Electro - Hydraulics & Pneumatics

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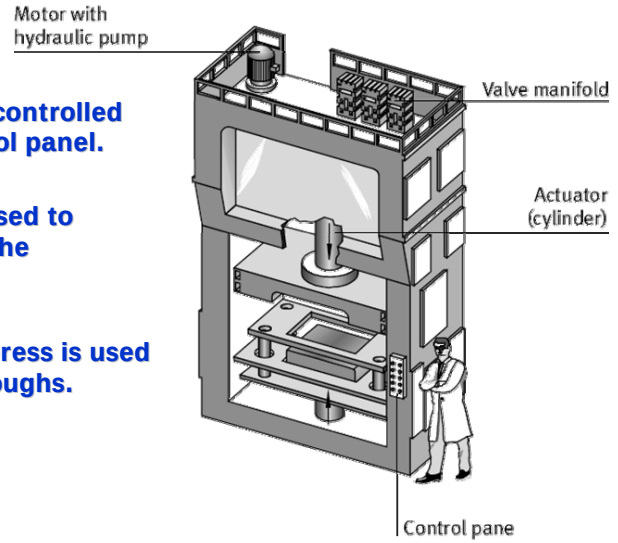
By: Alireza Safikhani

Electro Hydraulic Press

- The hydraulic press is controlled via the electrical control panel.
- Electrical signals are used to activate the valves in the hydraulic installation.
- The electro hydraulic press is used to form rectangular troughs.



Electro Hydraulics

Comparison

Pneumatics/ Hydraulics		Electrics/ Electronics
– Cylinders – Motors – Components	Working elements	– Electric motors – Solenoids – Linear motors
– Directional control valves	Control elements	– Power contactors – Power transistors – Power thyristors
– Directional control valves – Isolating valves – Pressure valves	Processing elements (Control elements)	– Contactors – Relays – Electronic modules
– Switches – Push button actuators – Limit switches – Program module – Sensors	Input elements	– Switches – Push button actuators – Limit switches – Program module – Sensors – Indicators/generators

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Electro Hydraulics

- Hydraulic systems are used wherever high power concentration, good heat dissipation or extremely high forces are required.
- Electro-hydraulic systems are made up of hydraulic and electrical components:
  - The movements and forces are generated by hydraulic means (e.g. by cylinders).
  - Signal input and signal processing, on the other hand, are effected by electrical and electronic components (e.g. electromechanical switching elements or stored-program controls).

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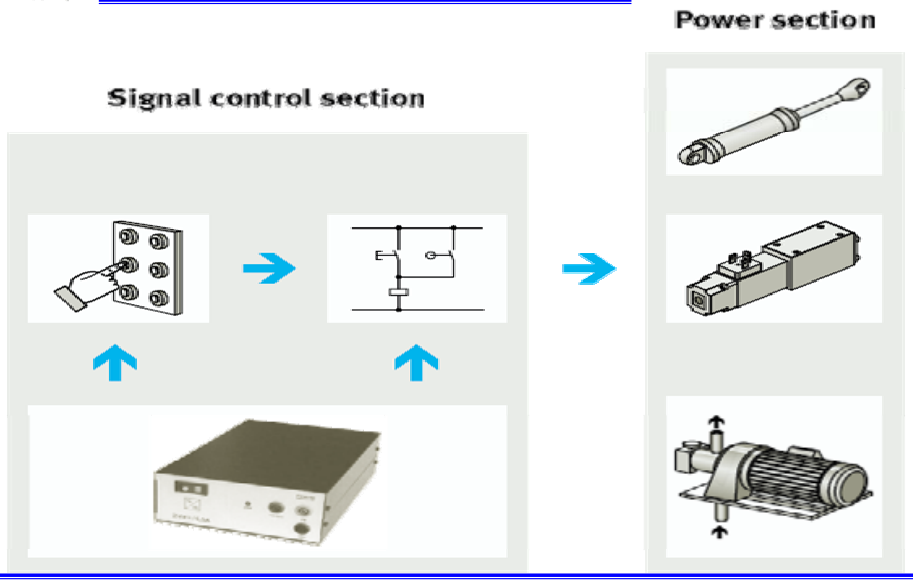
Sections of an Electro Hydraulic System



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Sections of an Electro Hydraulic System

- Signal control section
  - Input and processing of electrical signals.
  - Solenoid valves form the interface between the electrical signal control section and the hydraulic power section.
- Hydraulic power section
  - Controls the flow of hydraulic fluid by means of solenoid valves. Actuators convert hydraulic energy into motions.

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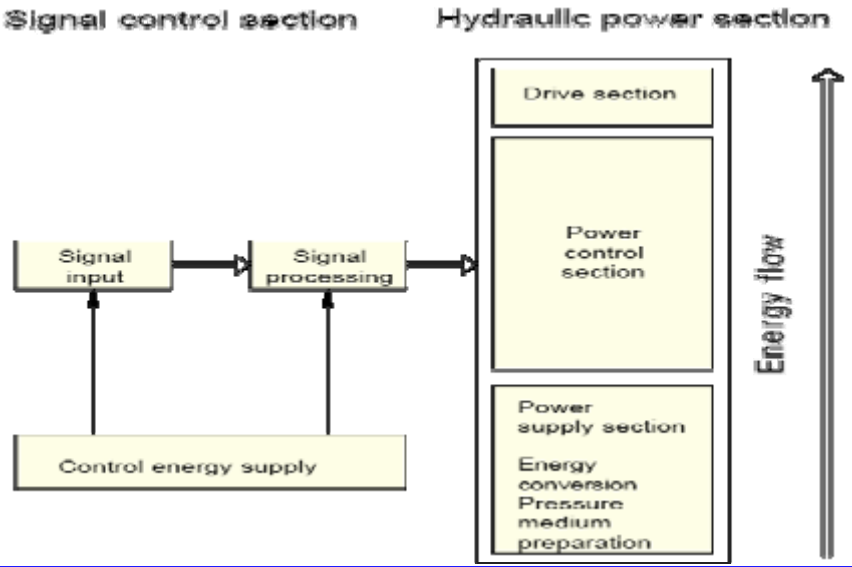
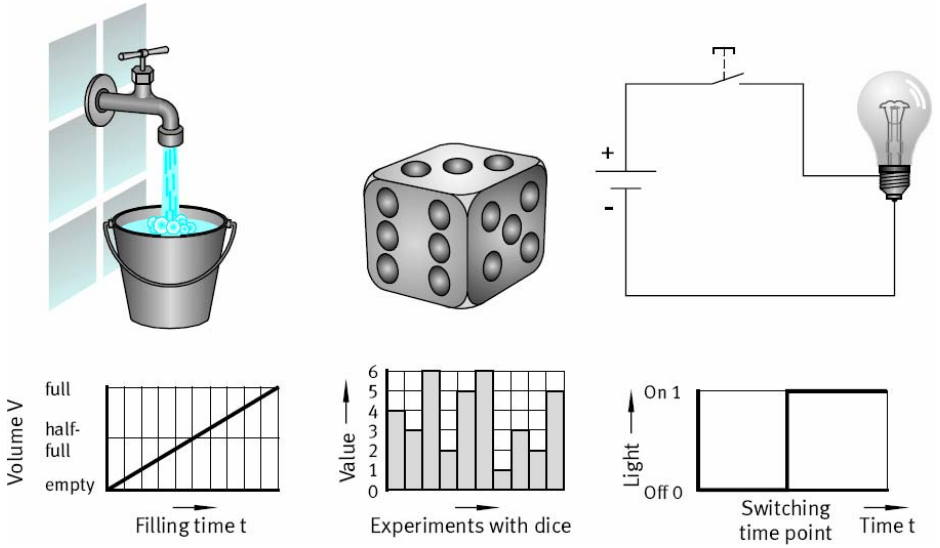
Electro Hydraulics



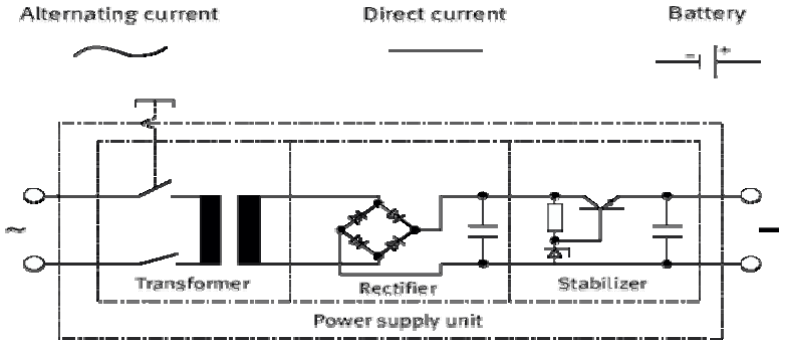
Electrical power supply unit

- *Connection to mains supply.*
- *Supplies signal control section with specified or maximum voltage and current values includes.*
  - *Voltage transformation*
  - *Rectification*
  - *Stabilization*
  - *Fuse protection*
- *In mobile hydraulic systems, rechargeable battery systems or generators are used as a power supply for the signal control section.*

Analogue, digital and binary



Electrical power supply unit



Components Of EH Circuits

- **Standards**
  - **ANSI**
  - **DIN (40 900)**
  - **ISO**

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Switching Contacts and Types of Actuation

- The following switch contact designs are used as input and processing elements:
  - Normally-open contact
  - Normally-closed contact
  - Changeover contact
- Types of actuation for switching elements are:
  - Manual
  - Mechanical
  - Relay
  - Magnet field
- Identifying letters in electrical circuit diagrams: S (S1, S2, ...)

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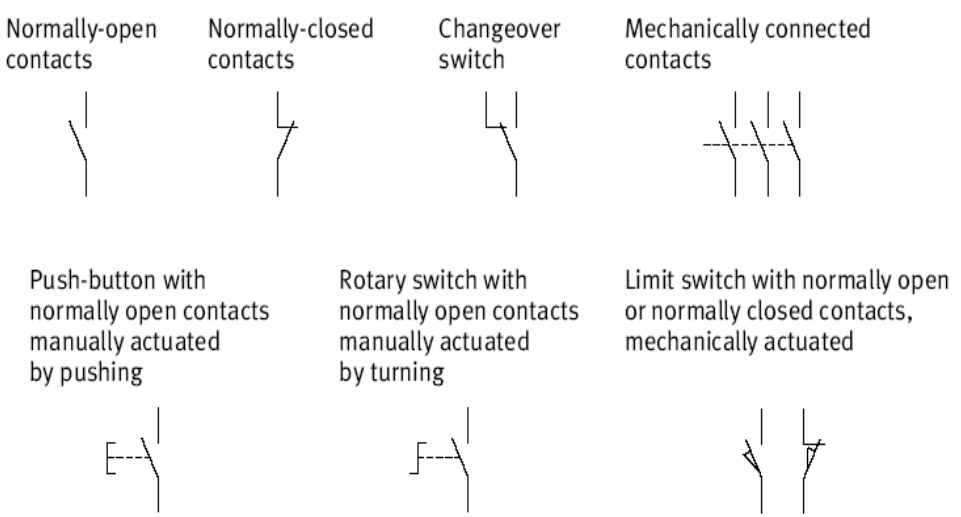
Switching Elements



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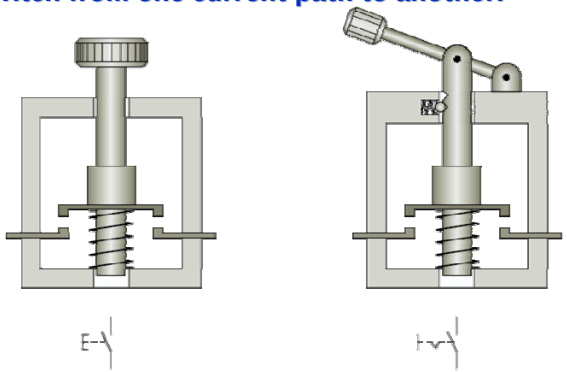
Momentary and sustained contact switches

- A momentary contact switch has a “rest position” and an “actuated position”.
- A sustained contact switch has two detents. It thus has two rest positions.
- Momentary and sustained switches can close or open current paths or switch from one current path to another.



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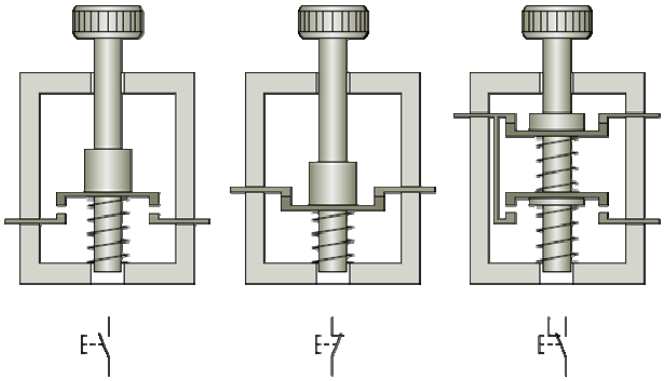
N/O, N/C and changeover contacts

- N/O: Contact normally open in rest position.
- N/C: Example, Momentary-contact switch
- Changeover contact: N/O and N/C contacts in a single housing; one contact is open while the other is closed.



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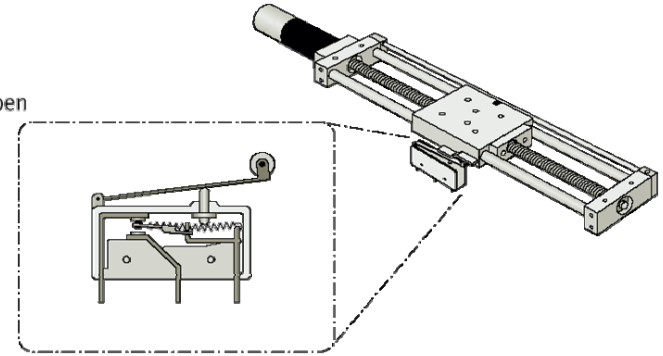
Limit Switches

- Determining the position of a positioning slide.
- Electrical contacts are actuated when a defined intermediate or end position is reached.
- Limit switches can be connected up as N/O, N/C or changeover contacts.

Limit switch with normally open or normally closed contacts, mechanically actuated



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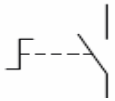
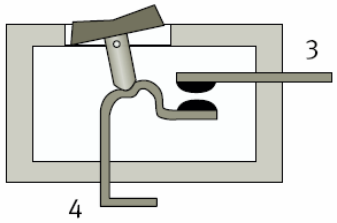
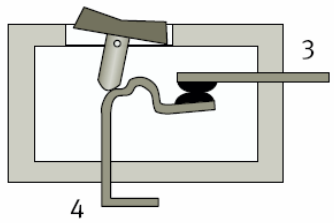
Rotary & Latch Switches

Rotary switch with normally open contacts manually actuated by turning







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Proximity switches

- Inductive
  - Signal is generated by the presence of any material with good conductivity in an oscillating magnetic field.
- Capacitive
  - Signal is also generated by all insulators with high dielectric constants in an electrical field.
- Optical
  - Signal is generated when light barriers are interrupted or when light is reflected back to an optical sensor.
- Reed switches
  - Signal is generated by magnets whose fields close the built-in contacts in the switch.

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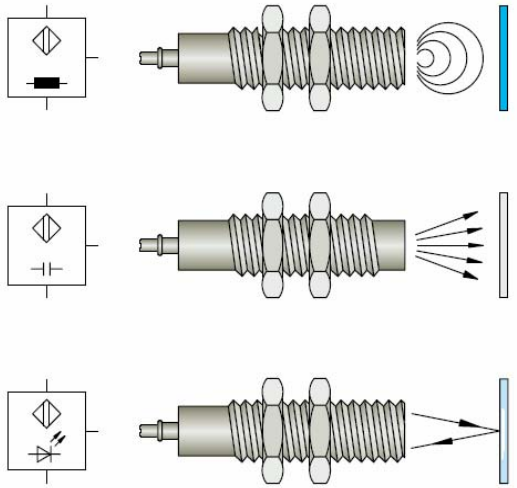
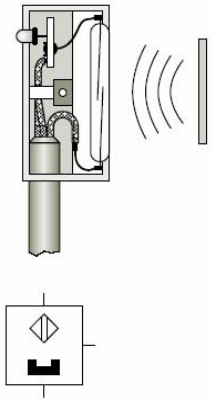
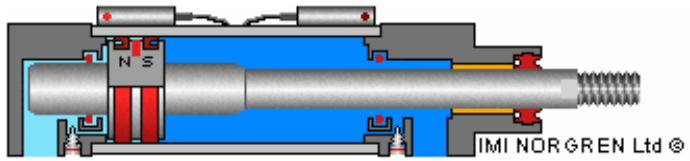
Proximity switches





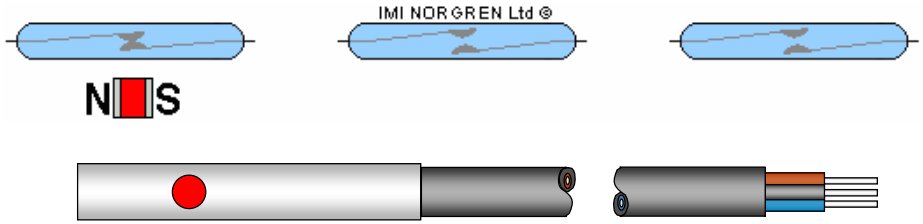
Magnetic cylinders

- Magnetic cylinders have a band of magnetic material inset around the circumference of the piston
- The polarity is in parallel with the axis of the cylinder
- The barrel is made of non ferrous material
- By placing reed switches along the outside of the cylinder, signals can be given at the extreme and intermediate positions of stroke

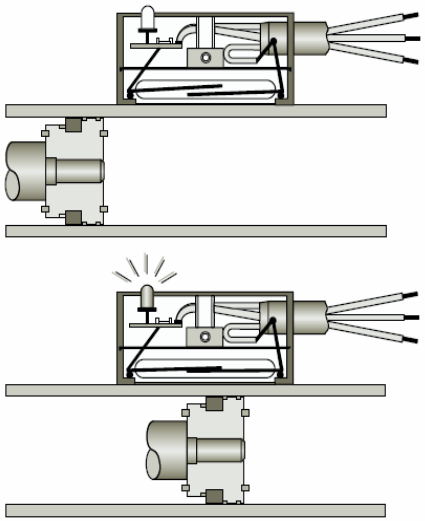


Reed switches

- A basic reed switch consists of a small glass tube containing soft iron contact reeds normally sprung open
- When a magnetic field is in range the reeds will become magnetic
- The ends will be of opposite polarity and pull themselves together



Reed switches

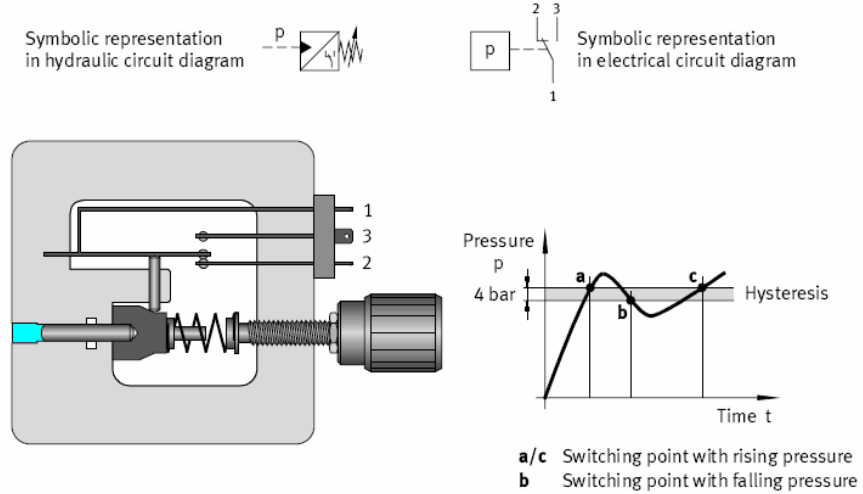


- actuated through a magnetic field.
- It has three connections:
  - ✓ One connection for the positive power supply
  - ✓ One connection for the negative power supply
  - ✓ One signal or switch output
- The reed switch is attached directly to the body of a cylinder. It is actuated by a magnetic ring on the cylinder piston.
- Identifying letters in electrical circuit diagrams: B (B1, B2, ...)

Pressure switches

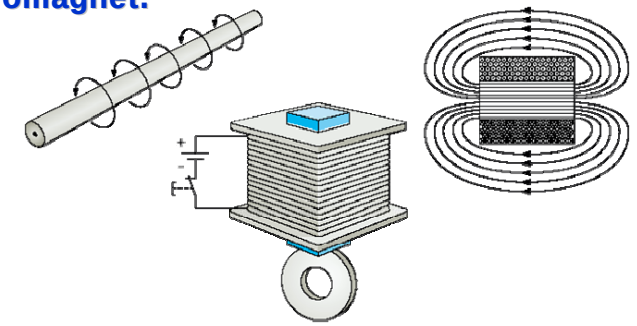
- Actuation of electrical contacts when a defined minimum pressure is reached.
- The minimum pressure (switching point) can be varied by means of an adjustable spring.
- Example shows switching at approx. 4 bar with rising or falling pressure.
- Generally connected up in practice as a changeover contact.

Pressure switches



Solenoid (electromagnet)

- A coil carrying an electrical current develops a uniform magnetic field in its axial direction due to the overlapping of field lines.
- By appropriate alignment of elementary magnets, an iron core can be made into a switchable electromagnet.

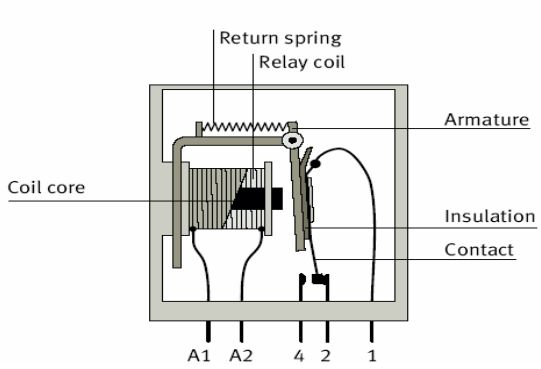


Relay

- the construction of a relay can be very different, but the function is nevertheless the same in principle:
  - When a voltage is applied to the relay coil through contacts A1 and A2, an electric current flows through the windings. A magnetic field is built up and pulls the armature against the core of the coil.
  - Switch contact 1 is connected with switch contact 4.
  - After removing the voltage, the armature is brought back into its initial position by a spring.
  - Switching contact 1 is connected with switching contact 2.
- A relay can have multiple switching contacts which can be actuated simultaneously.
- There are the following types, for example:
  - Polarized relay
  - Current impulse relay
  - Time relay
  - Thermal relay

Relay

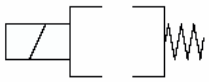
- Identifying letters in electrical circuit diagrams: Y (Y1, Y2, ...)
- Identifying letters for RELAYS in electrical circuit diagrams: K (K1, K2, ...)



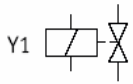
Representation in Circuits

Electro-magnetically actuated on both sides

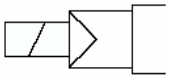
Electro-magnetically actuated on one side, with spring return



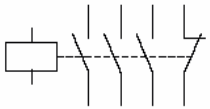
Representation in electrical circuit diagrams

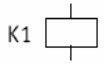


Electro-magnetically actuated, with pilot control



Contactor or relay with 3 normally open contacts and 1 normally closed contact





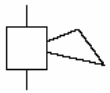
Electrical Output Devices

- **Supply acoustic signals:**
  - **For example, horns, sirens**
  - **Identifying letters in electrical circuit diagrams: H (H1, H2, ...)**
- **Supply optical signals:**
  - **For example, lamps, LEDs**
  - **Identifying letters in electrical circuit diagrams: H (H1, H2, ...)**
- **Do work:**
  - **For example, electric motors**
  - **Identifying letters in electrical circuit diagrams: M (M1, M2, ...)**

Electrical Output Devices

Signalling device

Audible indicator: Horn

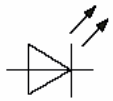


Siren

Bell

Illuminating indicators: Lamp

Light emitting diode (LED)



Motors

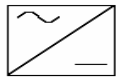
DC motor

Electrical Circuit Symbols, General

direct voltage, direct current

alternating voltage, alternating current

rectifier (mains connection device)



permanent magnet

resistor, general

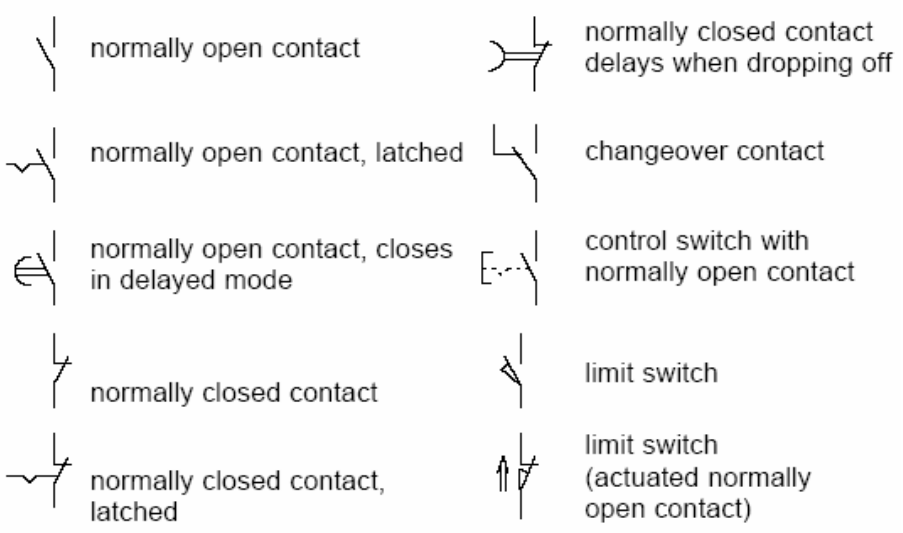
coil (inductance)

indicator light

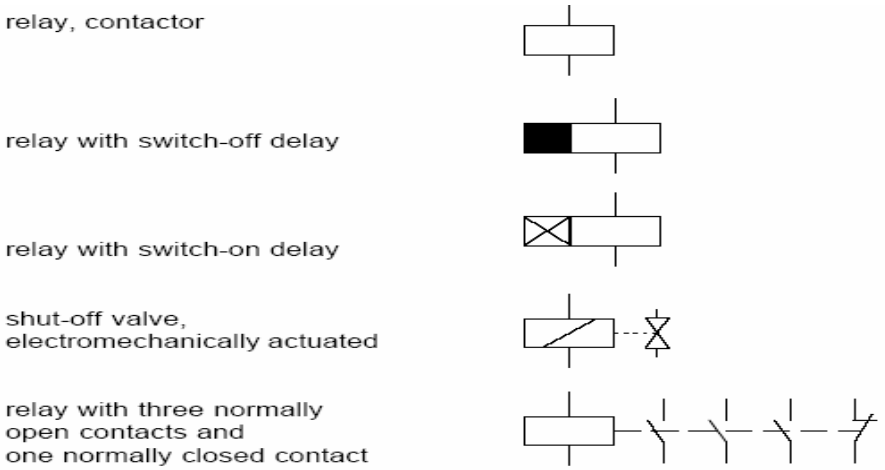
capacitor

earthing, general

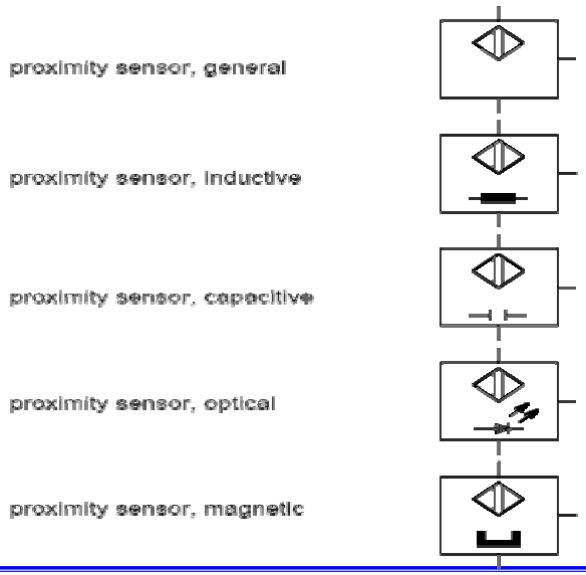
Switching elements



Electromechanical switching elements

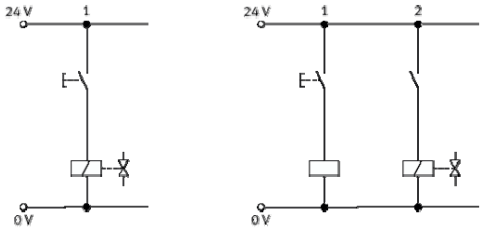


Block symbols for proximity sensors



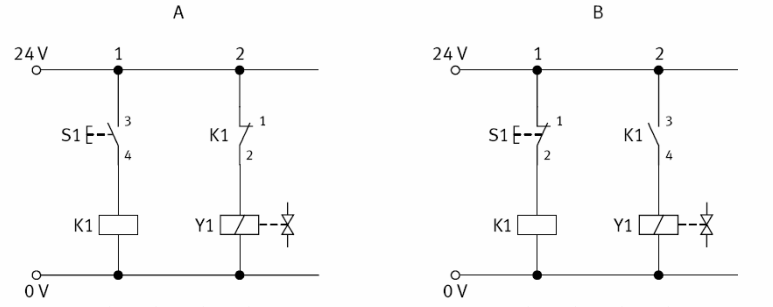
Direct activation – indirect activation

- **Direct activation**
  - **Connection of a solenoid valve via a switch**
- **Indirect activation**
  - **Connection of a solenoid valve via a relay**
- **Advantage of indirect activation**
  - **Separation of control and power circuits**
  - **The current passing through switch S1 (Fig. B) is lower, and the service life of the switch is significantly greater.**



Signal inversion

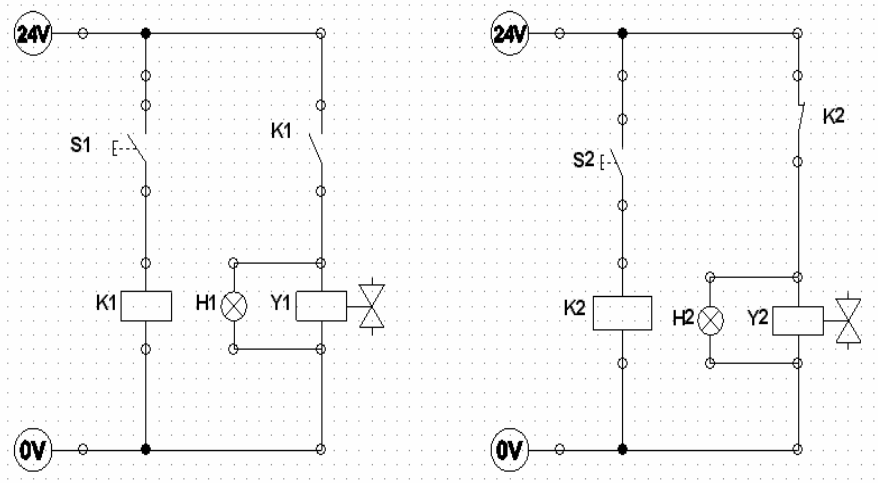
- The output signal is inversely proportional to the input signal.



S1	K1	Y1
0	0	1
1	1	0

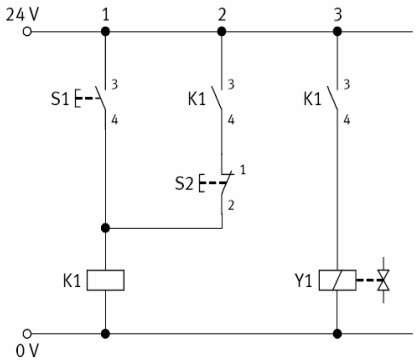
S1	K1	Y1
0	1	1
1	0	0

Animation



Latching

- **Latching only with indirect activation.**
- **Actuation of switch S1: Relay K1 reverses holding the current path of K1 closed.**
- **The actuation of switch S2 interrupts the latched current path.**



S1	S2	K1 & Y1
0	0	0
0	1	0
1	0	1
1	1	1

dominant on

Circuit diagram

- **In the Pneumatic/ Hydraulic circuit diagram, the signal flow is represented from bottom to top.**
- **In the electrical circuit diagram, the signal flow is represented from top to bottom.**
- **Lines of potential with constant voltage are drawn horizontally.**
- **Current paths are drawn vertically and numbered consecutively.**
- **Circuit symbols are shown in the direction of current flow.**
- **Switching elements are generally shown under zero-voltage conditions.**

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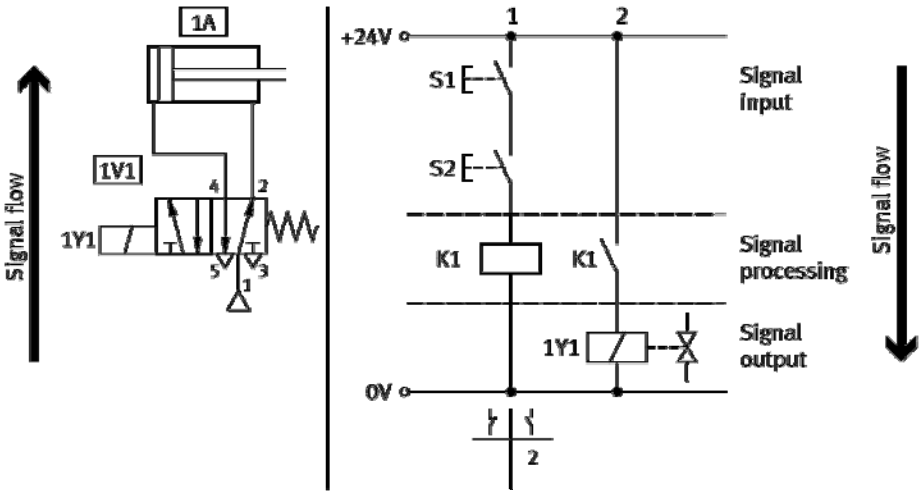
Example



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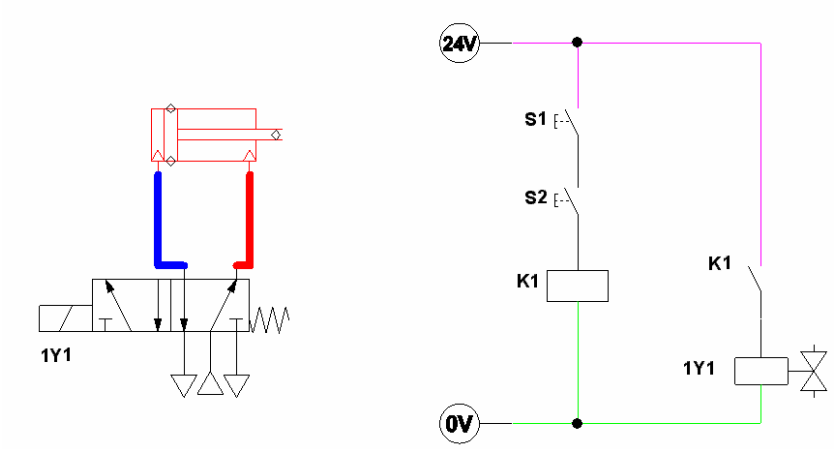
Example Animation



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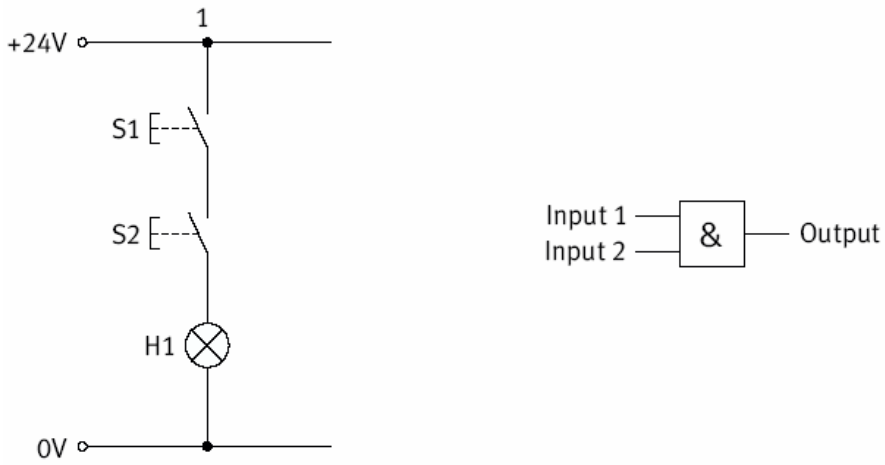
The AND Logic Function



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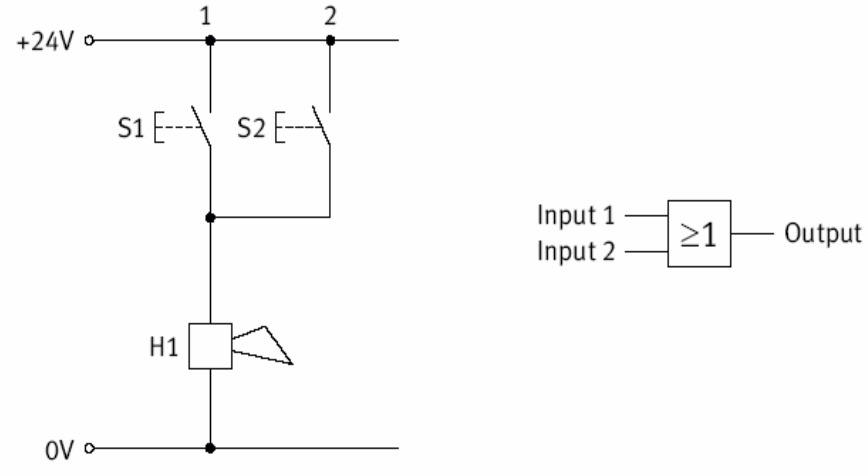
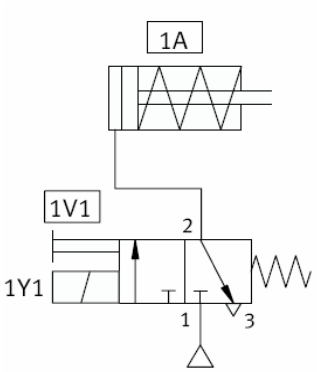
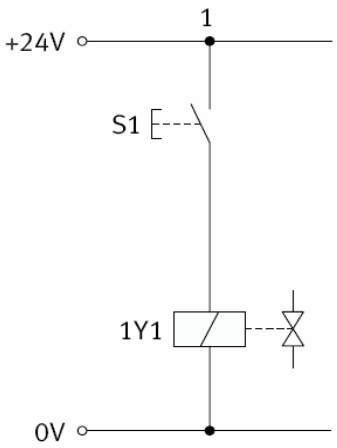
The OR Logic Function

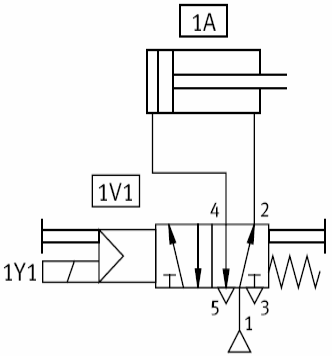


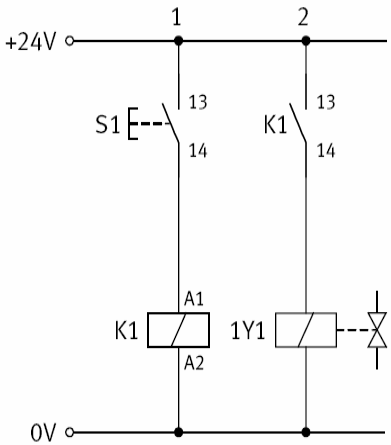
Direct Actuation of a Single-Acting Cylinder



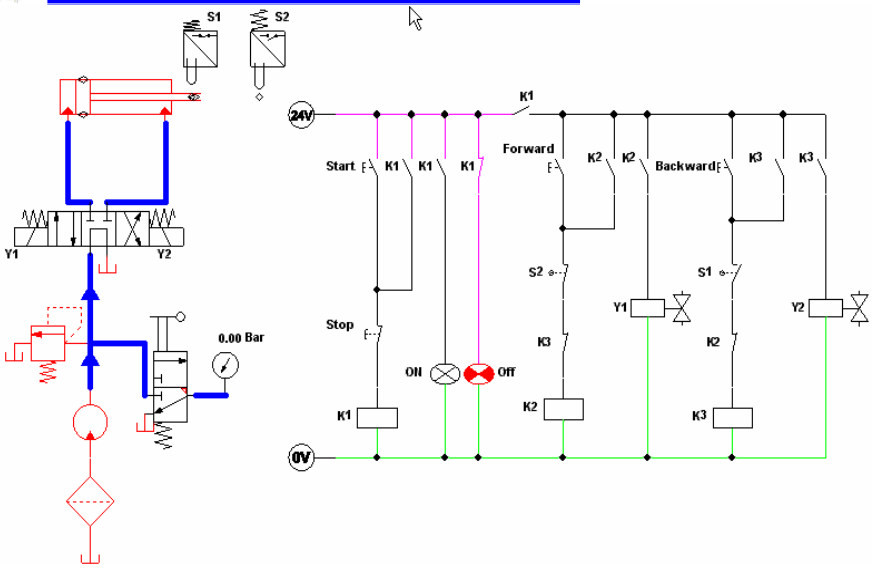


Indirect Actuation of a Double-Acting Cylinder





Cylinder Actuation



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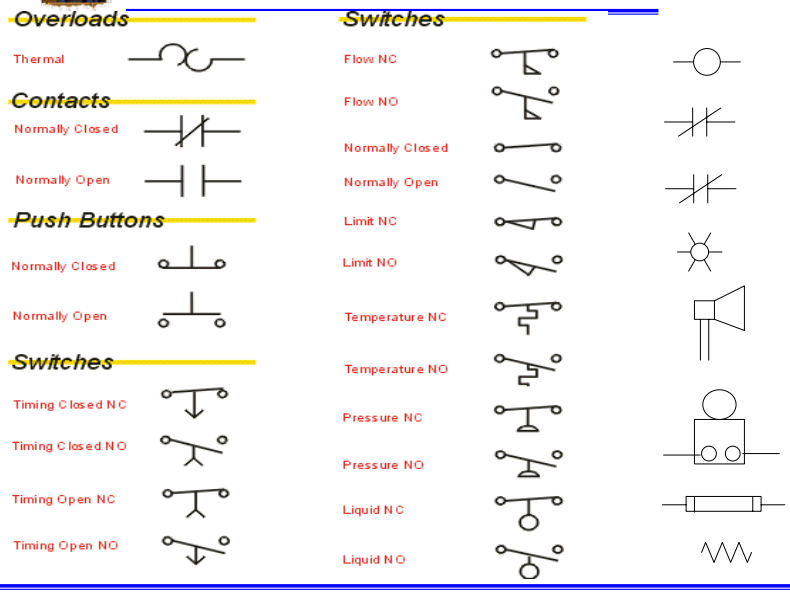

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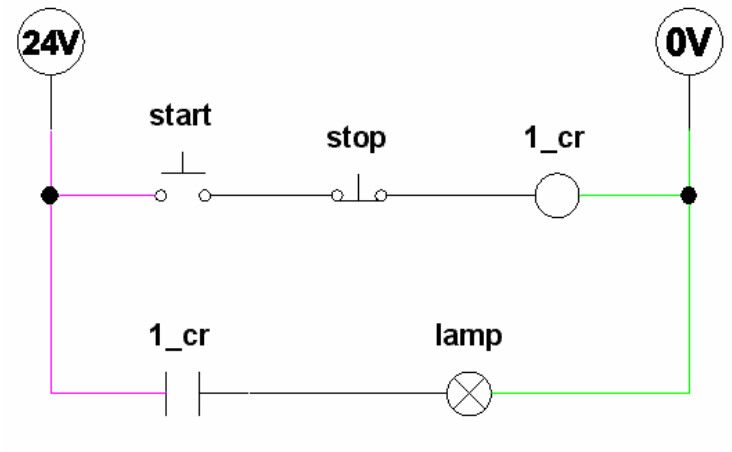

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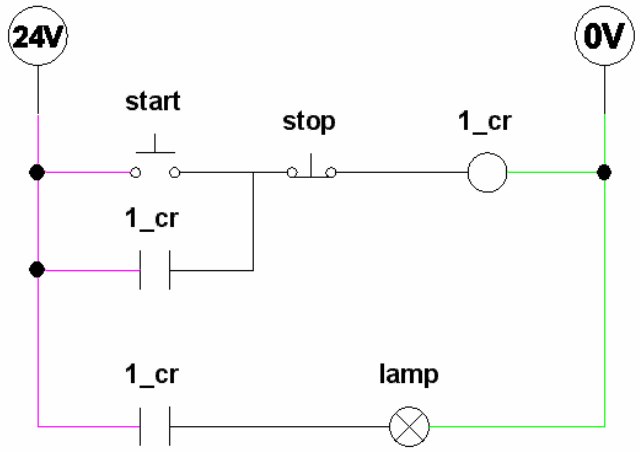

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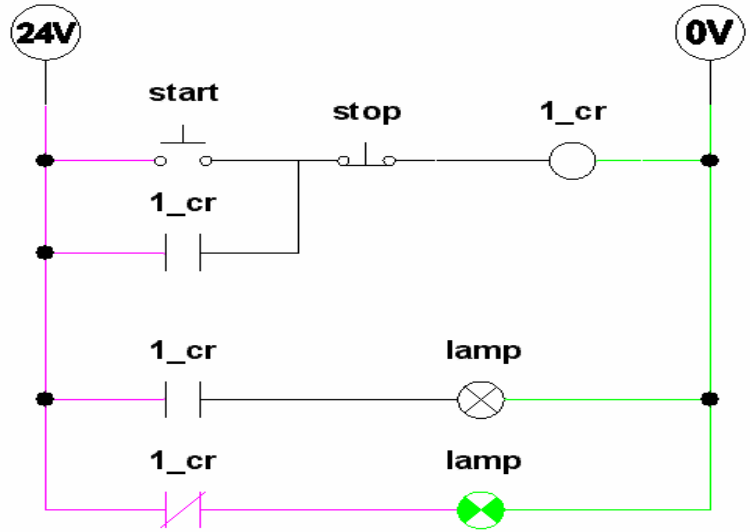

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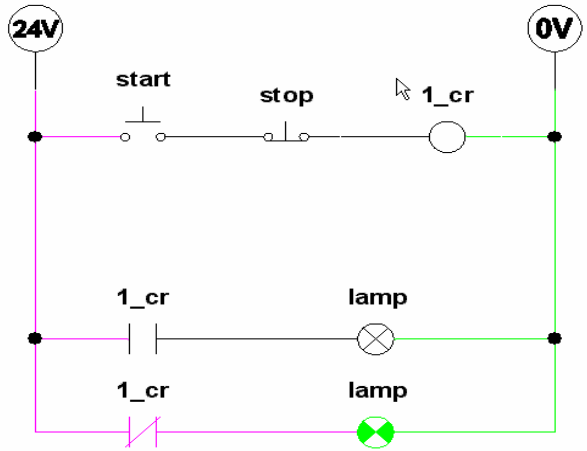
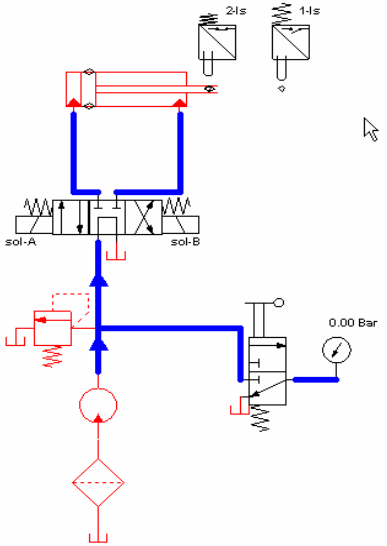
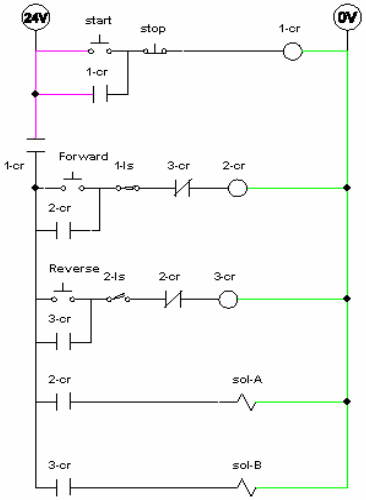
ANSI 4



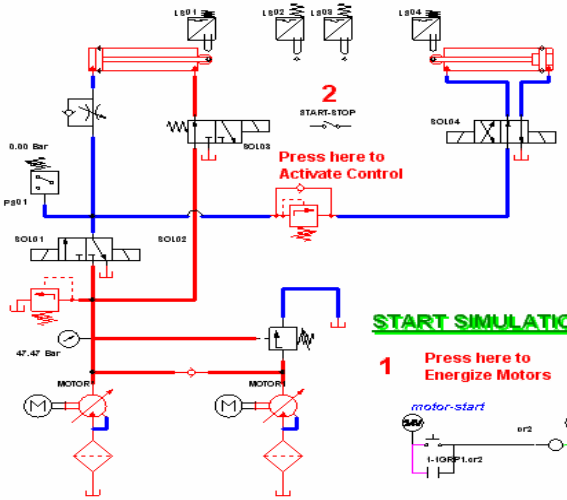
ANSI of Slide 46





ANSI 6

ELECTRO-HYDRAULIC CIRCUIT



START SIMULATION

1 Press here to Energize Motors