



# Robotics II

Imran Khan

## Interfacing and Vision Systems

School of Applied Technology  
Robotics and Automation

# Interfacing

Common point at which two or more systems communicate with each other.

# Interfacing Examples

- Sensors
- Limit switches
- External Relays
- Operator alarms
- Safety Equipment
- Bar code readers
- Conveyors
- Transfer line
- PLC
- Machine Vision System

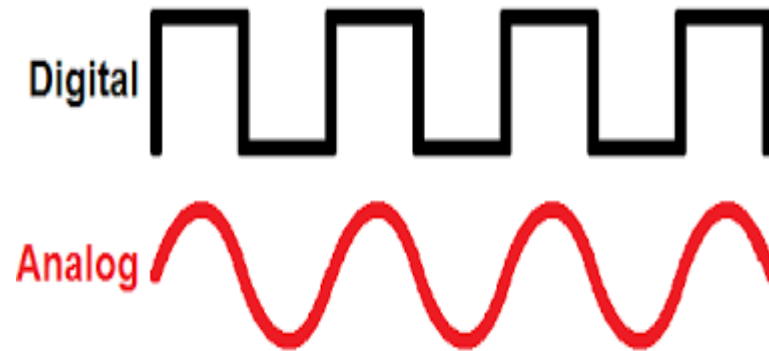
# Analog and Digital Signals

- Continuous Signal

Continue change with respect to time

- Discrete Signals

Constant in the given span of time



# Analog Signals & Devices

## Example of Analog

### Signals

- Pressure Signals
- Temperature Signals
- Force Signals
- Displacement

## Example of Analog Devices

Pressure Sensors

Displacement Sensors

Temperature Sensors

# Digital Inputs & Signals

- Common digital inputs

Generally, each robot has 16 digital inputs.

- Limit switch ( At Robotic Joints)
- Light curtains
- Motion detectors
- Door switches
- Safety fences

Robots receive a signal indicating the state of an external switch (on or off) through a digital input port.

# Example of Digital Input Devices

## Examples

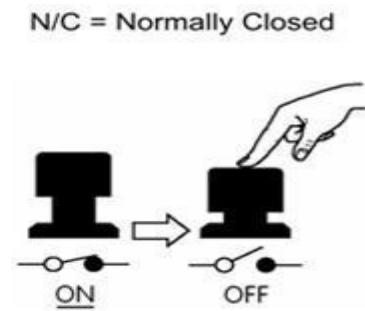
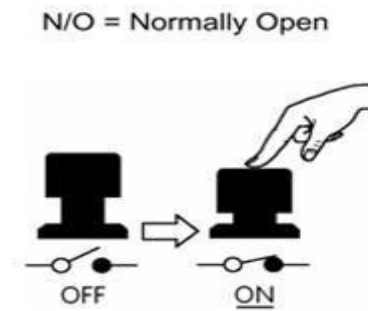
Push Button

Limit Switches

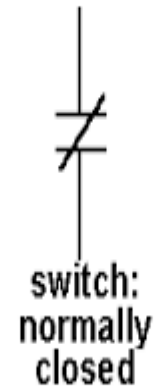
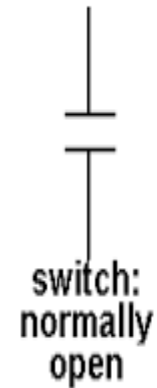
Digital Sensors : Light sensors; proximity sensors  
(capacitive and Inductive)

# Type of Input Devices: Normally Open and Normally Closed

## Mechanical Switch



## Switch in PLC





# Digital Inputs

Common digital inputs

Generally, each robot has 16 digital inputs.

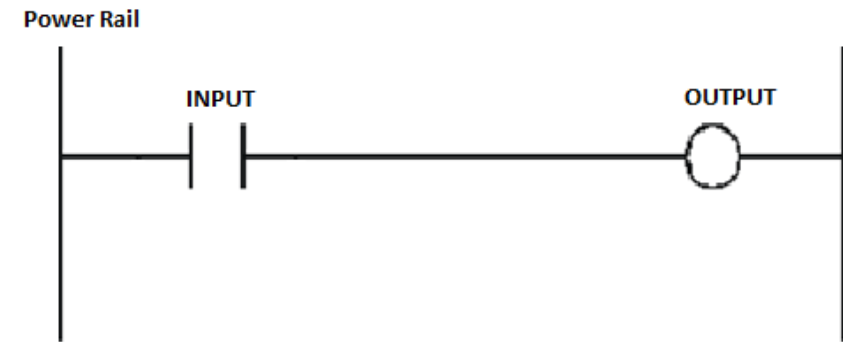
- Limit switch ( At Robotic Joints)
- Light curtains
- Motion detectors
- Door switches
- Safety fences

Robots receive a signal indicating the state of an external switch (on or off) through a digital input port.

# Type of circuits

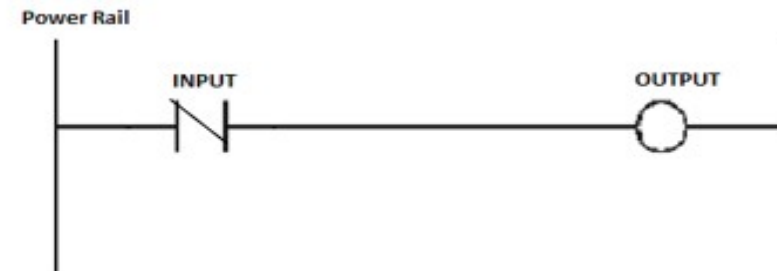
## Normally open circuit:

When input is energized then circuit is completed.

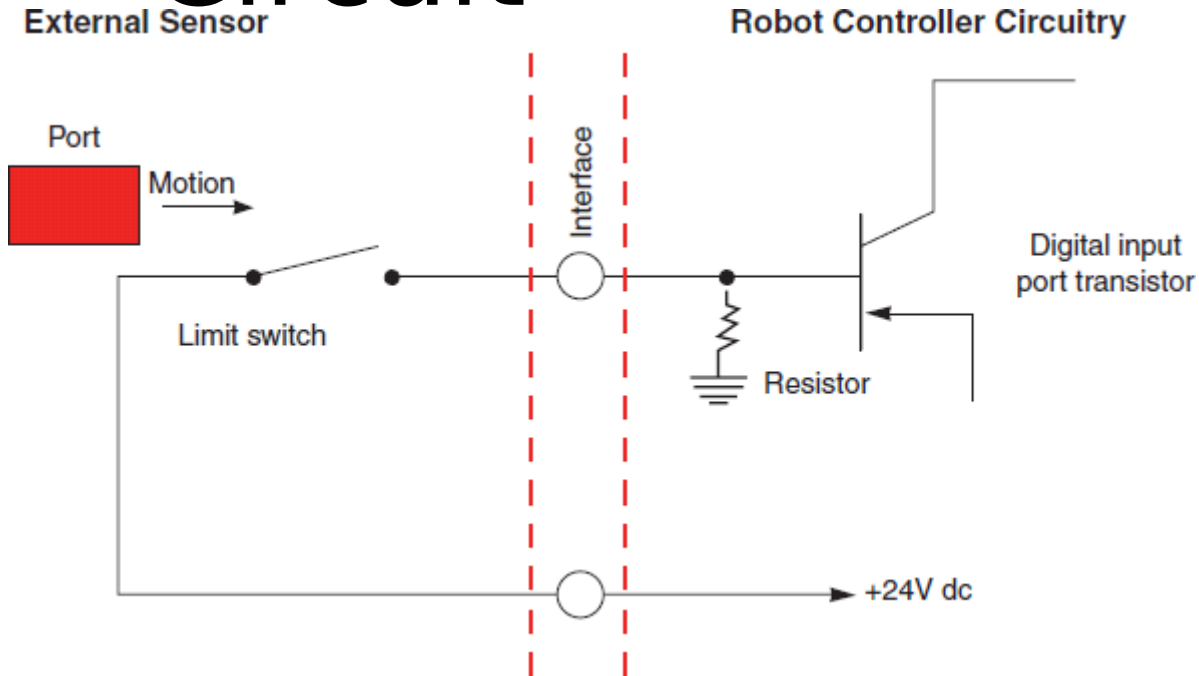


## Normally Closed Circuit:

When input is energized then the circuit is broken.



# Digital Input Circuit



Limit switch is connected to a typical input port. When no object is present, the limit switch is open. When an object is present the limit switch closes and conducts 24V direct current to the transistor. The controller circuitry detects transistor state and passes the information to the robot's computer program

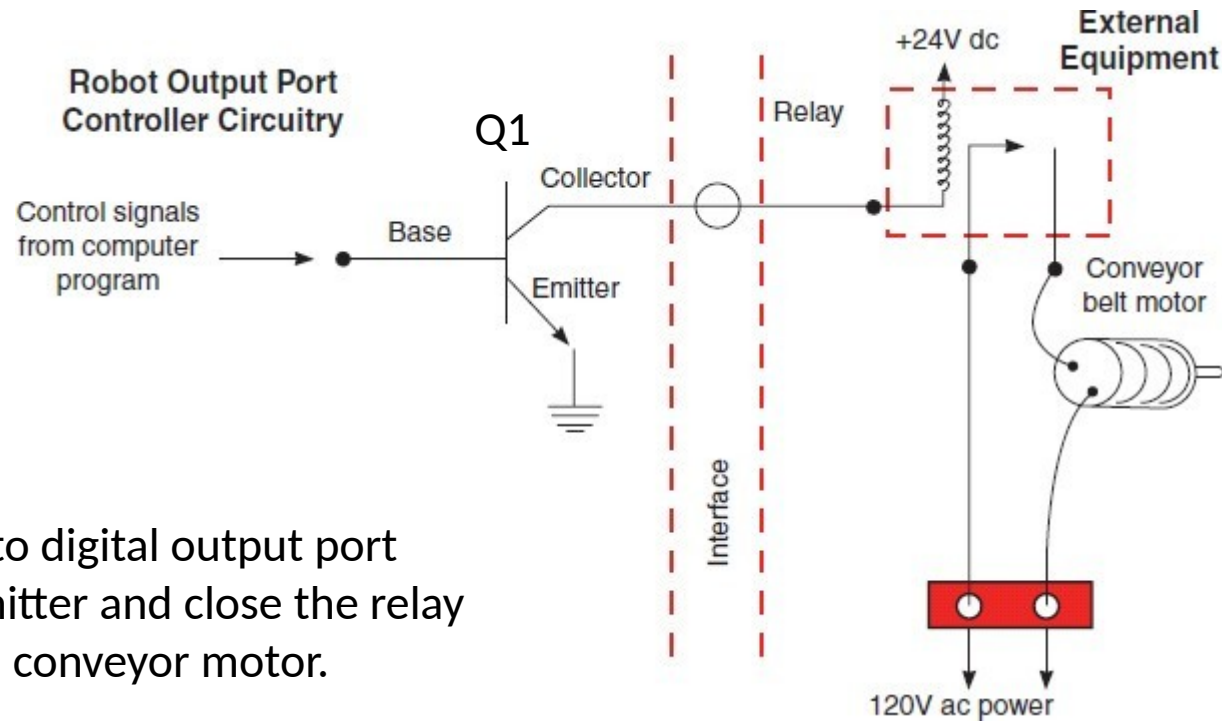
# Output Devices

- Light bulb/indicators
- Motors
- Actuators (Pneumatics)

# Digital Output Ports

- Examples of digital output signals
- Conveyor Belt
- Motor
- Solenoid

# Digital Output



When enough voltage is applied to digital output port transistor Q1. It grounded the emitter and close the relay contact to supply 120 V AC to the conveyor motor.

# Low Level Signals

- Low level signal is 0 Volt

Whenever a control signal from the computer program directing the robot is at low voltage level the base (control element) of transistor Q1 does not conduct. When the base is at low voltage level, the output current is zero and the circuit is high resistance. The motor control relay (CR) is not energized and the motor is off

# High Level Signal

High level signal is 12 V or 24 V

When the computer sends a high-level signal to the base control element of transistor Q1, the resistance between emitter and collector became very low . In this condition control relay energized and the conveyor motor is turn on

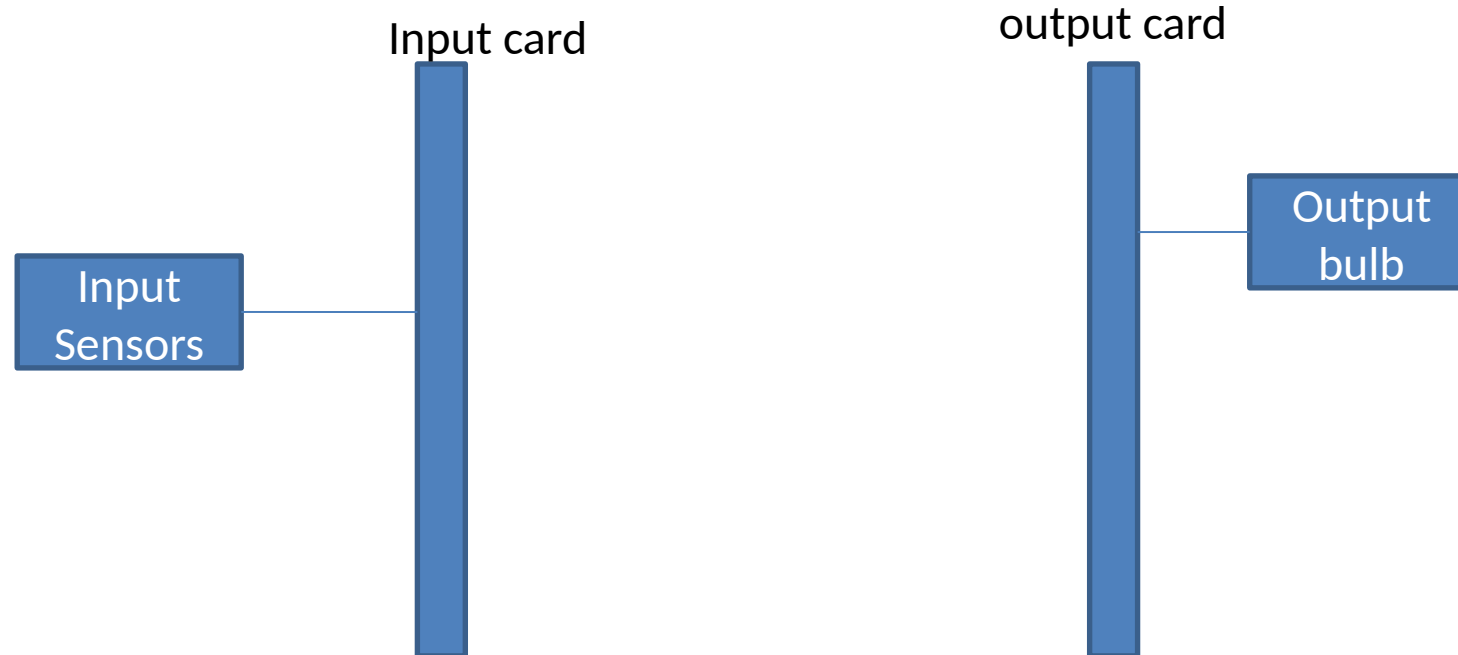


# Input and Output Device connections

- Input Devices connect with Robot or PLC Input Card
- Output devices connect with Robot or PLC Output Card
- Safety Devices connect with Robot or PLC safety card/module

# Input and Output Device connections

- Input Devices connect with Robot or PLC Input Card
- Output devices connect with Robot or PLC Output Card



# Connection of Safety devices









The default setup of the dedicated safety I/O is for these inputs to be jumpered or bypassed, as shown in the figure below:



Emergency button

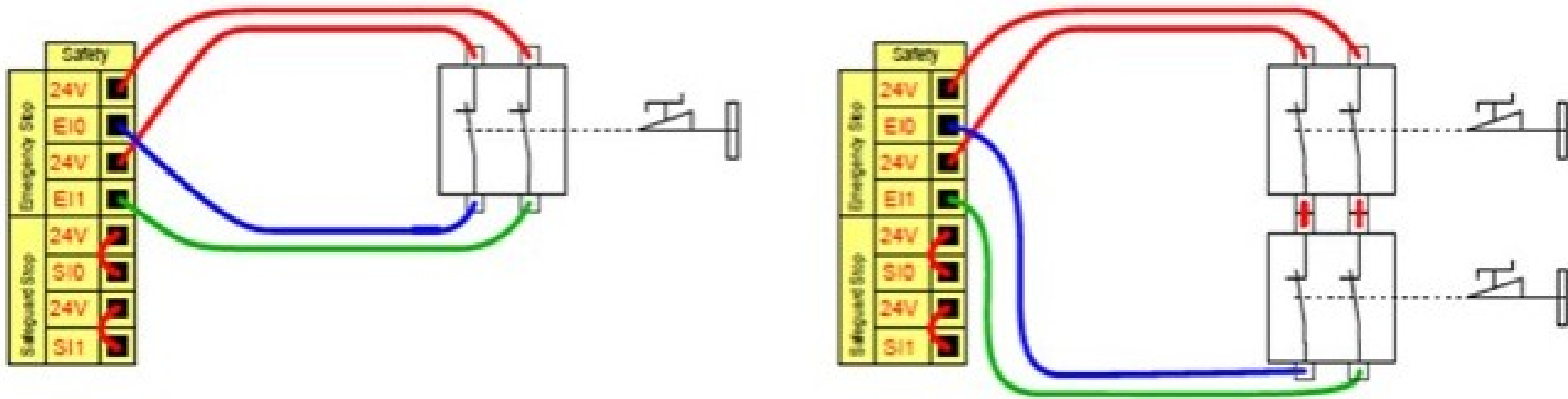


Programmed or Controlled stop button - safeguard

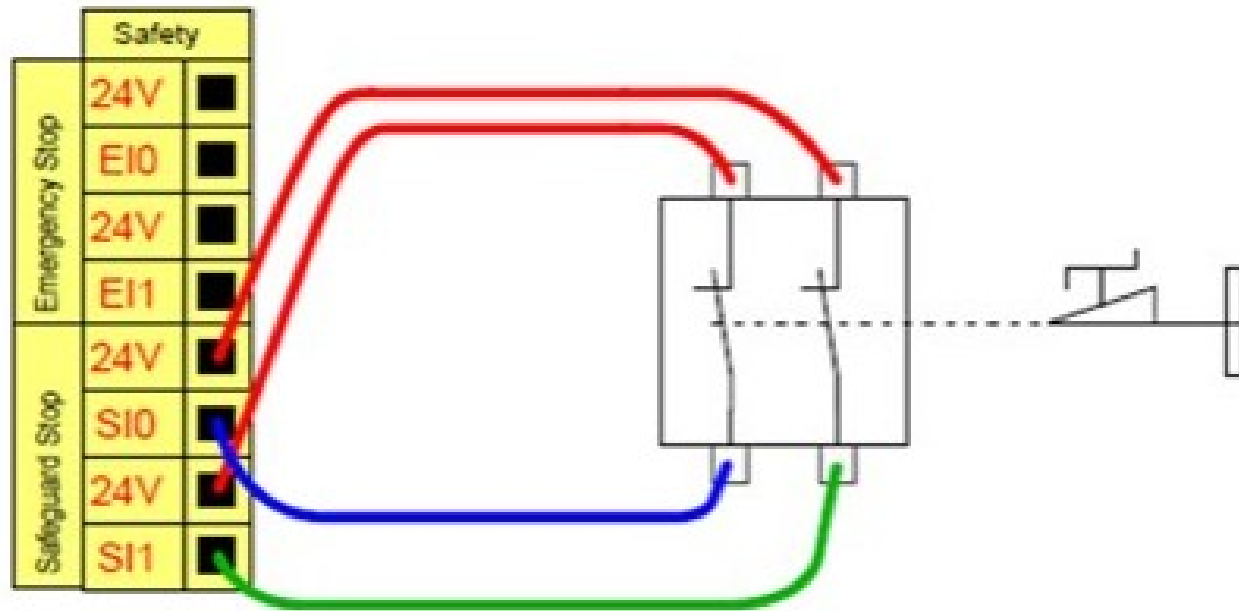
Safety	
Emergency Stop	24V 
	EI0 
	24V 
	EI1 
Safeguard Stop	24V 
	SI0 
	24V 
	SI1 

# Connection of an External Emergency stop

Safety devices always connect with two channels normally closed circuits where the normal input and output devices are connected with normally open circuit.



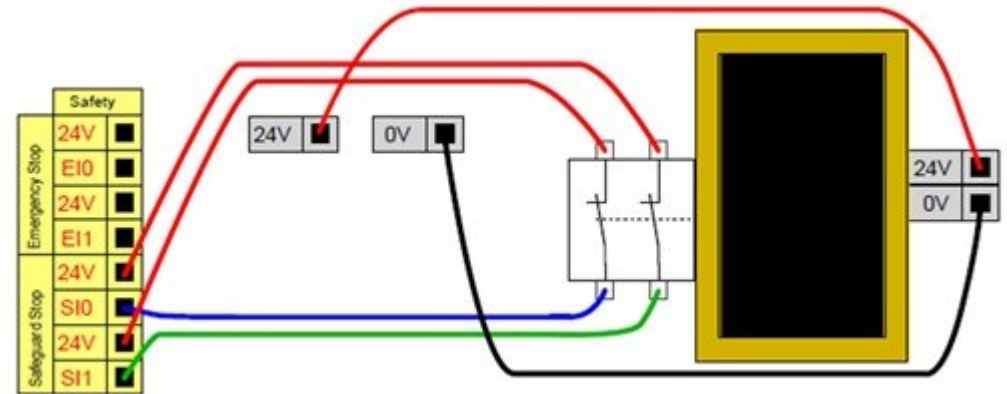
# Safeguard stop with automatic reset Switch



# Safeguard stop with manual reset

If an application requires safeguarding and whole-body access is possible without continuous detection, then a manual reset or other means to prevent restart is required.

To have a safeguard stop with a manual reset, the configurable I/O is used. A reset control device is installed outside the hazard zone or safeguarded space, according the risk assessment. This reset enables restarting robot motion.

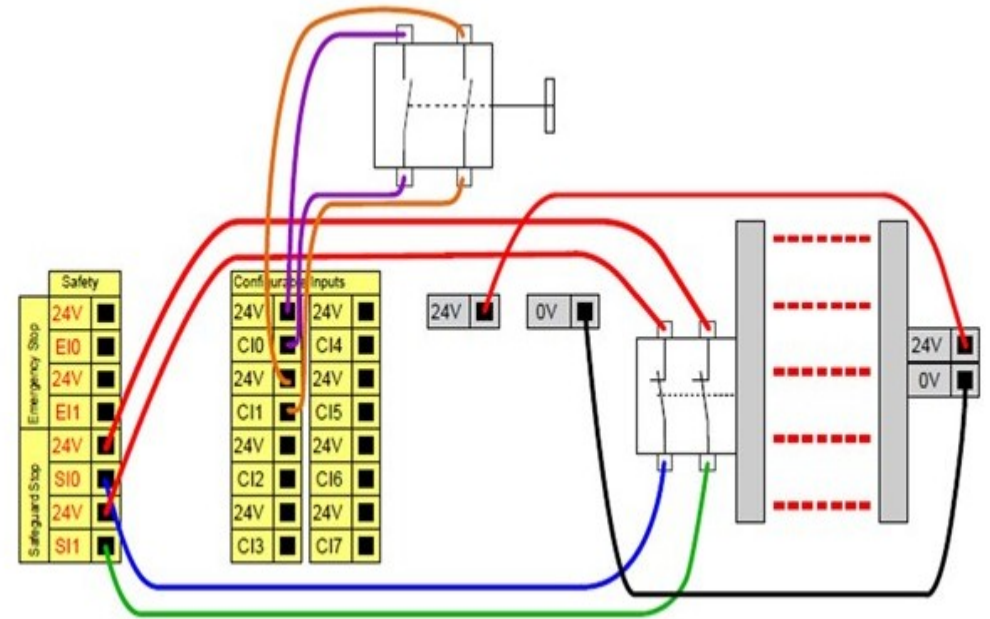


# Safeguard stop with manual reset – Light Curtain

Examples where a manual reset would be required:

1. Use of an interlocked guard where whole-body access is possible.
2. Use of a light curtain to initiate a stop. After passing through the light curtain's detection zone, the operator would not be detected – just like whole body access with an interlocked guard.
3. Use of a safety mat or a safety laser scanner with incomplete coverage such that an operator can gain access to hazard zones and be undetected by the protective device.

The reset control device must be a two-channel type. In this example, the I/O configured for reset is “CI0-CI1”, see below.



# Serial Communication

- Serial Transmission
- Deliver digital data over long distances
- Deliver at slow rate
- Transmit one bit at a time
- Common Serial Port in Robot is RS-232C
- Connect Robot to PC using RS-232C
- Total Cable capacitance is limited to 2500
- Maximum data transfer limit is 20 Kilobit

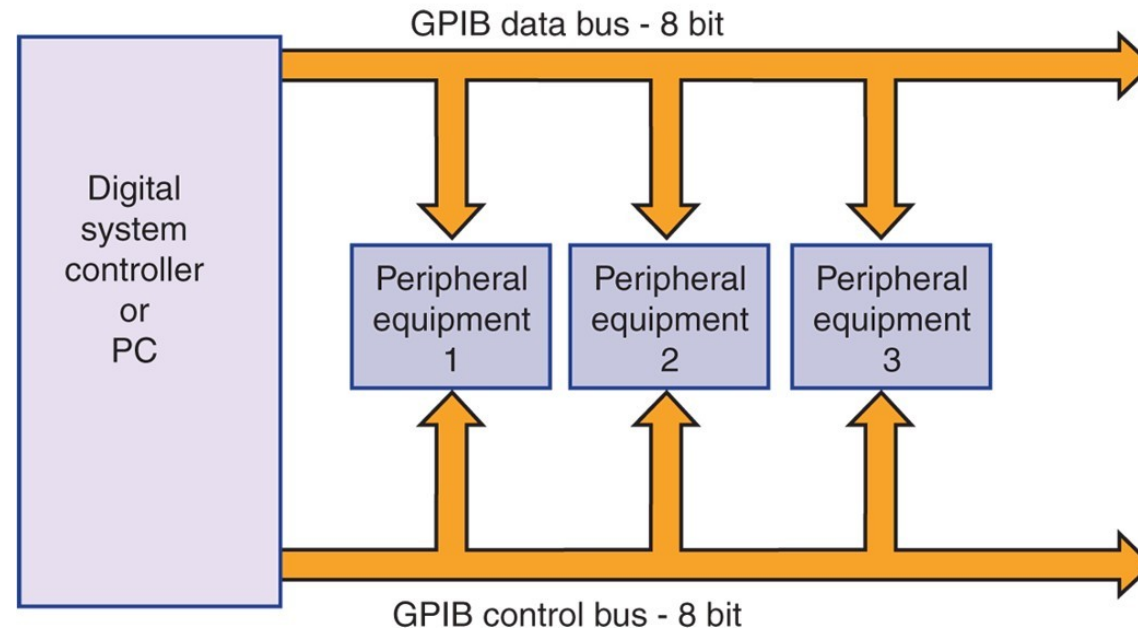


# Parallel Communication

- Sends multiple bits of data at the same time, following side-by-side paths
- Faster
- Costly for over long distance
- General Purpose Interface Bus (GPIB)

# General Purpose Interface Bus

## GPIB Interface Bus



GPIB can support a maximum 15 devices