Programmable Logic Controller

Analog Output

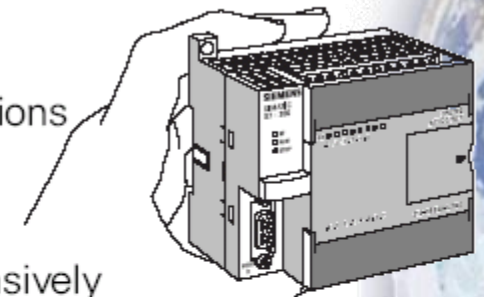
An output from a system that can continuously vary over a range of current or voltage such as 4 to 20 milliamps or 0 to 10 volts.

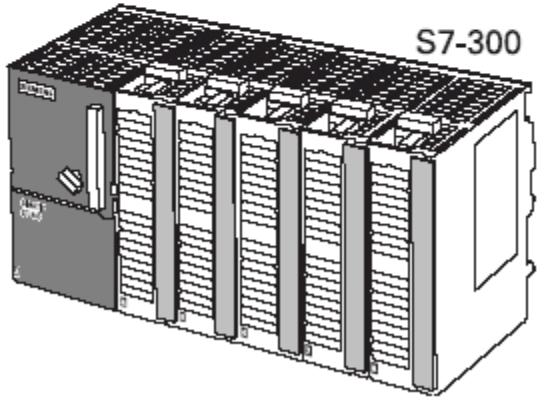


Programmable Logic Controller

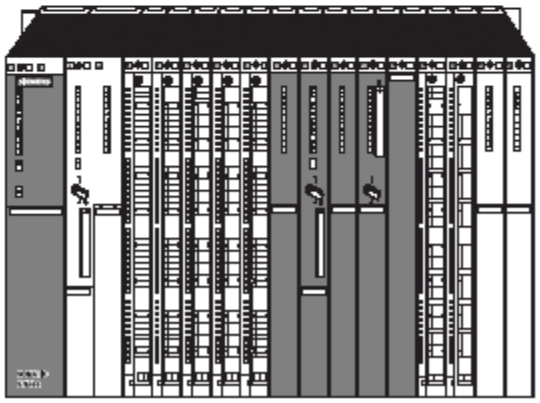
PLC's Are

- Smaller physical size than hard-wire solutions
- Easier and faster to make changes
- PLCs have integrated diagnostics and override functions
- Diagnostics are centrally available
- Applications can be immediately documented
- Applications can be duplicated faster and less expensively





S7-300

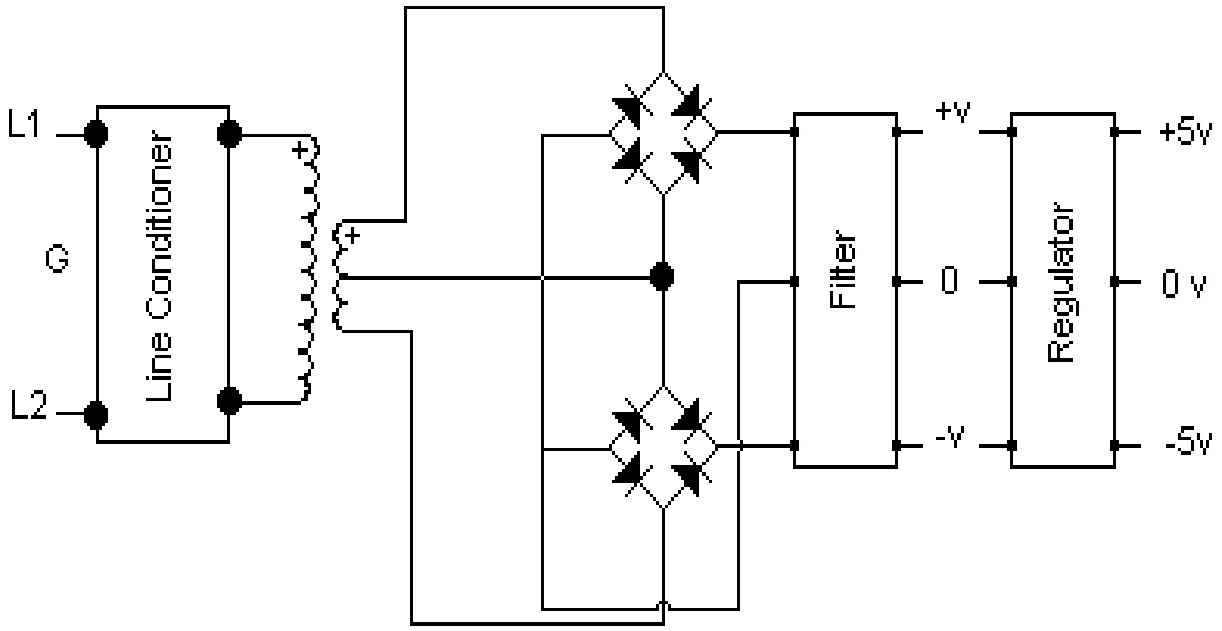


S7-400

The Power Supply

- +5 volts ***at 2 to 3 amp for:***
  - » **CPU**
  - » **MEMORY**
  - » **Digital interface**
  - » **Logic**
- ± 12 volts ***at 1 amp for:***
  - » **EPROM**
  - » **EEPROM**
  - » **-12 volts to provide -5 volts**
  - » **Serial communication circuits**
- ± 15 volts ***at 1 amp for:***
  - » **Analog interface circuits**
  - » **Including the Operational Amplifiers**

The Power Supply



The Power Supply

External Power Supply Unit:

1- For Relay Output

: Voltage 24 V DC ±10%
Ripple Voltage less than 4 Vp-p
Current 150 mA (24 VDC at all points ON)
Output points 16 Points

2- For Transistor Output (Source Loading)

: Voltage 12/24 V DC (10.2 to 30 V)
Current 100 mA (Type all points ON)
Output points 64 Points

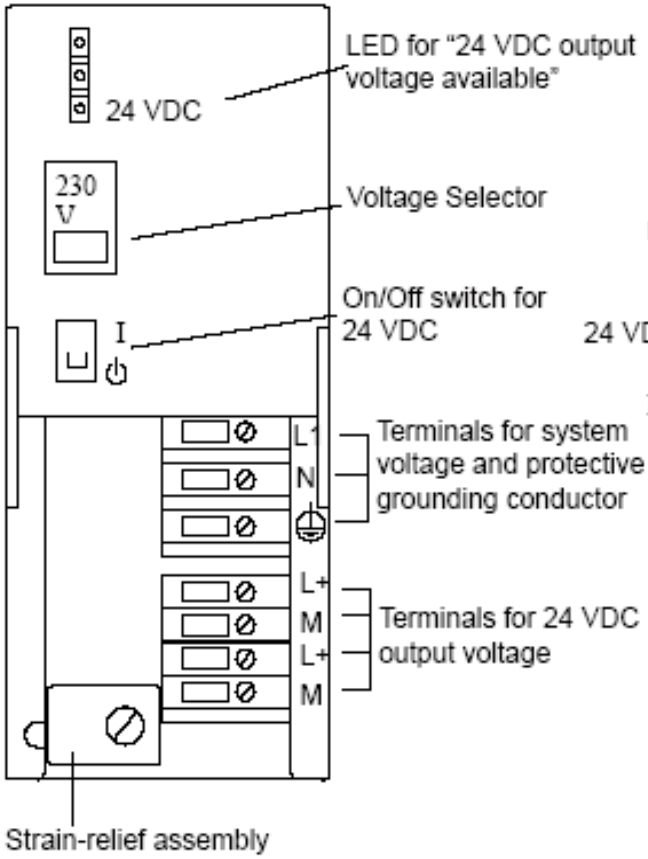
The Power Supply

External Power Supply Unit:

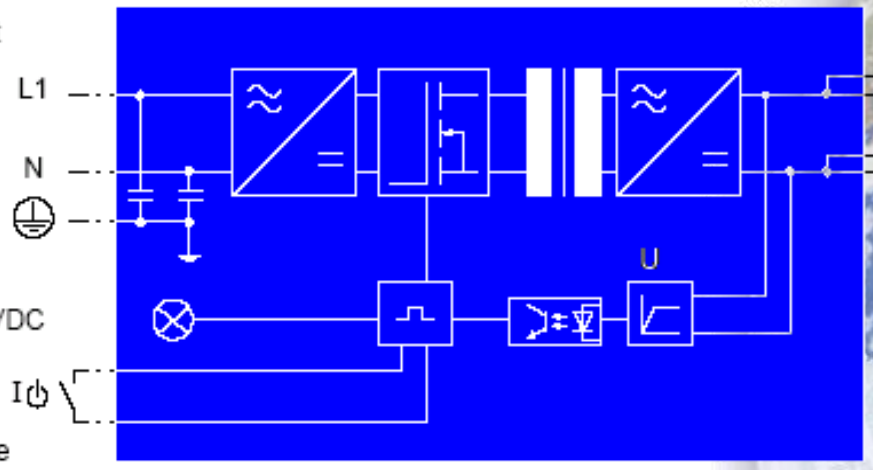
3- For Transistor Output
: Voltage 12/24 V DC ±10%
Current 135 mA (24 VDC at all points ON)
Output points 16 Points

4- For TTL and CMOS Output
: Voltage 5/12 V DC ±10%
Current 100 mA (12v DC type per common)
Output points 32 Points

The Power Supply

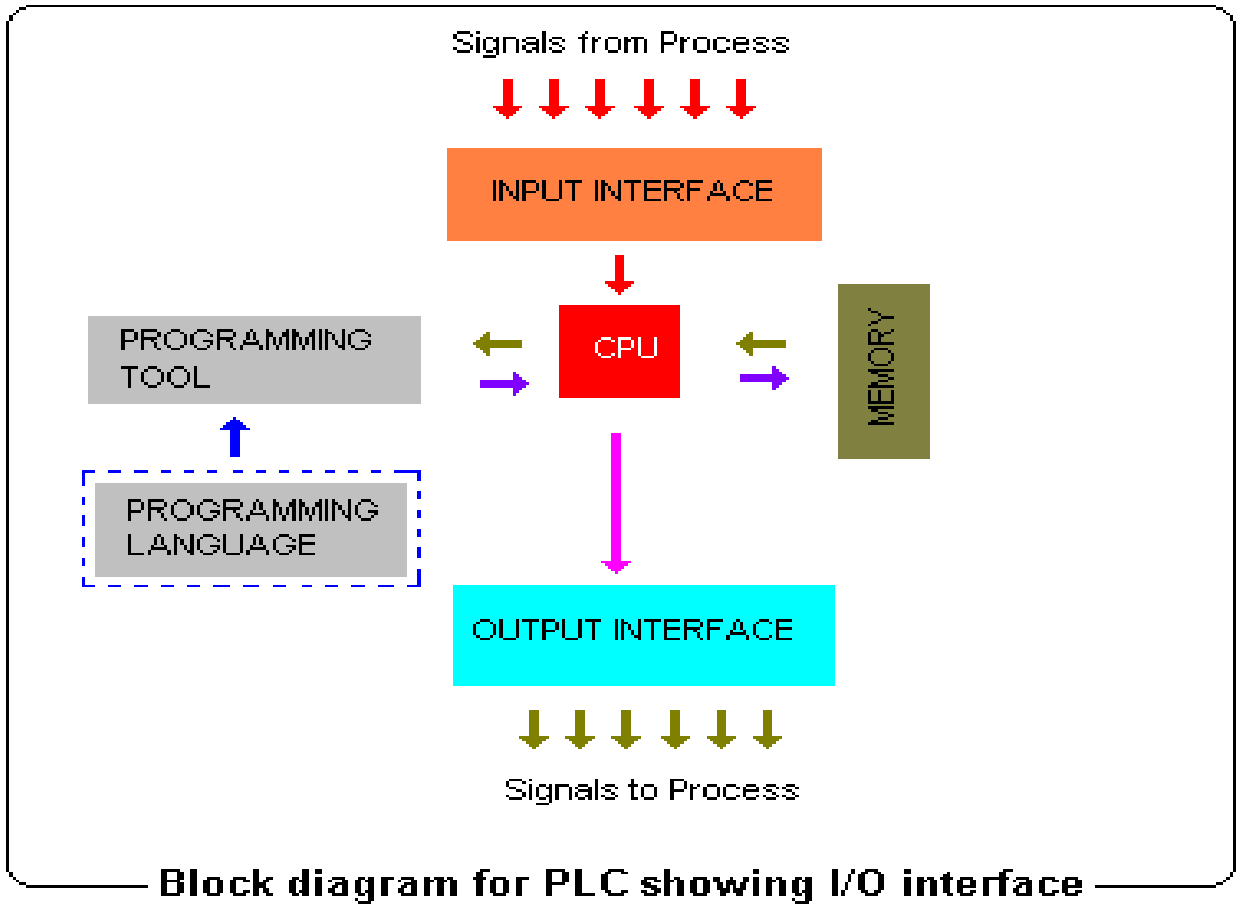


Wiring Schematic of the PS 307 Power Supply Module (2 A)



Basic Diagram

The I/O System

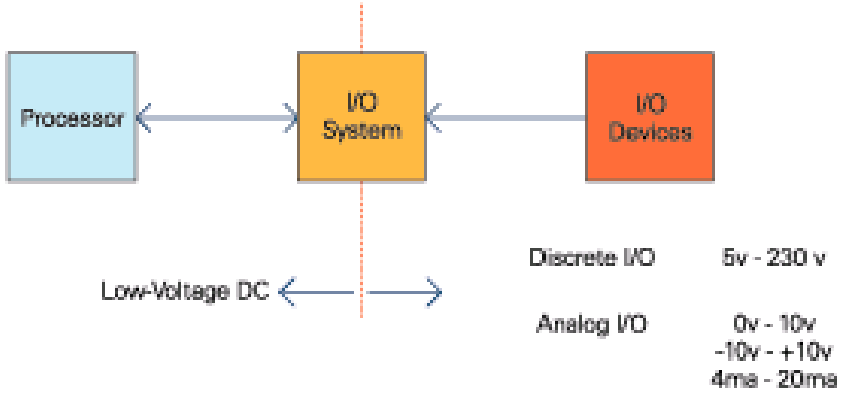


Block diagram for PLC showing I/O interface

The I/O System

Input/Output (I/O) System

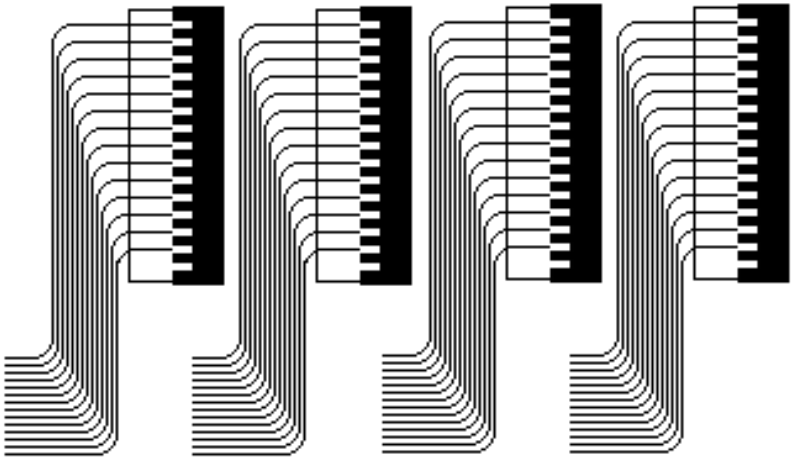
The part of a control system that interfaces to the real world. The I/O system accepts signals from switches and sensors, and provides signals to actuating devices, indicators, etc.



The I/O System

FIELD INPUT DEVICES

Provides the "SIGHTS & SOUND" of the Control System to the Processor



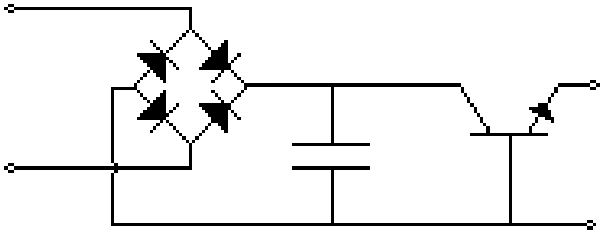
I/O MODULE TERMINATION

The Interconnection means Between the Real World Devices & The PLC System

INPUT MODULE BLOCK DIAGRAM

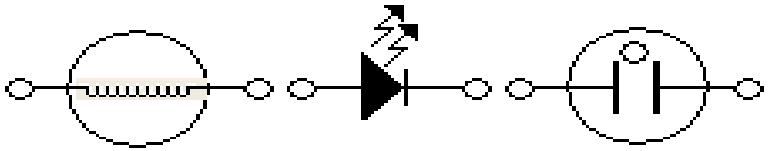
The I/O System

Input Conditioning & Level Conversion



CONDITIONING AND LEVEL CONVERSION

Converts the Field Signals to LOW-VOLTAGE level and formats usable by the PC Processor

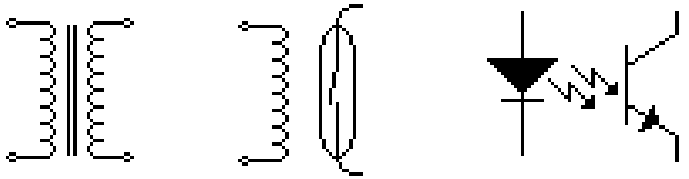


MODULE STATUS INDICATORS

Provides a Visual Indication as to the Functional Status of the Input Module Points

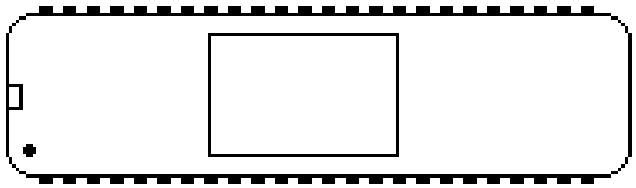
INPUT MODULE BLOCK DIAGRAM

The I/O System



ELECTRICAL ISOLATION

Electrically Isolates the Field Signals from the Processor Signals

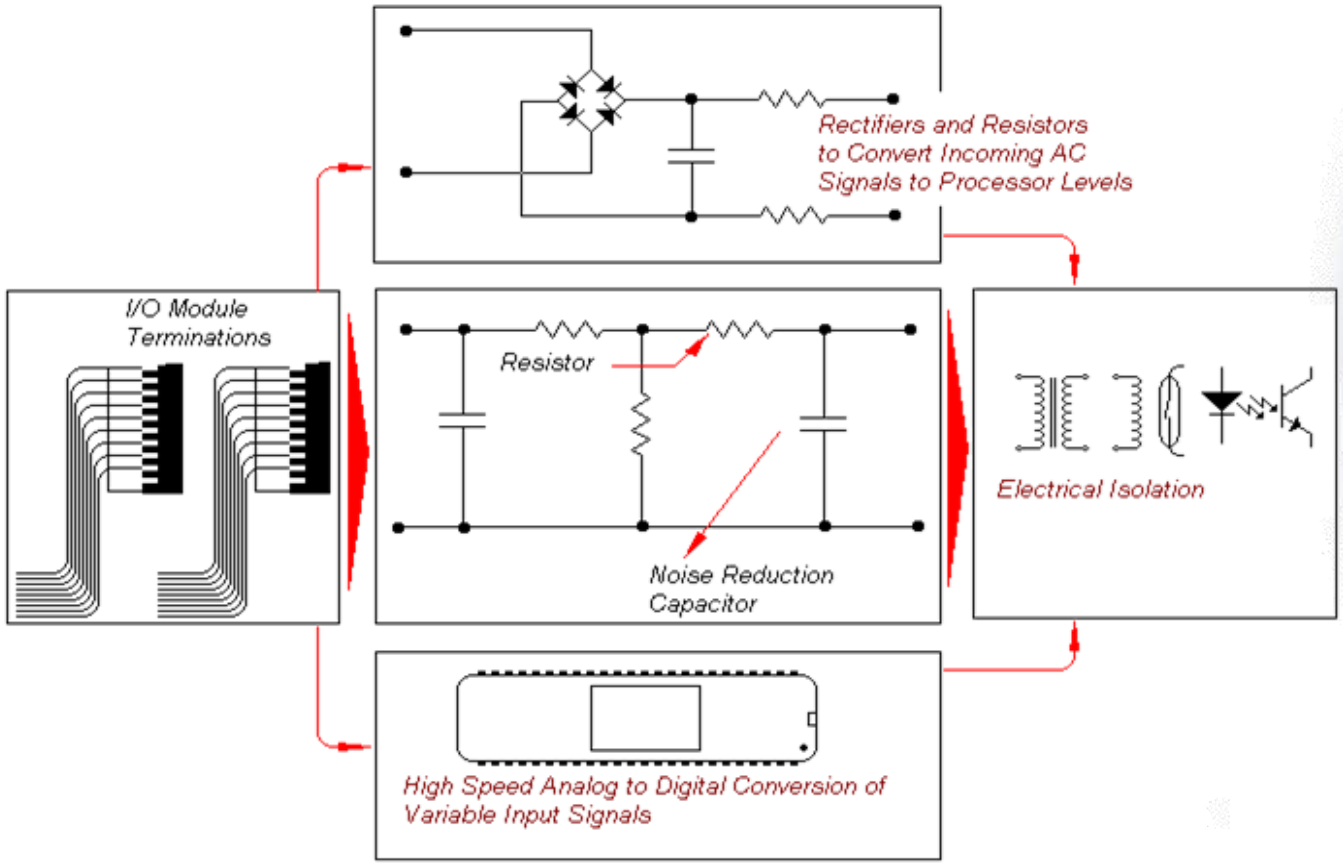


INTERFACE/MULTIPLEX ELECTRONICS

Electronic Circuitry that provides High Speed "PICTURES" of INPUT Device Statuses to the Processor

INPUT MODULE BLOCK DIAGRAM

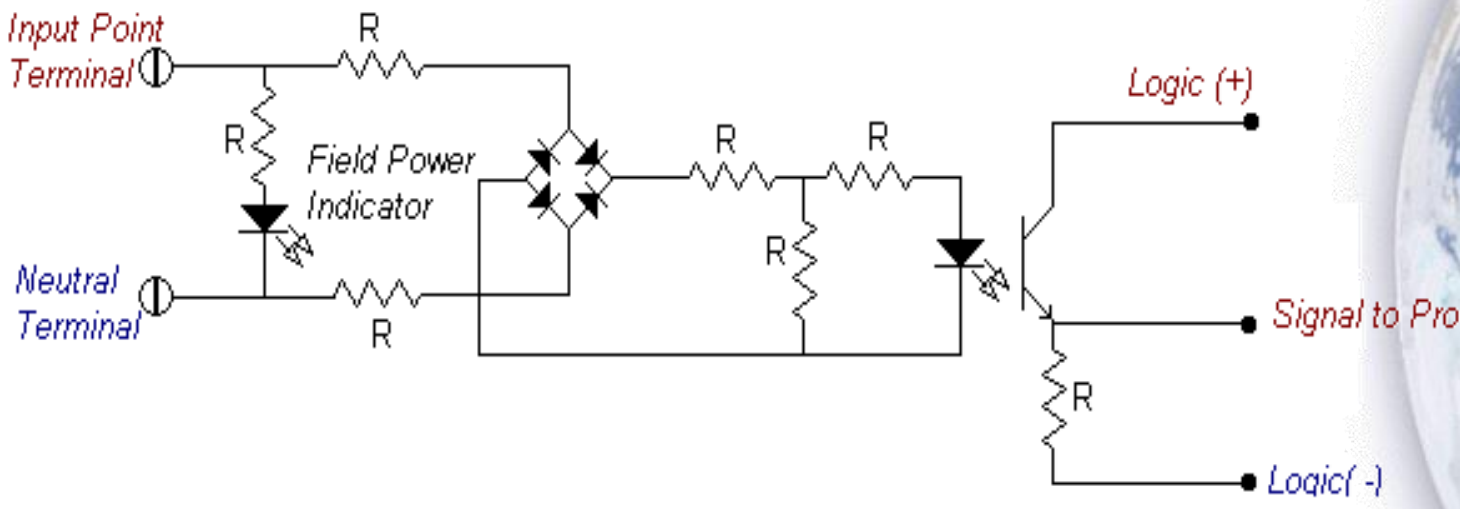
The I/O System



FORMS OF INPUT MODULE LEVEL CONVERSION

INPUT MODULE Level Conversion

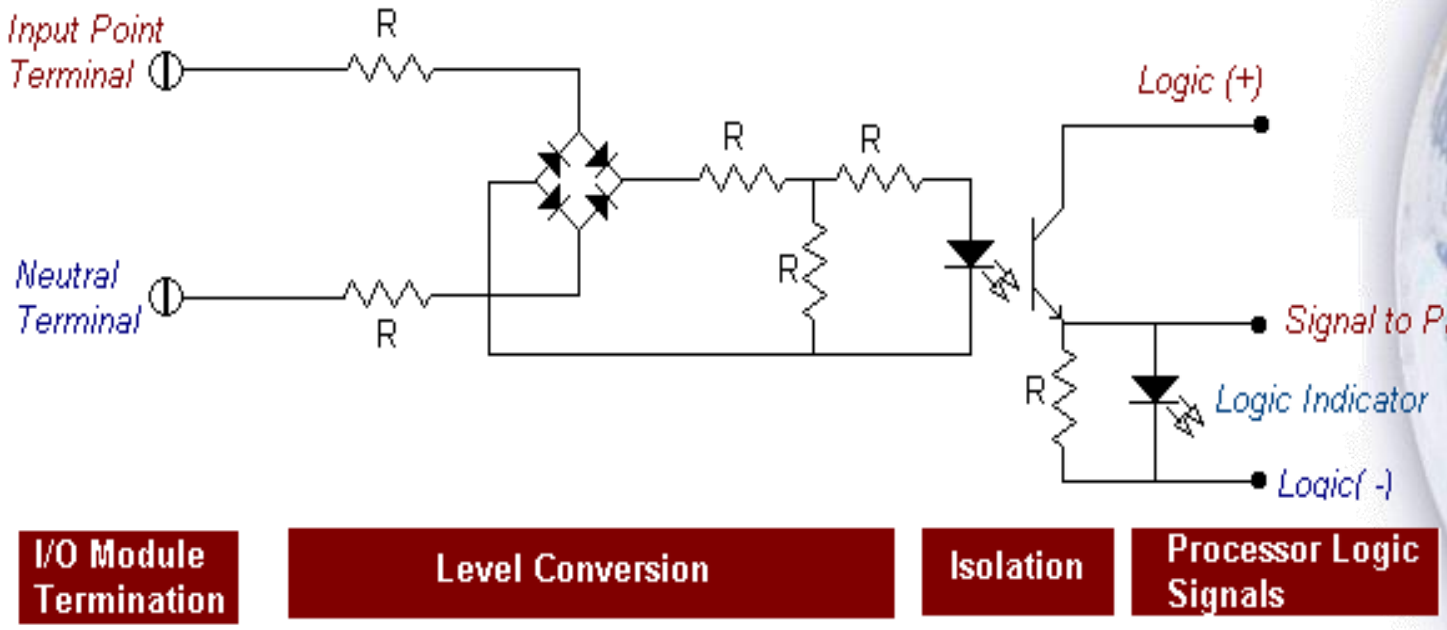
The I/O System



STATUS INDICATOR POWERED FROM FIELD POWER

INPUT MODULE Level Conversion

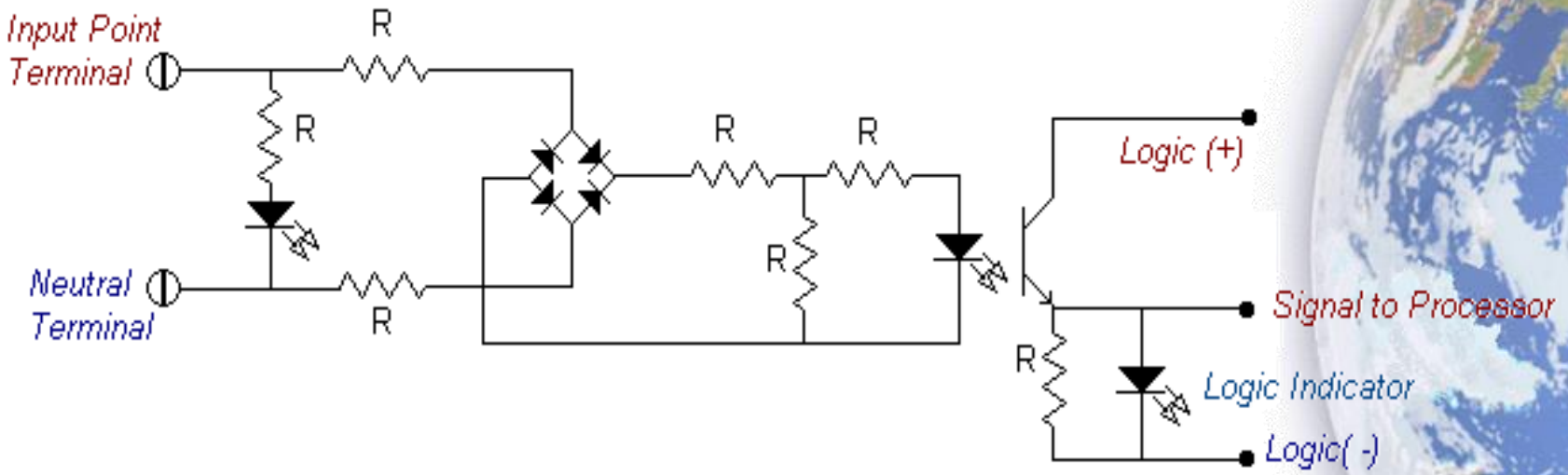
The I/O System



STATUS INDICATOR POWERED FROM LOGIC POWER

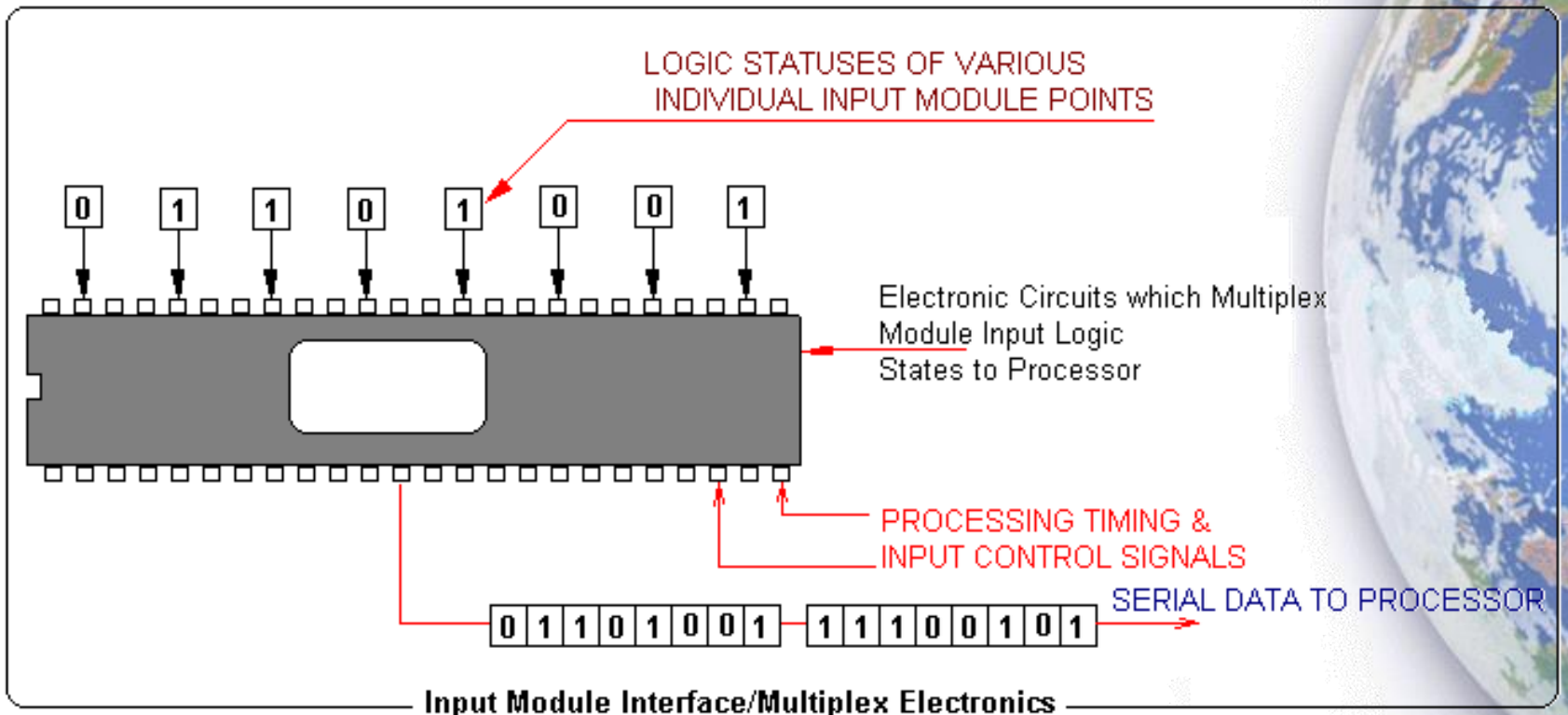
INPUT MODULE Level Conversion

The I/O System



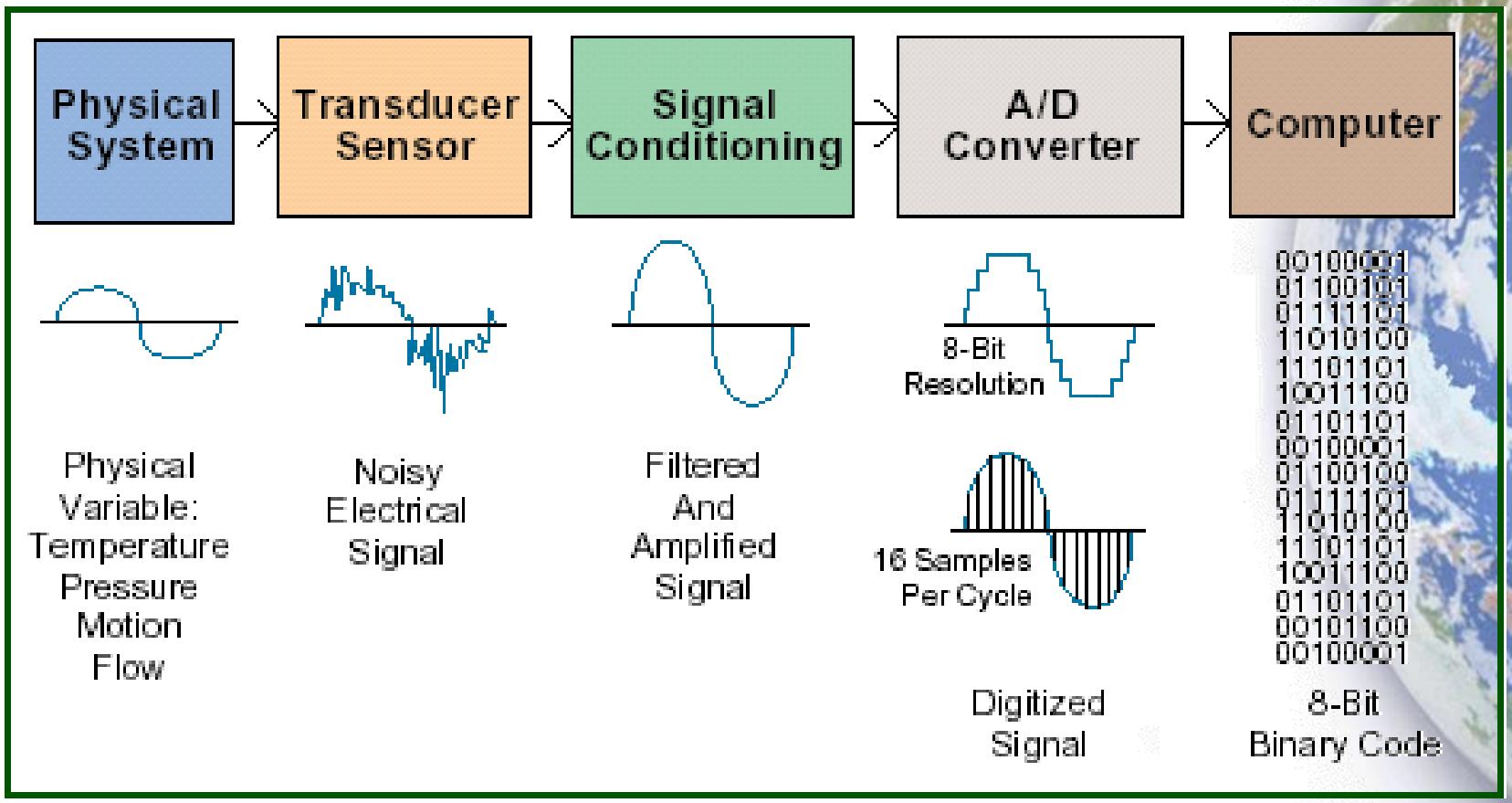
INPUT MODULE Level Conversion

The I/O System



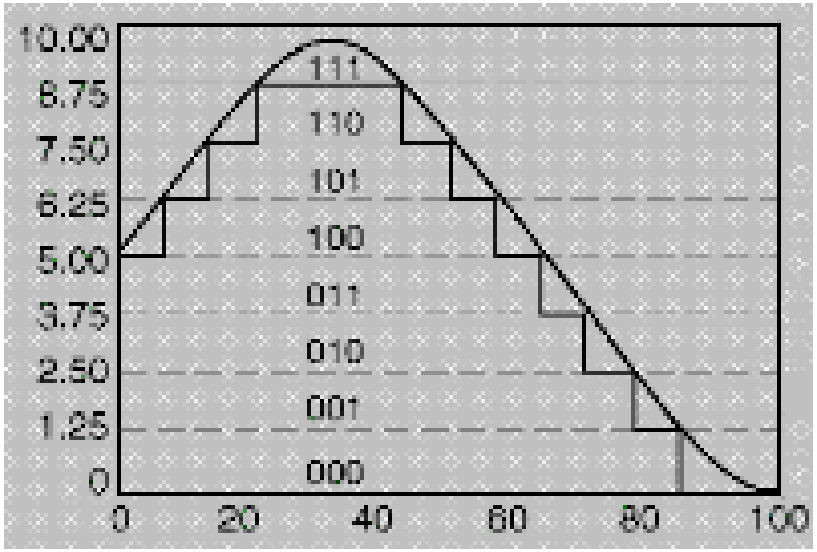
INPUT MODULE Level Conversion

The I/O System

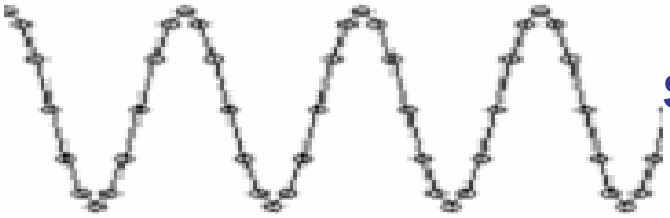


Signal Flow

The I/O System

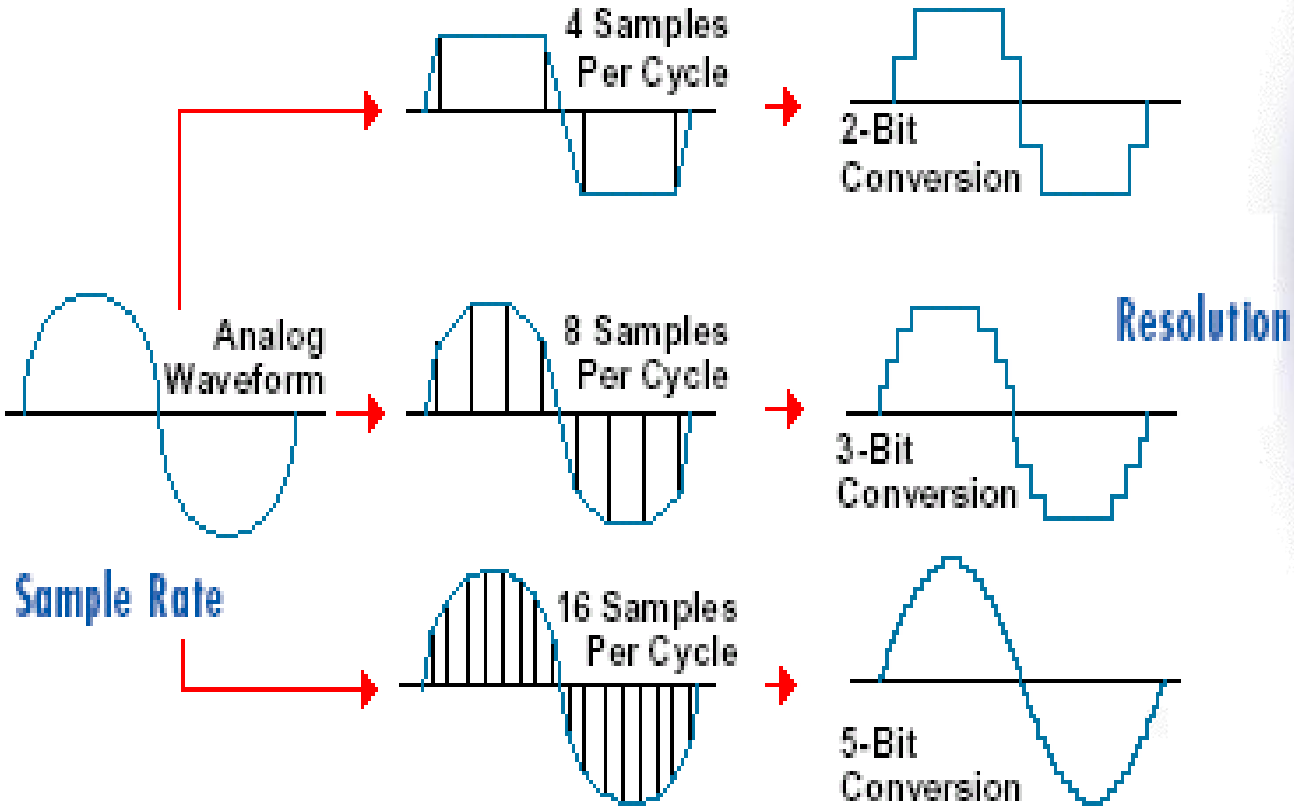


Resolution



Sampling

The I/O System

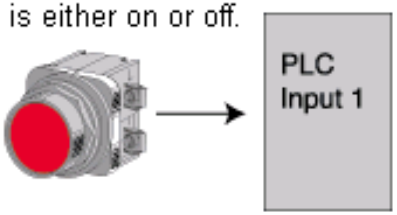


Signal Flow

The I/O System

Discrete Input

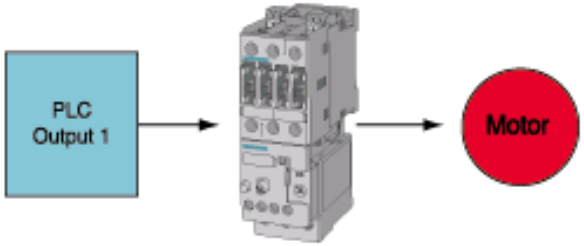
An input that is either on or off.



- Pushbutton
- Selector Switch
- Limit Switch
- Relay Contacts
- Motor Starter Contacts
- Photoelectric eyes
- Proximity Switches
- Thumb-Wheel switches
- Circuit breakers

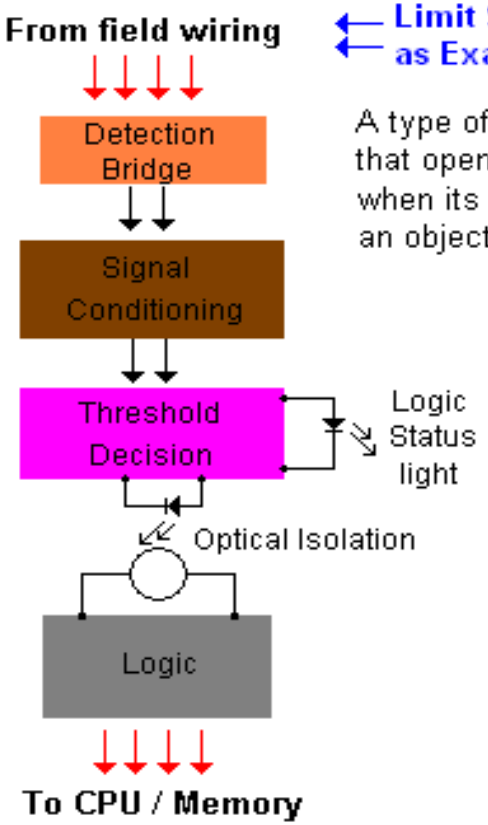
Discrete Output

An output that is either on or off.



- ❑ Control Relays
- ❑ Alarms
- ❑ Valves
- ❑ Motor Starter
- ❑ Solenoids
- ❑ Fans
- ❑ Lights

The I/O System

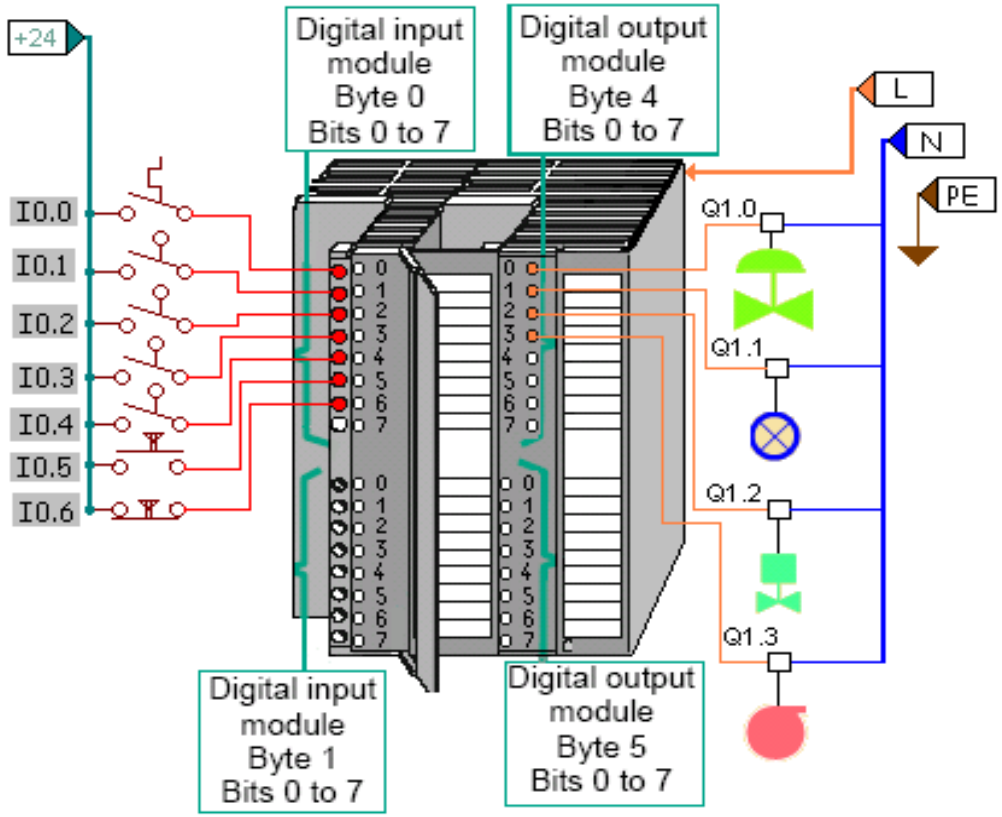


Limit Switches as Exambles

A type of position sensing switch that opens or closes its contacts when its actuator is moved by an object.

Block diagram of AC/DC input Circuit

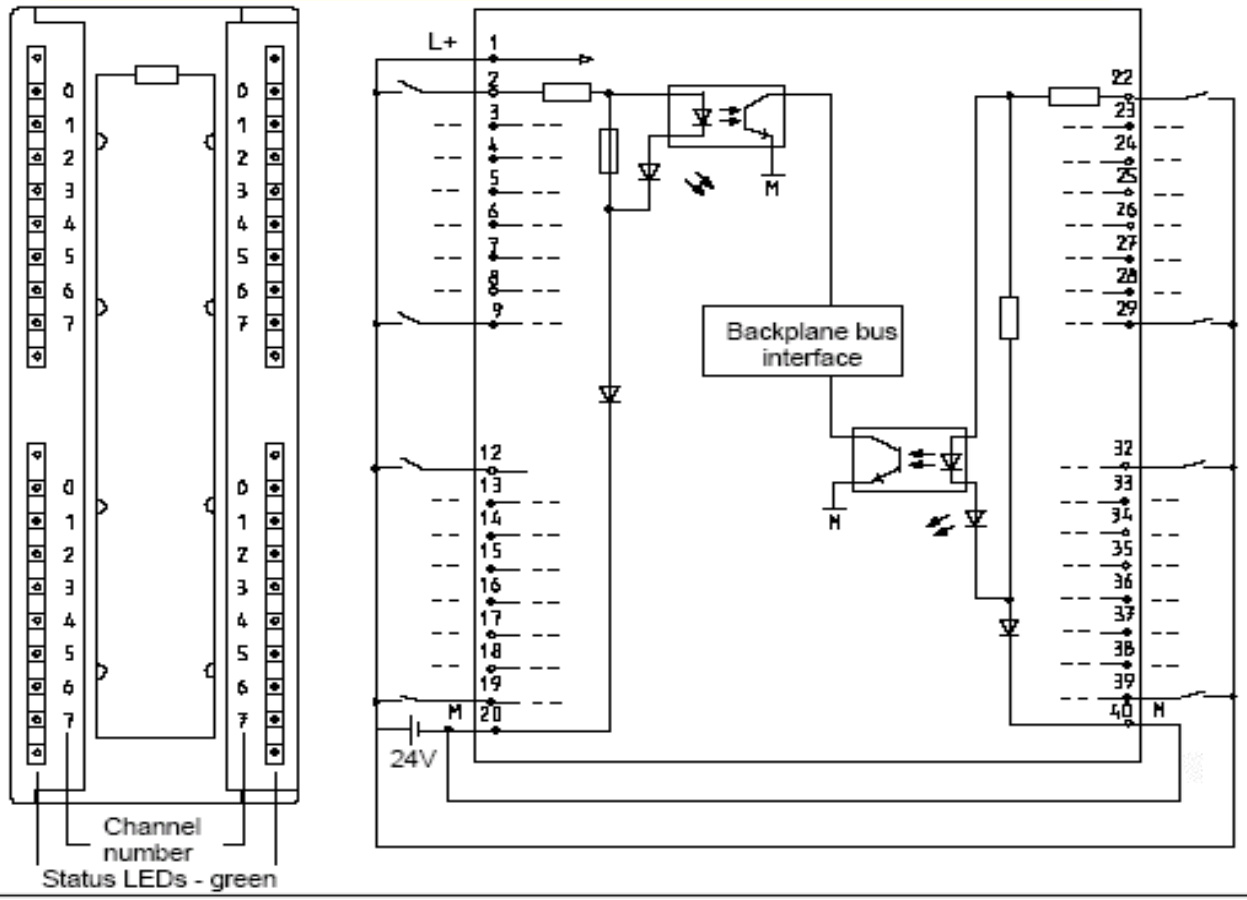
The I/O System



Input Output Device

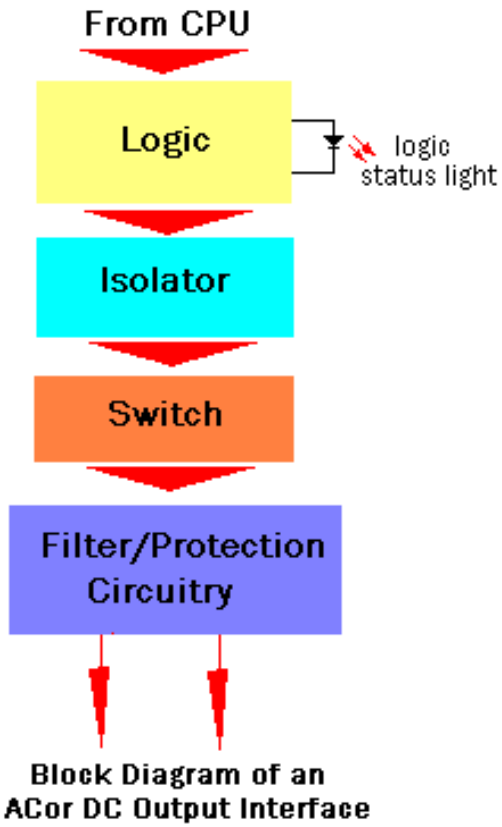
The I/O System

Module View and Block Diagram of the Digital Input Module SM 321; DI 32× 24VDC



Input Module

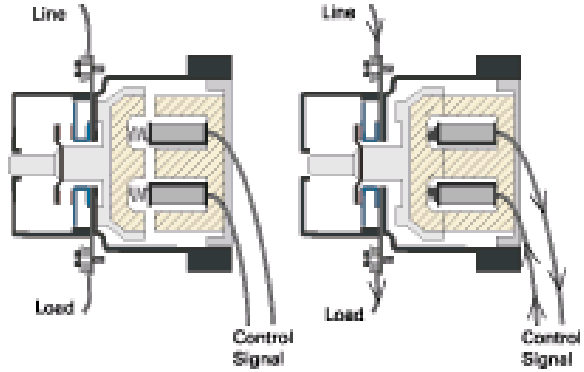
The I/O System



Block Diagram of an ACor DC Output Interface

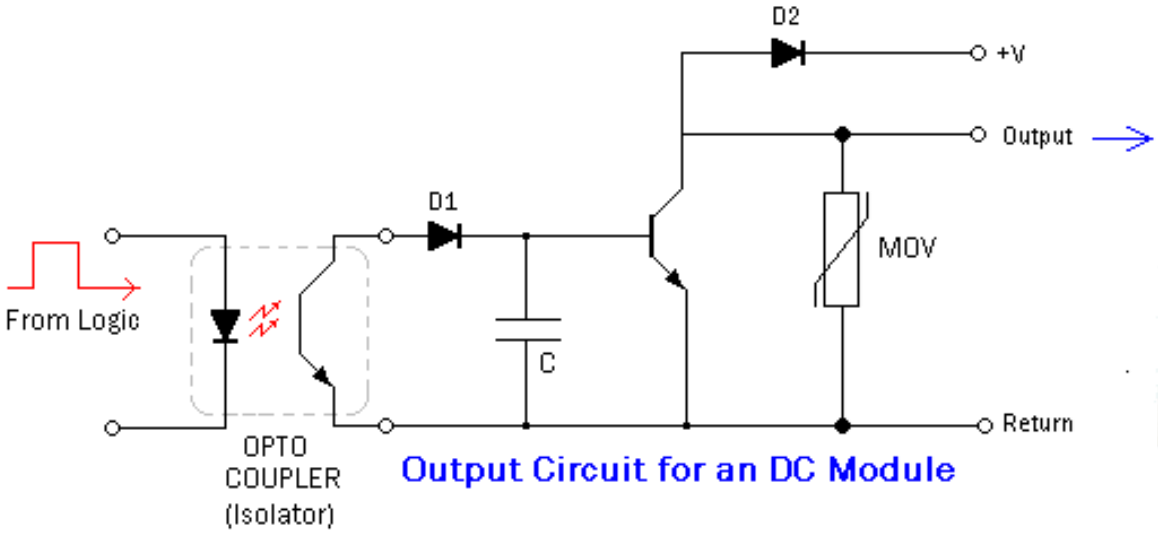
Contactor

An device used to energize and de-energize an electrical circuit.



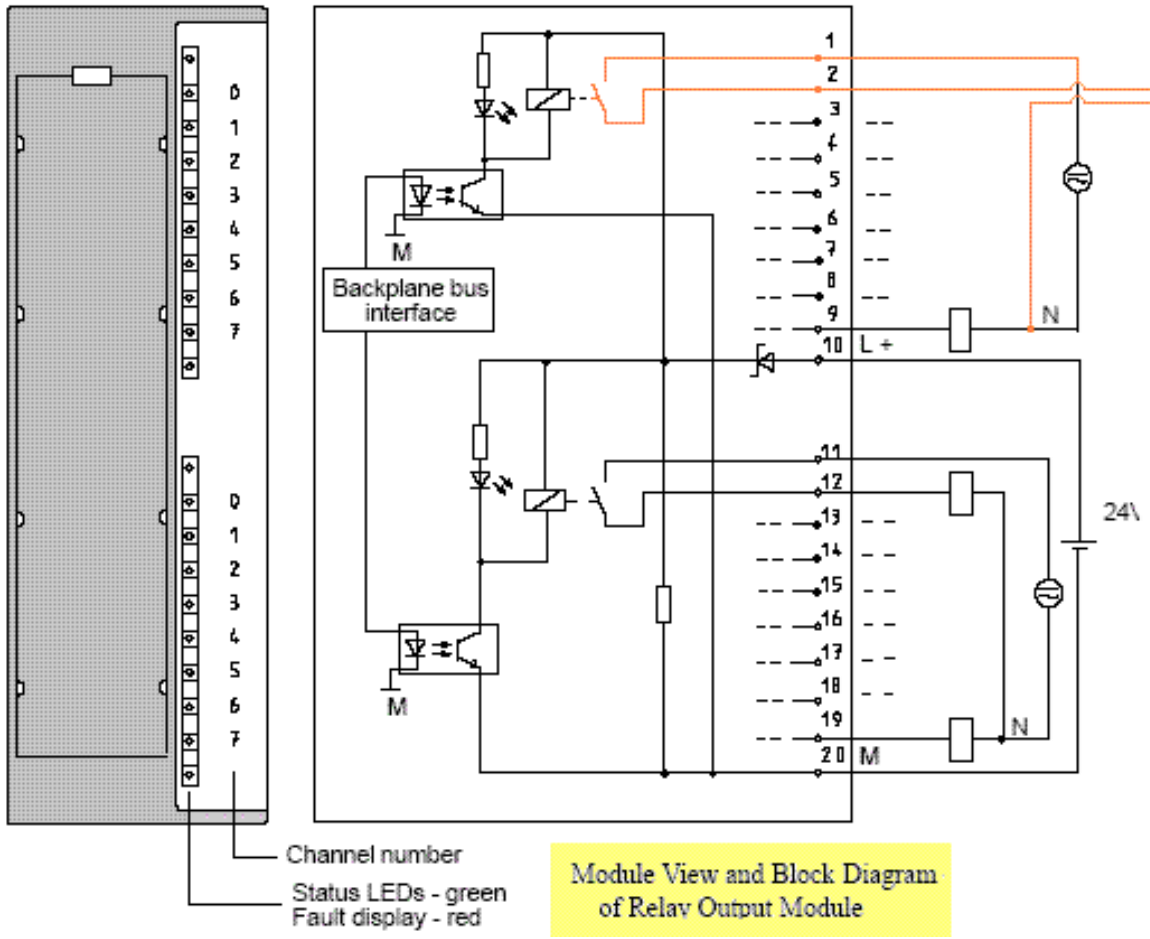
Contactor Deenergized Contactor Energized

The I/O System

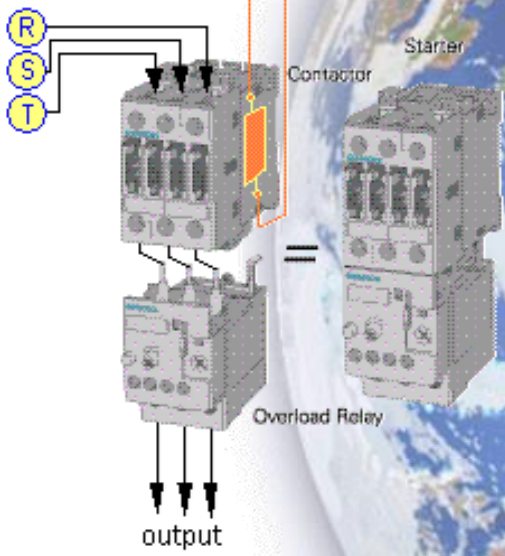


Output Circuit for an DC Module

The I/O System



Module View and Block Diagram of Relay Output Module

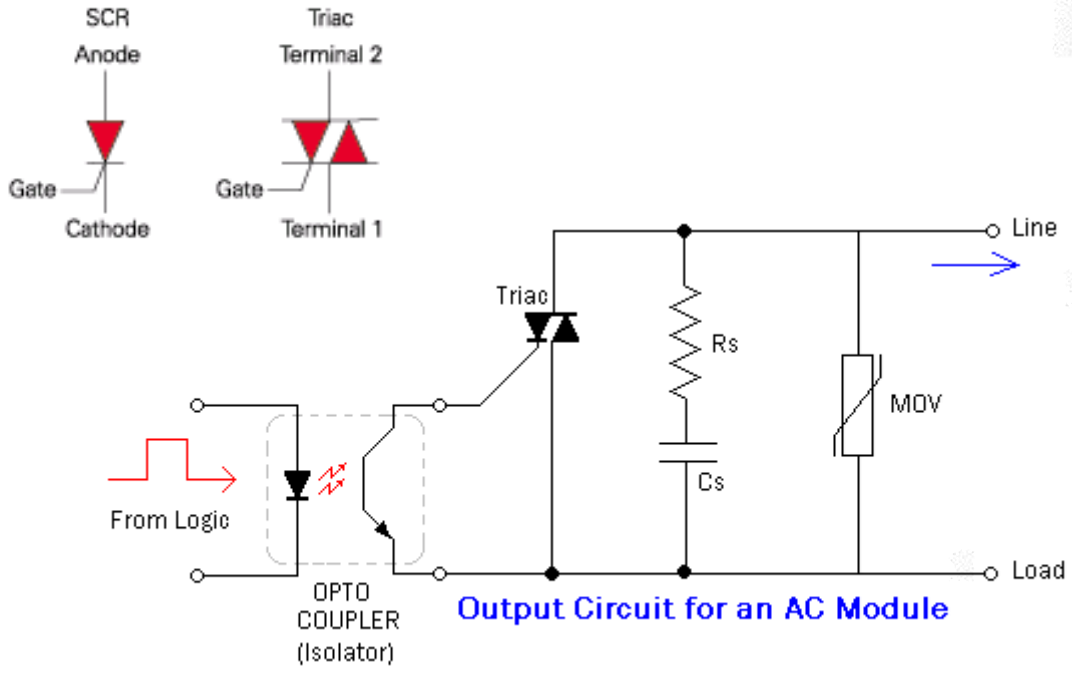


Output Module

The I/O System

Thyristor

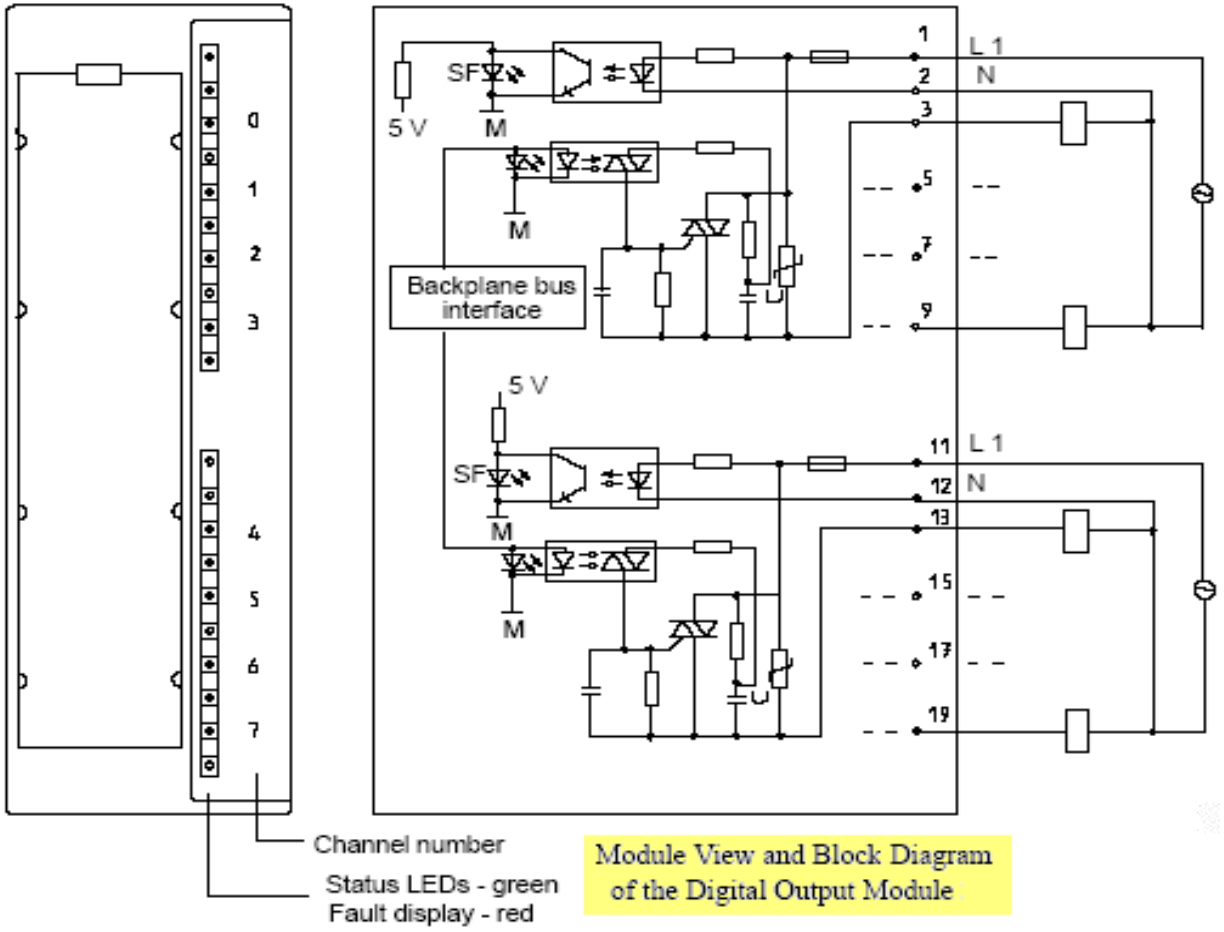
A family of multi-layer semiconductor devices that includes silicon controlled rectifiers (SCR), triacs, and gate turnoff (GTO) thyristors. Thyristors are often used in rectifier or power switching circuits.



Output Circuit for an AC Module

Output Module

The I/O System



Module View and Block Diagram of the Digital Output Module

Output Module