

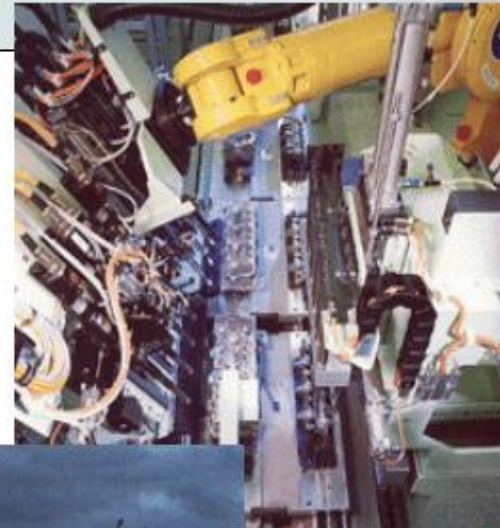
Session One

•AUTOMATION & PLC

Ph. D. Engineer Magd Nasr
University of Applied Science & Technology
Karlstad SWEDEN



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



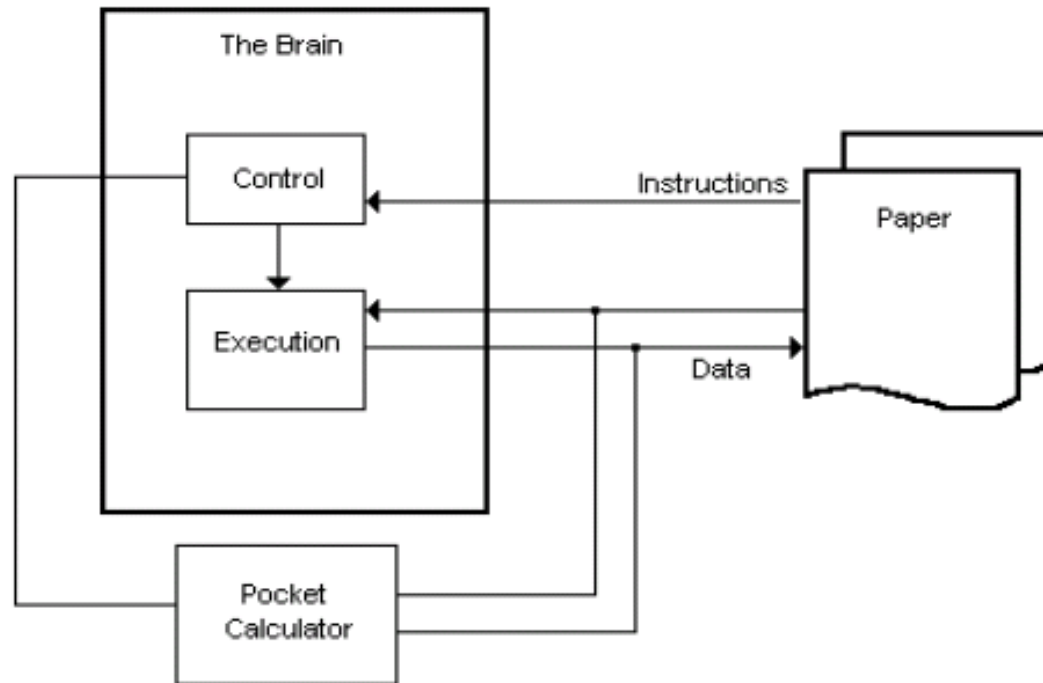
Programmable Logic Controller

- 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

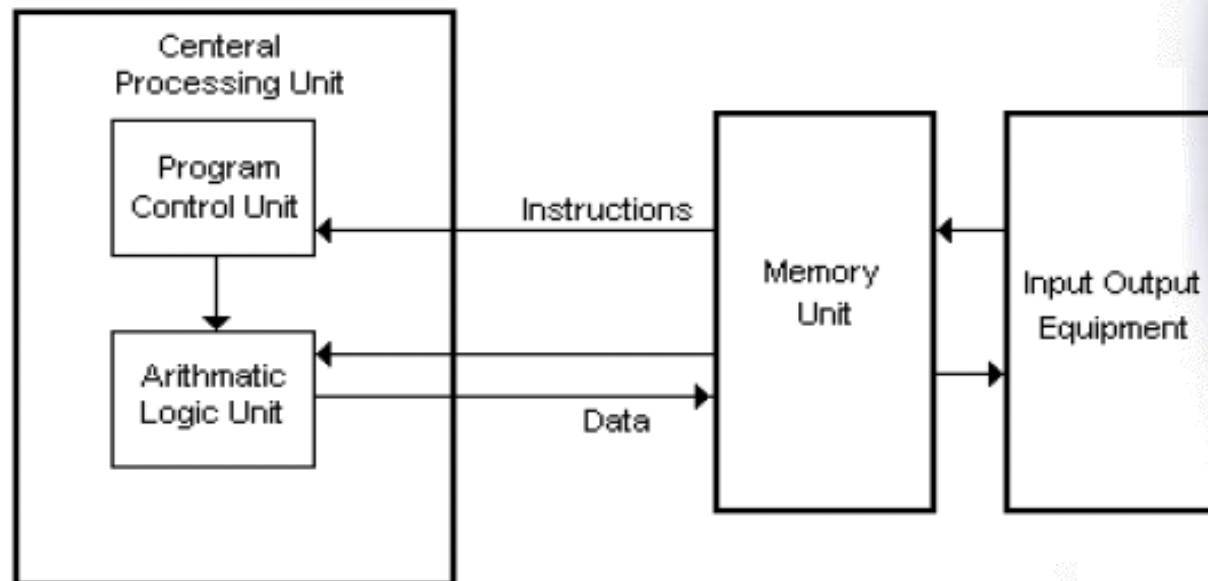
- Function of input output data & Instructions of HC



THE MAIN COMPONENTS OF A HUMAN COMPUTATION

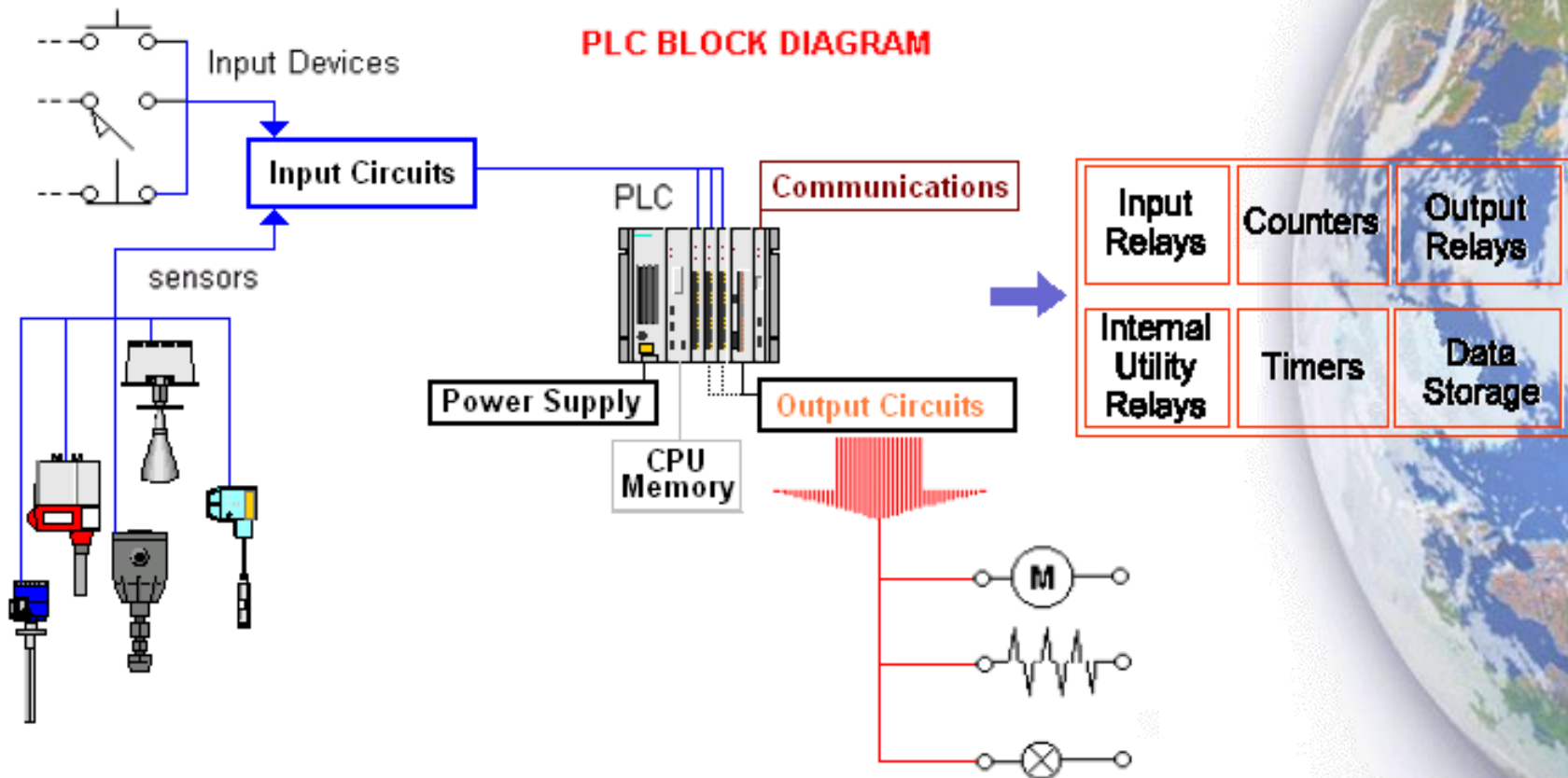
Programmable Logic Controller

- The main Components of the Machine Computing

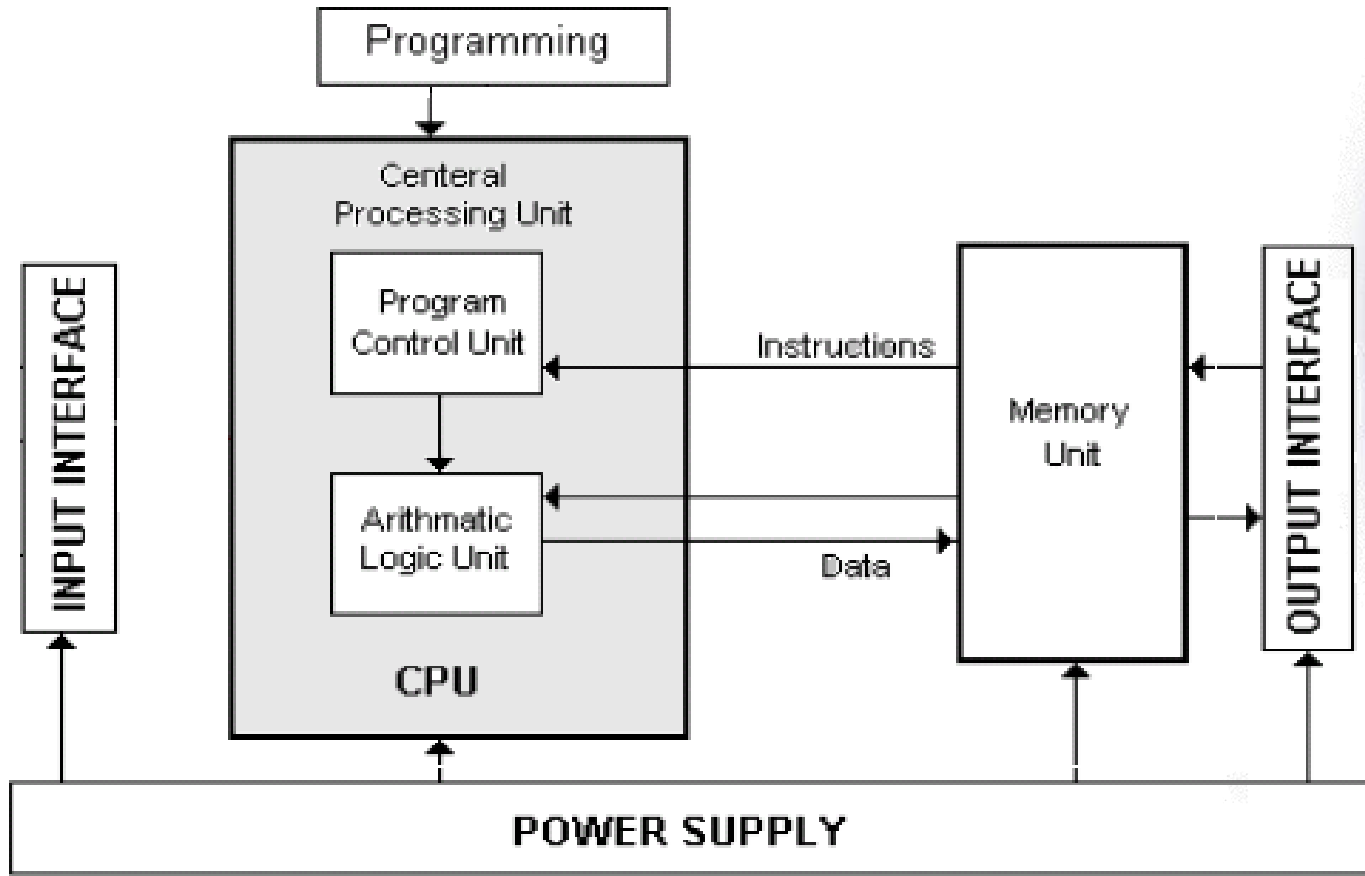


MACHINE COMPUTING

Programmable Logic Controller

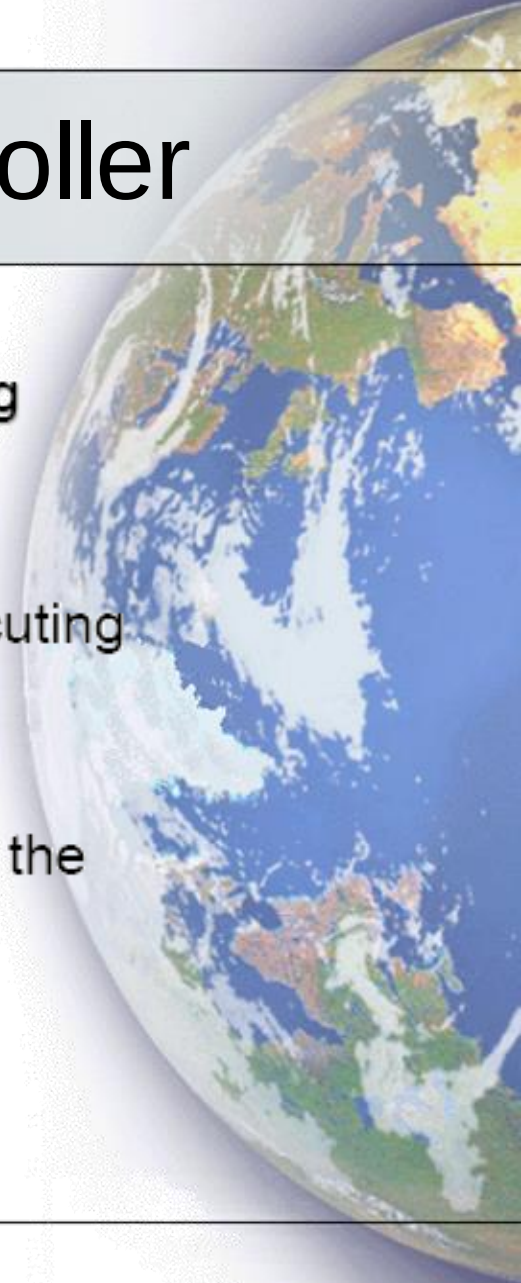


Programmable Logic Controller



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

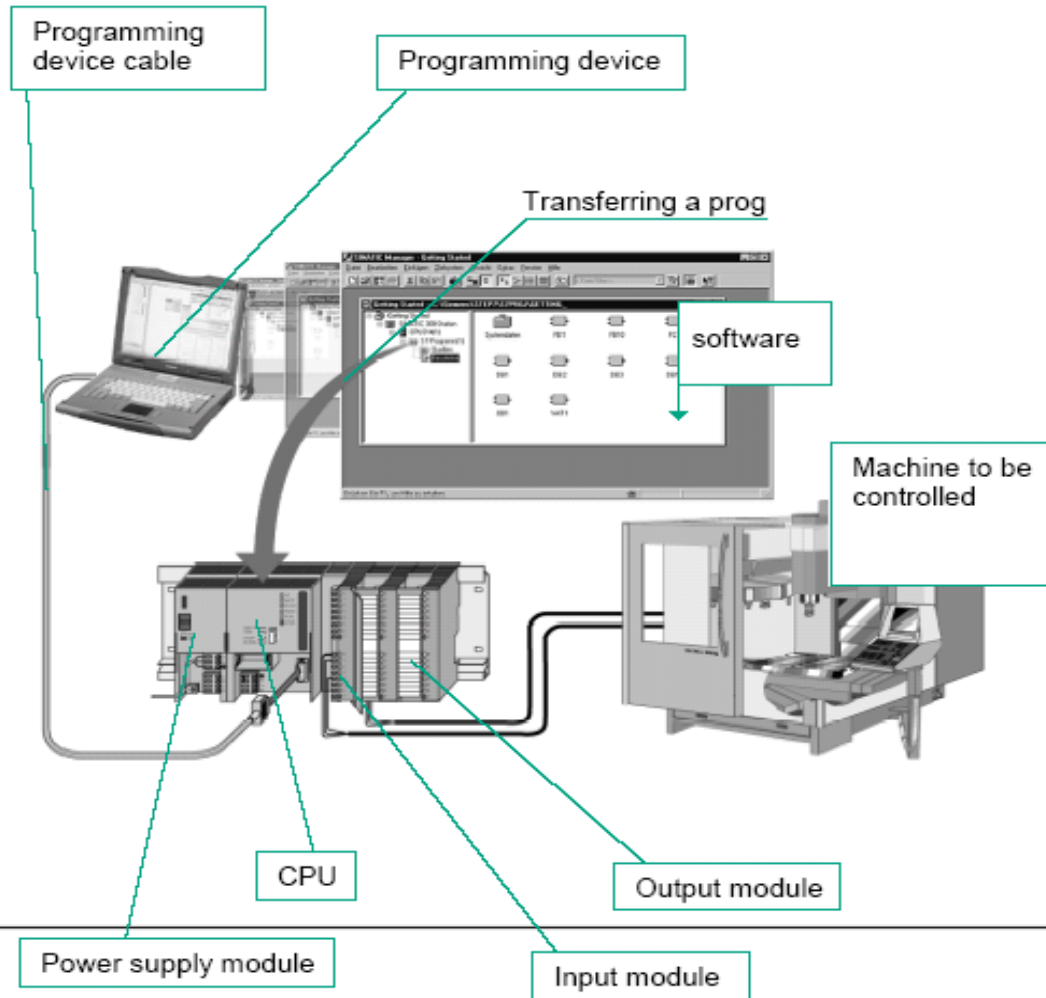


Programmable Logic Controller

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

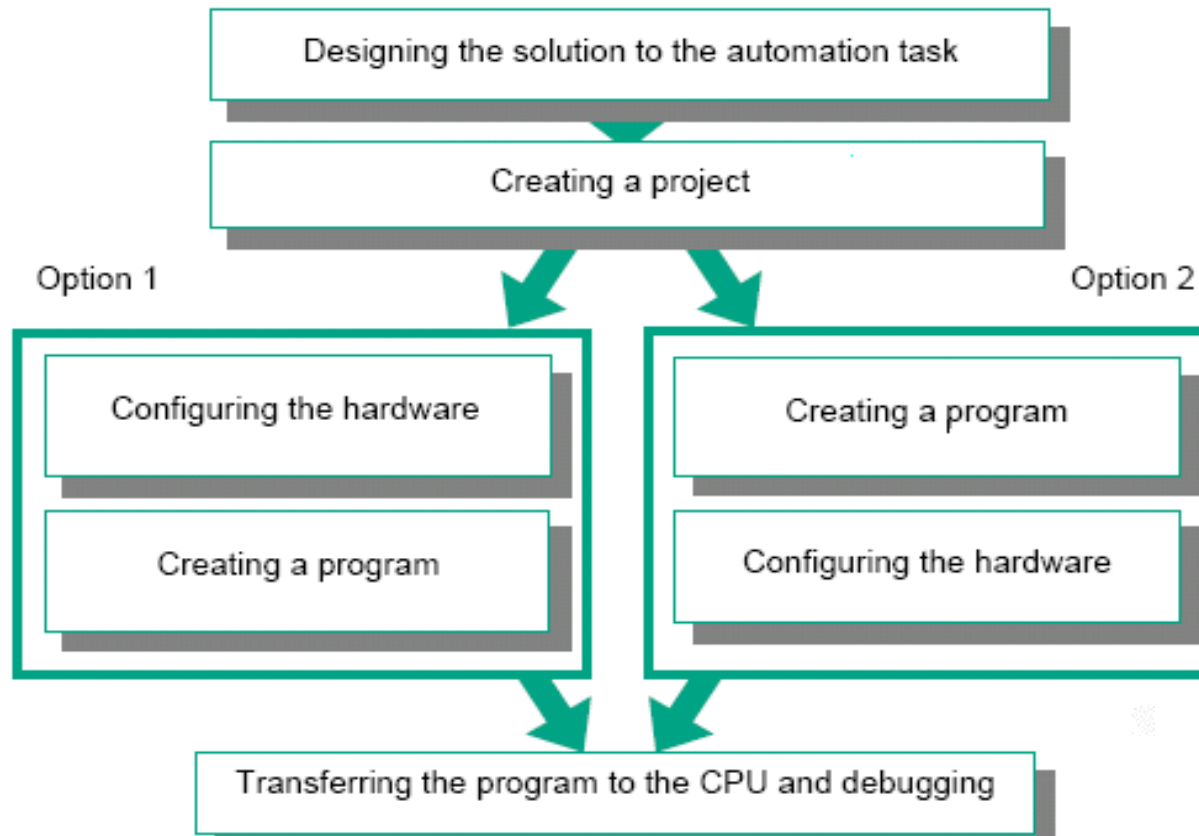


Programmable Logic Controller

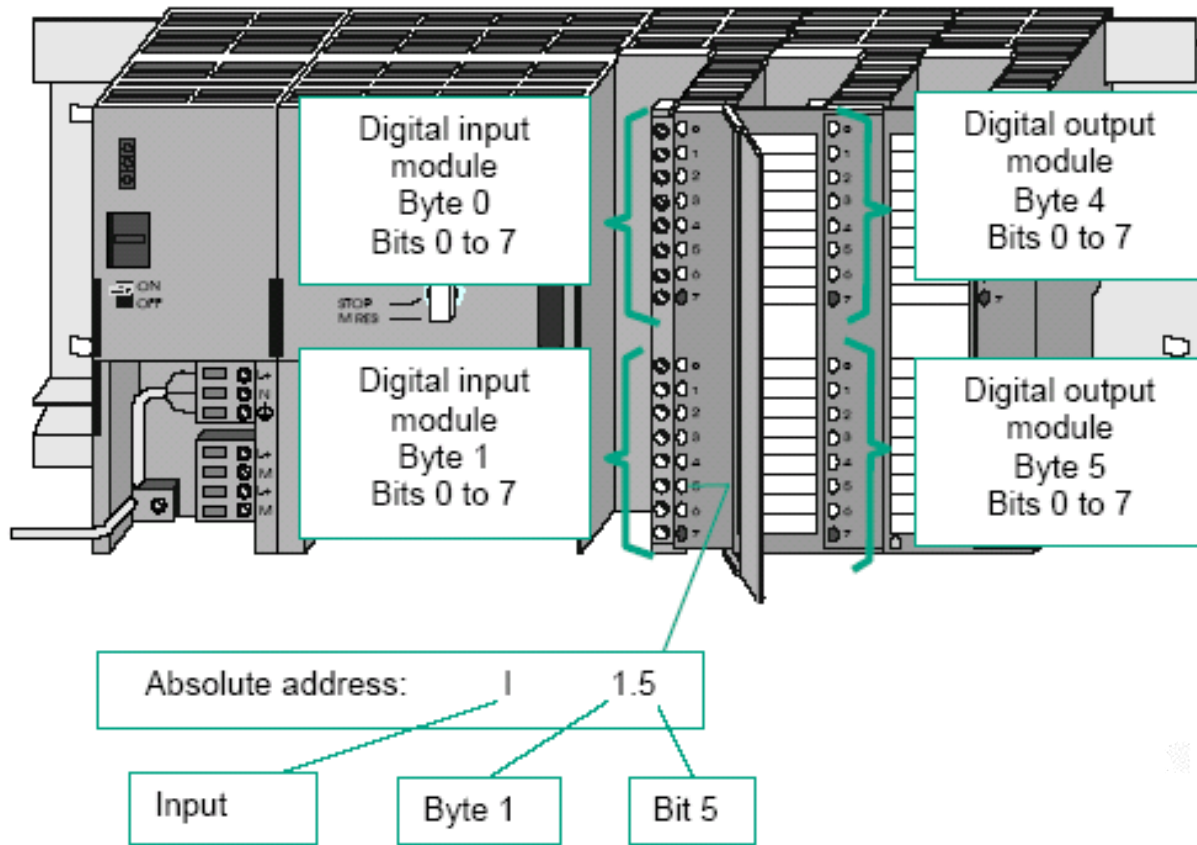


Programmable Logic Controller

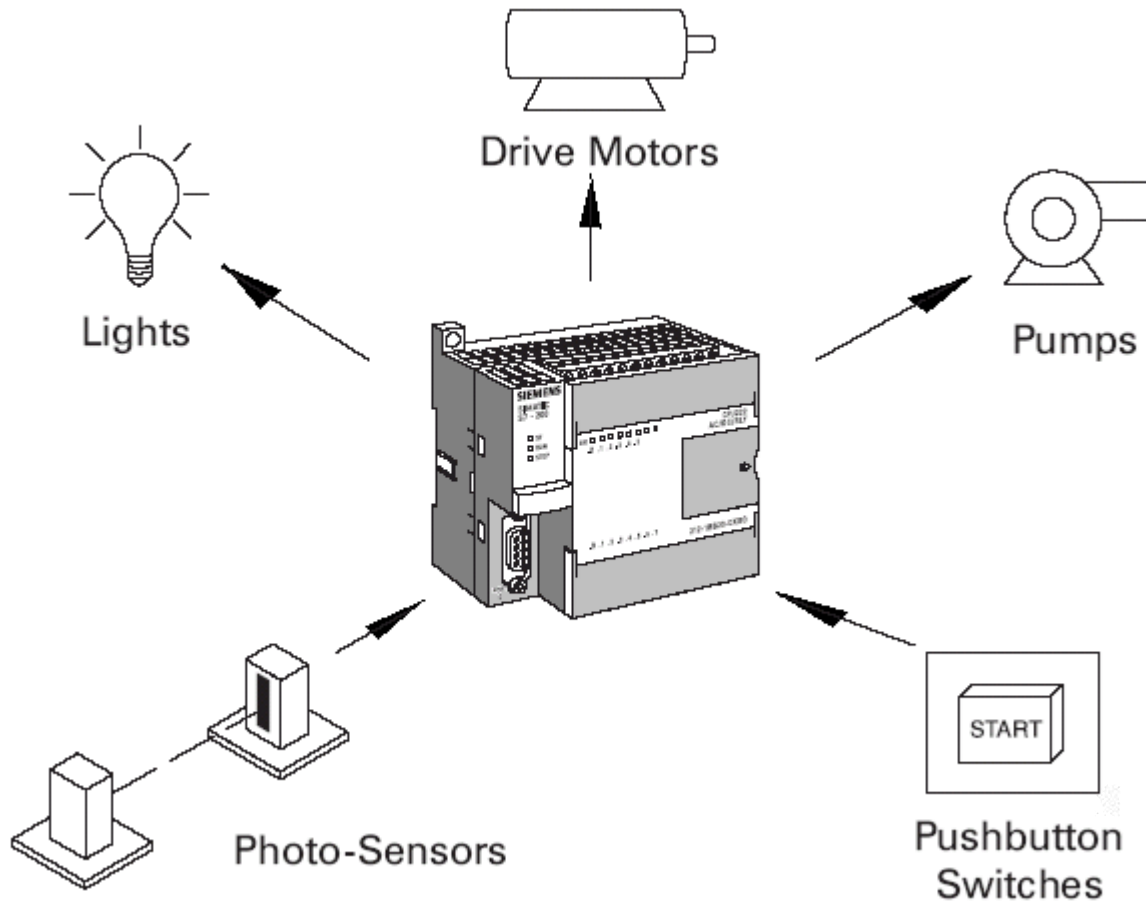
Basic Procedure projects can be created in different orders.



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.

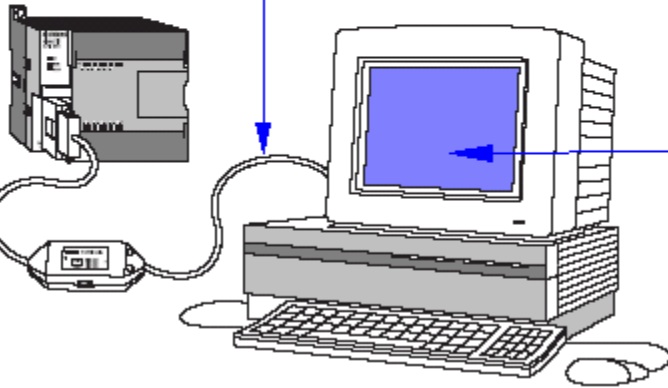
Output modules

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



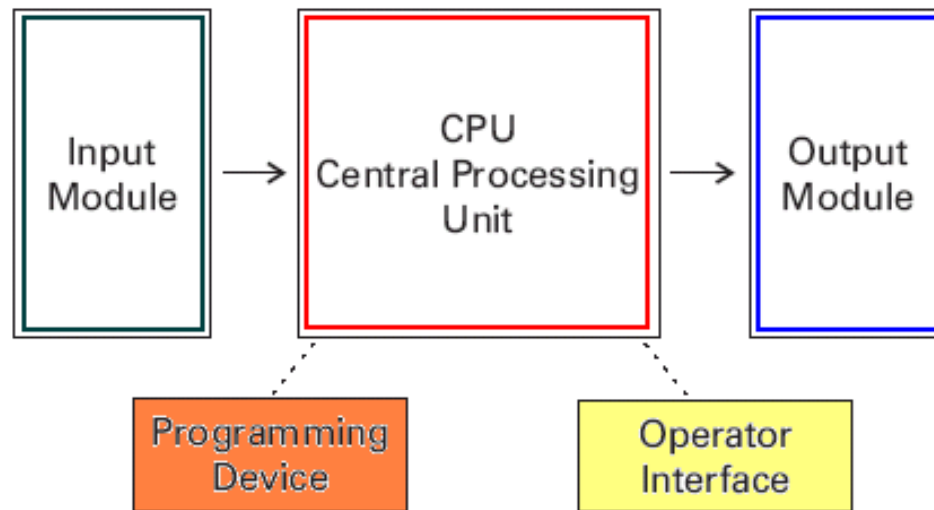
Programmable Logic Controller

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



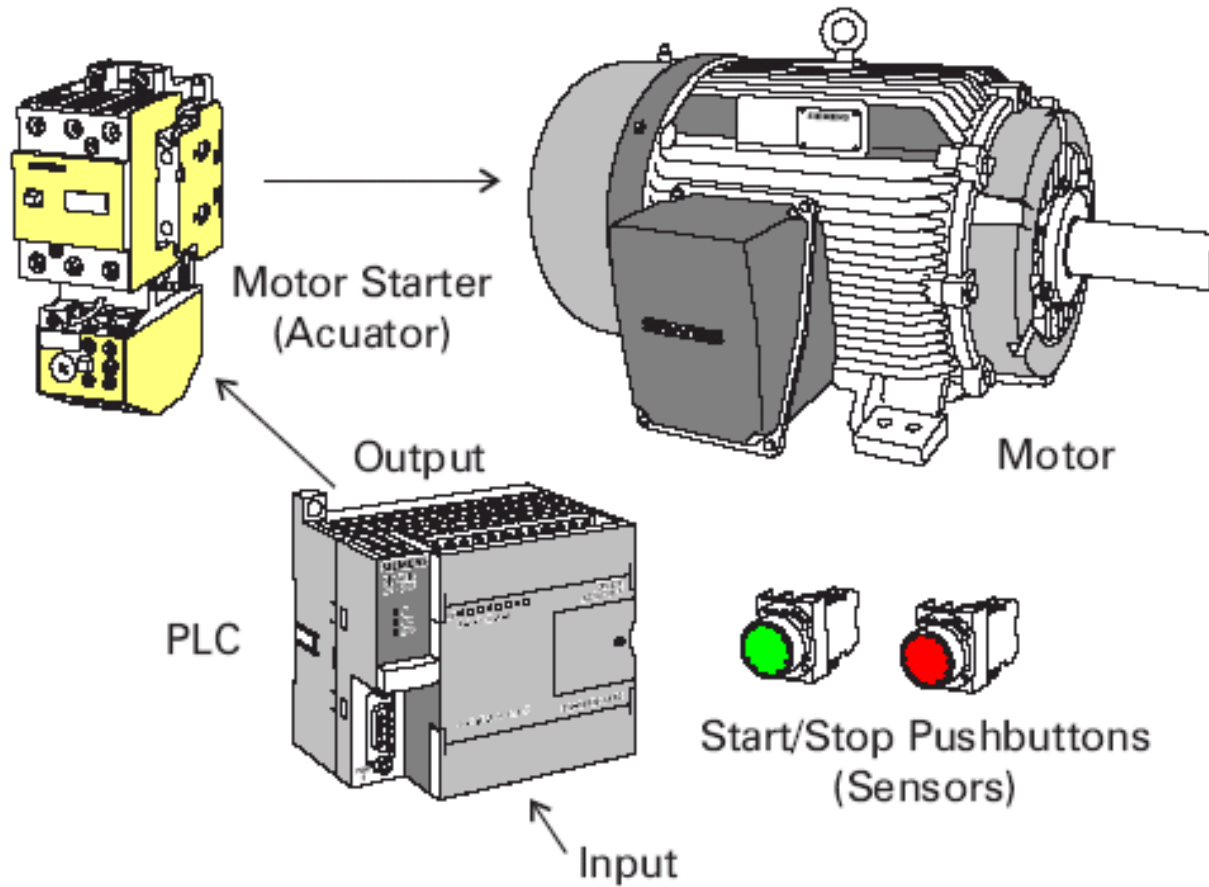
An operator interface device allows process information to be displayed and new control parameters to be entered.

Programmable Logic Controller

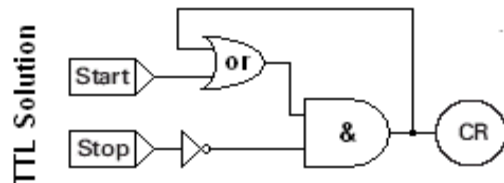
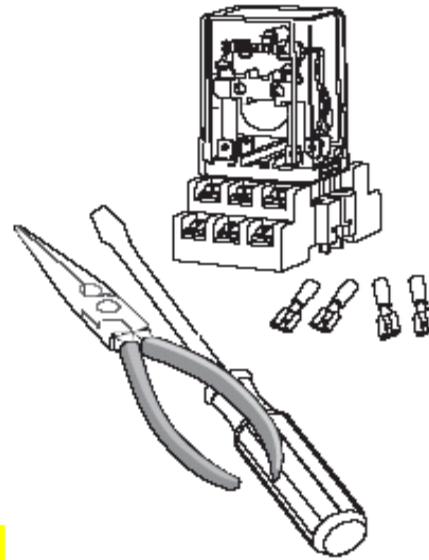
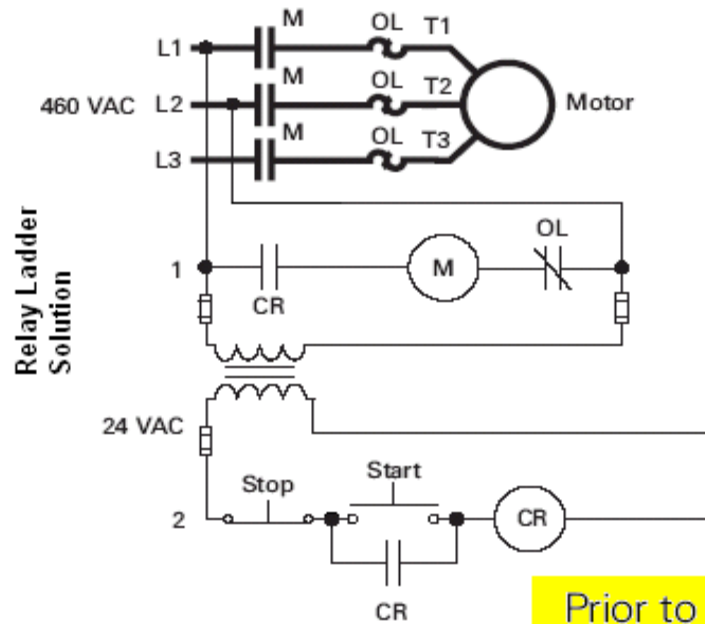


Pushbuttons (sensors), in this simple example, connected to PLC inputs, can be used to start and stop a motor connected to a PLC through a motor starter (actuator).

Programmable Logic Controller



Programmable Logic Controller



Prior to PLCs,

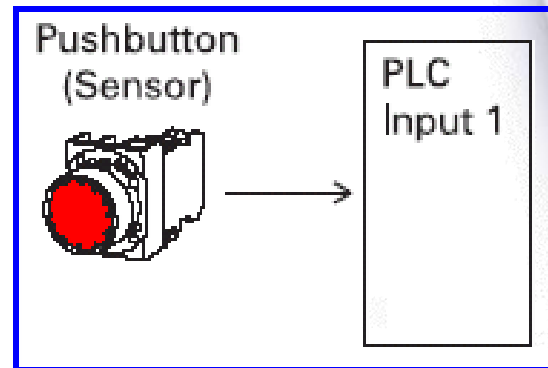
Circuit diagrams had to be designed, electrical components specified and installed, and wiring lists created.

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 condition (open/closed) of the pushbutton contacts.

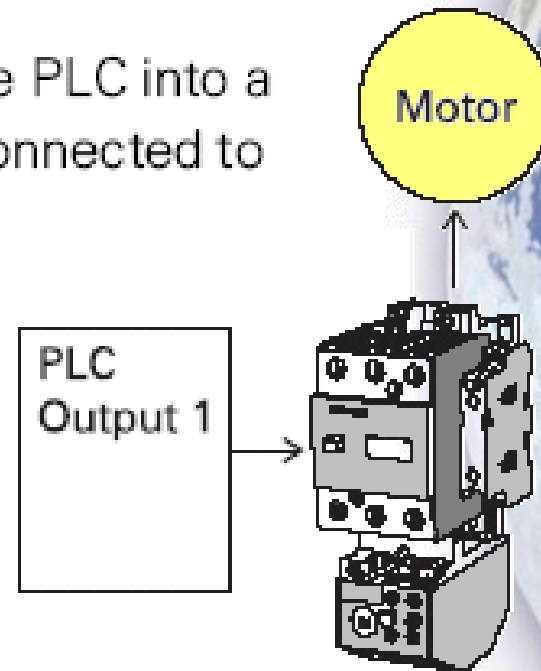


Programmable Logic Controller

Actuators

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

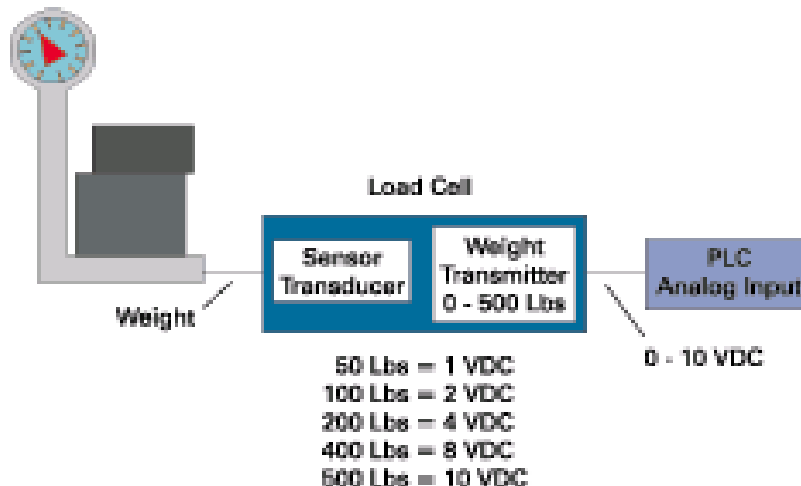
A motor starter is one example of an actuator that is connected to the PLC output. Depending on the output PLC signal the motor starter will either start or stop the motor.



Programmable Logic Controller

Analog Input

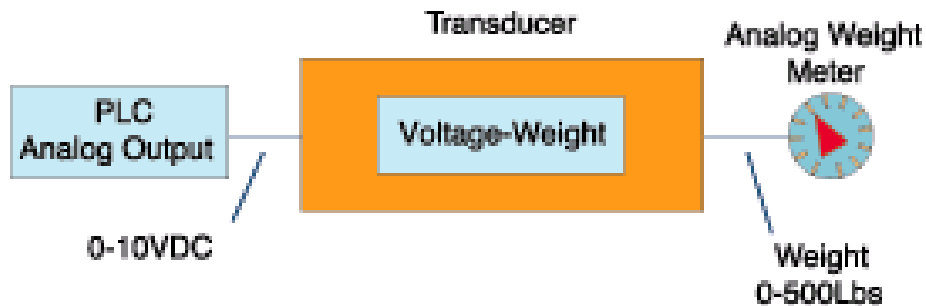
An input to a system that can continuously vary over a range of current or voltage such as 4 to 20 milliamps or 0 to 10 volts.



Programmable Logic Controller

Analog Output

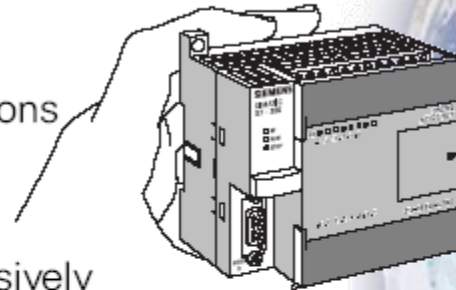
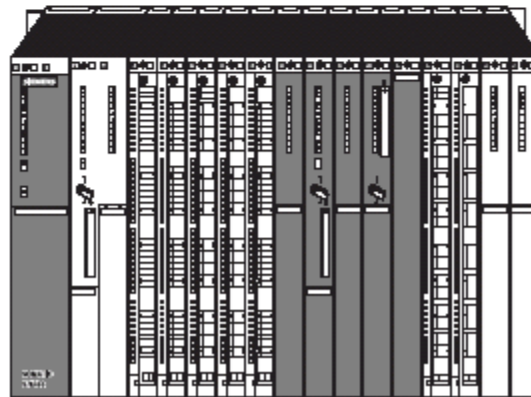
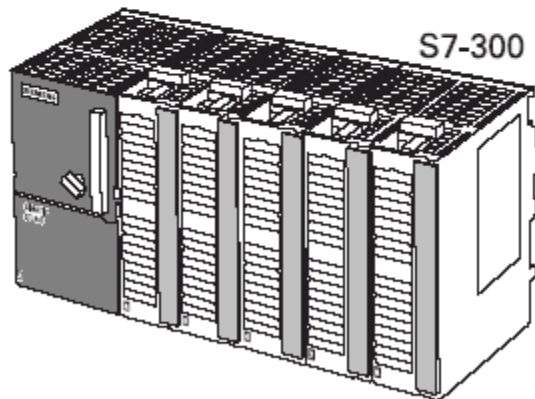
An output from a system that can continuously vary over a range of current or voltage such as 4 to 20 milliamps or 0 to 10 volts.



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



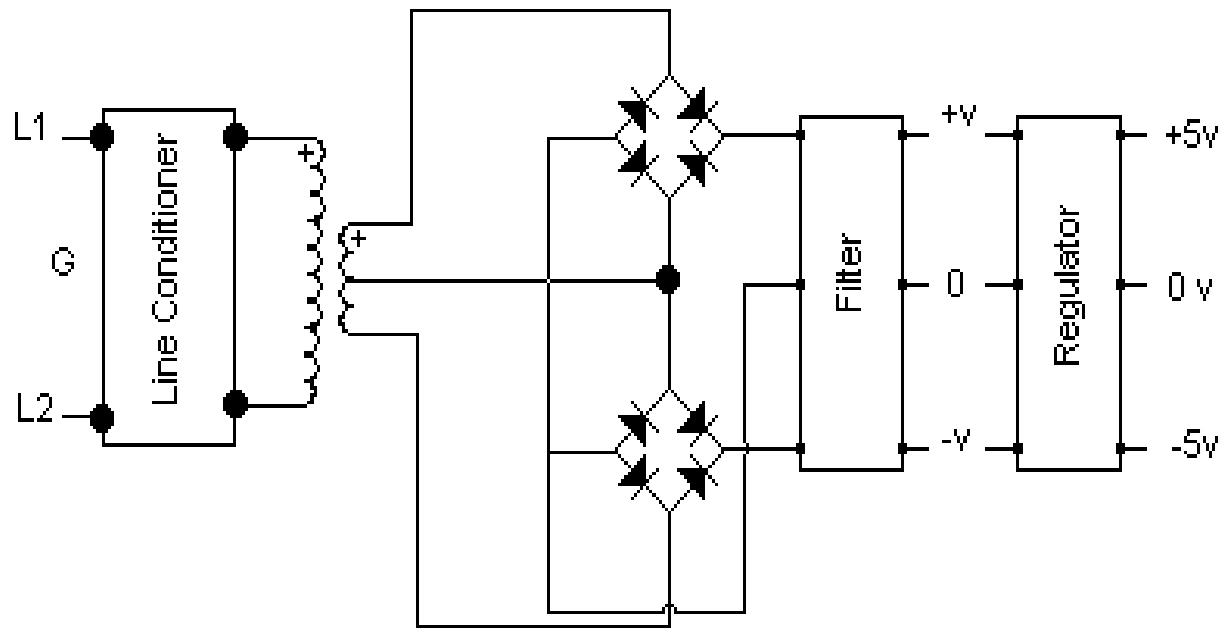
The Power Supply



- +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 $\pm 10\%$

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 $\pm 10\%$

Current 135 mA (24 VDC at all points ON)

Output points 16 Points

4- For TTL and CMOS Output

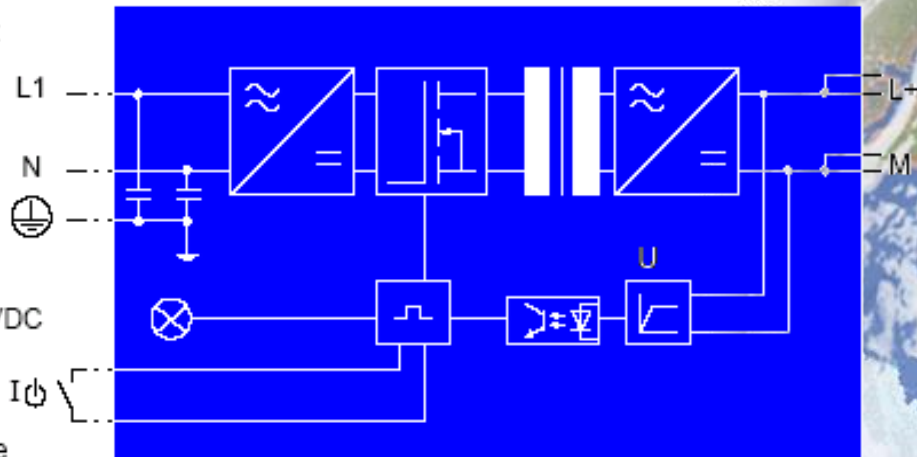
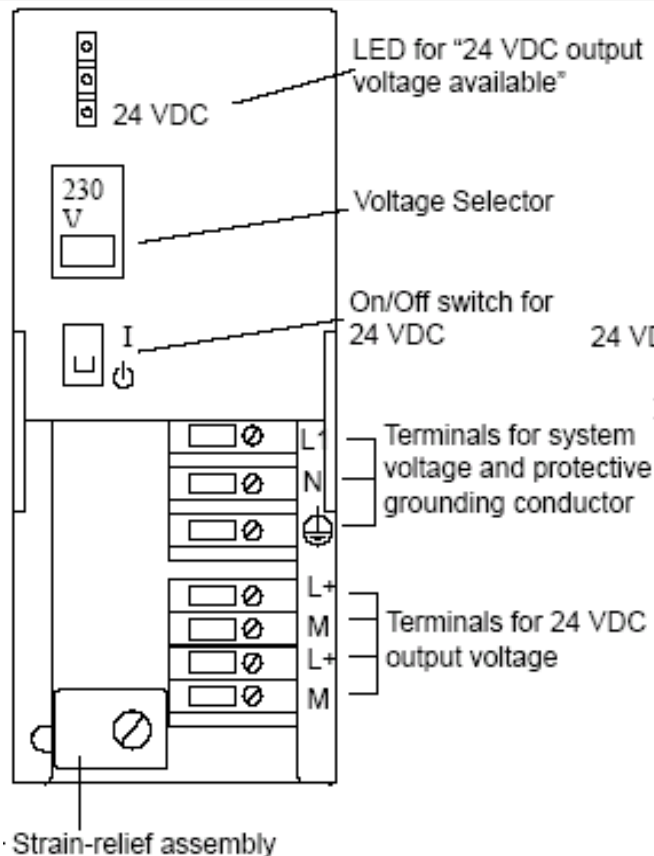
: Voltage 5/12 V DC $\pm 10\%$

Current 100 mA (12v DC type per common)

Output points 32 Points



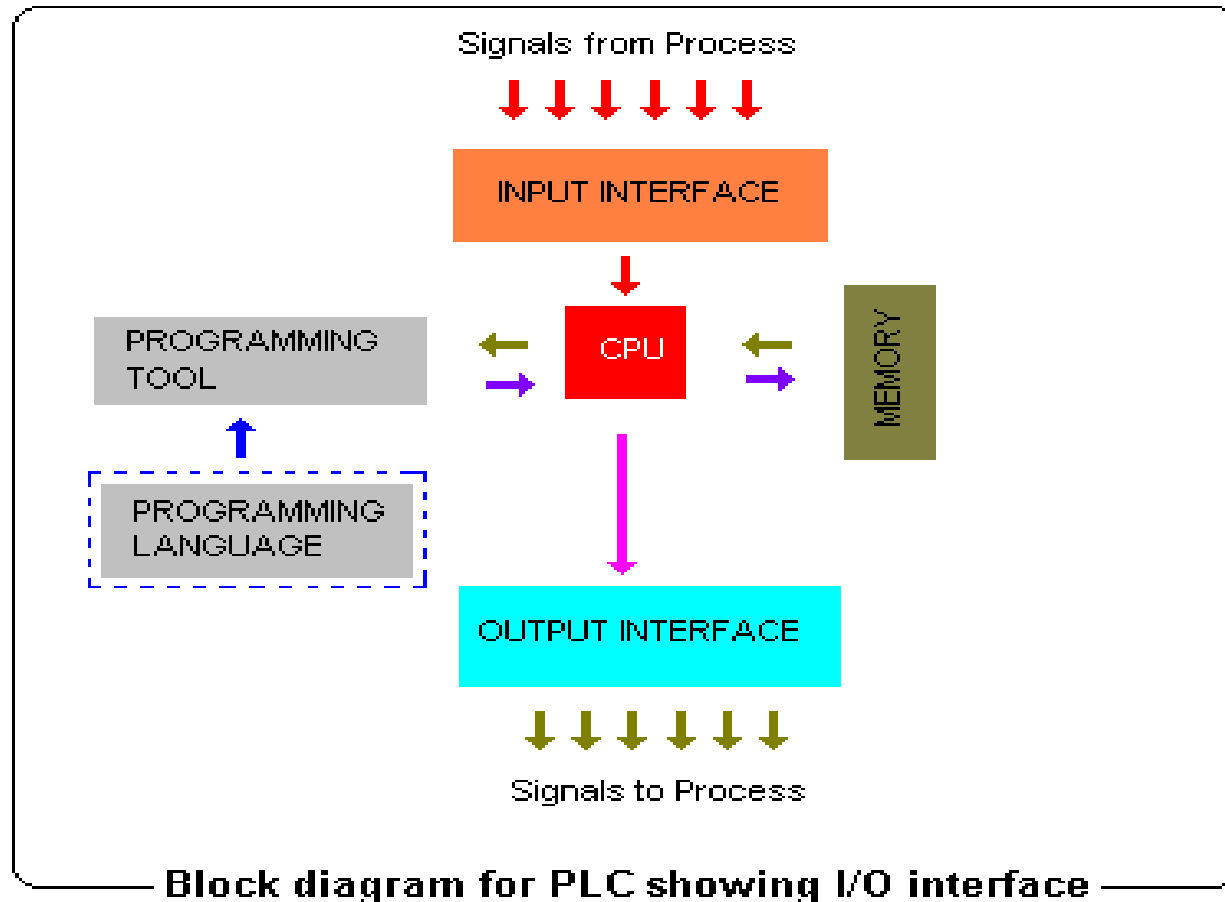
The Power Supply



Basic Diagram

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

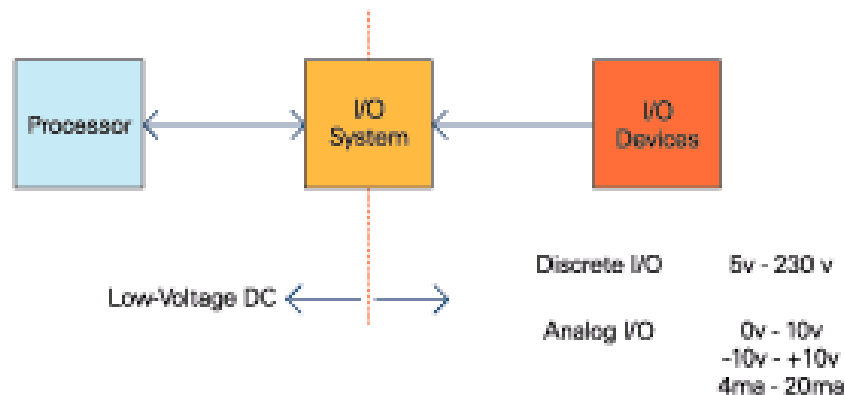
The I/O System



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.

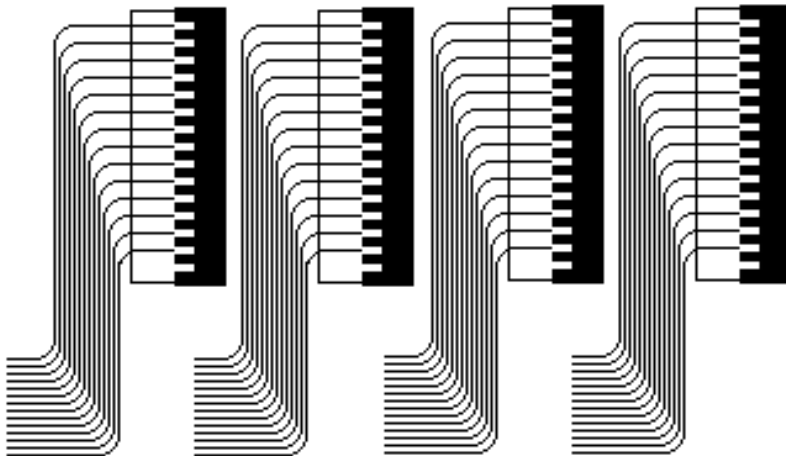


The I/O System



FIELD INPUT DEVICES

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



I/O MODULE TERMINATION

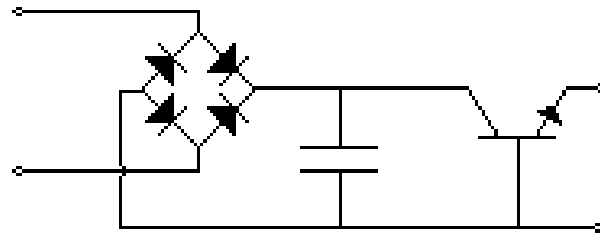
The Interconnection means Between the Real World Devices & The PLC System

INPUT MODULE BLOCK DIAGRAM



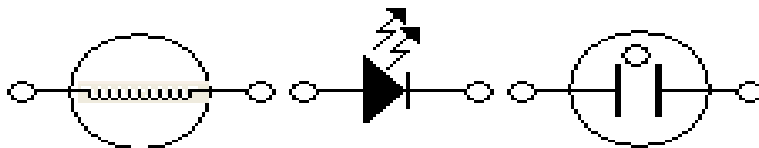
The I/O System

*Input Conditioning
& Level Conversion*



CONDITIONING AND LEVEL CONVERSION

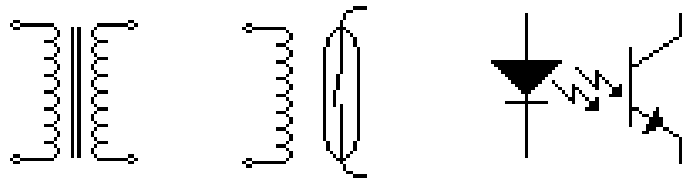
*Converts the Field Signals to LOW-VOLTAGE level and
formats usable by the PC Processor*



MODULE STATUS INDICATORS

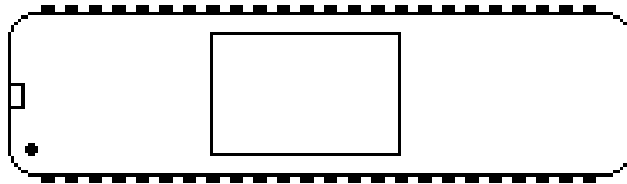
*Provides a Visual Indication as to the
Functional Status of the Input Module Points*

The I/O System



ELECTRICAL ISOLATION

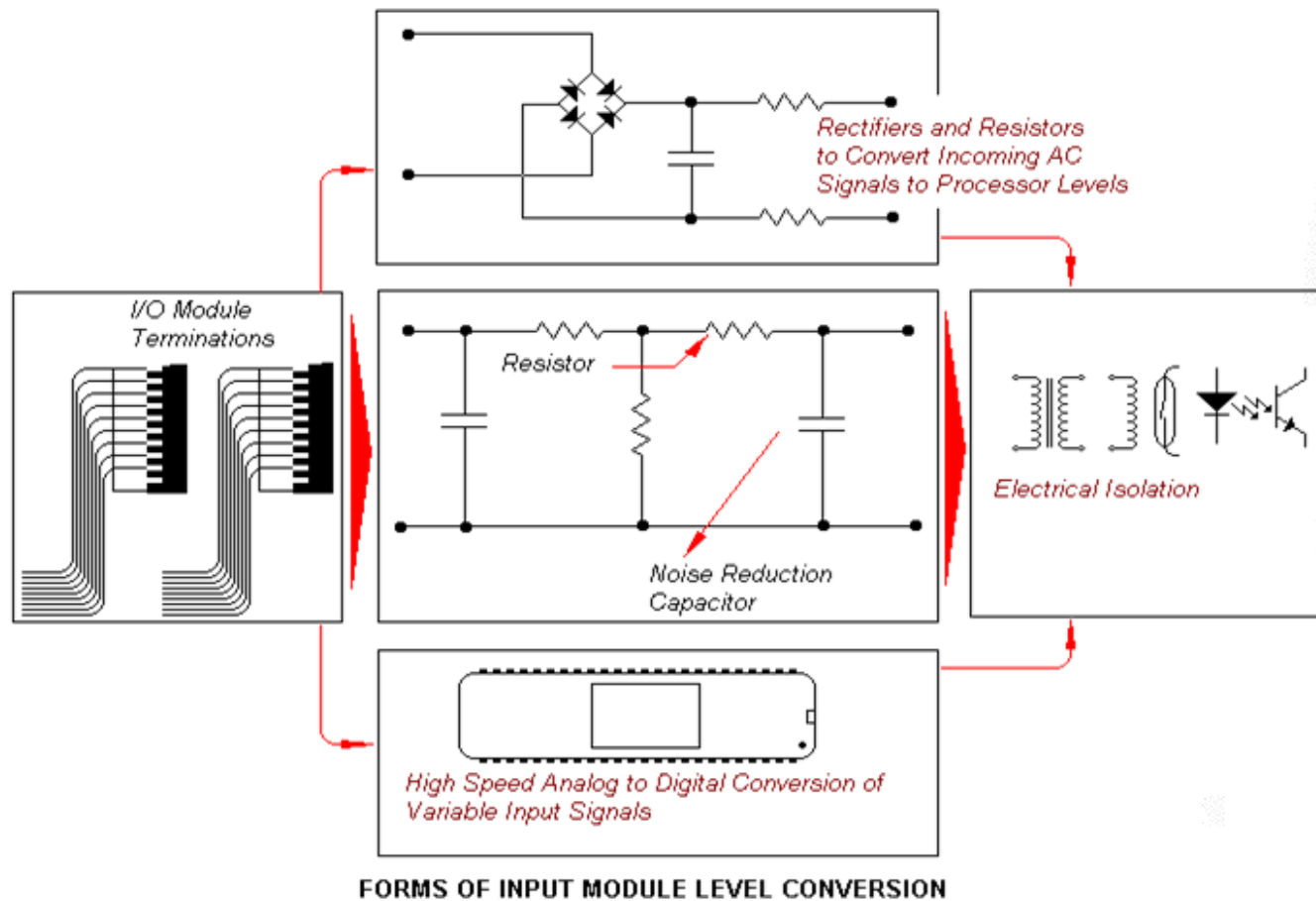
Electrically Isolates the Field Signals from the Processor Signals



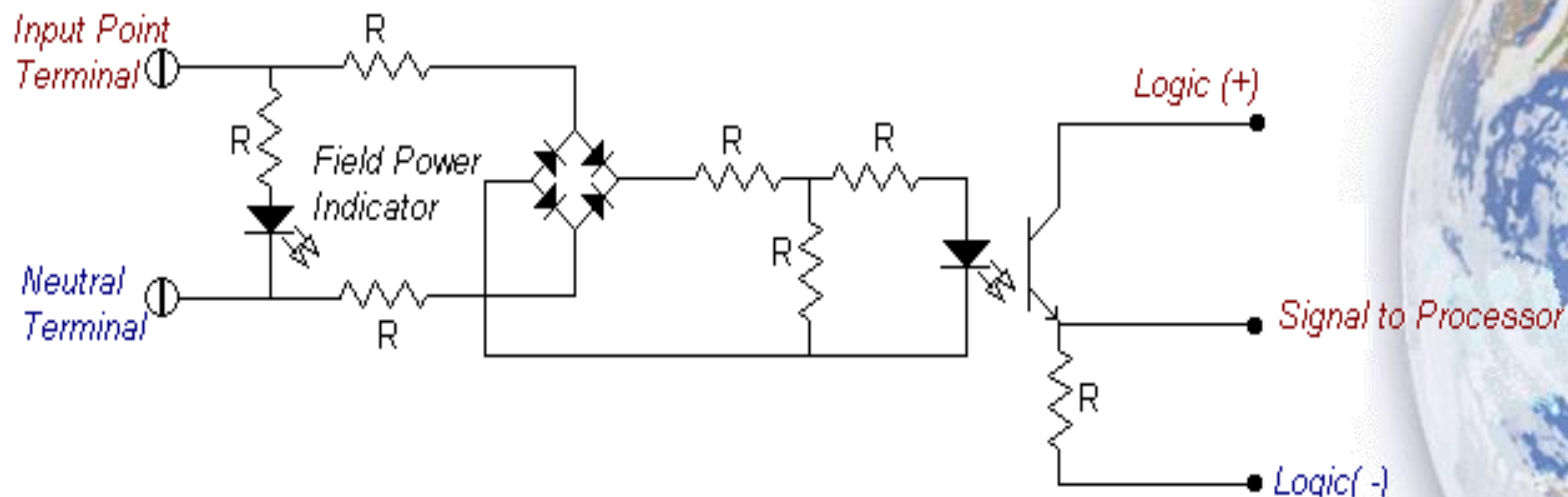
INTERFACE/MULTIPLEX ELECTRONICS

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

The I/O System



The I/O System



I/O Module Termination

Level Conversion

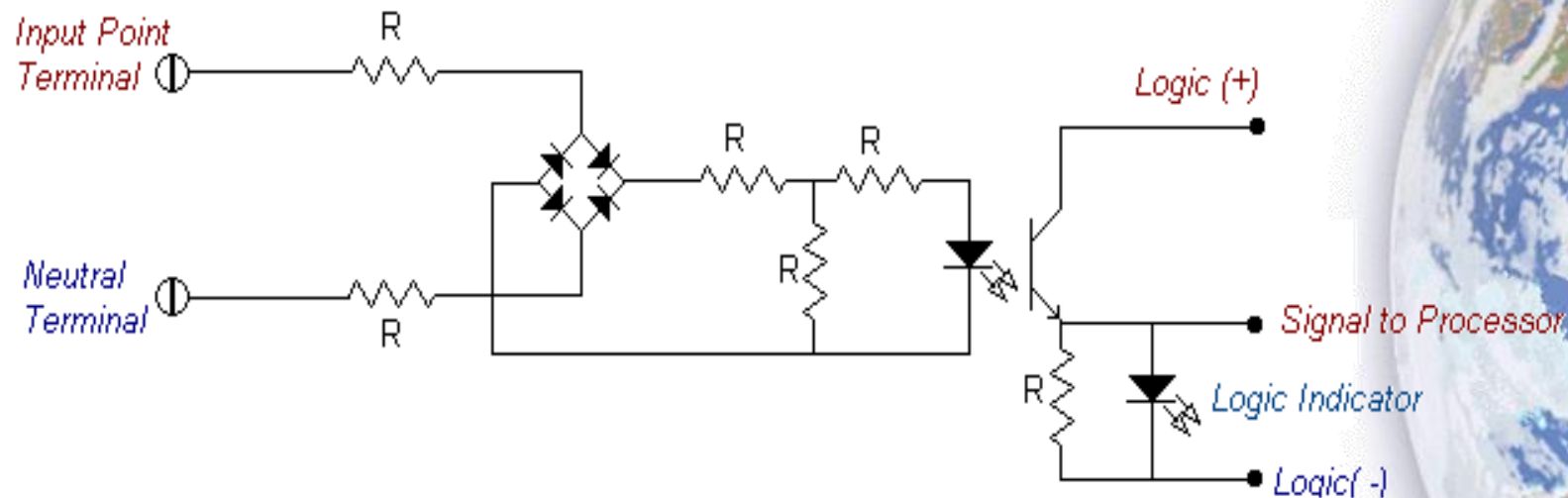
Isolation

Processor Logic Signals

STATUS INDICATOR POWERED FROM FIELD POWER

INPUT MODULE Level Conversion

The I/O System



**I/O Module
Termination**

Level Conversion

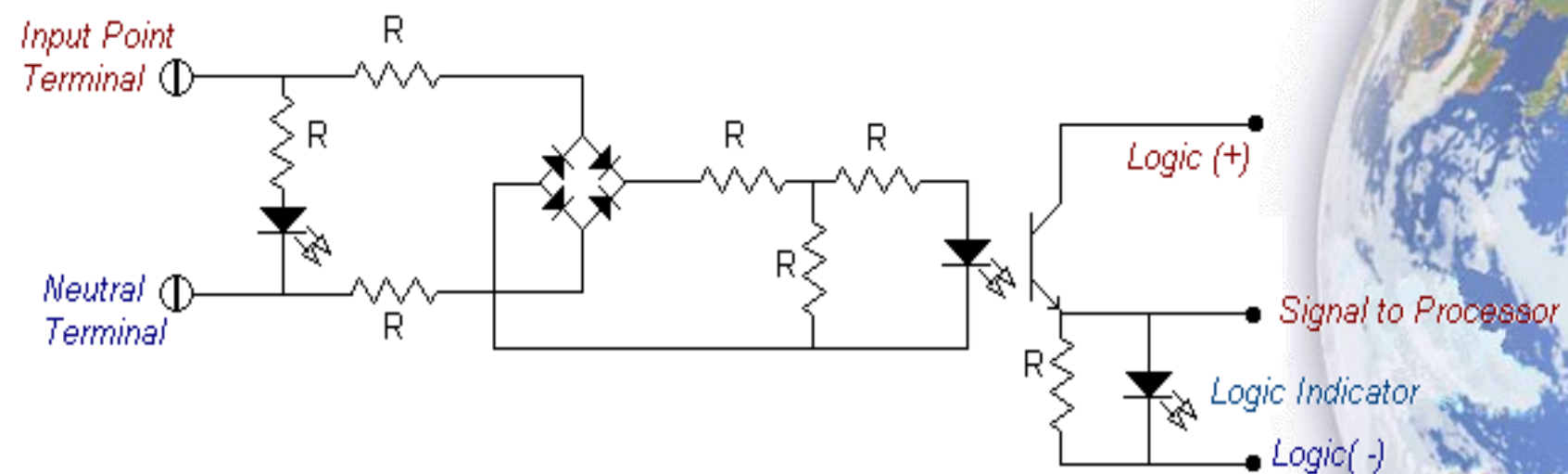
Isolation

**Processor Logic
Signals**

STATUS INDICATOR POWERED FROM LOGIC POWER

INPUT MODULE Level Conversion

The I/O System



**I/O Module
Termination**

Level Conversion

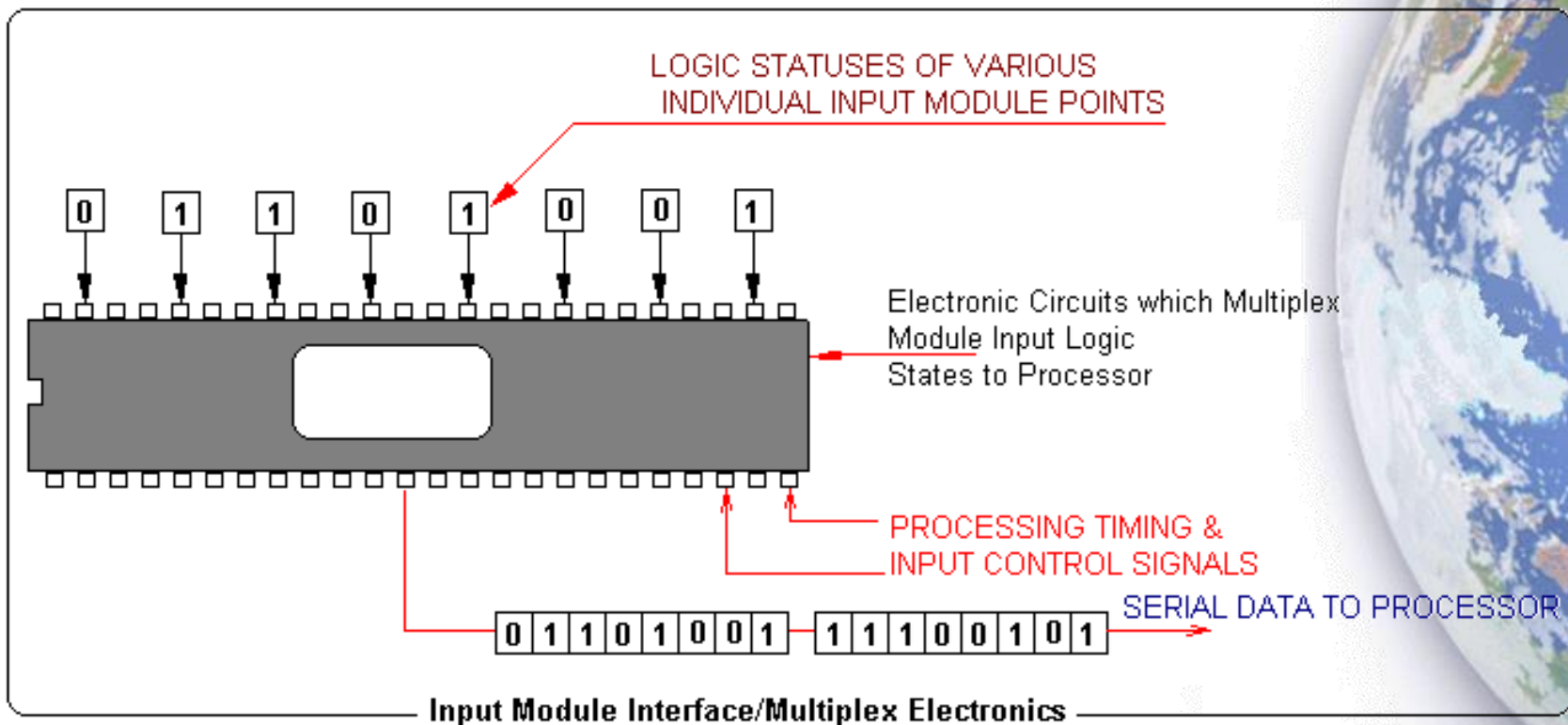
Isolation

**Processor Logic
Signals**

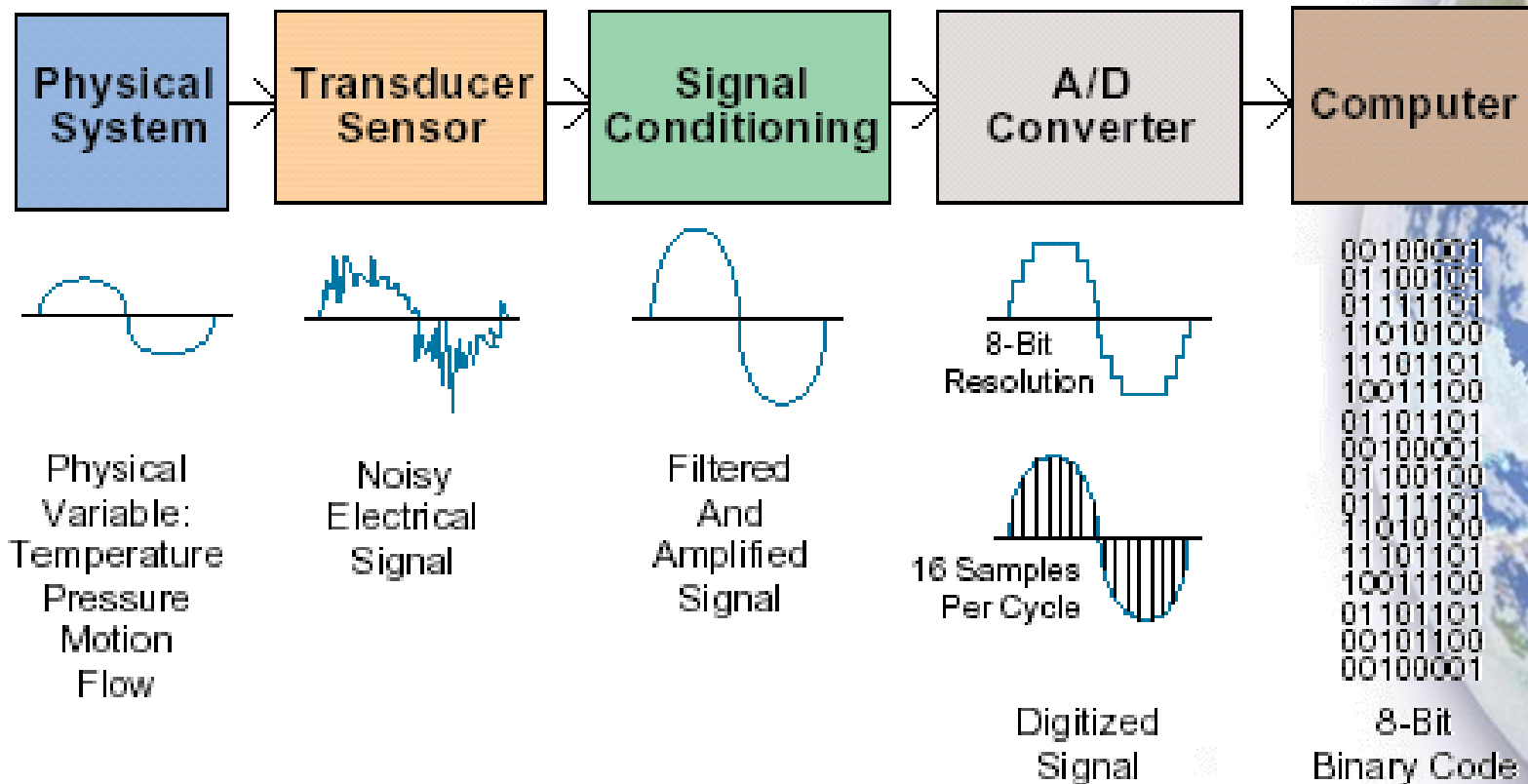
POWER & LOGIC INDICATORS

INPUT MODULE Level Conversion

The I/O System

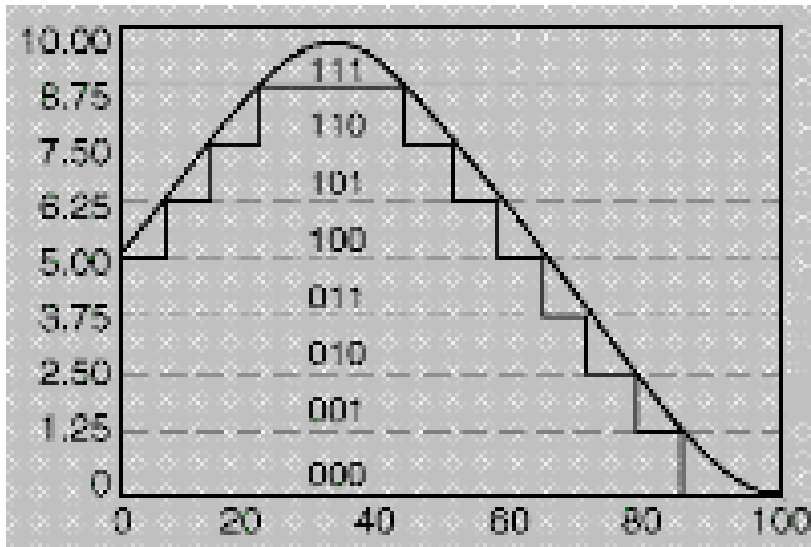


The I/O System

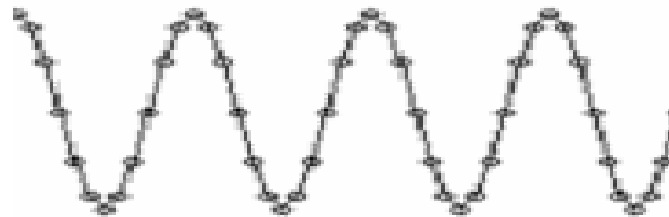


Signal Flow

The I/O System



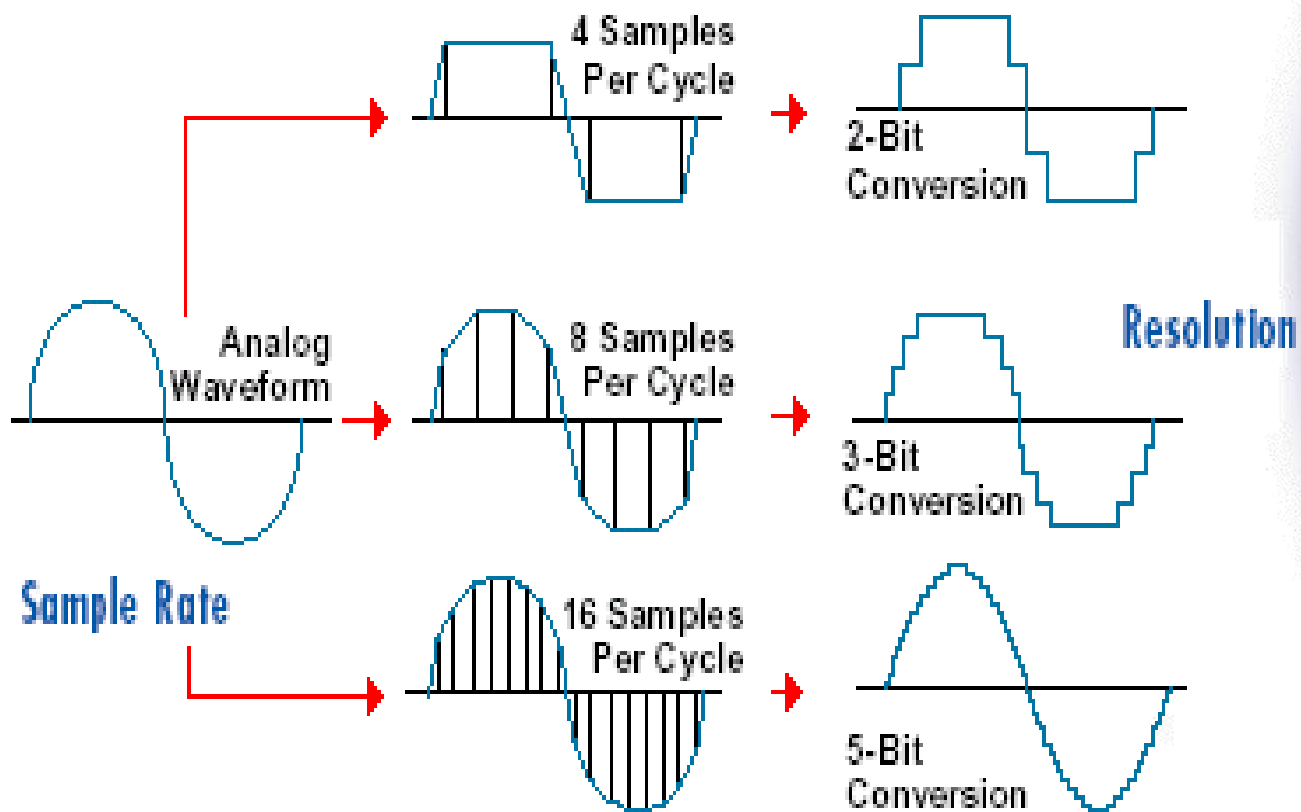
Resolution



Sampling



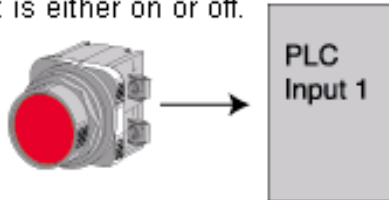
The I/O System



The I/O System

Discrete Input

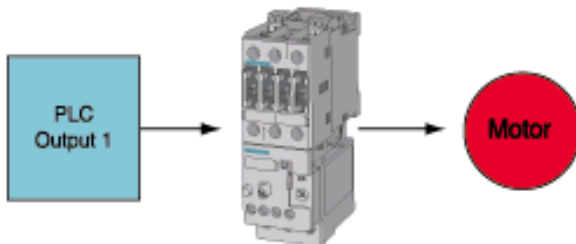
An input that is either on or off.



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

Discrete Output

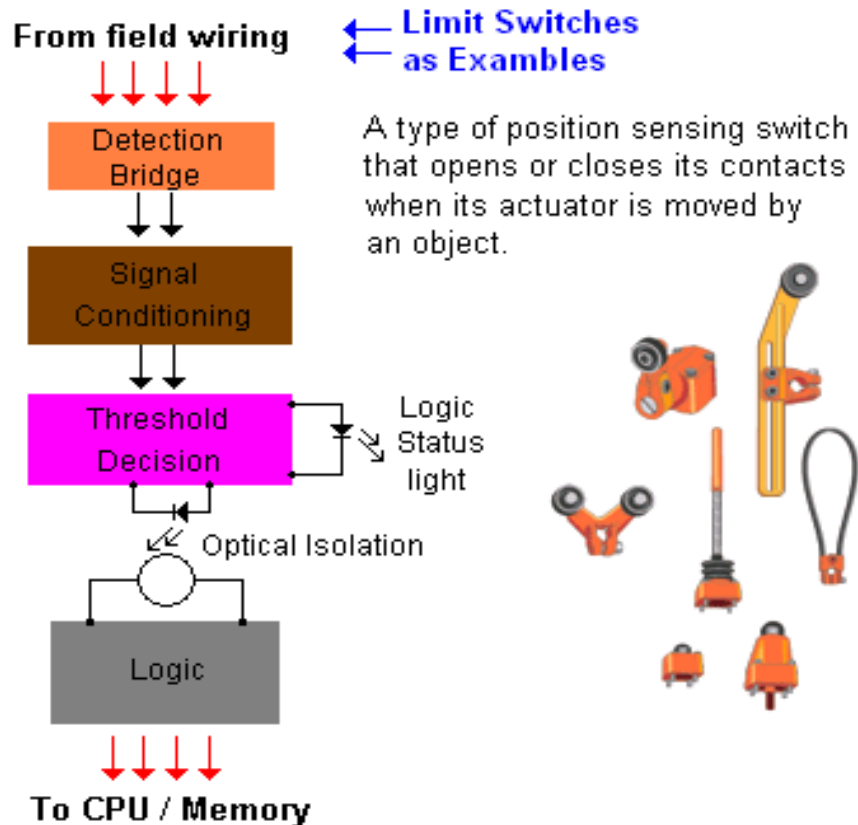
An output that is either on or off.



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

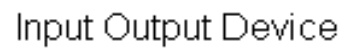


The I/O System



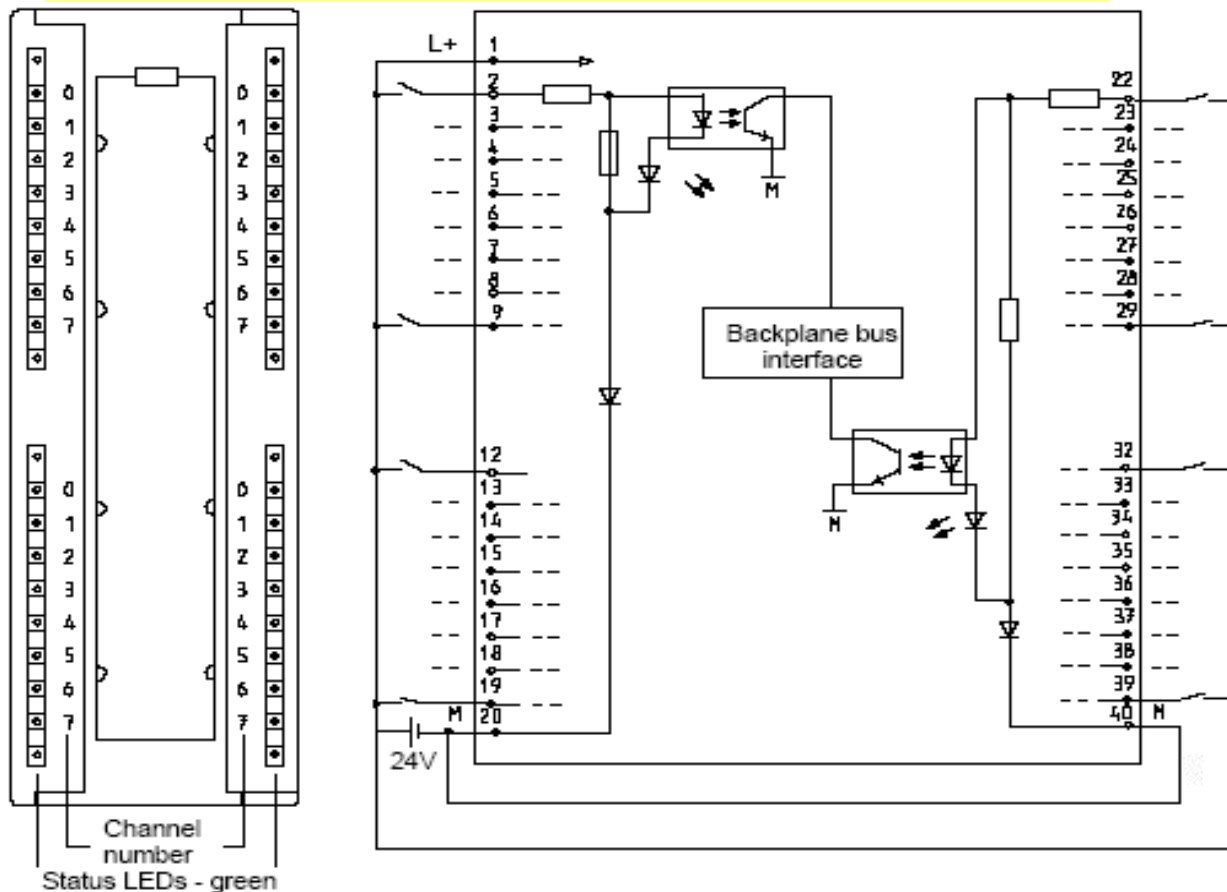
Block diagram of AC/DC input Circuit

A close-up, high-angle view of the Earth's surface, showing a mix of blue oceans, green landmasses, and white clouds. The image is framed by a white border.



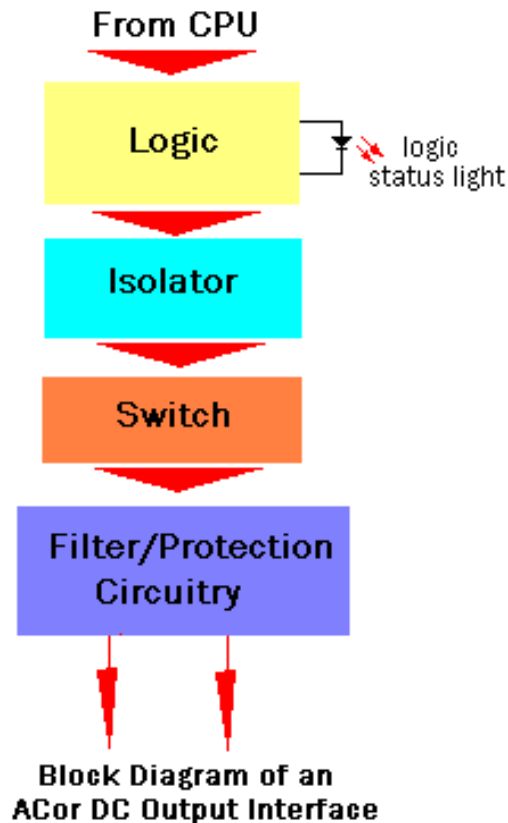
The I/O System

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



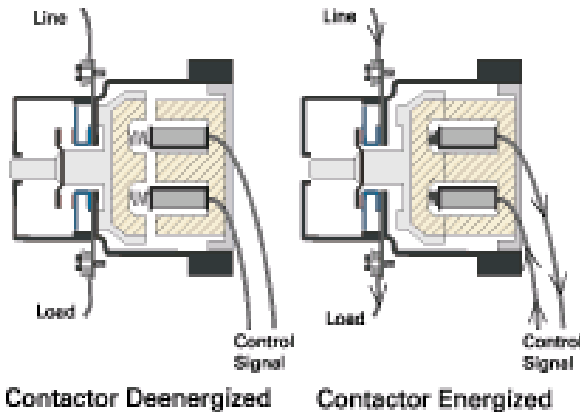
Input Module

The I/O System

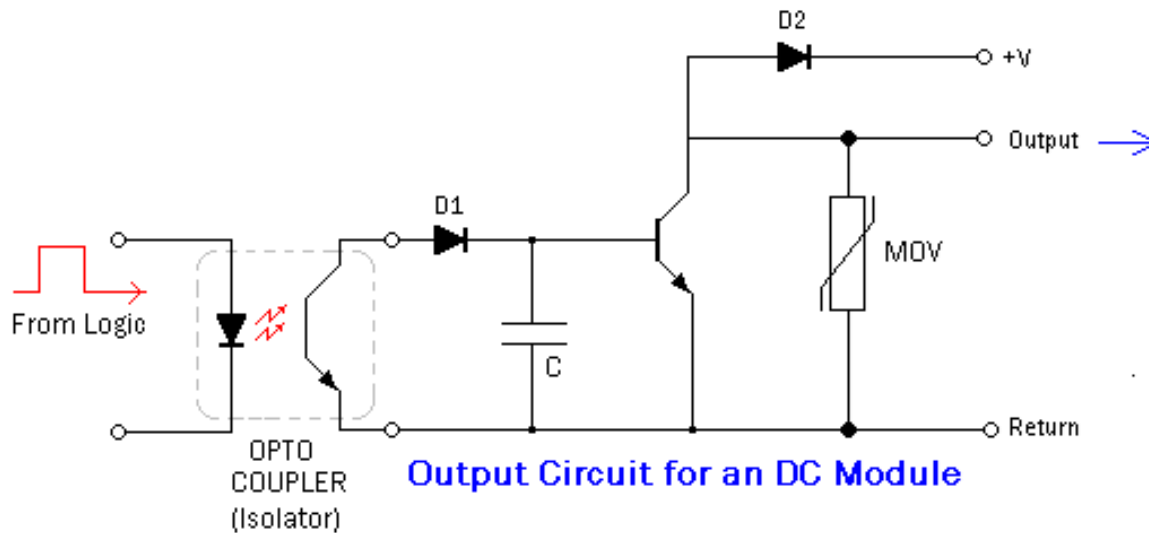


Contactor

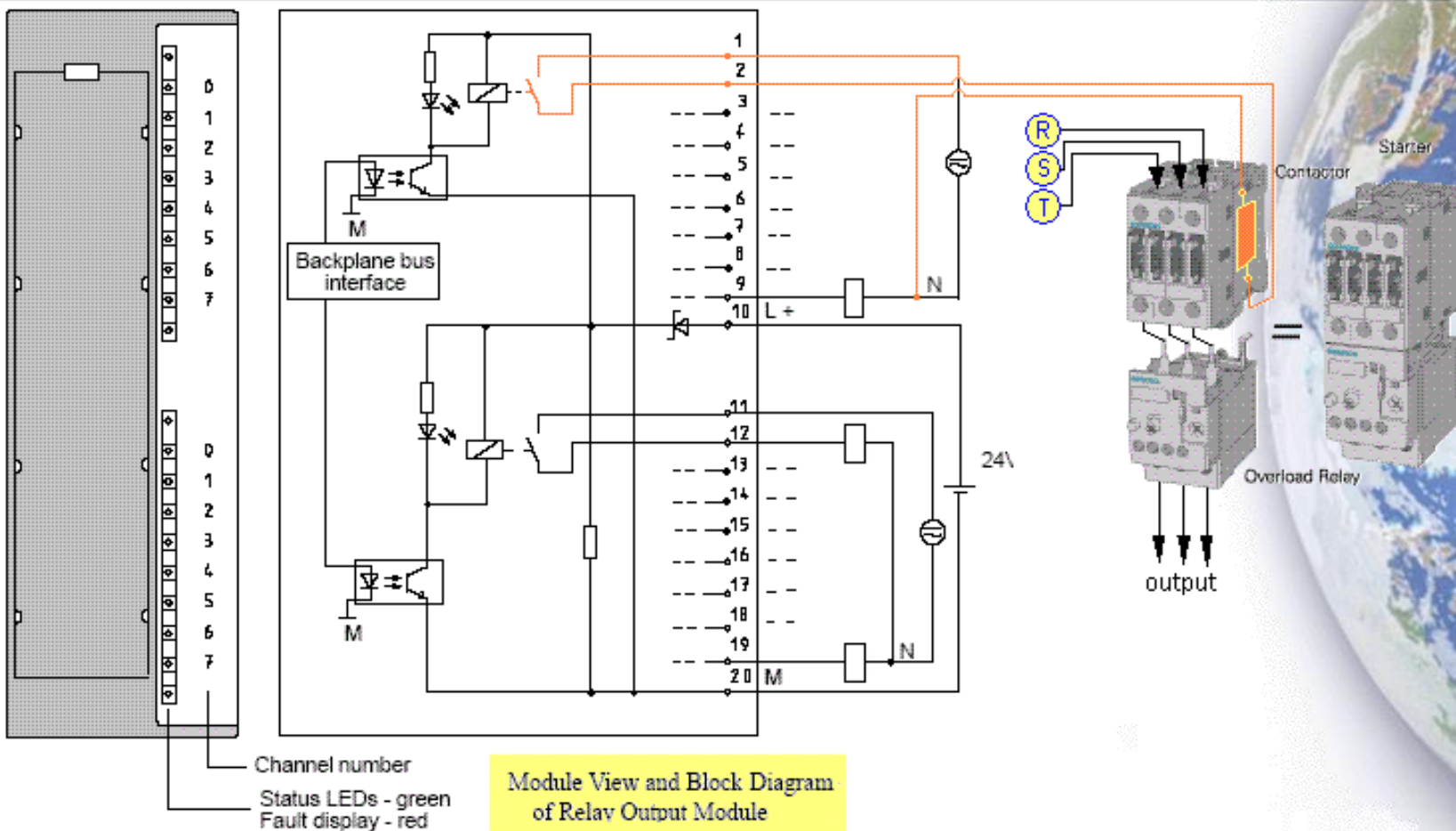
An device used to energize and de-energize an electrical circuit.



The I/O System



The I/O System

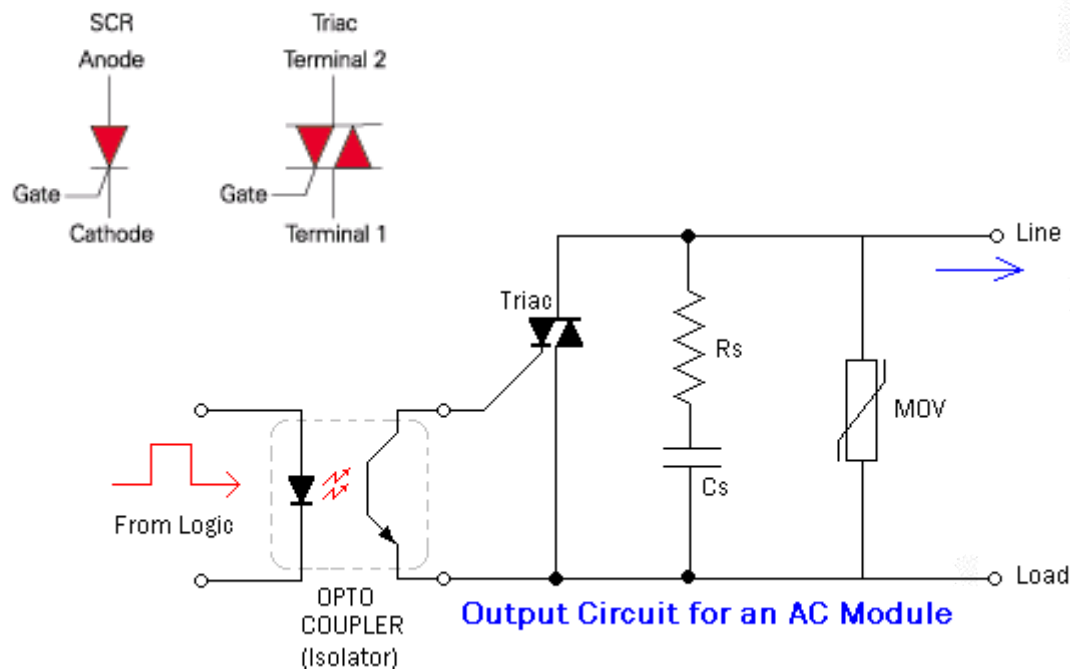


Output Module

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.



The I/O System

