PLC-Controlled Circuits Using Sensors (optional)

EXERCISE OBJECTIVE

- Implement circuits using sensors, the Programmable Logic Controller, and the Reversible AC Motor.

DISCUSSION

Sensors are used to perform many functions in automated manufacturing and material handling systems. They are used as inputs to the PLCs for counting, positioning, determining product orientation, sorting, and monitoring operations for example.

PROCEDURE OUTLINE

The Procedure is divided into the following sections:

- Set up and connections
- Equipment required
- Project 1 - motor speed
  Project description. Requirements. Equipment list. Schematic diagram of the circuit. Programmable Logic Controller. Circuit setup. Circuit approval.
- Project 2 - number of plugs per 15 motor rotations
  Project description. Requirements. Equipment list. Schematic diagram of the circuit. Programmable Logic Controller. Circuit setup. Circuit approval.
- Project 3 - change motor rotation direction every ten turns
  Project description. Requirements. Equipment list. Schematic diagram of the circuit. Programmable Logic Controller. Circuit setup. Circuit approval.

PROCEDURE

Set up and connections

In this exercise, you will design three circuits using sensors, the Programmable Logic Controller, and the Reversible AC Motor.

Referring to a project description, you will draw the schematic diagram, setup the circuit, and test the circuit.

Equipment required

The lists of equipment required for this exercise are shown in the Procedure.

Project 1 - motor speed

Project description

Your client desires to know the rotation speed of the Reversible AC Motor.

To do so, you will design a system that counts the number of motor rotations during one minute.

Requirements

- Use the Limit Switch to count the number of rotations performed by the motor during one minute.

- Measure the time and control the operation of the system using the Programmable Logic Controller module.

- The system is started by turning a selector on the Switches module.

- After one minute of operation, the system automatically stops.

- The number of motor rotations is displayed by the PLC (counter display).

- The counter of the PLC, used to count the number of motor rotations, is reset using a push button on the Switches module.

- Use the Interposing Relays and Contactor modules to supply the motor.

Equipment list

The equipment required to perform this project is shown in Table 15.

Table 15. Equipment list

Model	Description
3103 (or 8110 or 8134)	Industrial Controls Mobile Workstation
3112	Switches
3125	Lockout Module
3127-2	Contactor
3128	Programmable Logic Controller
3129	Interposing Relays
3138	Control Transformer
3139	DC Power Supply
3149	Limit Switch
3174-3	Reversible AC Motor
3196 (or 8821)	AC Power Supply
8951-8	Connection Leads
8951-E	Connection Leads
38503	Magnetic Labels

A schematic diagram and a ladder program are suggested in Appendix F. However, it is suggested that you design your own circuit and refer to the Appendix F only if necessary.

Schematic diagram of the circuit
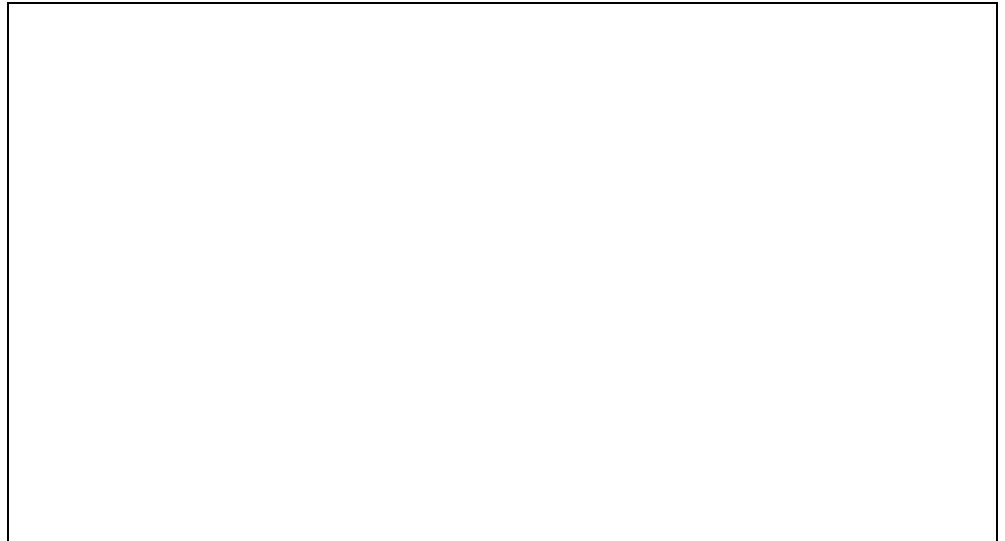
Draw the schematic diagram of the circuit in Figure 38.

Figure 38. Schematic diagram of the circuit.

Programmable Logic Controller
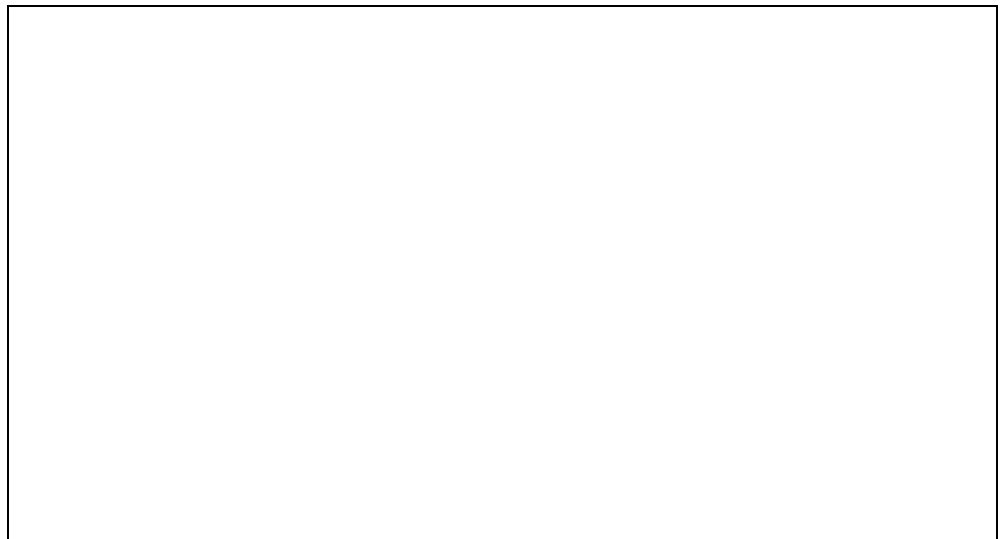
Draw your ladder program in Figure 39.

Figure 39. Ladder program.

Enter your ladder program into the Programmable Logic Controller.

Circuit setup

Set up the circuit you designed. Identify the controls with magnetic labels.

Circuit approval

Test your circuit to make sure that it operates as desired by your client.

Once your circuit is approved, turn the individual power switch of the AC Power Supply off, then disconnect the circuit.

Project 2 - number of plugs per 15 motor rotations

Project description

Your client desires to know the number of plugs detected by a sensor during 15 motor rotations of the Reversible AC Motor.

To do so, you will design a system that counts the number of motor rotations during one minute.

Requirements

- Use the Background Suppression Photoelectric Switch to detect the hole near the center of the metallic disk. This sensor is used to count the number of motor rotations.

- Use the Capacitive Proximity Switch to detect the plastic plugs inserted in the holes in the periphery of the metallic disk.

- The operation of the system is controlled using the Programmable Logic Controller module.

- The system is started by turning a selector on the Switches module.

- After 15 motor rotations, the system automatically stops.

- The number of plugs detected during the fifteen rotations is displayed by the PLC (counter display).

- The counters of the PLC are simultaneously reset using a push button on the Switches module.

- Use the Interposing Relays and Contactor modules to supply the motor.

Equipment list

Table 16. Equipment list.

Model	Description
3103 (or 8110 or 8134)	Industrial Controls Mobile Workstation
3103-3 (or 8810 or 8134)	Mobile Workstation
3112	Switches
3125	Lockout Module
3127-2	Contactor
3128	Programmable Logic Controller
3138	Control Transformer
3129	Interposing Relays
3139	DC Power Supply
3174-3	Reversible AC Motor
3196 (or 8821)	AC Power Supply
6373-B	Background Suppression Photoelectric Switch
6376-B	Capacitive Proximity Switch
8951-8	Connection Leads
8951-E	Connection Leads
38503	Magnetic Labels

A schematic diagram and a ladder program are suggested in Appendix F. However, it is suggested that you design your own circuit and refer to the Appendix F only if necessary.

Schematic diagram of the circuit

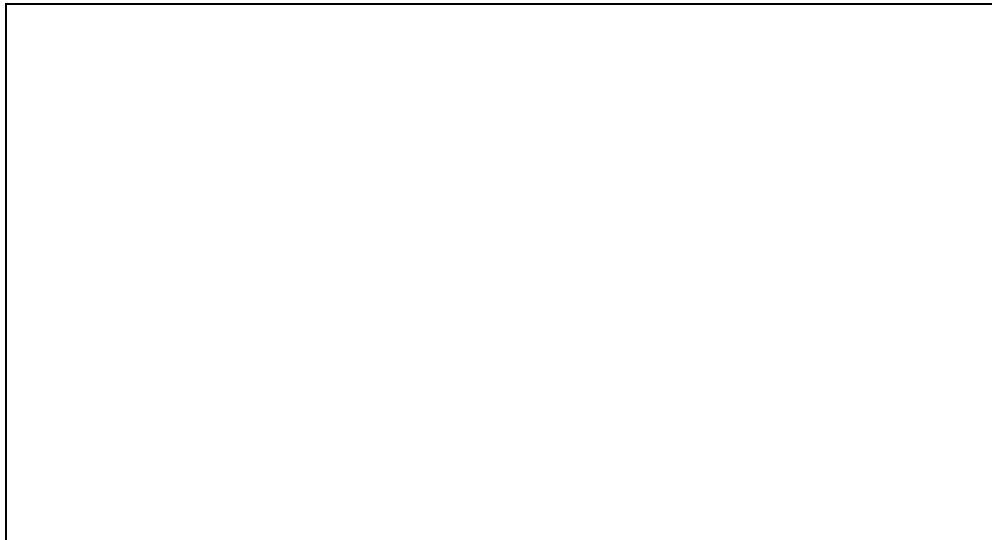Draw the schematic diagram of the circuit in Figure 40.

Figure 40. Schematic diagram of the circuit.

Programmable Logic Controller
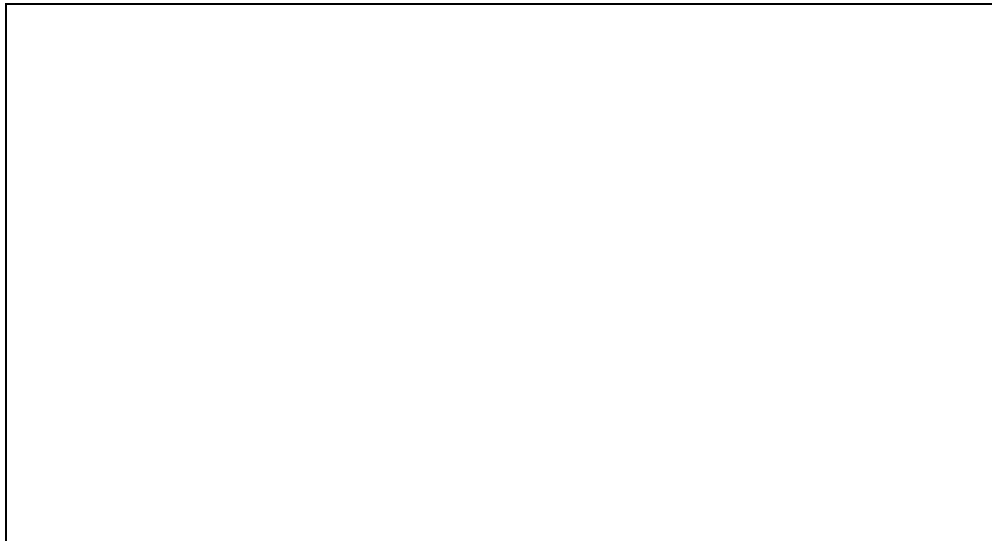
Draw your ladder program in Figure 41.

Figure 41. Ladder program.

Enter your ladder program into the Programmable Logic Controller.

Circuit setup

Set up the circuit you designed. Identify the controls with magnetic labels.

Circuit approval

Test your circuit to make sure that it operates as desired by your client.

Once your circuit is approved, turn the individual power switch of the AC Power Supply off, then disconnect the circuit.

Project 3 - change motor rotation direction every ten turns

Project description

Your client desires that the rotation direction of the Reversible AC Motor changes every ten turns.

To do so, you will design a system that counts the number of motor turns and changes the rotation direction of the motor.

Requirements

- Select the Polarized Retroreflective Photoelectric Switch with the reflective block to detect the hole in the fiber disk. This sensor is used to count the number of motor rotations.

- The operation of the system is controlled using the Programmable Logic Controller module.

- The system is started/stopped by turning a selector on the Switches module.

- After ten motor rotations, the rotation direction changes.

- The number of motor rotation is displayed by the PLC (counter display).

- The counters of the PLC are automatically reset by the program.

- Use the Interposing Relays and Dual Contactors modules to supply the motor.

Equipment list

The equipment required to perform this project is shown in Table 17.

Table 17. Equipment list.

Model	Description
3103 (or 8110 or 8134)	Industrial Controls Mobile Workstation
3112	Switches
3119	Dual Contactors
3125	Lockout Module
3128	Programmable Logic Controller
3138	Control Transformer
3129	Interposing Relays
3139	DC Power Supply
3174-3	Reversible AC Motor
3196 (or 8821)	AC Power Supply
6374-B	Polarized Retroreflective Photoelectric Switch
6396	Reflective Block
8951-8	Connection Leads
8951-E	Connection Leads
38503	Magnetic Labels

A schematic diagram and a ladder program are suggested in Appendix F. However, it is suggested that you design your own circuit and refer to the Appendix F only if necessary.

Schematic diagram of the circuit
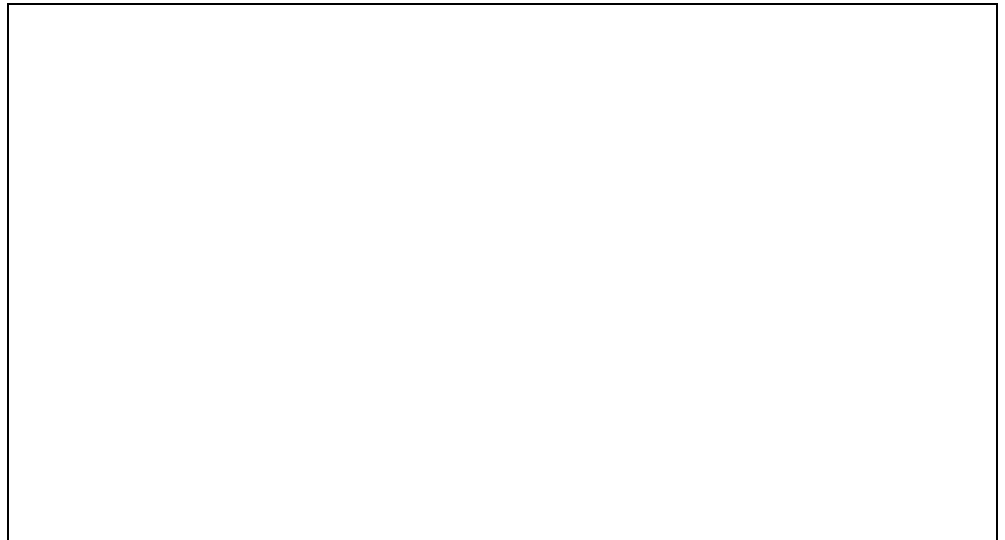
Draw the schematic diagram of the circuit in Figure 42.

Figure 42. Schematic diagram of the circuit.

Programmable Logic Controller
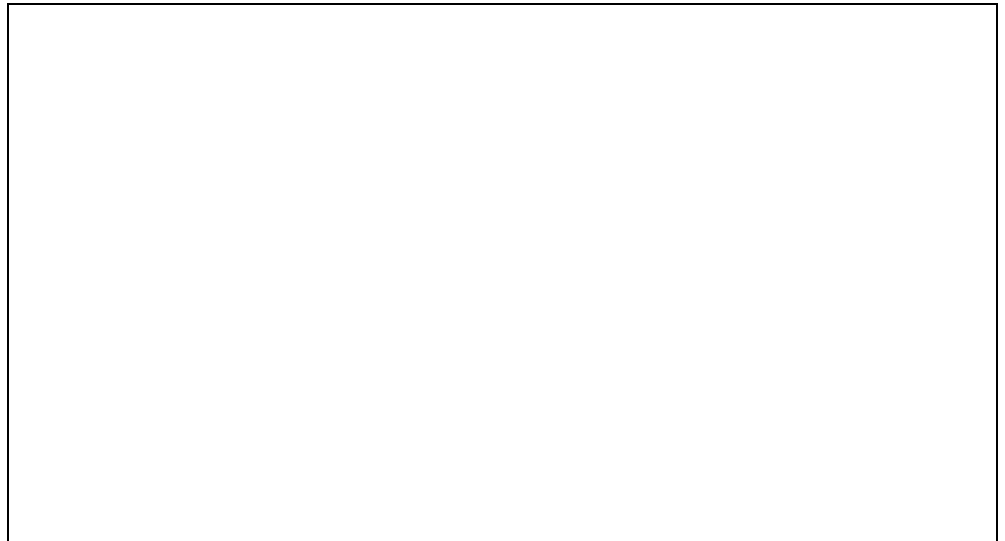
Draw your ladder program in Figure 43.

Figure 43. Ladder program.

Enter your ladder program into the Programmable Logic Controller.

Circuit setup

Set up the circuit you designed. Identify the controls with magnetic labels.

Circuit approval

Test your circuit to make sure that it operates as desired by your client.

Once your circuit is approved, turn the individual power switch of the AC Power Supply off, disconnect the circuit, and return the equipment to the storage location.

CONCLUSION

In this exercise, you designed three circuits using the sensors as inputs to the Programmable Logic Controller.

You used the Reversible AC Motor to drive the disks and use the motor in both directions of rotation.