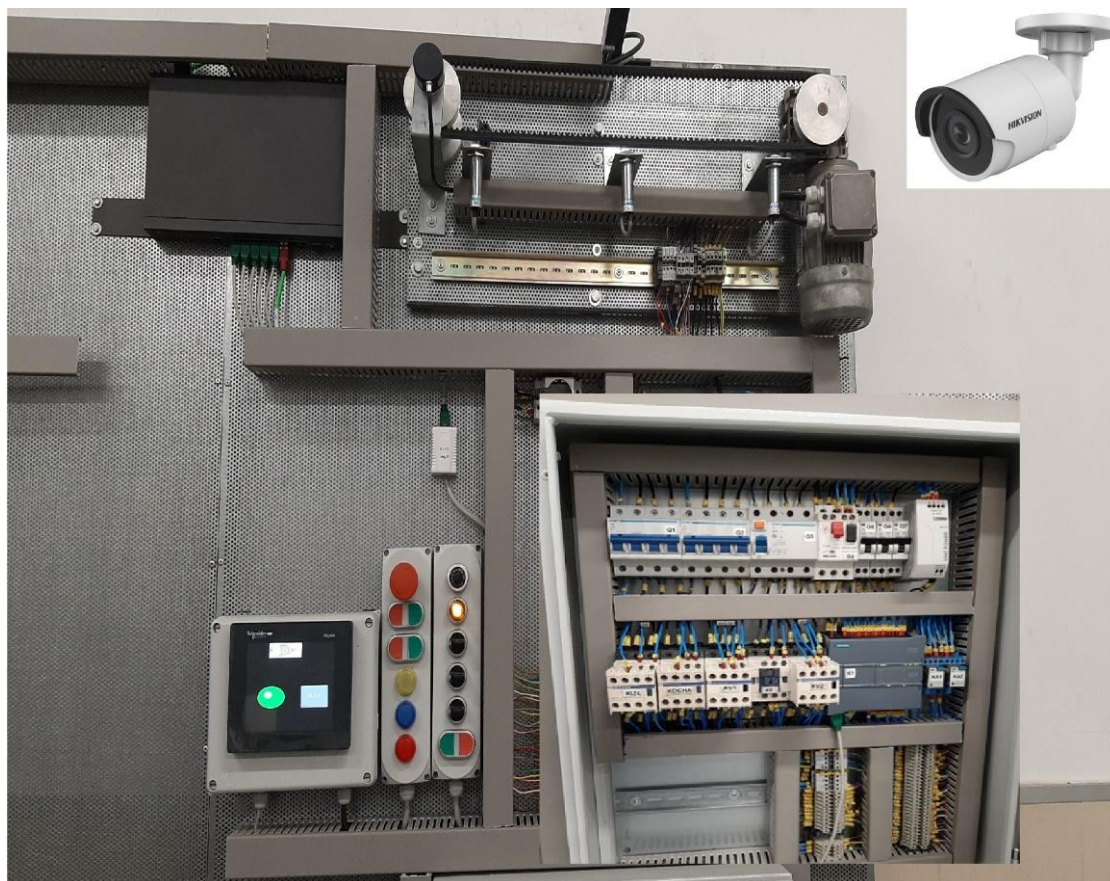


PROGRAMING ELECTRICAL AUTOMATION SYSTEMS



Practice 2 - Programmed Control Maneuver for Reversing the Rotation of a Three-Phase Motor.

Theoretical Concepts Questionnaire

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Student Name:

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Theoretical Concepts Questionnaire

1. The S7-1200 PLC used in the workshop is an "AC/DC/Rly" model. What does "AC" specifically refer to in this naming convention?
 - A) The type of inputs (Alternating Current).
 - B) The type of communication protocol.
 - C) The power supply required to turn on the PLC (230V AC).
 - D) The speed of the processor.

2. Which electrical component is used to physically disconnect the power to the motor in case of an overcurrent (thermal protection)?
 - A) KA1 Relay.
 - B) Q4 Motor Starter
 - C) PLC Output Q0.1.
 - D) Incremental Encoder.

3. According to the Workshop Manual, why is the KE contactor critical for the "Direct-to-Grid" maneuver?
 - A) It reverses the motor rotation.
 - B) It connects the motor windings in a Star (Y) configuration for 400V.
 - C) It provides 24V DC to the PLC.
 - D) It acts as a safety brake.

4. If you need to detect a non-metallic object on the belt, would the current B1/B2 sensors work?
 - A) Yes, because they are inductive.
 - B) No, because inductive sensors only detect metallic (ferrous) materials.
 - C) Yes, because they are capacitive.
 - D) No, because they are only designed for speed measurement.

5. What is the function of the "NC" (Normally Closed) contact in the Emergency Stop (I11.0)?
 - A) It sends a "1" to the PLC when the button is NOT pressed.
 - B) It sends a "0" to the PLC when the button is NOT pressed.
 - C) It is only used for the light indicator.
 - D) It prevents the PLC from turning on.
6. The incremental encoder is connected to the PLC to measure pulses. In which category of PLC signals does this fall?
 - A) High-Speed Counter (HSC) inputs.
 - B) Analog Output 0-10V.
 - C) Relay Outputs.
 - D) Wireless signals.
7. Why must the PLC outputs Q0.3 (Right) and Q0.4 (Left) never be active at the same time?
 - A) It would drain the battery.
 - B) It would cause a phase-to-phase short circuit in the power stage.
 - C) The PLC would enter Error mode and shut down.
 - D) The motor would simply stay still without damage.
8. What is the role of the 24V DC Power Supply (G1) in the cabinet?
 - A) To power the three-phase motor.
 - B) To provide the control voltage for the PLC, sensors, and contactor coils.
 - C) To convert AC to 400V.
 - D) To provide internet to the PLC.
9. When using the Frequency Inverter (Variador), which contactor must be active to connect the motor in Delta ()?
 - A) KE
 - B) KDCHA
 - C) KV1
 - D) KIZQ

10. What is the significance of the "PNP" type assigned to the sensors in the manual?
 - A) They switch the positive (+24V) side to the PLC input.
 - B) They switch the negative (0V) side to the PLC input.
 - C) They are "Plug and Play" and require no wiring.
 - D) They only work with AC current.
11. Which document should you consult to find the specific wire numbers and terminal connections?
 - A) The Guided Practice PDF.
 - B) The Electrical Diagram.
 - C) The TIA Portal Help menu.
 - D) The Windows User Manual.
12. In the TIA Portal software, what does "Compiling" a project do?
 - A) It sends the program to the PLC.
 - B) It checks the code for syntax errors and prepares the binary file.
 - C) It turns on the motor.
 - D) It opens the camera feed.
13. What happens to the PLC's outputs if the CPU is switched to "STOP" mode?
 - A) They remain in their last state.
 - B) All outputs are deactivated (Go to 0/OFF).
 - C) They switch to manual control.
 - D) The PLC explodes.
14. What is the purpose of a "Thermal Overload" signal (from Q4) being sent to a PLC input?
 - A) To tell the PLC to increase the fan speed.
 - B) To inform the control logic that a hardware trip occurred so it can stop the sequence and trigger an alarm.
 - C) To reset the breaker automatically.
 - D) It has no purpose.

15. If the PLC IP is 10.240.35.2 and your computer is on 192.168.1.15, why do you need the VPN?
- A) To make the internet faster.
 - B) To place both devices on the same virtual network so they can "see" each other.
 - C) To hide your location from Siemens.
 - D) To encrypt the video feed.
16. What physical component does the PLC use to turn on the high-power contactors?
- A) Internal Transistors.
 - B) Relay Outputs.
 - C) The Ethernet Port.
 - D) The USB Port.
17. What is the purpose of the "L+" and "M" terminals on the PLC?
- A) 230V Power Input.
 - B) 24V DC Power Input (L+ is positive, M is Ground/Negative).
 - C) Connection to the motor.
 - D) Connection to the Encoder only.
18. In a Ladder (KOP) diagram, what does a "Normally Open" contact (--) | |--) represent in terms of logic?
- A) It is true when the bit is 0.
 - B) It is true when the bit is 1.
 - C) It is always true.
 - D) It represents a physical wire.

19. Why does the workshop include a Virtual Dashboard?

- A) Because the physical buttons don't work.
- B) To allow remote students to trigger PLC inputs without being physically present.
- C) To play games during the lab.
- D) To program the PLC without TIA Portal.

20. What is the maximum voltage that the PLC's digital inputs can safely receive in this system?

- A) 400V AC
- B) 230V AC
- C) 24V DC
- D) 5V DC

Theoretical Concepts Questionnaire. Solutions

1. The S7-1200 PLC used in the workshop is an "AC/DC/Rly" model. What does "AC" specifically refer to in this naming convention?
 - A) The type of inputs (Alternating Current).
 - B) The type of communication protocol.
 - C) The power supply required to turn on the PLC (230V AC).** In Siemens nomenclature, the first term (AC) refers to the CPU's power supply.
 - D) The speed of the processor.
2. Which electrical component is used to physically disconnect the power to the motor in case of an overcurrent (thermal protection)?
 - A) KA1 Relay.
 - B) Q4 Motor Starter:** Q4 is the manual motor starter that provides thermal-magnetic protection.
 - C) PLC Output Q0.1.
 - D) Incremental Encoder.
3. According to the Workshop Manual, why is the KE contactor critical for the "Direct-to-Grid" maneuver?
 - A) It reverses the motor rotation.
 - B) It connects the motor windings in a Star (Y) configuration for 400V.** To run a 230/400V motor on a 400V grid, the windings must be in Star; KE is the contactor that creates the star point
 - C) It provides 24V DC to the PLC.
 - D) It acts as a safety brake.
4. If you need to detect a non-metallic object on the belt, would the current B1/B2 sensors work?
 - A) Yes, because they are inductive.
 - B) No, because inductive sensors only detect metallic (ferrous) materials.** The workshop uses inductive sensors, which operate based on electromagnetic fields and only detect metal
 - C) Yes, because they are capacitive.

- D) No, because they are only designed for speed measurement.
5. What is the function of the "NC" (Normally Closed) contact in the Emergency Stop (I11.0)?
- A) It sends a "1" to the PLC when the button is NOT pressed:** Safety devices are usually NC so that if a wire breaks (loss of signal), the PLC sees a "0" and stops the process.
- B) It sends a "0" to the PLC when the button is NOT pressed.
- C) It is only used for the light indicator.
- D) It prevents the PLC from turning on.
6. The incremental encoder is connected to the PLC to measure pulses. In which category of PLC signals does this fall?
- A) High-Speed Counter (HSC) inputs:** Standard digital inputs are too slow for encoder pulses; the S7-1200 uses specialized HSC inputs for this
- B) Analog Output 0-10V.
- C) Relay Outputs.
- D) Wireless signals.
7. Why must the PLC outputs Q0.3 (Right) and Q0.4 (Left) never be active at the same time?
- A) It would drain the battery.
- B) It would cause a phase-to-phase short circuit in the power stage:** Simultaneous activation of reversing contactors connects two different phases to the same terminal, causing a short circuit
- C) The PLC would enter Error mode and shut down.
- D) The motor would simply stay still without damage.
8. What is the role of the 24V DC Power Supply (G1) in the cabinet?
- A) To power the three-phase motor.
- B) To provide the control voltage for the PLC, sensors, and contactor coils:** Industrial control logic (PLC/Sensors) operates at 24V DC for safety and standard compliance
- C) To convert AC to 400V.
- D) To provide internet to the PLC.

9. When using the Frequency Inverter (Variador), which contactor must be active to connect the motor in Delta ()?
- A) KE
 - B) KDCHA
 - C) KV1:** The manual specifies KV1 for the Delta connection used with the 230V output of the inverter.
 - D) KIZQ
10. What is the significance of the "PNP" type assigned to the sensors in the manual?
- A) They switch the positive (+24V) side to the PLC input:** PNP sensors output a high signal (+24V) to the PLC input when activated
 - B) They switch the negative (0V) side to the PLC input.
 - C) They are "Plug and Play" and require no wiring.
 - D) They only work with AC current.
11. Which document should you consult to find the specific wire numbers and terminal connections?
- A) The Guided Practice PDF.
 - B) The Electrical Diagram:** The Electrical Diagram is the only document showing the physical wiring and terminal strips (X1, X2).
 - C) The TIA Portal Help menu.
12. In the TIA Portal software, what does "Compiling" a project do?
- A) It sends the program to the PLC.
 - B) It checks the code for syntax errors and prepares the binary file:** Compiling is a local check to ensure the logic is valid before attempting a download
 - C) It turns on the motor.
 - D) It opens the camera feed.
13. What happens to the PLC's outputs if the CPU is switched to "STOP" mode?
- A) They remain in their last state.

- B) **All outputs are deactivated (Go to 0/OFF)**: For safety, when a PLC stops executing code, all outputs are forced to a safe (OFF) state
- C) They switch to manual control.
- D) The PLC explodes.
14. What is the purpose of a "Thermal Overload" signal (from Q4) being sent to a PLC input?
- A) To tell the PLC to increase the fan speed.
- B) **To inform the control logic that a hardware trip occurred so it can stop the sequence and trigger an alarm**: Monitoring protections via PLC allows for better diagnostics and safer shutdowns
- C) To reset the breaker automatically.
- D) It has no purpose.D) The Windows User Manual.
15. If the PLC IP is 10.240.35.2 and your computer is on 192.168.1.15, why do you need the VPN?
- A) To make the internet faster.
- B) **To place both devices on the same virtual network so they can "see" each other**: PLCs are on private industrial networks; a VPN bridges your remote PC to that network
- C) To hide your location from Siemens.
- D) To encrypt the video feed.
16. What physical component does the PLC use to turn on the high-power contactors?
- A) Internal Transistors.
- B) **Relay Outputs**: The "Rly" in S1214 AC/DC/Rly stands for Relays, which can handle the higher current/voltage needed for contactor coils.
- C) The Ethernet Port.
- D) The USB Port.
17. What is the purpose of the "L+" and "M" terminals on the PLC?
- A) 230V Power Input.

- B) 24V DC Power Input (L+ is positive, M is Ground/Negative):** L+ and M are the standard labels for the 24V DC power rails in Siemens PLCs
- C) Connection to the motor.
- D) Connection to the Encoder only.
18. In a Ladder (KOP) diagram, what does a "Normally Open" contact (--) | |--) represent in terms of logic?
- A) It is true when the bit is 0.
- B) It is true when the bit is 1:** A Normally Open contact "closes" and allows logic flow when the associated memory bit or input is active (1)
- C) It is always true.
- D) It represents a physical wire.
19. Why does the workshop include a Virtual Dashboard?
- A) Because the physical buttons don't work.
- B) To allow remote students to trigger PLC inputs without being physically present:** It maps web-based clicks to actual PLC memory bits or inputs for remote operation
- C) To play games during the lab.
- D) To program the PLC without TIA Portal.
20. What is the maximum voltage that the PLC's digital inputs can safely receive in this system?
- A) 400V AC
- B) 230V AC
- C) 24V DC:** The S7-1214 DC inputs are designed for 24V DC nominal voltage
- D) 5V DC