



Introduction to Electrical

Overview:

This course is designed to give you a basic understanding of electrical controls, a general knowledge of electrical components such as; relays, switches, starters, pushbuttons, control panels.

Course Outline:

- What is Control
- Manual and Automatic control
- Contacts, Switches, and Coils
- Logic Basics
- Types of Control Circuits
- What is a Control Panel
- Types of Control Panels
- Open Loop vs. Closed Loop
- CP Electrical 328 numbering definition
- Review

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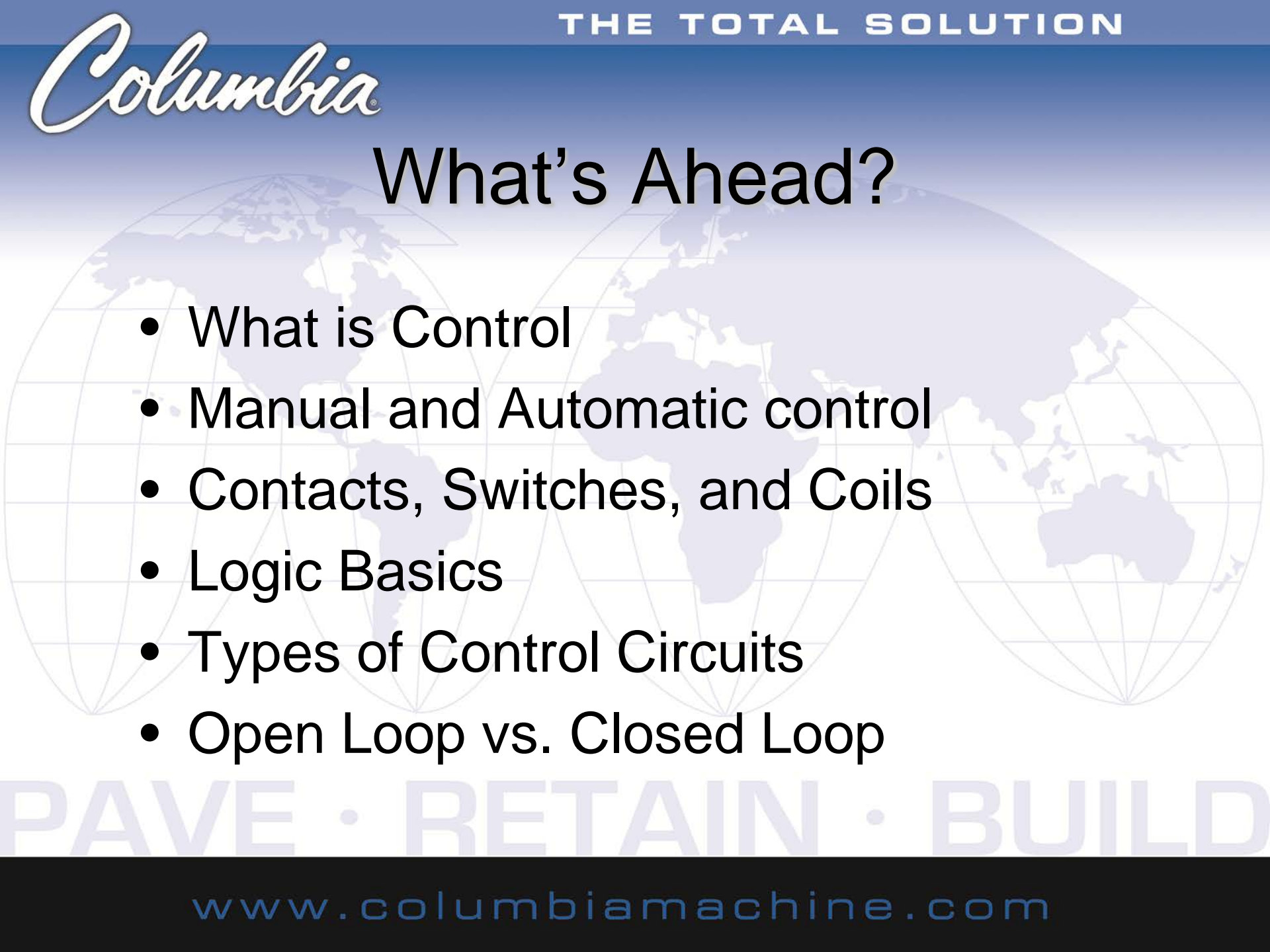
Electrical Control Circuits

Basic Principles and Operation

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What's Ahead?

- 
- A faint, light blue world map is visible in the background, centered behind the text. It shows the continents and is overlaid with a grid of latitude and longitude lines.
- What is Control
 - Manual and Automatic control
 - Contacts, Switches, and Coils
 - Logic Basics
 - Types of Control Circuits
 - Open Loop vs. Closed Loop

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What is Control?

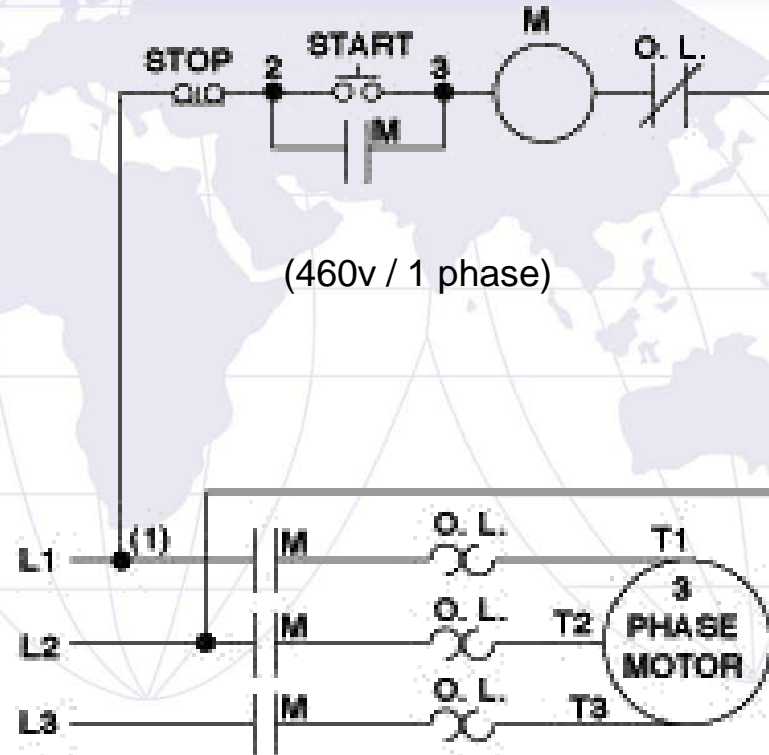
- Control is a broad term that means anything from a simple toggle switch to a complex system with components such as relays, timers, and switches.

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What is Control?

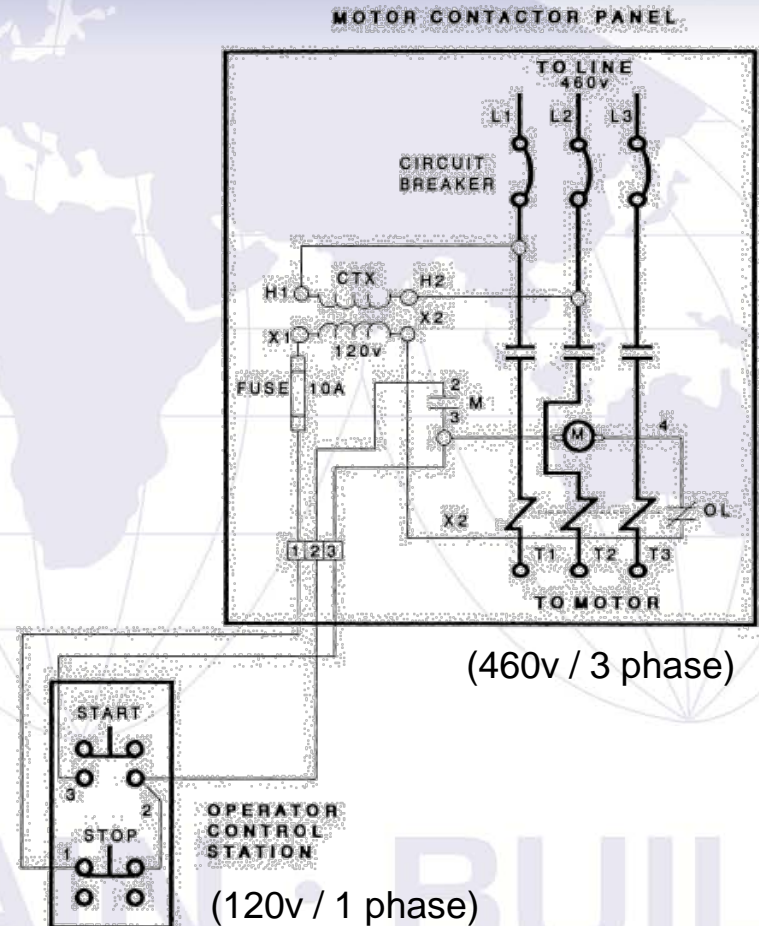
Control circuits may use the same voltage that feeds the loads they are controlling.

To line: (460v / 3 phase)



What is Control?

Control circuits may also be a different voltage than the loads they control. This is done using a separate power supply or by using a step-down transformer.



Manual and Automatic Control

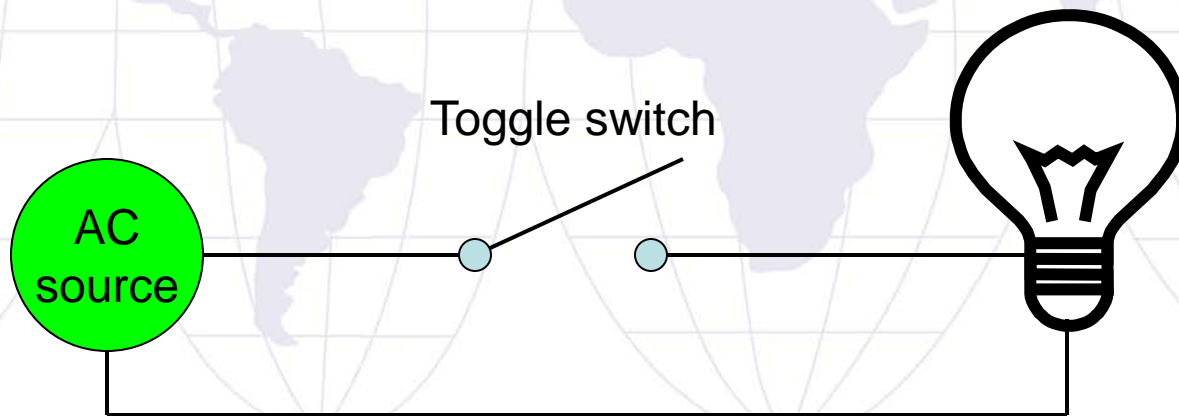
Control circuits may require:

- Manual control
- Automatic control
- or a combination of both

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Manual Control

Manual Control circuits use components that require human interaction in order to operate.



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Manual Control

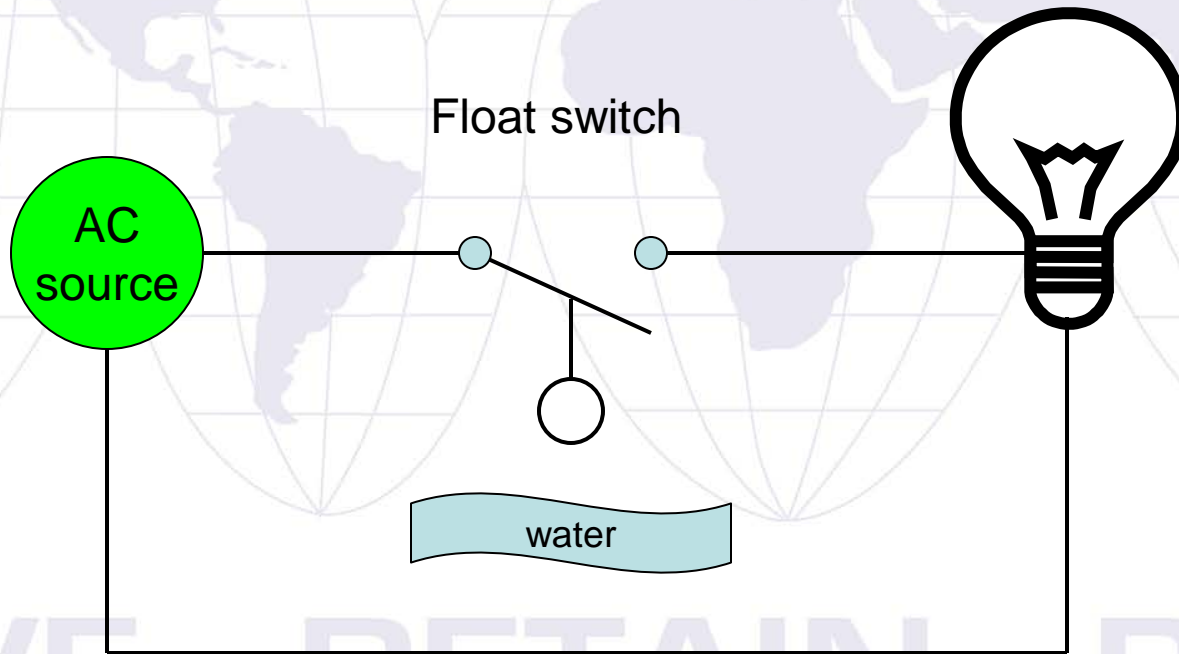
Manual Control circuits use components that require human interaction in order to operate.



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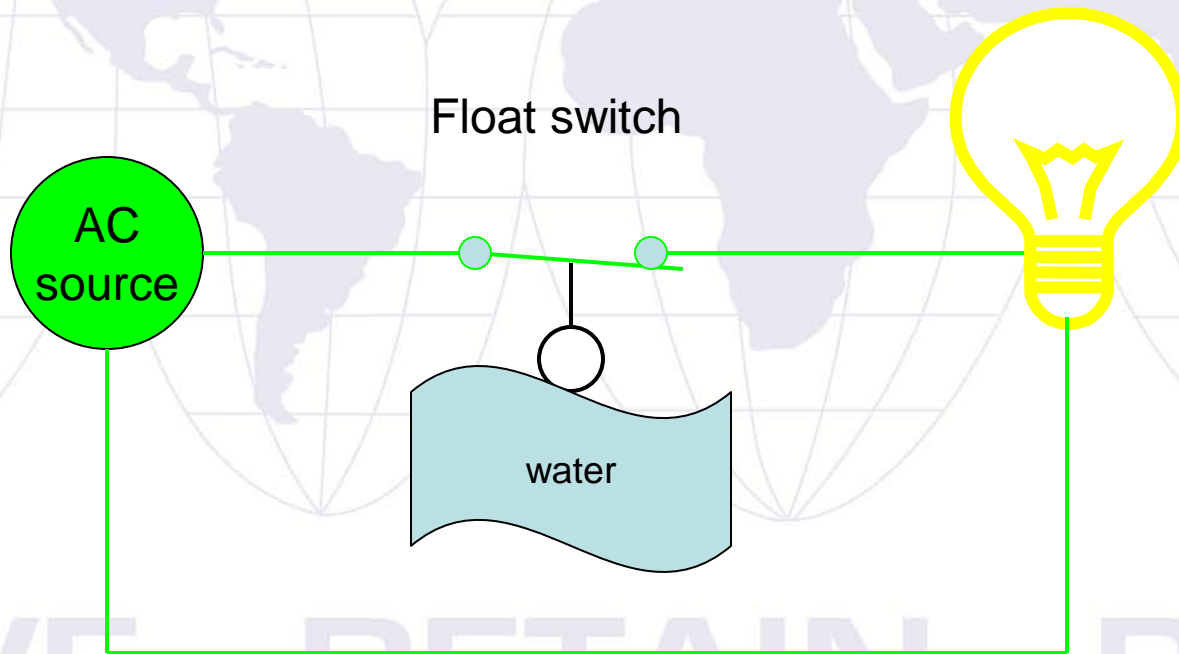
Automatic Control

Automatic control circuits can operate themselves without the need for human interaction.



Automatic Control

Automatic control circuits can operate themselves without the need for human interaction.





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Switches, Contacts and Coils

The most common types of components found in a control circuit are:

- Switches
- Contacts
- Coils

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Switches

- Toggle
- Pushbutton
- Selector switch
- Limit switch
- Proximity switch

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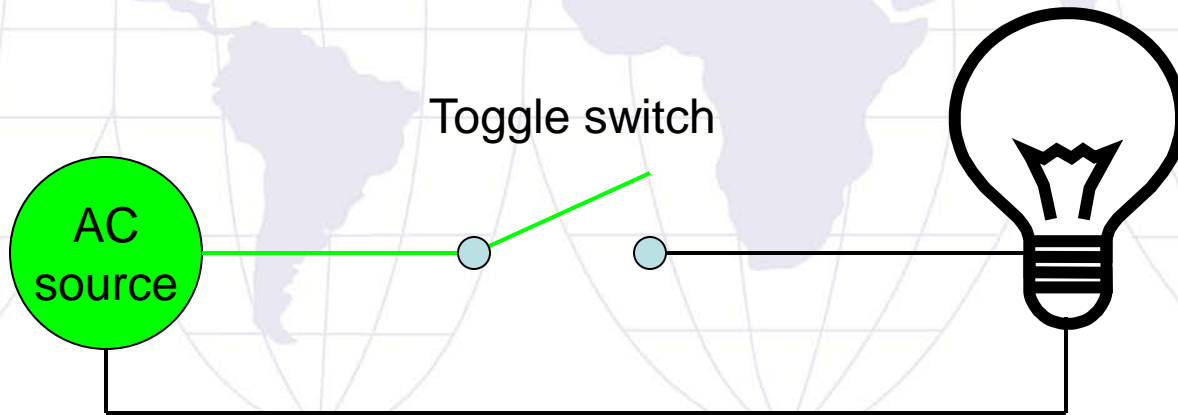
Toggle Switches

Toggle switches are generally used in 2-wire control circuits.



Toggle Switches

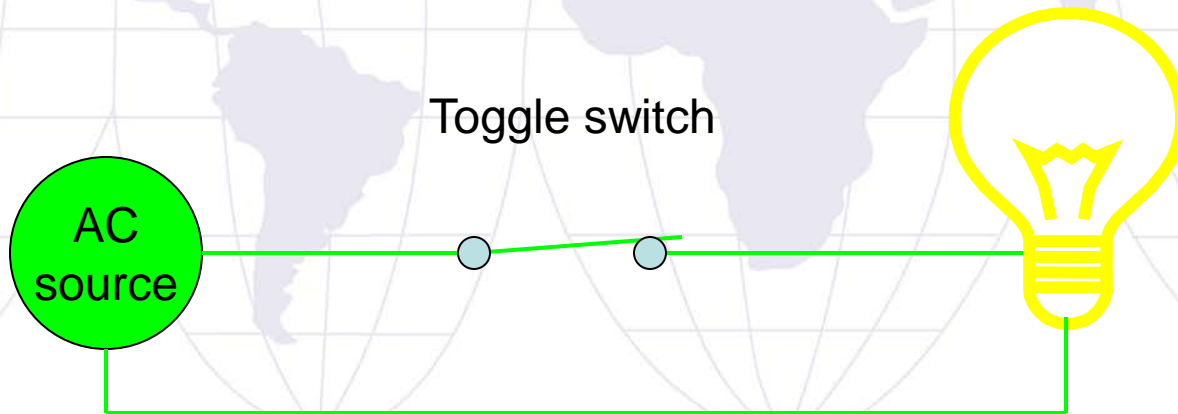
2-wire control circuit



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Toggle Switches

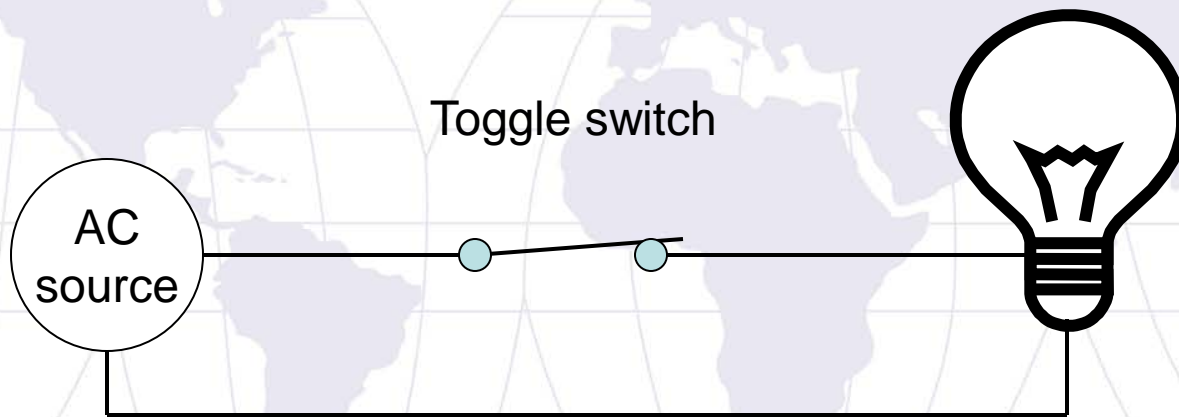
2-wire control circuit



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Toggle Switches

2-wire control circuit

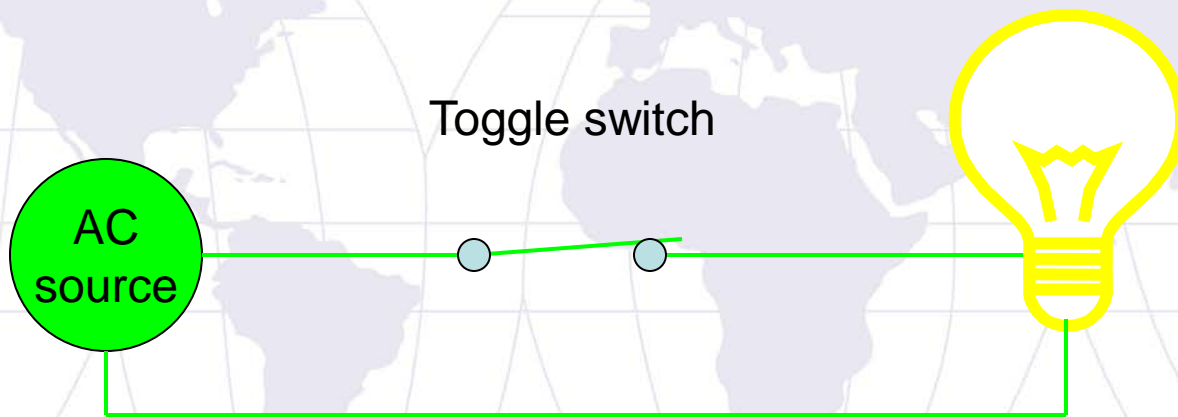


SAFETY TIP!

2-wire control circuits should not be used on mechanical loads due to restart after a loss of power occurs.

Toggle Switches

2-wire control circuit



SAFETY TIP!

2-wire control circuits should not be used on mechanical loads due to restart after a loss of power occurs.

Pushbuttons

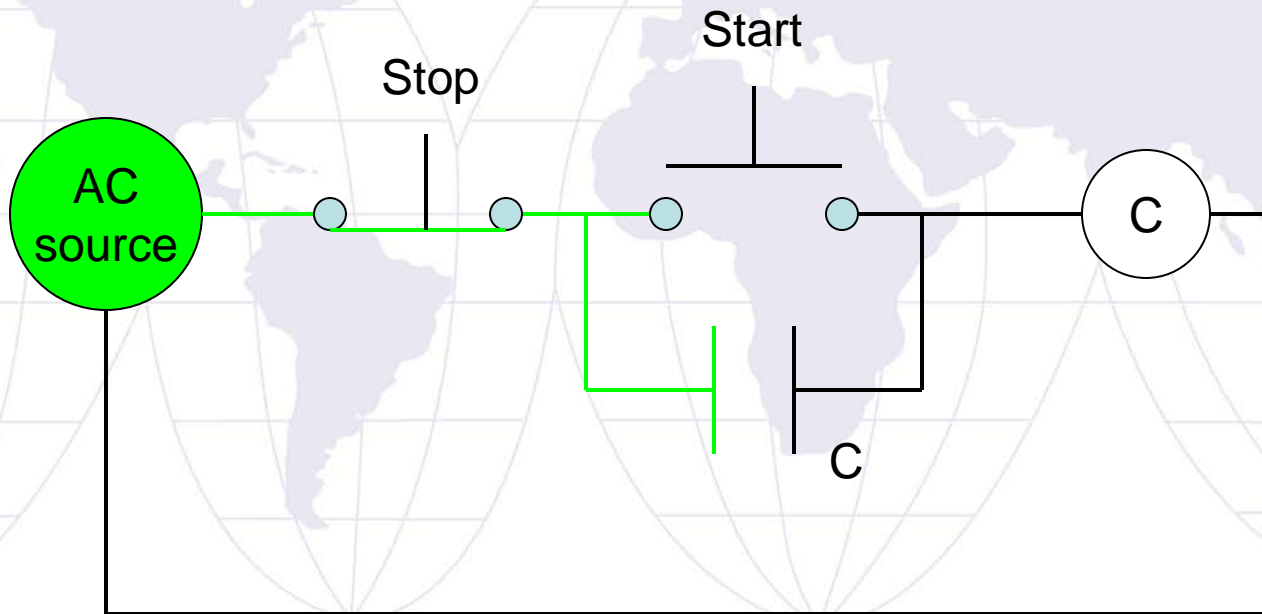
Pushbuttons are generally used in 3-wire control circuits because of their momentary operation.



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Pushbuttons

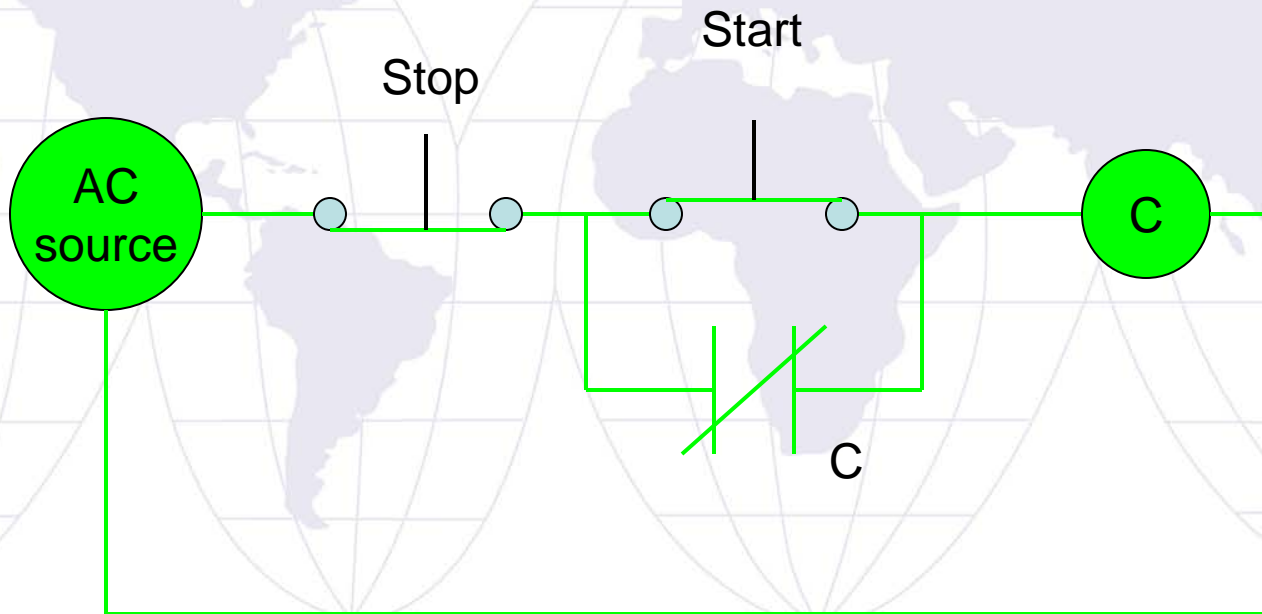
3-wire control circuit



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Pushbuttons

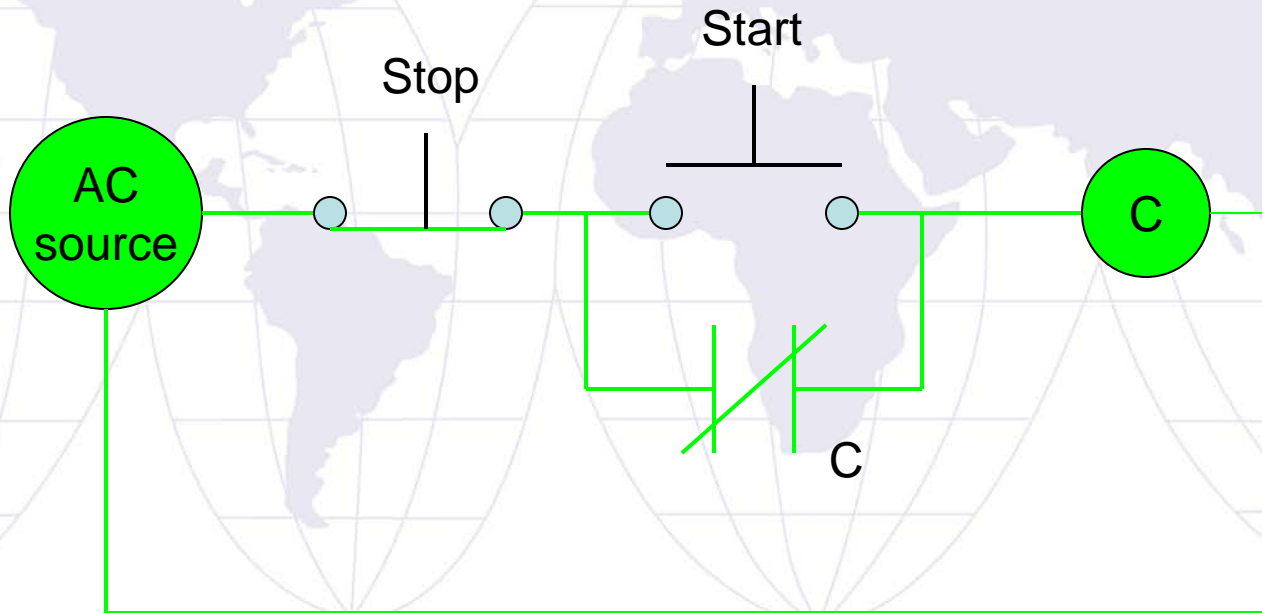
3-wire control circuit



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Pushbuttons

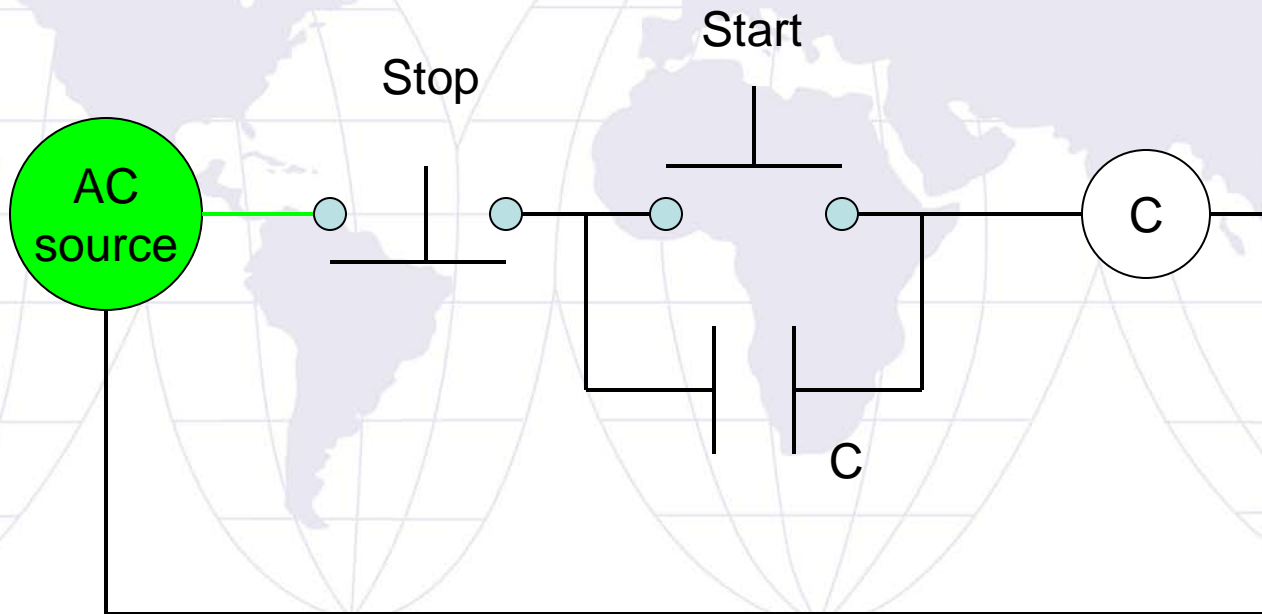
3-wire control circuit



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Pushbuttons

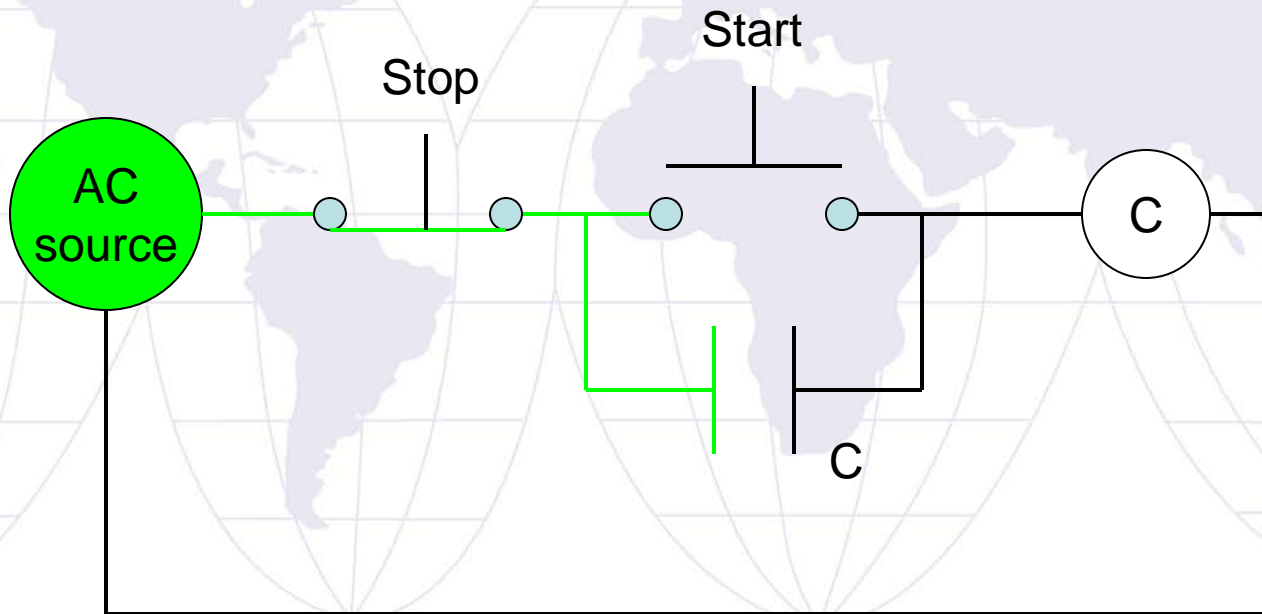
3-wire control circuit



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Pushbuttons

3-wire control circuit



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Selector Switch

Selector switches allow manual or automatic operation of a circuit.



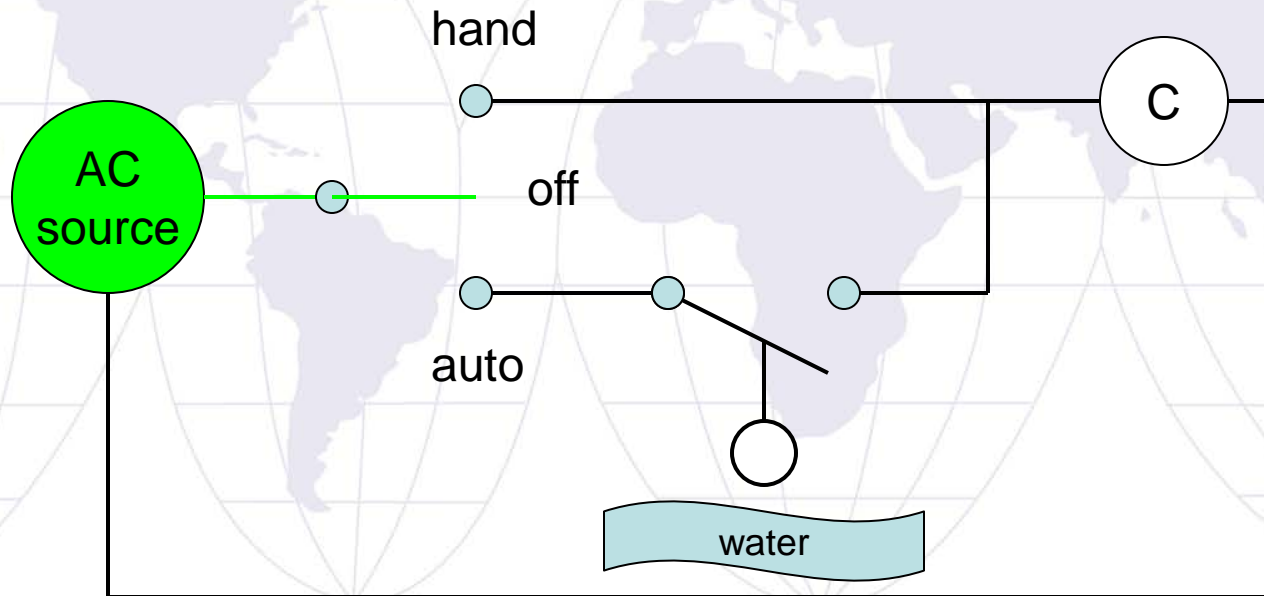
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Selector Switch



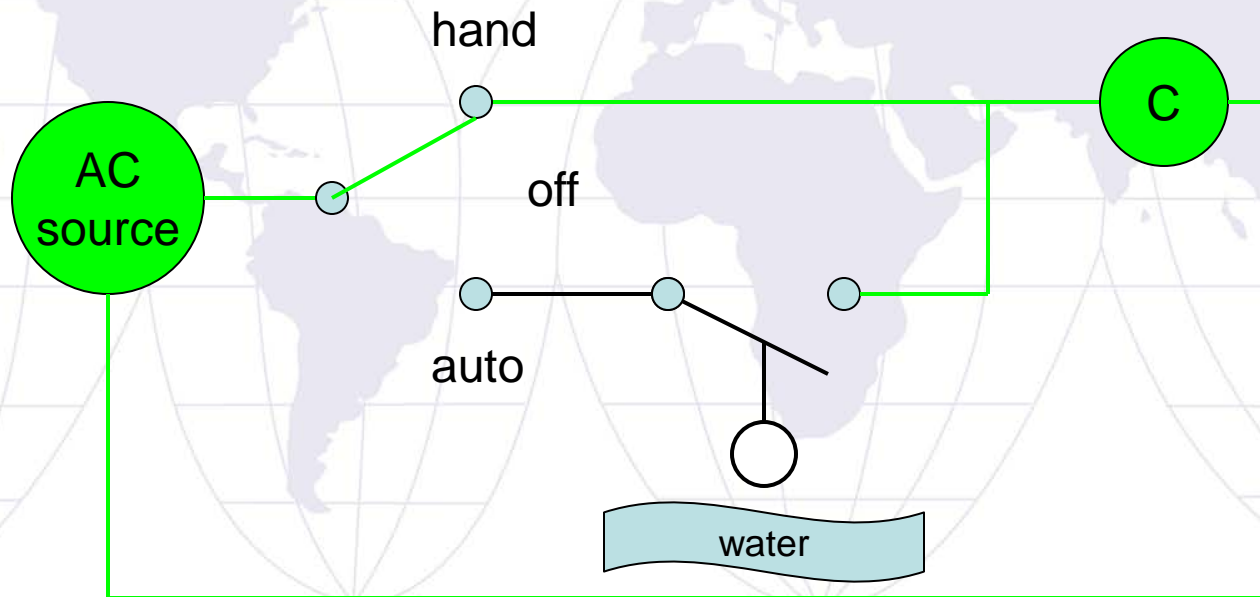
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Selector Switch



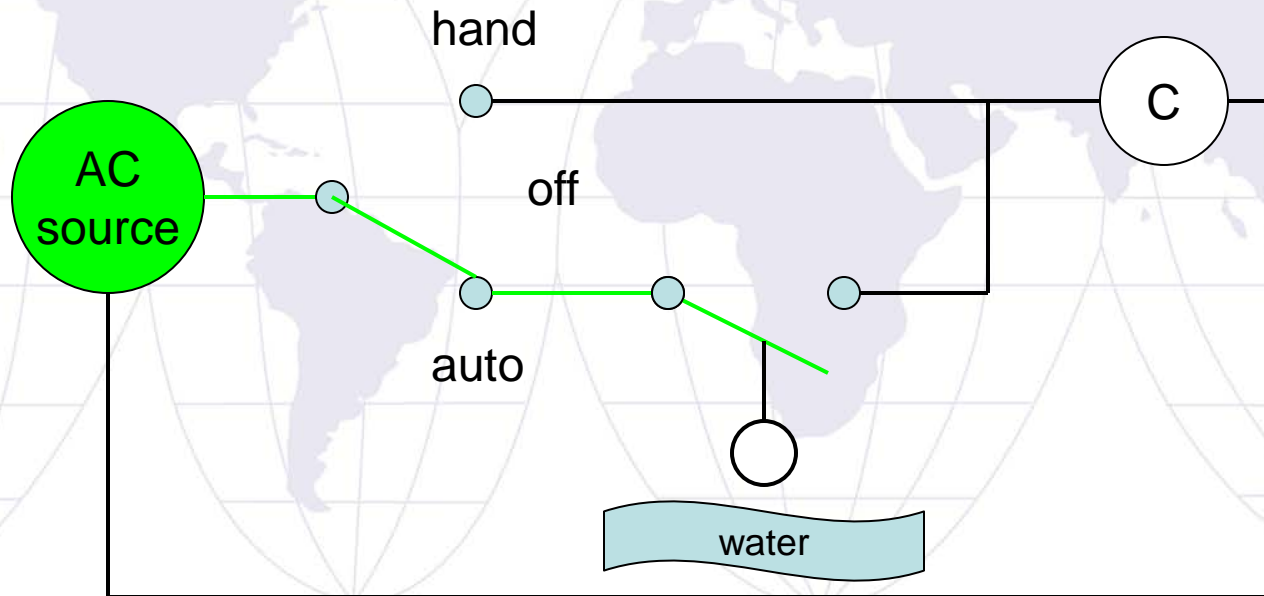
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Selector Switch



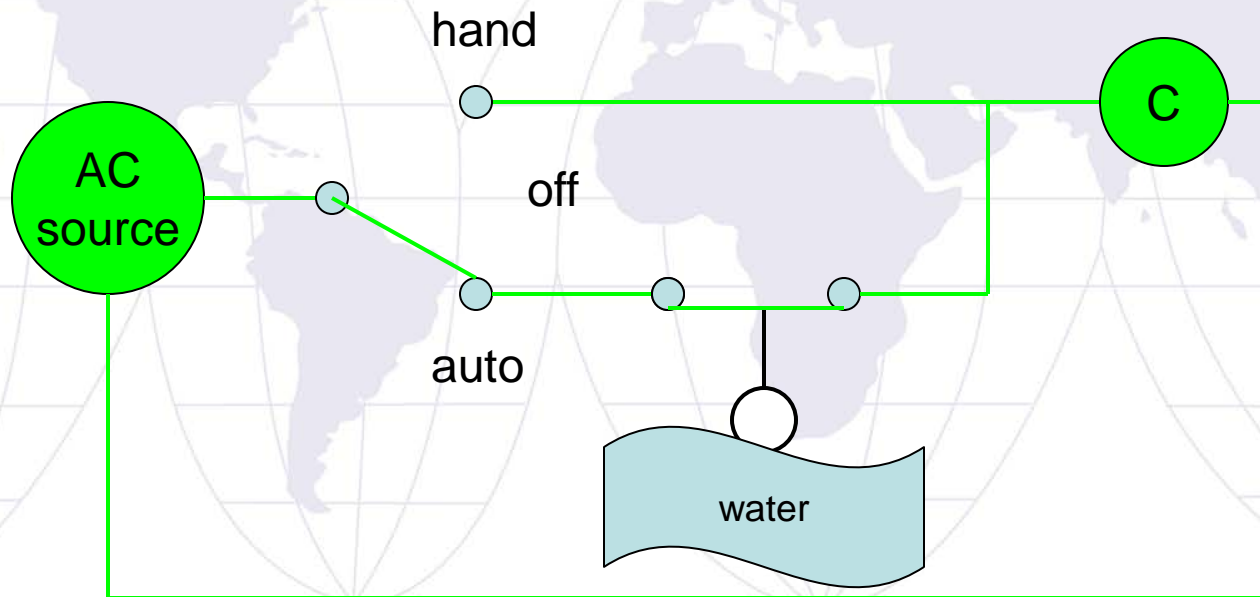
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Selector Switch



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Coils & Contacts

Control Relay (coils and contacts) is a electromechanical device which activates one or more circuits. Used for automatic operation.



5UU2-76



5UUH2-76



713UPA-76



5SRR-76

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Coils & Contacts

Timing Relay
Pneumatic



Relay Non-
Latching



Relay
Latching



Timing Relay
Solid State



Relay 8 pin
Blade



Relay 8 pin,
Optical

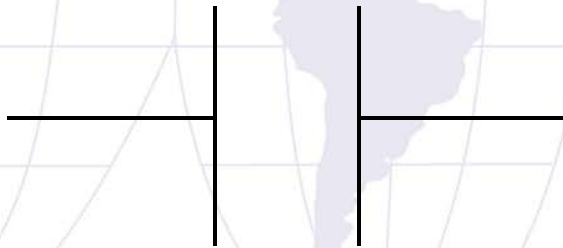


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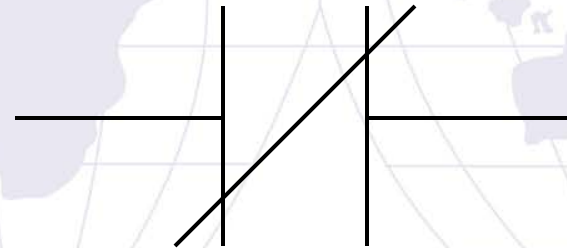
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Contacts

Contacts can be Normally Open (NO) or Normally Closed (NC).



NO



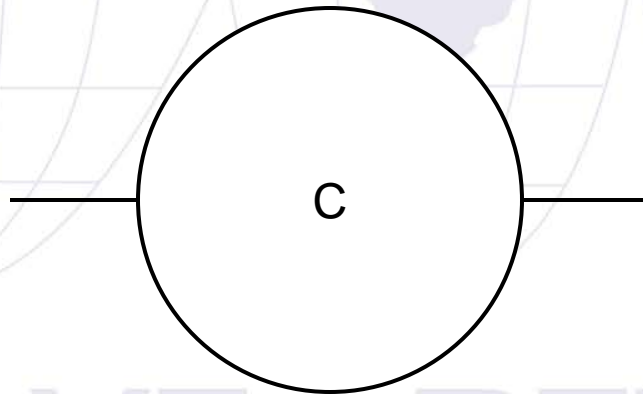
NC



Contact Block

Coils

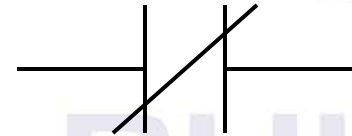
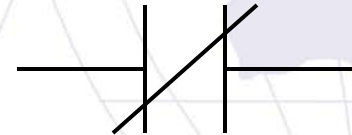
When coils are energized, any contacts that are controlled by them change from their normal to energized state.



NO

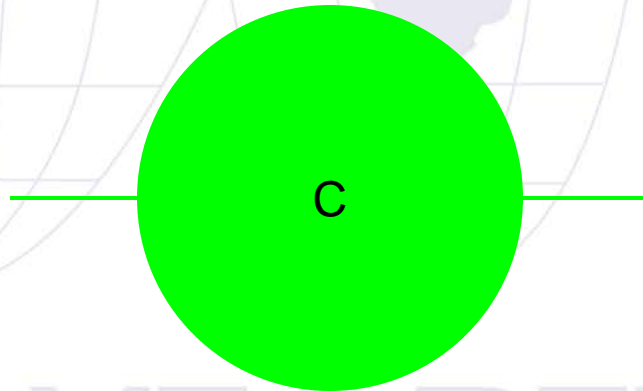


NC



Coils

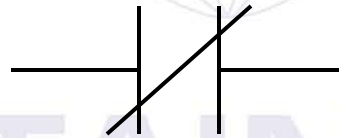
When coils are energized, any contacts that are controlled by them change from their normal to energized state.



NO



NC



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Logic Basics

- AND
- OR

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AND Logic

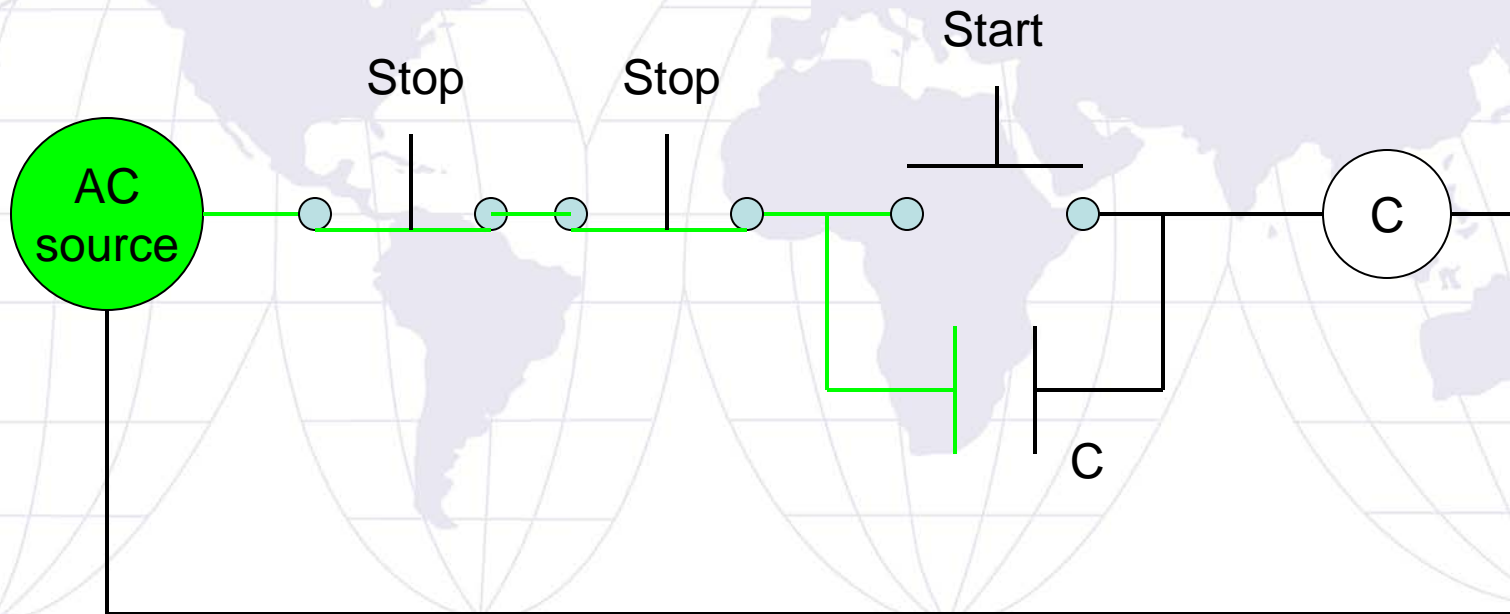
AND logic is a series relationship between contacts in a control circuit. A control circuit with two or more stop buttons would be an example of AND logic.

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AND Logic



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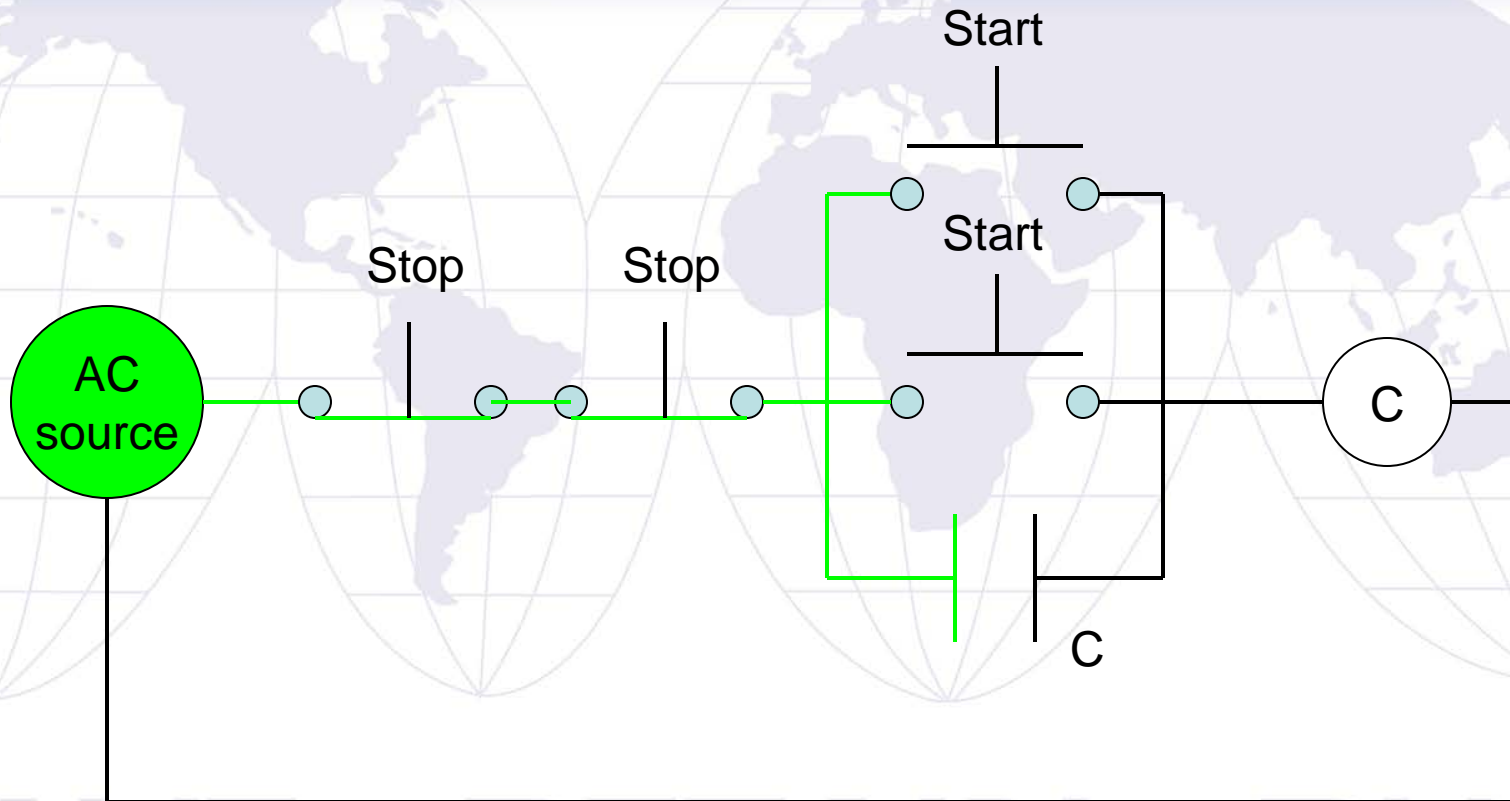
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OR Logic

OR logic is a parallel relationship between contacts in a control circuit. A circuit containing two or more start buttons is an example of OR logic.

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OR Logic



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Types of Control Circuits

- Magnetic
- Electronic
- Programmable

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Magnetic Control Circuits

Magnetic control circuits use the principles of magnetic induction to properly operate equipment. All components of this type of circuit are hard wired together.



Starter



Relay

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Electronic Control Circuits

Electronic control circuits function through the use of manufactured equipment modules that use solid state components. These components are usually soldered together on a circuit board.

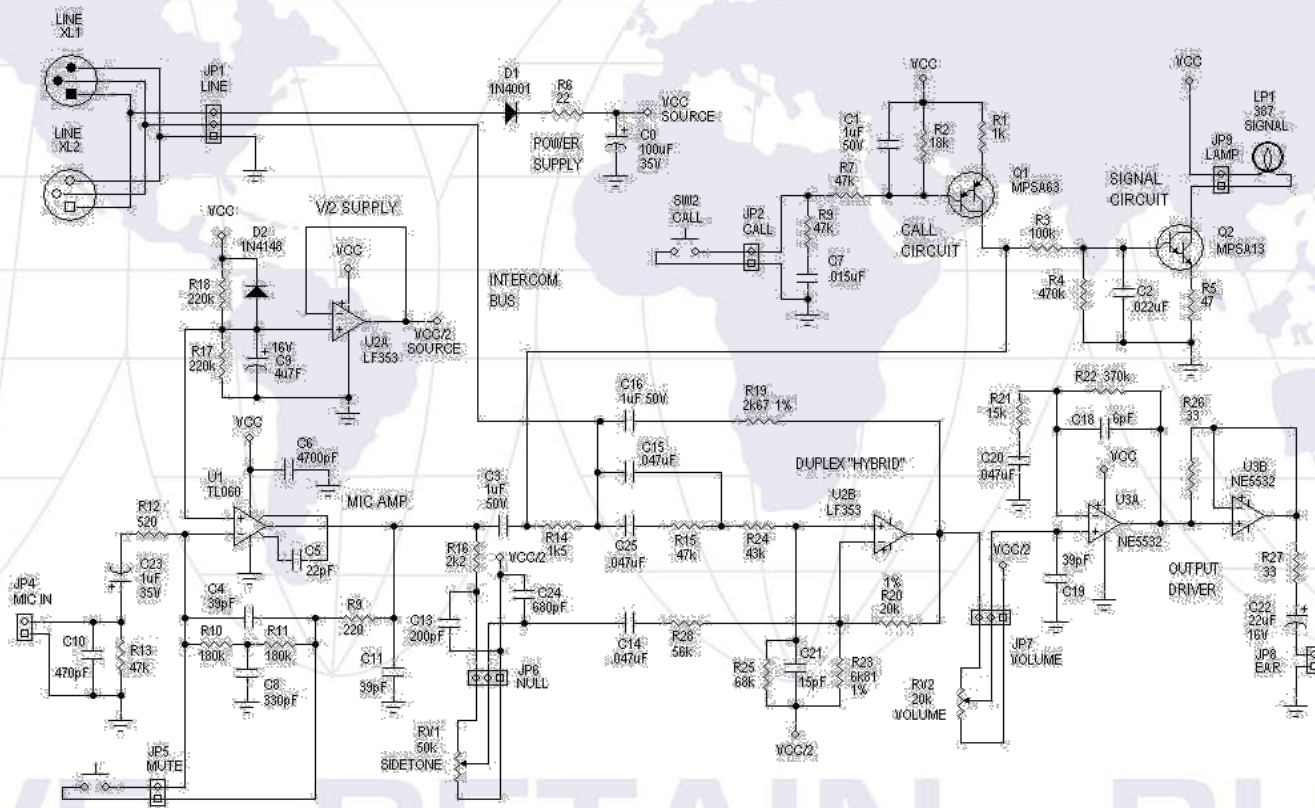


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Electronic Control Circuits



Programmable

A programmable logic controller (PLC) is a central module that has all of the circuit switches (inputs) and coils (outputs) connected to it. The circuit logic is programmed into the controller through the use of a computer. A microprocessor (CPU) solves the logic of the program.

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Programmable Logic Controllers

TI545



DL440



DL240



AB SLC5/03

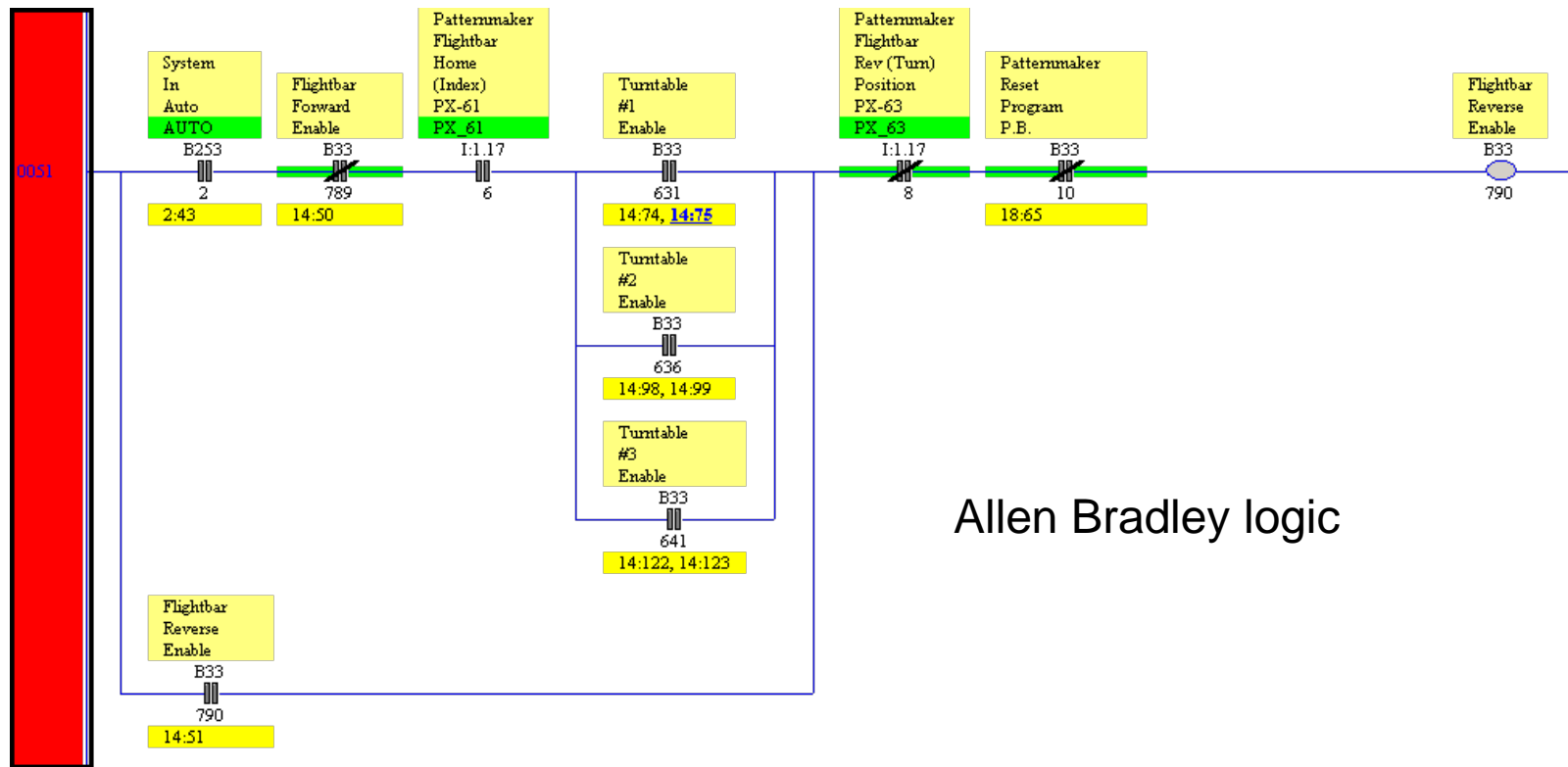
DL340



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Programmable Logic Controllers



What is a Control Panel

An enclosure that contains the electrical components; relays, starters, or PLC, that is designed to control the sequence of operation of a machine or device.

Types of Control Panels

- Motor control
- Relay control
- PLC control
- Manual control (P.B. Station)
- HMI (Operator Interface)

Types of Control Panels

P.B. Station



PLC Panel



Relay Panel



PLC w/ HMI

VFD Drive



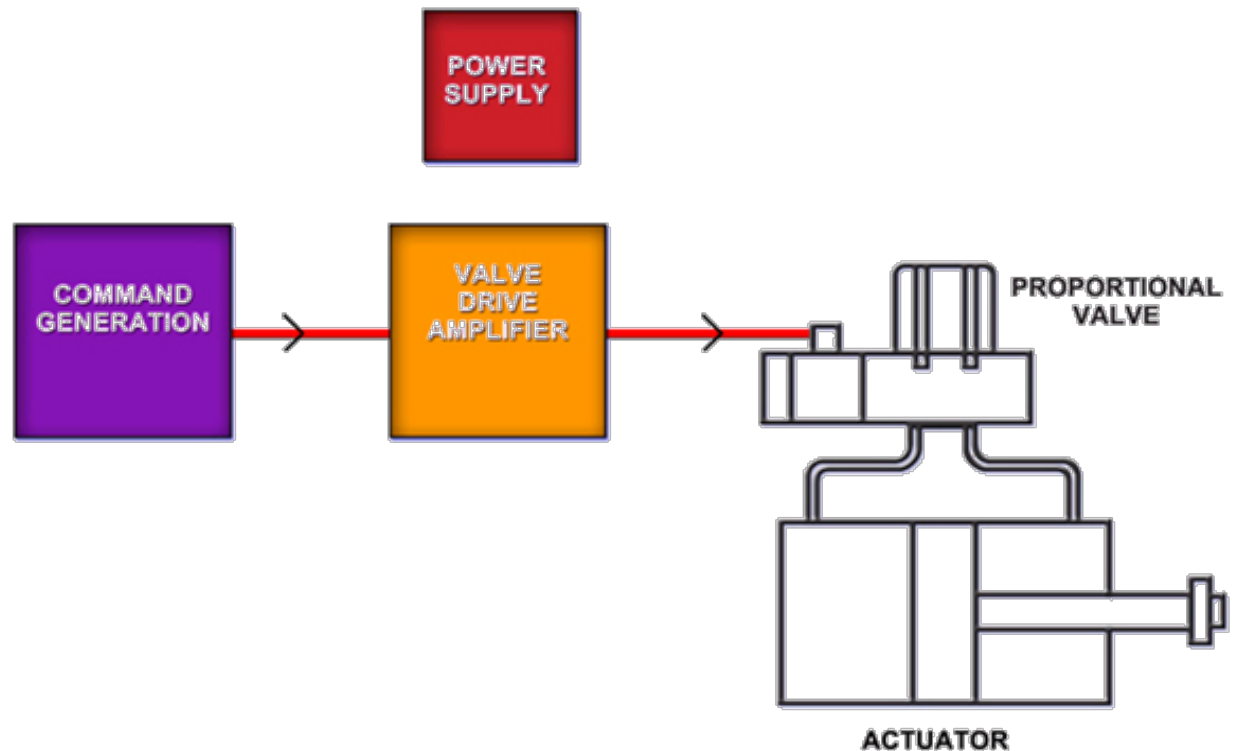
Open Loop vs. Closed Loop

Choosing between an open loop and a closed loop will depend on the requirements of the system you are controlling.

Open Loop

An open loop system controls a process without the use of any feedback.

Examples:
PTS, RTS,
Trac-A-Rac,
Splitter w/enc.,
UL Conv. w/enc.



Closed Loop

A closed loop system controls and monitors a process through the use of feedback.

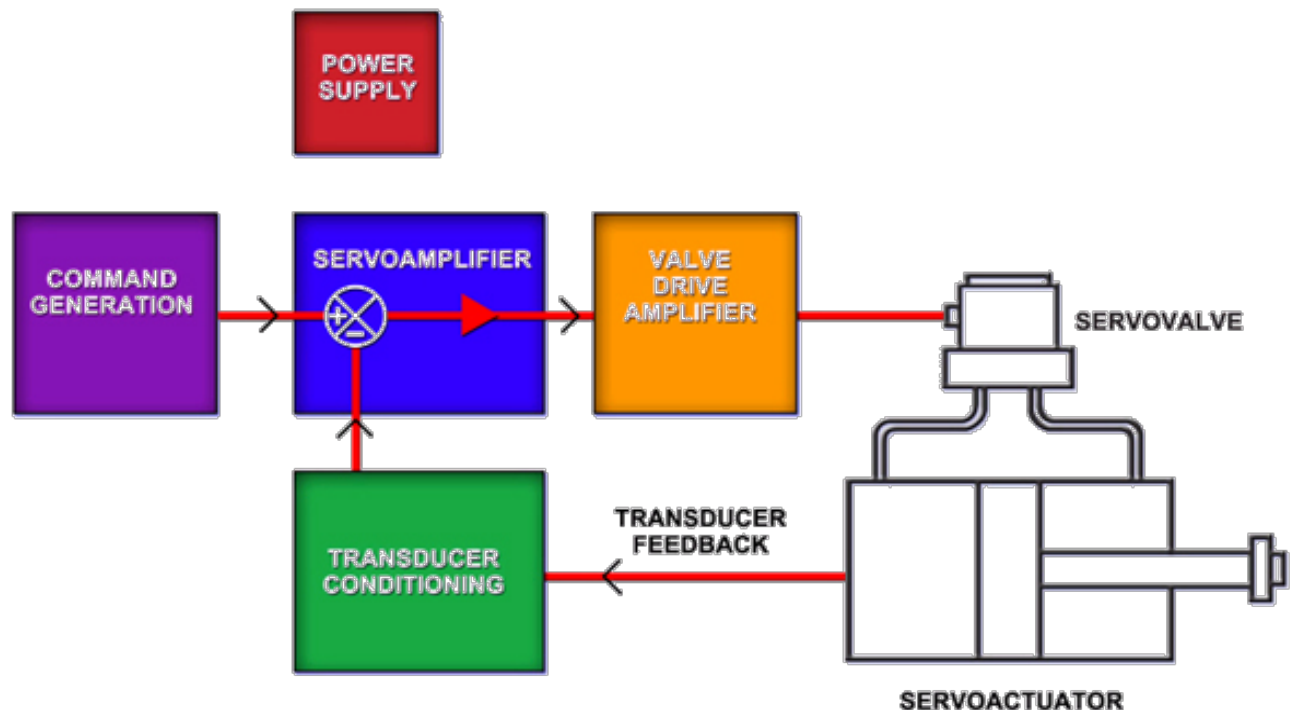
Examples:

PTS-3

LPM

Robotics

Splitter w/servo



Electrical Numbering

The list below are commonly used (328) electrical numbers.

328.2.xxx	Auto Offbearer (UL)	328.120.xxx	Control Panel
328.3.xxx	Skip Hoist	328.122.xxx	Pump Unit
328.6.xxx	Clamp Turnover	328.129.xxx	Trac-A-Rac
328.10.xxx	Cuber	328.130.xxx	Pallet Transporter (PTS)
328.24.xxx	Block Machine	328.133.xxx	Machine Electrical
328.59.xxx	Splitter	328.155.xxx	Rack Transfer Sys (RTS)
328.100.xxx	Conversion Kit	328.161.xxx	Modular Batching (MBS)
328.102.xxx	P.B. Stations	328.164.xxx	VFD
328.104.xxx	Transfer Car Sys (TR)	328.179.xxx	UL Conversion

Electrical Control Circuits

Let's Review!

What is Control?

Control is a broad term that means anything from a simple toggle switch to a complex system with components such as relays, timers, switches, starter, and PLC.

Manual and Automatic Control

Manual control circuits use components that require human interaction in order to operate.

Automatic control circuits can operate themselves without the need for human interaction.

Contacts, Switches, and Coils

The most common types of components found in a control circuit are contacts, switches, and coils.

Logic Basics

AND logic is a series relationship between contacts in a control circuit.

OR logic is a parallel relationship between contacts in a control circuit.

Types of Control Circuits

continued

Magnetic control circuits use the principles of magnetic induction to properly operate equipment.

All components of this type of circuit are hard wired together.

Types of Control Circuits

continued

Electronic control circuits function through the use of manufactured equipment modules that use solid state components.

These components are usually soldered together on a circuit board.

Types of Control Circuits

continued

A programmable logic control circuit is designed on a computer and downloaded into a device with a microprocessor.

Open Loop vs. Closed Loop

An open loop system controls a process without the use of any feedback.

A closed loop system controls and monitors a process through the use of feedback.

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