APPENDIX D
PRE/POST ASSESSMENT TESTING

NOTES TO INSTRUCTOR

The tests for your curriculum come in two forms. Forms A and B of the tests are comparable. You may elect to use one form as a pre-test and the other as a post-test or you may decide to mix the two, with some students taking Form A, some Form B.

MB 650ML PLC Test

Form A, Answer Key

Name _____

Date _____

Circle the number of the correct answer.

1. Why is a sequencer instruction better than cascading timers?

   1. Sequencers use fewer outputs than timers.
   2. Sequencers can be event driven.
   3. Sequencers do not require the reset instruction.
   4. Sequencers avoid tying up timers which might be needed somewhere else in the program.
   5. All of the above.

2. Which of the following is NOT a status indicator light on the PLC?

   1. Force I/O.
   2. Battery Low.
   3. PC Run.
   4. Auto/Manual.
   5. DC Power.

3. What are the basic components of any DC circuit?

   1. Switch, output device, and input device.
   2. Power supply, input device, and output device.
   3. Input device, power supply, and light.
   4. Power supply, light, and switch.
   5. Output device, power supply, and switch.

4. What is the sequence of steps to Run a previously created program?

   1. Go Online, Run
   2. Go Offline, Run
   3. Verify, Download, Go Online, Run
   4. Verify, Download, Go Offline, Run
   5. Download, Run

MB 650ML PLC Test
Form A, Answer Key

5. Which symbol represents a normally closed input element?

1. -( )-
2. -| |-
3. -(\)-
■ 4. -|\|-
5. It cannot be determined from the information given.

6. The arithmetic logic unit:

1. Stores the status of the input devices.
2. Stores the meaning of the various programming instructions and addresses.
■ 3. Solves logic problems and does mathematical calculations.
4. Tells the CPU when and how to act on input data.
5. Signals the outputs when to operate.

7. What is the function of the controller in a PLC?

1. It signals the PLC input module.
■ 2. It interprets the electrical signals from the input module and controls the signals to the output module.
3. It controls the output devices.
4. It is controlled by the PLC output module.
5. It tells the computer when an input device has been activated.

8. How are input elements ANDed in a ladder logic diagram?

1. They are placed one below the other on branches.
2. A backslash (\) is placed in the element symbol.
■ 3. They are placed next to each other on the same line of the diagram.
4. There must be only one input element on a rung.
5. They are placed next to each other on the rail.

MB 650ML PLC Test
Form A, Answer Key

9. Convert from binary to decimal: 0101 0101

1. 55.
2. 81.
3. 154.
■ 4. 85.
5. 33.

10. How is a mask used in a sequencer?

■ 1. It defines which outputs are being used by the sequencer so that other outputs can be used in the rest of the program.
2. It defines which inputs are used to control the sequencer.
3. It determines if the sequencer is event driven or time driven.
4. It defines all addresses which can be used by a sequencer.
5. Answers 1 and 4 only.

11. What is the function of the Interface cable?

■ 1. It is used to communicate with the computer in the PLC.
2. It is used to monitor program operation.
3. It displays the status of program instructions.
4. It is used to put the controller in the run mode.
5. It is used to edit a PLC program.

12. How does an on-delay timer work?

■ 1. It starts timing when its input element is energized and turns on its output after a preset interval.
2. It starts timing when its input element is de-energized and turns off its output after a preset interval.
3. It starts timing when its input element is de-energized and turns on its output after a preset interval.
4. It starts timing when its output element is energized and turns off its input after a preset interval.
5. It starts timing a preset interval after its input has been energized.

MB 650ML PLC Test
Form A, Answer Key

13. What is the function of the I/O interface on the trainer panel?

1. It is used to connect the input and output devices directly to the PLC controller.
2. It is used to connect the input devices to the output devices.
■ 3. It is used to connect the input devices to the input module and the output module to the output devices.
4. It is used to provide electrical power to the PLC.
5. There is no I/O interface on the trainer panel.

14. Where is the shift register instruction programmed in a ladder logic diagram?

1. Inside an SQO instruction.
2. After all other program rungs.
■ 3. Inside a zone control relay.
4. Inside an MCR instruction.
5. At the very beginning of the program.

15. Convert from hexadecimal to binary: 902F

1. 1111 0000 0011 1110.
2. 1001 0000 0011 1011.
■ 3. 1001 0000 0010 1111.
4. 1011 0000 0011 1111.
5. None of the above.

16. What does an MCR instruction do in a PLC program?

■ 1. It controls the operation of the group of rungs within its zone.
2. When de-energized, it turns off all outputs within its zone.
3. When energized, it turns on all outputs within its zone.
4. It replaces a hard-wired master control relay in a circuit.
5. It has the same function as a zone control relay instruction.

MB 650ML PLC Test
Form A, Answer Key

17. Define the term "accumulated value."

1. It is the time elapsed in a program during operation.
2. It is the value at which a timer or counter will activate its output.
3. It is the value used in a sequencer to control output operation.
■ 4. It is the number of units counted in a timer or counter at any given point in the program cycle.
5. It is the amount of time the controller takes to complete one cycle of the program.

18. Which numbering system is used to address the inputs and outputs on the MICROLOGIX 1000 PLC?

1. Binary.
2. Hexadecimal.
3. Decimal.
■ 4. Octal.
5. Roman.

19. Convert from octal to decimal: 21

■ 1. 17.
2. 21.
3. 18.
4. 16.
5. None of the above.

20. What is the function of the ENTER key on the pendant?

1. It is used to clear the PLC's memory.
2. It is pressed after an element has been keyed in during programming.
■ 3. It is used to indicate that an instruction is complete, such as at the end of a rung during programming.
4. It is used after each keystroke to accept the keystroke.
5. Answers 3 and 4 only.

MB 650ML PLC Test
Form A, Answer Key

21. What is represented by "013" in the PLC?

1. An external input.
2. An normally open output element.
■ 3. An external output.
4. An internal relay.
5. A normally closed input.

22. What must you do to ensure that a timer or counter will activate the rungs it controls?

1. Use a non-retentive timer or counter.
2. Program the reset instruction before all uses of the timer or counter as a contact.
■ 3. Program the reset instruction after all uses of the timer or counter as a contact.
4. Program the reset instruction next to the timer or counter instruction.
5. None of the above.

23. What is an internal relay used for?

■ 1. It converts a single input into multiple outputs.
2. It converts a single output into multiple inputs.
3. It automatically changes the status of the input device.
4. All of the above.
5. None of the above.

24. What is the purpose of the computer display screen when programming the PLC?

1. It shows the status of an element during program operation.
2. It prompts the user for instructions during programming and operation.
3. It indicates the type and address of the element.
■ 4. All of the above.
5. Answers 1 and 3 only.

MB 650ML PLC Test
Form A, Answer Key

25. How is D.C. current used with the MICROLOGIX 1000 PLC?

1. D.C. power is used to run the PLC itself.
2. D.C. power is used to run the input devices.
■ 3. D.C. electricity runs the input devices and output devices used with the PLC.
4. The output devices are powered by D.C. electricity.
5. None of the above.

26. Define the term "output device."

1. The part of the PLC which interprets the electrical signals from the input module and controls the signals to the output module.
2. An electrical device used to signal the PLC input module.
3. The part of the PLC which tells the computer when an input device has been activated.
■ 4. An electrical device controlled by the PLC output module.
5. The part of the PLC used to control the outputs.

27. What is the function of a CPU?

■ 1. It tells the arithmetic logic unit when and how to act on input data.
2. It tells the RAM when and how to activate the outputs.
3. It tells the RAM when and how to act on input data.
4. It tells the output devices when to turn on and off.
5. It tells the ALU when and how to activate the outputs.

28. Explain why a timer must reset itself in a timer/counter program.

1. A timer reset instruction would get confused with the counter reset instruction.
2. A timer must always be used to reset itself.
3. A reset instruction will not work when the timer is latched on.
■ 4. The timer must be able to repeat itself continuously while the counter counts up to its preset value.
5. All of the above.

MB 650ML PLC Test
Form A, Answer Key

29. Identify the true statement:

1. Internal relay elements make a program harder to change.
■ 2. A relay coil element will energize any input element with the same address.
3. Internal relays may have only normally open contacts.
4. Internal relays must be the same status as the input devices controlling them.
5. All of the above are false.

30. Describe RAM.

1. The memory portion of the input module.
■ 2. Memory used to store a PLC program in the controller.
3. Memory used to store the meaning of the various programming instructions and addresses.
4. All of the above.
5. None of the above.

31. What is an input device?

1. The part of the PLC which tells the computer when an input has been activated.
2. The part of the PLC used to control the output devices.
■ 3. An electrical device used to signal the PLC input module.
4. The part of the PLC which interprets the electrical signals from the input module and controls the signals to the output module.
5. An electrical device controlled by the PLC.

32. What is the purpose of Boolean Algebra?

1. It is used to calculate the values of mathematical equations.
2. It uses logical relationships to represent mathematical equations.
3. It is used to make logical decisions.
4. It is used to create logical relationships.
■ 5. It uses mathematical equations to represent logical decisions and logical relationships.

MB 650ML PLC Test
Form A, Answer Key

33. How do you unlatch a latched instruction -(L)-?

■ 1. An independently controlled input element controls the unlatching instruction with the same address as the latched instruction.
2. A normally closed input element is ANDed with the latching instruction.
3. The same input instruction controls the latching and unlatching rungs.
4. An unlatching instruction must be programmed with its own address.
5. All unlatching instructions are controlled by a single input instruction.

34. Identify the true statement:

1. There may be multiple outputs on a single ladder rung.
2. There is no relationship between a ladder logic diagram and a Boolean equation.
3. There may be only one input on a single ladder rung.
4. An output element cannot be used to control other rungs.
■ 5. A ladder logic diagram must have as many distinct elements as the circuit it describes.

35. A shift register:

1. Sequences outputs in response to the change in status of an input element.
■ 2. Moves individual bits of data through a series of consecutive output addresses.
3. Is rarely used in industrial PLC programming.
4. Controls the rungs within its zone.
5. Replaces a sequencer in the MICROLOGIX 1000 PLC.

MB 650ML PLC Test

Form B, Answer Key

Name _____

Date _____

Circle the number of the correct answer.

1. What is the function of the controller in a PLC?

1. It signals the PLC input module.
■ 2. It interprets the electrical signals from the input module and controls the signals to the output module.
3. It controls the output devices.
4. It is controlled by the PLC output module.
5. It tells the computer when an input device has been activated.

2. What is an internal relay used for?

■ 1. It converts a single input into multiple outputs.
2. It converts a single output into multiple inputs.
3. It automatically changes the status of the input device.
4. All of the above.
5. None of the above.

3. What is represented by the numbers next to the input and output connectors on the trainer panel?

■ 1. The numbers are the addresses of the corresponding connections on the input module and output module of the PLC.
2. The switches and lights are each identified by a number to keep them separate.
3. The numbers next to the input and output connectors correspond to the numbers of the switches and lights.
4. All of the above.
5. None of the above.

4. How is D.C. current used with the MICROLOGIX 1000 PLC?

1. D.C. power is used to run the PLC itself.
2. D.C. power is used to run the input devices.
■ 3. D.C. electricity runs the input devices and output devices used with the PLC.
4. The output devices are powered by D.C. electricity.
5. None of the above.

MB 650ML PLC Test
Form B, Answer Key

5. What part of a ladder logic diagram represents the Boolean OR relationship?

■ 1. Branch.
2. Rail.
3. Inputs.
4. Rung.
5. Element.

6. What is the function of the Interface cable?

■ 1. It is used to communicate with the computer in the PLC.
2. It is used to monitor program operation.
3. It displays the status of program instructions.
4. It is used to put the controller in the run mode.
5. It is used to edit a PLC program.

7. What is the sequence of steps to Run a previously created program?

1. Go Online, Run
2. Go Offline, Run
■ 3. Verify, Download, Go Online, Run
4. Verify, Download, Go Offline, Run
5. Download, Run

8. Define the term "accumulated value."

1. It is the time elapsed in a program during operation.
2. It is the value at which a timer or counter will activate its output.
3. It is the value used in a sequencer to control output operation.
■ 4. It is the number of units counted in a timer or counter at any given point in the program cycle.
5. It is the amount of time the controller takes to complete one cycle of the program.

MB 650ML PLC Test
Form B, Answer Key

9. What is shown by a ladder logic diagram of an electrical circuit?

1. The conditions needed to make the circuit operate.
2. How the wires are connected to the elements of the circuit.
3. The positions of the elements in the system.
■ 4. All possible conditions which exist in the circuit.
5. All of the above.

10. What does an MCR instruction do in a PLC program?

■ 1. It controls the operation of the group of rungs within its zone.
2. When de-energized, it turns off all outputs within its zone.
3. When energized, it turns on all outputs within its zone.
4. It replaces a hard-wired master control relay in a circuit.
5. It has the same function as a zone control relay instruction.

11. Describe RAM.

1. The memory portion of the input module.
■ 2. Memory used to store a PLC program in the controller.
3. Memory used to store the meaning of the various programming instructions and addresses.
4. All of the above.
5. None of the above.

12. A normally closed switch:

1. Should only be used with a normally open input element.
■ 2. Is energized until pressed.
3. Cannot be used properly with a PLC.
4. Must be pressed to turn off an output and pressed a second time to turn on an output.
5. Is de-energized until it is pressed.

MB 650ML PLC Test
Form B, Answer Key

13. What is the purpose of Boolean Algebra?

1. It is used to calculate the values of mathematical equations.
2. It uses logical relationships to represent mathematical equations.
3. It is used to make logical decisions.
4. It is used to create logical relationships.
■ 5. It uses mathematical equations to represent logical decisions and logical relationships.

14. Define the term "output device."

1. The part of the PLC which interprets the electrical signals from the input module and controls the signals to the output module.
2. An electrical device used to signal the PLC input module.
3. The part of the PLC which tells the computer when an input device has been activated.
■ 4. An electrical device controlled by the PLC output module.
5. The part of the PLC used to control the outputs.

15. What can a latching instruction do?

1. Keep an output on at all times.
2. Act like a normally open momentary switch.
3. Act like a normally closed maintain switch.
4. Prevent an output from activating.
■ 5. Keep a circuit operating when a momentary start switch has been released.

16. Explain why a timer must reset itself in a timer/counter program.

1. A timer reset instruction would get confused with the counter reset instruction.
2. A timer must always be used to reset itself.
3. A reset instruction will not work when the timer is latched on.
■ 4. The timer must be able to repeat itself continuously while the counter counts up to its preset value.
5. All of the above.

MB 650ML PLC Test
Form B, Answer Key

17. What does the rung do in a ladder logic diagram?

1. It indicates where elements are placed in a circuit.
■ 2. It carries the information about the inputs and outputs in the circuit.
3. It indicates the status of the input devices.
4. It shows when an output device is activated.
5. It represents the Boolean AND relationship.

18. The arithmetic logic unit:

1. Stores the status of the input devices.
2. Stores the meaning of the various programming instructions and addresses.
■ 3. Solves logic problems and does mathematical calculations.
4. Tells the CPU when and how to act on input data.
5. Signals the outputs when to operate.

19. Why is a sequencer instruction better than cascading timers?

1. Sequencers use fewer outputs than timers.
2. Sequencers can be event driven.
3. Sequencers do not require the reset instruction.
■ 4. Sequencers avoid tying up timers which might be needed somewhere else in the program.
5. All of the above.

20. How do you unlatch a latched instruction -(L)-?

■ 1. An independently controlled input element controls the unlatching instruction with the same address as the latched instruction.
2. A normally closed input element is ANDed with the latching instruction.
3. The same input instruction controls the latching and unlatching rungs.
4. An unlatching instruction must be programmed with its own address.
5. All unlatching instructions are controlled by a single input instruction.

MB 650ML PLC Test
Form B, Answer Key

21. What does the sequencer do for a shift register?

1. It shifts the bits of data to the right.
2. It latches the zone in which the shift register is operating.
3. It clears the addresses to which bits of data are shifted.
■ 4. It activates the ZCL instruction so that a bit of data will be shifted.
5. A sequencer should not be programmed with a shift register.

22. Identify the false statement:

1. The preset value indicates the length of time before a timer will change the status of its output.
2. The accumulated value shows the number of time units counted at any given point in the timing cycle.
■ 3. A retentive timer restarts its timing cycle every time it is turned off.
4. One timer can be used to reset itself and other timers.
5. A reset command keeps resetting the timer as long as the reset is activated.

23. Describe the input module of a PLC.

1. An electrical device controlled by the PLC output module.
2. The part of the PLC which interprets the electrical signals from the inputs and controls the signals to the output module.
3. The part of the PLC used to control the output devices.
4. An electrical device used to signal the PLC input module.
■ 5. The part of the PLC which tells the computer when an input device has been activated.

24. What is the major advantage of a PLC over a hard-wired circuit?

1. The PLC only has to be rewired; the program does not need to be changed.
■ 2. In a PLC only the program must be changed; a circuit has to be rewired.
3. The PLC can handle more input and output devices.
4. The PLC is more compact and more portable.
5. The hard-wired system has more advantages than the PLC.

MB 650ML PLC Test
Form B, Answer Key

25. What does the term "normally open" mean?

■ 1. In its normal condition, the element or device is not energized.
2. The switch must be pressed and held down to complete a circuit.
3. The output device is always on.
4. In its normal condition, the element or device is energized.
5. The switch must be pressed to turn off an output and pressed a second time to turn on an output.

26. How many input branches can be used in a ladder logic diagram?

1. 10.
2. Inputs may not be branched.
3. 20.
■ 4. There is no limit.
5. 3.

27. Convert from octal to decimal: 21

■ 1. 17.
2. 21.
3. 18.
4. 16.
5. None of the above.

28. How is a mask used in a sequencer?

■ 1. It defines which outputs are being used by sequencer so that other outputs can be used in the rest of the program.
2. It defines which inputs are used to control the sequencer.
3. It determines if the sequencer is event driven or time driven.
4. It defines all addresses which can be used by a sequencer.
5. Answers 1 and 4 only.

MB 650ML PLC Test
Form B, Answer Key

29. Which numbering system is used to display a computer's list of internal commands?

1. Binary.
■ 2. Hexadecimal.
3. Octal.
4. Roman.
5. Decimal.

30. Identify the true statement:

1. There may be multiple outputs on a single ladder rung.
2. There is no relationship between a ladder logic diagram and a Boolean equation.
3. There may be only one input on a single ladder rung.
4. An output element cannot be used to control other rungs.
■ 5. A ladder logic diagram must have as many distinct elements as the circuit it describes.

31. Describe event driven sequencers.
1. They activate an output every time an input is turned on.
2. There are no event driven sequencers in the MICROLOGIX 1000 PLC.
3. They activate one output each time a different input is turned on and off.
4. They activate a series of outputs after a preset time interval.
■ 5. They activate a series of outputs in response to an input being turned on and off a preset of number of times.

32. What does counter CTU do?

■ 1. It counts up one unit every time its input element changes from false (off) to true (on).
2. It counts one unit for every scan of the program.
3. It counts down from its preset value to 0.
4. It begins counting at its accumulated value whenever it is reset.
5. It counts one unit every time its input element changes from true (on) to false (off).

MB 650ML PLC Test
Form B, Answer Key

33. What is the purpose of RAC?

1. It allows the user to keep changing the preset value of a counter or timer.
■ 2. It resets a counter or timer to a value which is different from the original preset value.
3. It is the amount of time before a timer will activate its output.
4. It is the number of units already counted by a timer or counter.
5. None of the above.

34. Which symbol represents a normally closed input element?

1. -( )-
2. -| |-
3. -(\)-
■ 4. -|\|-
5. It cannot be determined from the information given.

35. How is the monitoring function used?

1. Program corrections can be made in monitoring mode.
2. Monitoring mode is used to program timers and counters.
3. The status of some program elements can be observed.
4. Internal relays can be controlled better.
■ 5. The status of input and output elements can be observed.

APPENDIX E

MB655 PLC APPLICATIONS

The MB655 PLC training system includes a series of built-in applications designed for PLC programmable control.

Motor/Screw Motion Application:

The motor/screw motion application located in the upper right hand corner of the PLC training panel consists of:

- One DC Motor mounted to the panel with banana jacks for start/stop and reversing motor motion control.
- Two Relays with 24 VDC coils and DPDT (double pole double throw) contacts located on the underside of the panel with banana jacks for controlling the DC motor forward and reverse motion.
- One Screw Carriage consisting of a moveable part with one cam-shaped end, one square-shaped end and metal indicator arrow, threaded rod for rotation, and stand.
- Two non-contact proximity sensors located on the underside of the panel with mating sensor mounted to the moveable part with banana jacks for input control.
- Silkscreened ruler on panel for distance reference and measurements.
- Two fixed position limit switches for part over-travel determination with feedback to motor for shutdown.
- Two limit switches with user adjustable mounting bracket for part travel distance determination with banana jacks for input control.
- LEDs: A series of LEDs (four pairs of LEDs) located next to device banana jacks, which are illuminated internally when a particular is electrically active. LEDs are located by the motor jacks indicating the direction of the motor rotation. LEDs are located next to the limit switch jacks (LS1 and LS2) indicating the limit switch actuator is physically depressed. LEDs are located next to the sensor jacks (SEN1 and SEN2) indicating that the moveable part is within proximity sensing of the sensor. LEDs are located near the panel relays (CR1 and CR2) indicating the relays are operational and electrically "alive".

As the DC motor controlled screw rotates, the attached part moves along the threaded rod. When the target attached to the part comes in proximity to the mating sensor located on the underside of the panel, an electrical signal is generated. Similarly, when the part reaches the adjustable limit switch, located on the top side of the panel at either end of the Screw Carriage is activated by the cam-shaped end of the moveable part depressing the switch actuator indicating that the travel distance has been reached. A second pair of limit switches located at each end of the stand are permanently positioned in place and activated by the square-shaped end of the moveable part. This limit switch pair is used to detect an over-travel situation by the moving part and automatically shuts down the motor to prevent an electrical overload situation.

The PLC can be programmed to control the motor motion by connecting the motor jacks to the appropriate outputs jacks of the PLC via electrical connecting wires (patchcords). Also, the adjustable limit switches and proximity sensors can be used as controllable inputs to the PLC by connecting their jacks to the respective PLC input jacks via patchcords.

DC Motor

A DC (direct current) motor is a motor that uses direct current to produce motion.

The direction of rotation of the shaft of all DC motors depends on the direction of the current. To reverse the direction of rotation, the current direction is reversed. In a DC permanent-magnet motor, reversing the connections of the power leads reverses the motor motion. The DC motor included in the MB655 training system is a DC permanent-magnet motor and is used as a rotary output from the PLC.

Limit Switch

A limit switch is a mechanical input that requires physical contact of the object with the switch activator. The physical contact is obtained from a moving object that comes in contact with the limit switch. The mechanical motion physically opens or closes a set of contacts within the limit switch enclosure. The contacts START or STOP the flow of current in the electrical circuit.

The four included limit switches are mounted at each end of the screw carriage and have normally open contacts. The limit switches can be activated manually by pressing the actuator, or by either end of the plastic part coming in contact with the actuator and physically depressing the actuator during motor operation. When the limit switch is activated, the normally open contacts are closed, thus closing the circuit and sending an electrical signal. This signal can be used as an input to the PLC.

Proximity Sensor

A Proximity Sensor is a sensor that detects the presence of an object through a sensing field. A proximity sensor does not come into physical contact with the object. Proximity sensors can detect the presence or absence of almost any solid or liquid, e.g. very small objects such as microchips to very large vessels containing liquid such as oil holding tanks. Proximity sensors are extremely versatile, safe, reliable, and may be used in applications where other limit switches cannot.

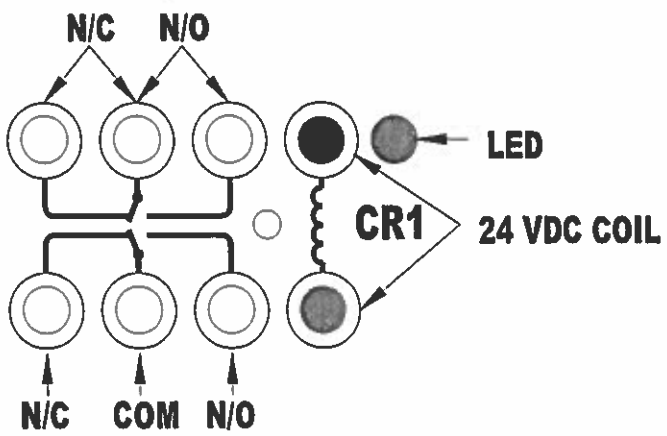
The proximity sensors used in the MB655 training system are magnetic reed sensors and are mounted to the underside of the training panel. As the mating top side sensor approaches the proximity of the underside sensor, a non-contact magnetic field electrical signal is generated indicating that the two sensors are within sensing proximity to one another. At the same time, a LED located on the training panel will illuminate. This electrical signal can be used as an input to the PLC.

Relay

A relay is an interface that controls one electrical circuit by opening and closing contacts in another circuit, i.e., "electrical switch". Relays are classified as electromechanical (used in the MB655 training system) or solid state. An electromechanical relay is a relay with sets of contacts which are closed (or opened) by magnetic force. These relays use a movable armature to switch the relay contacts. The armature is moved by an electromagnetic field developed when electrical power is applied to the coil.

A "break or throw" is the number of separate places on a contact that open or close in an electrical circuit. All contacts are single-break (single-throw) or double-break (double-throw).

A "pole" is the number of completely isolated circuits that a relay can switch. A single-pole contact can carry current through only one circuit. A double-pole contact can carry current through two circuits simultaneously. In a double-pole contact, two circuits are mechanically connected to open or close simultaneously and are electrically insulated from each other. The relays used in the MB655 training system, CR1 and CR2, are shown below.



Traffic Light Intersection:

The traffic light/intersection application located in the lower right hand corner of the PLC training panel consists of:

- Silkscreened graphical representation of a traffic light intersection.
- Two-dimensional traffic light with 2 red-colored LEDs, 2 yellow-colored LEDs, and 2 green-colored LEDs with banana jacks for PLC interfacing.
- Four non-contact proximity sensors (magnetic reed sensors) located on the underside of the training panel with mating top side sensor used for vehicle depictions with banana jacks for PLC interfacing.
- Four LEDs to indicate vehicle presence.

Vehicles are manually entered into the intersection by positioning the mating sensor in proximity to the sensor located on the underside of the panel. The mating sensor represents the vehicle. The corresponding LED depicts the vehicle being present at the intersection.

Traffic light control (timing and sequencing) is done through programming the PLC. Training panel push-buttons can be optionally used for introducing more traffic control functionality, e.g., adding pedestrians or other more complex traffic intersection parameters.

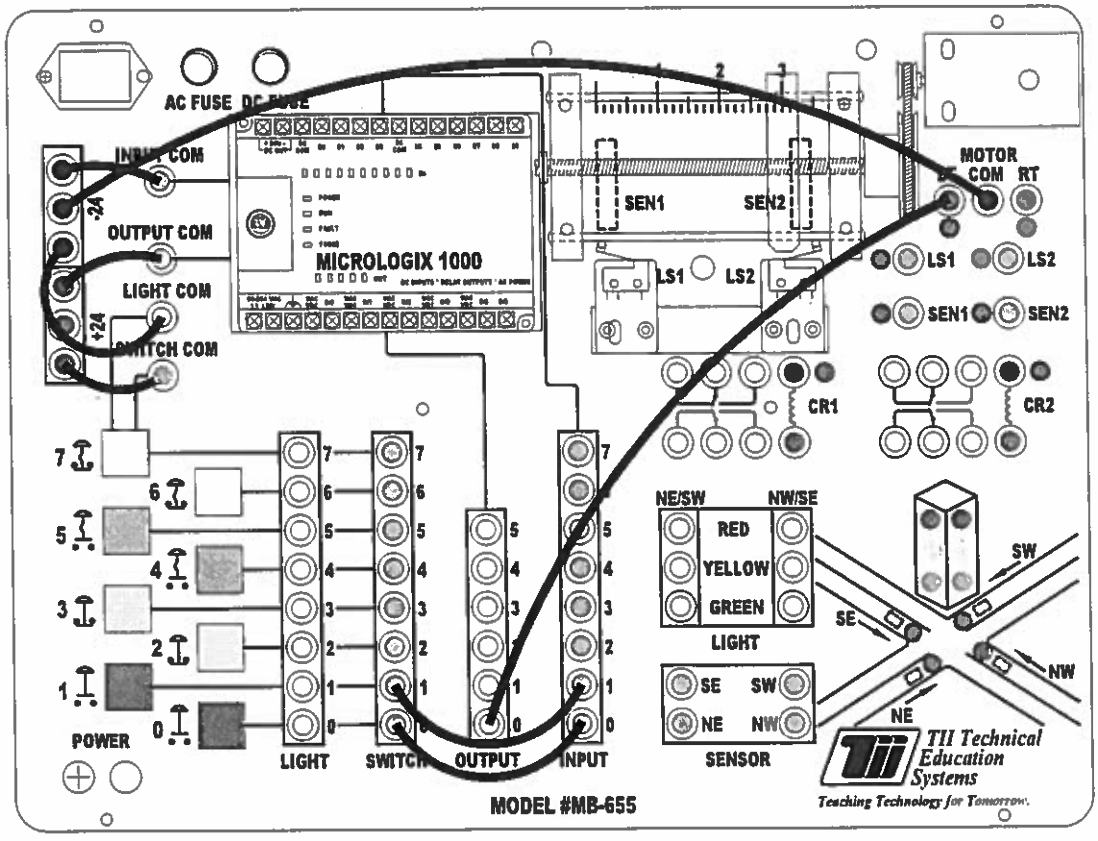
Exercise E1: Time Based Motor Application

Problem:

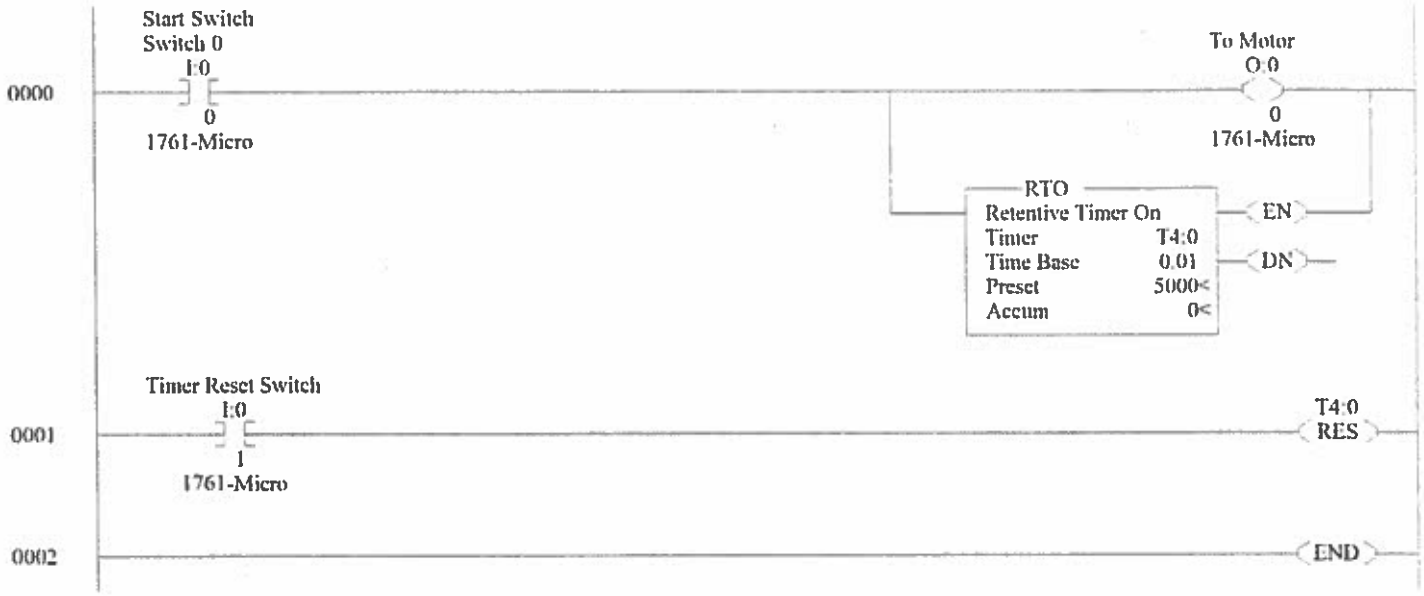
Use a retentive timer to measure 2 inches of travel of the Motor Screw Carriage. Use switch 0 to activate the sequence. Use switch 1 to reset the time for sequence recycling.

Procedure:

1. Determine the Carriage starting reference point and the desired two inch travel ending point. Use the moveable part with indicator as your guide. Note: use a starting reference point as shown on the panel scale between 0 and 1.
2. Press Switch 0 using PLC input 0 to activate motor and start timing the carriage movement.
3. Press switch 1 using PLC input 1 to reset the accumulated time and start the cycle over. Note: set the motor patch cord connection to LT (left) or RT (right) depending upon the direction of carriage travel.
4. Use PLC output 0 for motor motion control.
5. Create and download your program.
6. Make all the power and I/O patch cord connections.
7. How long does it take to travel the 2 inches?
8. Edit the program created in step 2 to have the Carriage travel 1 inch instead of 2 inches.
9. How long will it take the Carriage to travel the 1 inch?



LAD 2 - MAIN_PROG --- Total Rungs in File = 3



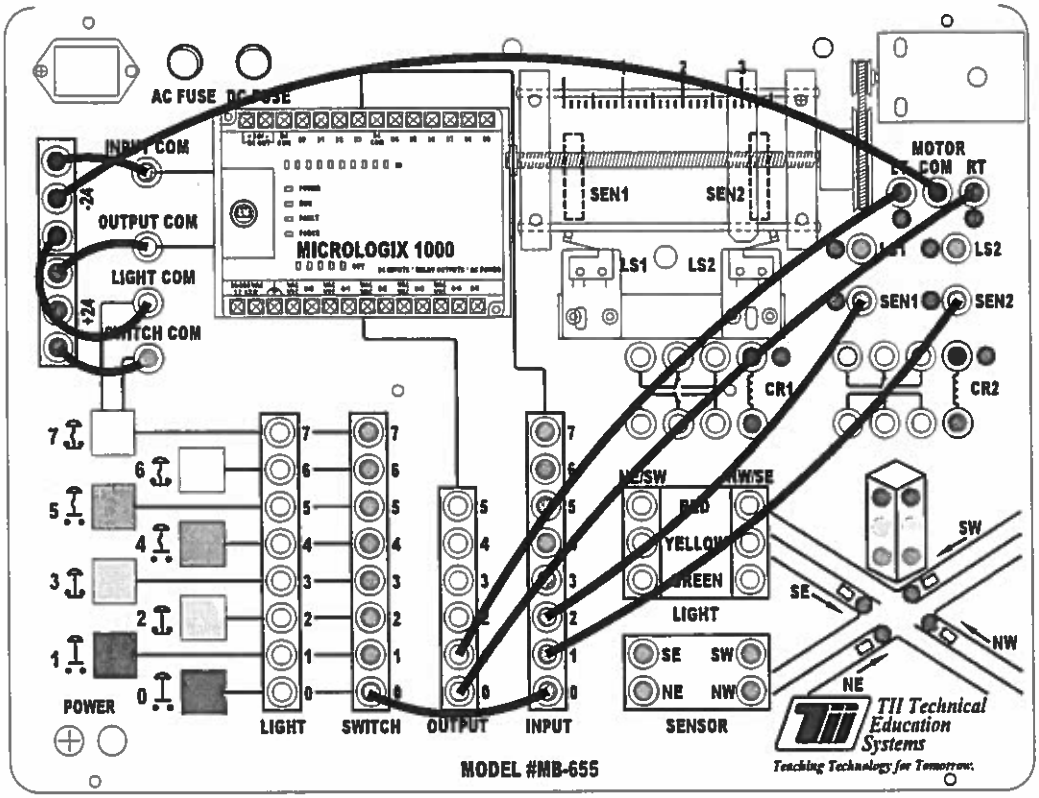
Exercise E2: Motor Application Using Sensors

Problem:

Use the Panel Sensors (Sen 1 and Sen 2) to determine the Motor Screw Carriage is correctly positioned. Control the motor rotation (forward and reverse) based on Sen 1 and Sen 2 inputs. Use switch 0 to activate the sequence.

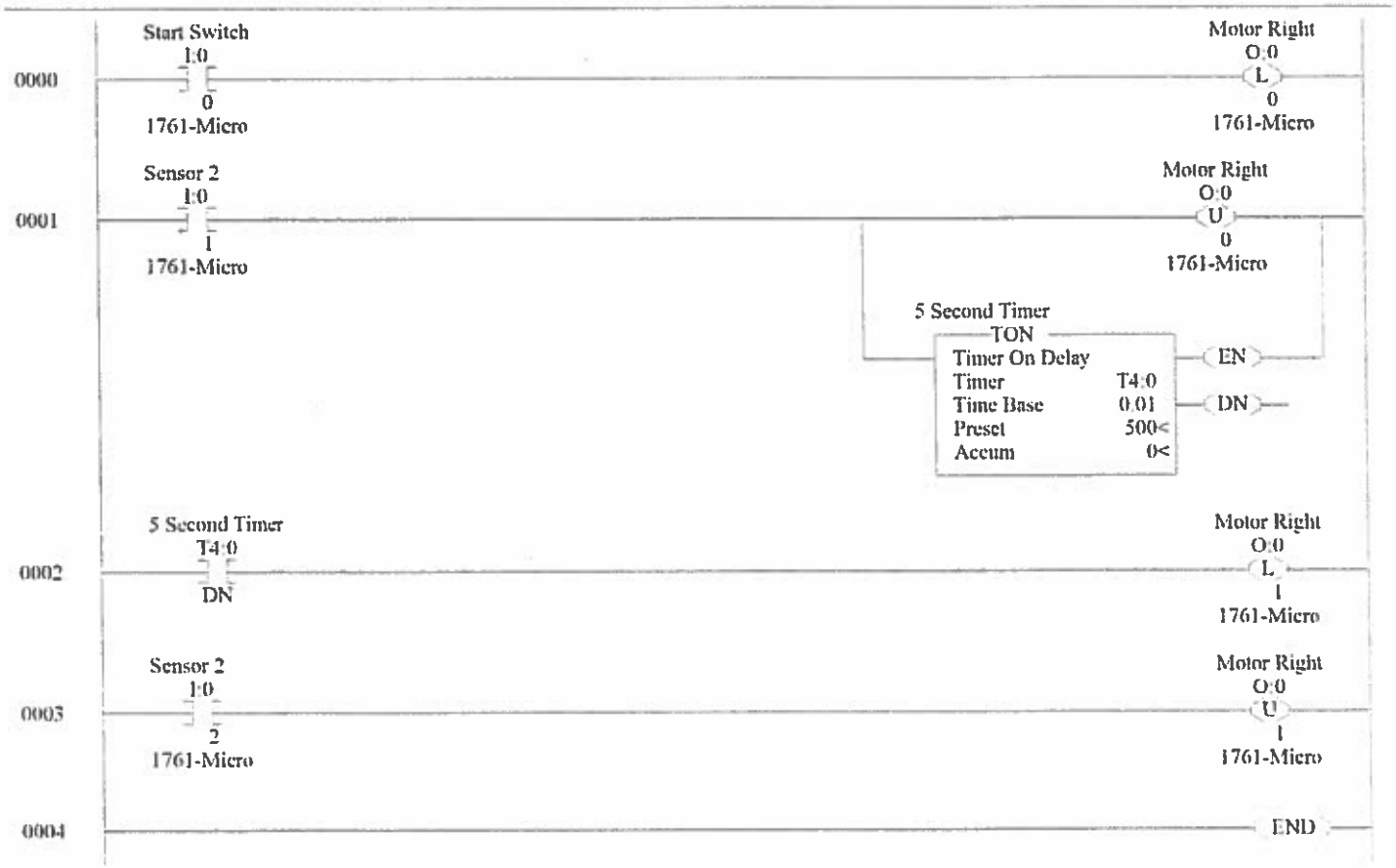
Procedure:

1. Position the Carriage so that sensor one (sen 1) is activated using PLC input 2. Note: sensor one (Sen 1) LED will be illuminated when the Carriage makes sensing contact with Sen 1.
2. Press switch 0 using PLC input 0 as a start switch to turn on the motor to move the Carriage from the left side of the stand to the right side of the stand. Use PLC output 0 and motor RT jacks.
3. Move the Carriage via motor operation until sensor two (sen 2) is activated using PLC input 1. Note: Sensor two (sen 2) LED will be illuminated when the Carriage makes sensing contact with Sen 2.
4. Once sensor two (sen 2) has been activated, stop the motor for 5 seconds.
5. After the 5 second delay, reverse the motor directional rotation using PLC output 1 and motor LT jacks to move the Carriage in the left direction toward the left side of the stand.
6. Move the Carriage via motor operation until sensor one (sen 1) is activated.
7. Stop the motor rotation at sensor one (sen 1). This completes the cycle.
8. Create and download your program.
9. Make all the power and I/O patch cord connections.
10. Edit the program created in step 8 using a counter to cycle the Carriage for three consecutive cycles without interruption. Use a pushbutton switch once to start the cycle sequence.



E2

LAD 2 - MAIN_PROG --- Total Rungs in File = 5



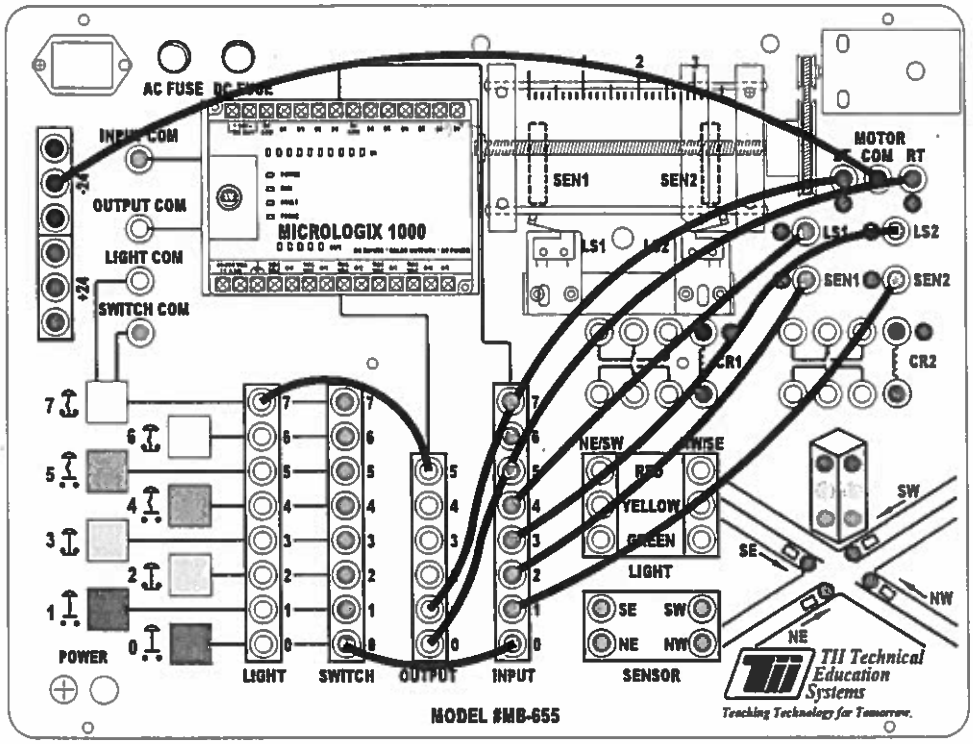
Exercise E3: AND Based Motor Application

Problem:

Use the Panel Sensors (Sen 1 and Sen 2) and Limit Switches (LS1 and LS 2) in combination to determine the Motor Screw Carriage is in position. Control the motor motion based on sensor and limit switch inputs. Use switch 0 to activate the sequence.

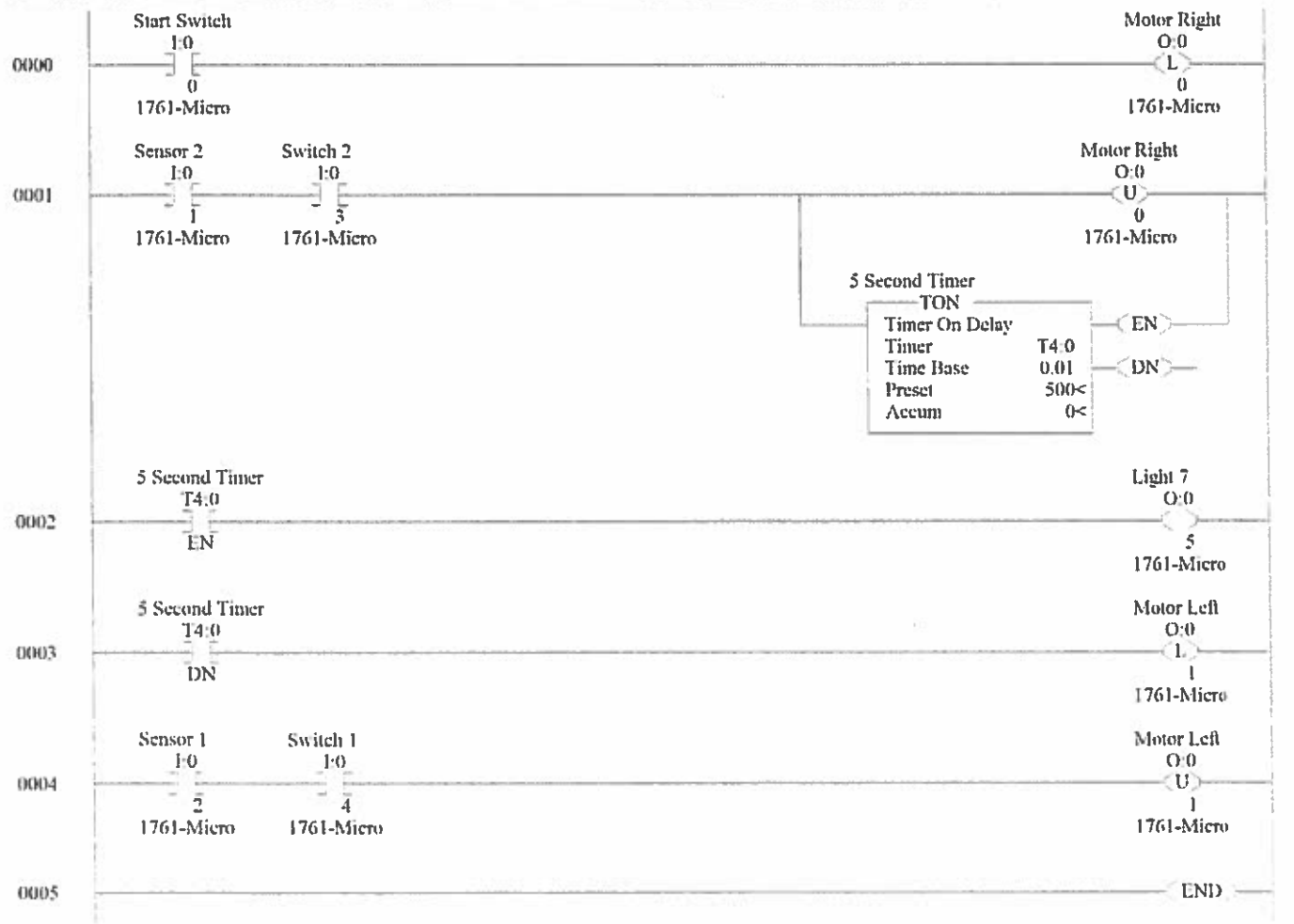
Procedure:

1. Adjust the Limit Switch (LS1 and LS2) positions by moving each switch approximately ½ inch "in" from the end of travel position.
2. Position the Carriage so that sensor one (sen 1) is activated using PLC input 2. Note: sensor one (sen 1) LED will be illuminated when the Carriage makes sensing contact with Sen 1.
3. Press switch 0 using PLC input 0 to latch PLC output 0 to activate the motor and move the Carriage to the right using the motor RT jacks.
4. Create an "AND" circuit with sensor two (Sen 2) using PLC input 1 and limit switch two (LS 2) using PLC input 3 to unlatch PLC output 0 to stop the motor motion.
5. Once the motor is stopped, use PLC output 5 to turn "on" light 7.
6. Use a timer to delay for 5 seconds.
7. After the 5 second delay, latch PLC output 1 to activate the motor and move the Carriage to the left using the motor LT jacks.
8. Create another "AND" circuit with sensor one (Sen 1) using PLC input 2 and limit switch one (LS 1) using PLC input 5 to unlatch PLC output 1 to stop the motor.
9. Create and download your program.
10. Make all the power and I/O patch cord connections.



E3

LAD 2 - MAIN_PROG --- Total Rungs in File = 6



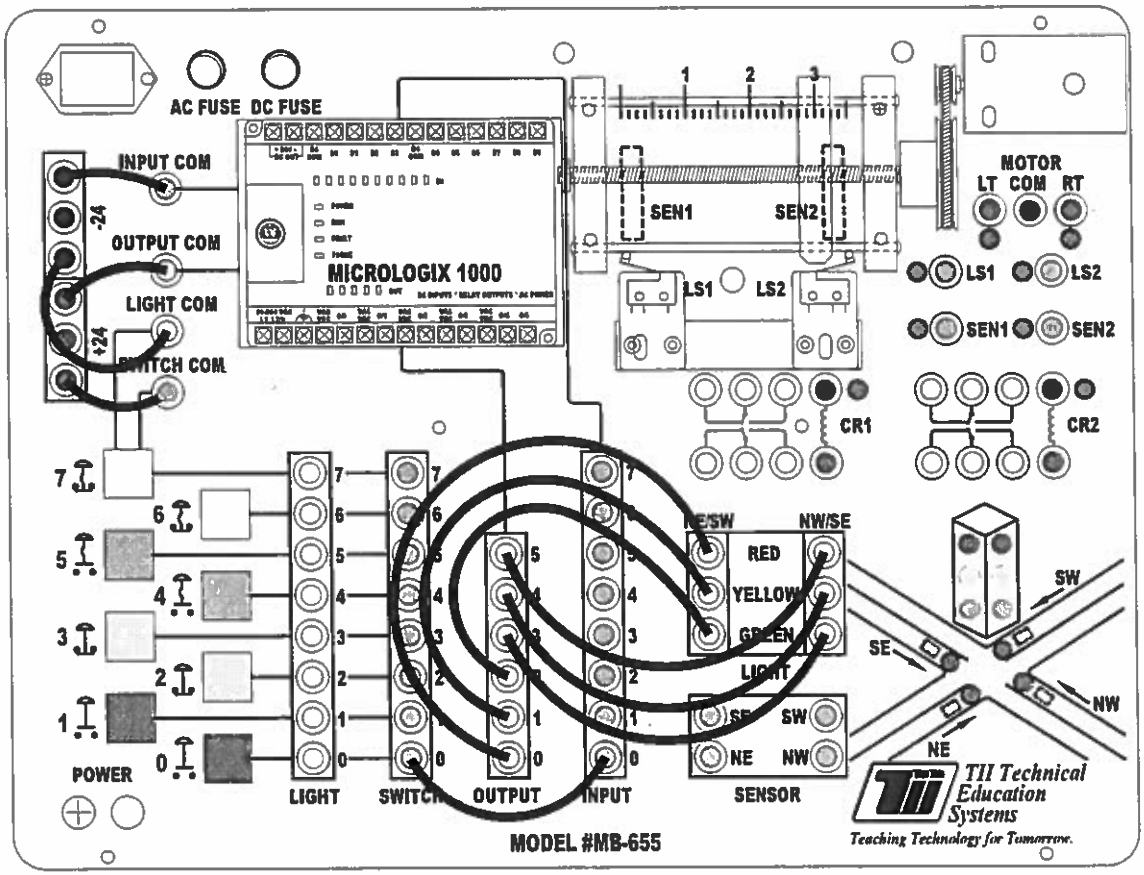
Exercise E4: Traffic Light With Timers

Problem:

Use cascading timers to cycle through the red, yellow, and green lights of the Traffic Signal Light in all traffic directions. Use switch 0 to start the cycle.

Procedure:

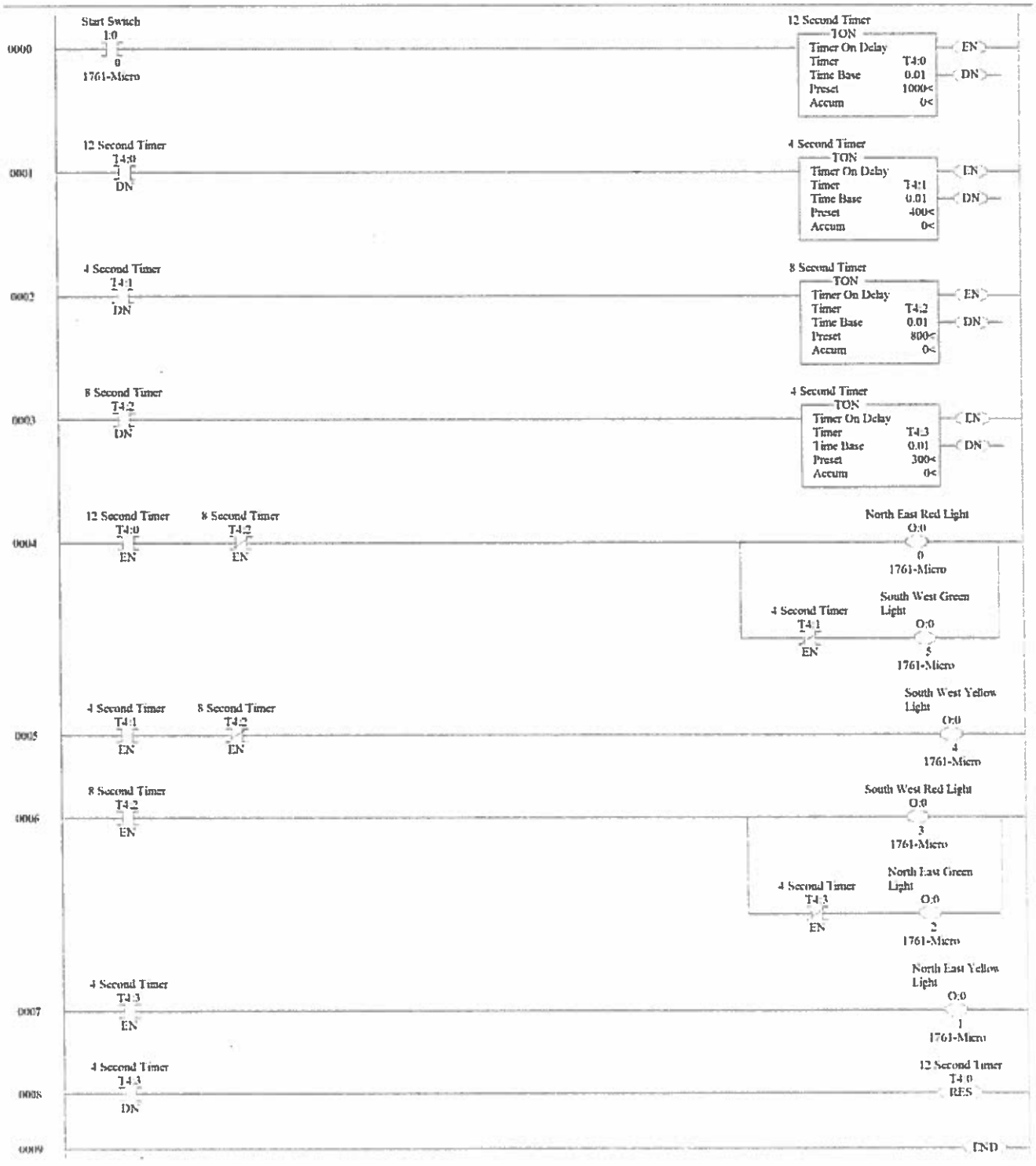
1. Use cascading timers for the NW/SE direction according to the following:
   a: Red NW/SE light using PLC output 5, set to a 10 second timer
   b. Yellow NW/SE light using PLC output 4, set to a 4 second timer
   c. Green NW/SE light using PLC output 3, set to a 8 second timer
2. Use cascading timers for the NE/SW direction according to the following:
   a: Red NE/SW light using PLC output 2, set to a 8 second timer
   b. Yellow NE/SW light using PLC output 1, set to a 3 second timer
   c. Green NE/SW light using PLC output 0, set to a 6 second timer
3. Press switch 0 using PLC input 0 to start the cycle.
4. Create and download your program.
5. Make all the power and I/O patch cord connections.



	NE Red	NE Yellow	NE Green	SW Red	SW Yellow	SW Green
Step 0	X					X
Step 1	X				X	
Step 2			X	X		
Step 3		X		X		

TRAFFIC LIGHT TIMERS E4

LAD 2 - MAIN_PROG --- Total Rungs in File = 10



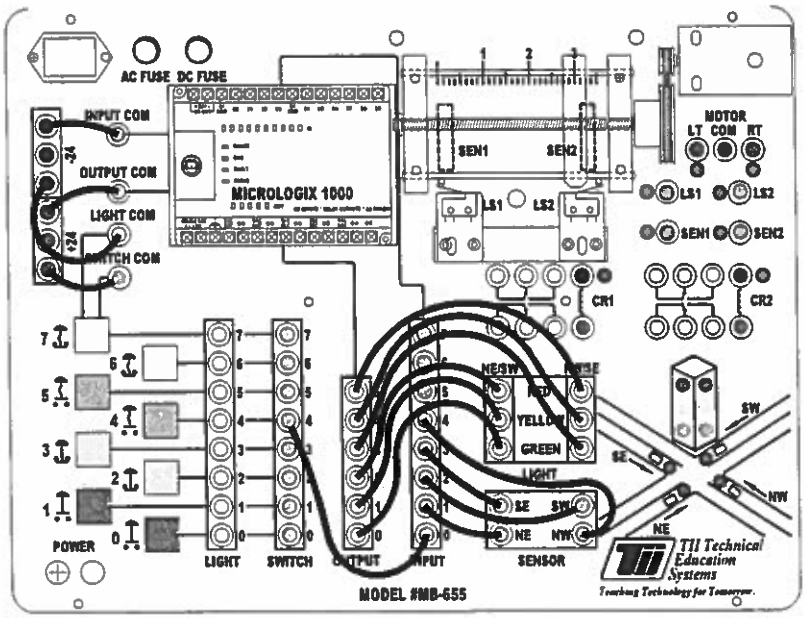
Exercise E5: Traffic Light With Sequencer

Problem:

Use a sequencer to cycle through the red, yellow, and green lights of the Traffic Signal Light in all traffic directions. Use switch 4 to start the cycle.

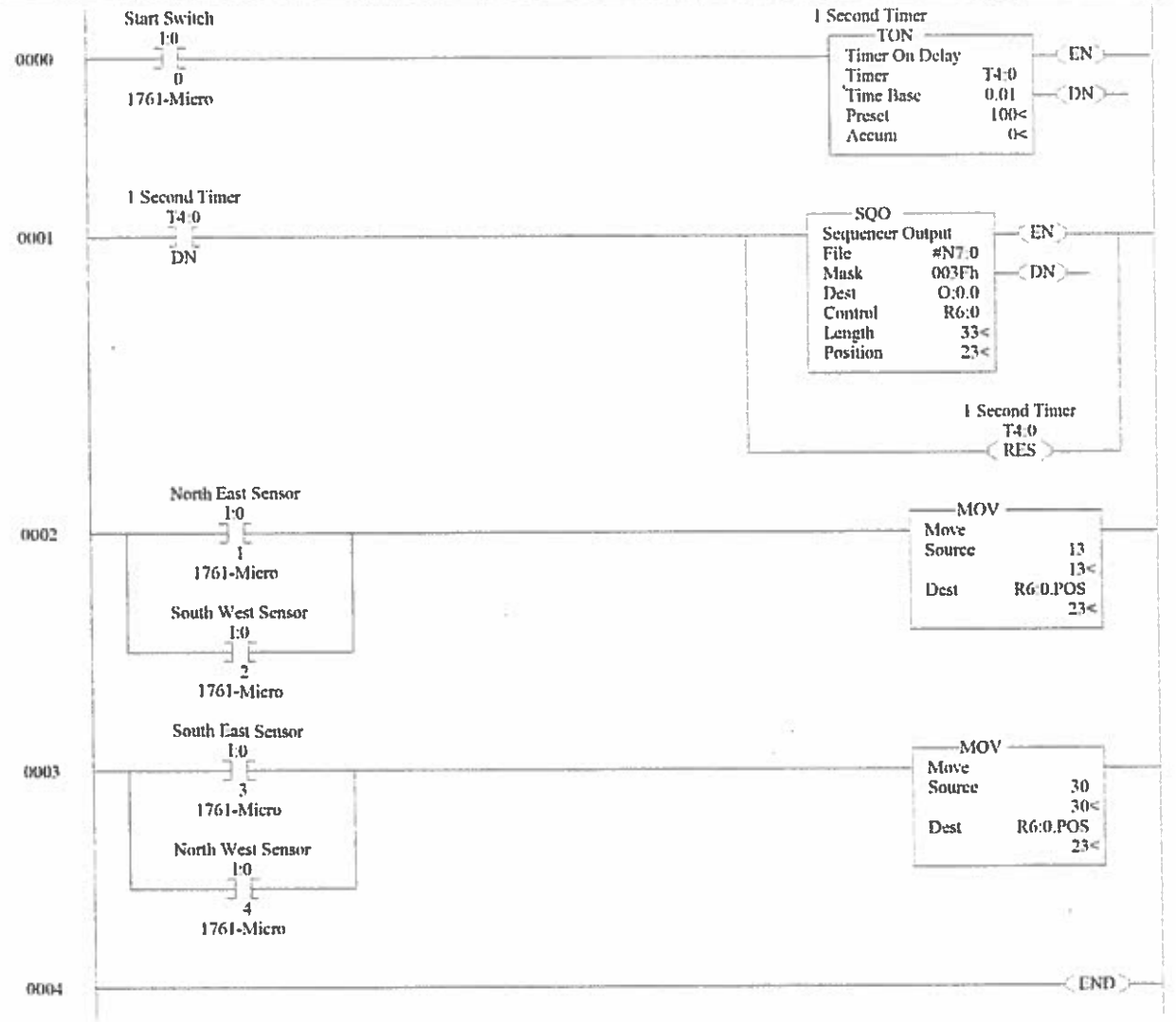
Procedure:

1. Use a sequencer for traffic light control in the NW/SE direction according to the following:
    a. Red NW/SE light using PLC output 5, set to a 12 second timer
    b. Yellow NW/SE light using PLC output 4, set to a 4 second timer
    c. Green NW/SE light using PLC output 3, set to a 8 second timer
2. Set a sequencer for traffic light control in the NE/SW direction according to the following:
    a. Red NW/SE light using PLC output 2, set to a 12 second timer
    b. Yellow NW/SE light using PLC output 1, set to a 4 second timer
    c. Green NW/SE light using PLC output 0, set to a 8 second timer
3. Connect the panel vehicle sensor representations according to the following:
    a. Set SE sensor to PLC input 3
    b. Set SW sensor to PLC input 2
    c. Set NE sensor to PLC input 1
    d. Set NW sensor to PLC input 4
4. Press switch 4 using PLC input 0 to start the cycle.
5. Create and download your program.
6. Make all power and I/O patch cord connections.
7. Edit the program created in step 5 by changing the Sequencer's sequence using the "MOVE" command.



TRAFFIC LIGHT SEQUENCER E5

LAD 2 - --- Total Rungs in File = 5



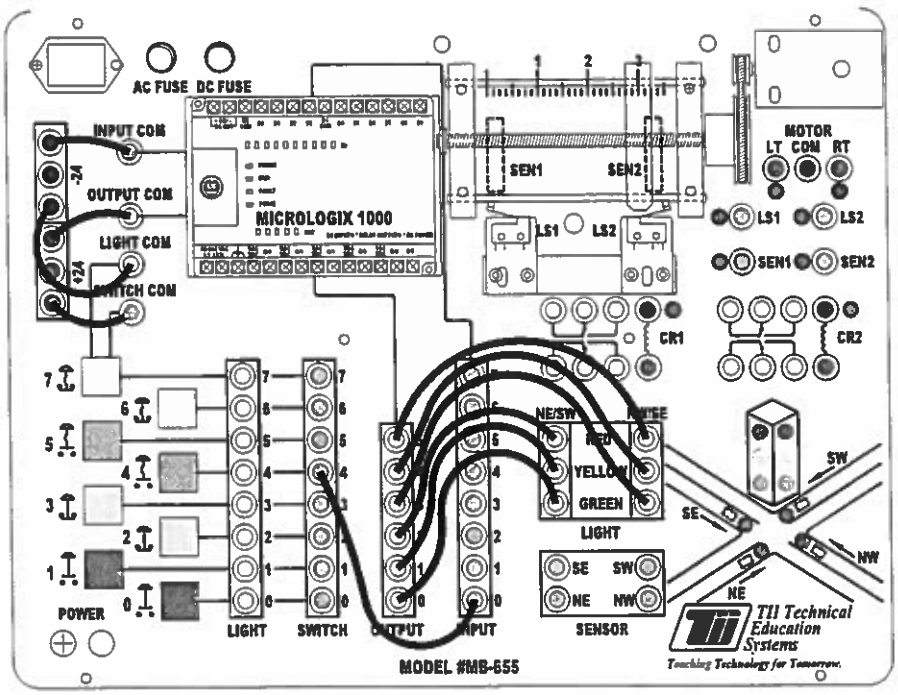
Exercise E6: Traffic Light With Timers and Delay

Problem:

Use cascading timers to cycle through the red, yellow, and green lights of the traffic in all traffic directions. Add a green light delay so that ALL traffic directions show a Red light is "on" before the Green light goes "on". Use switch 4 to start the cycle.

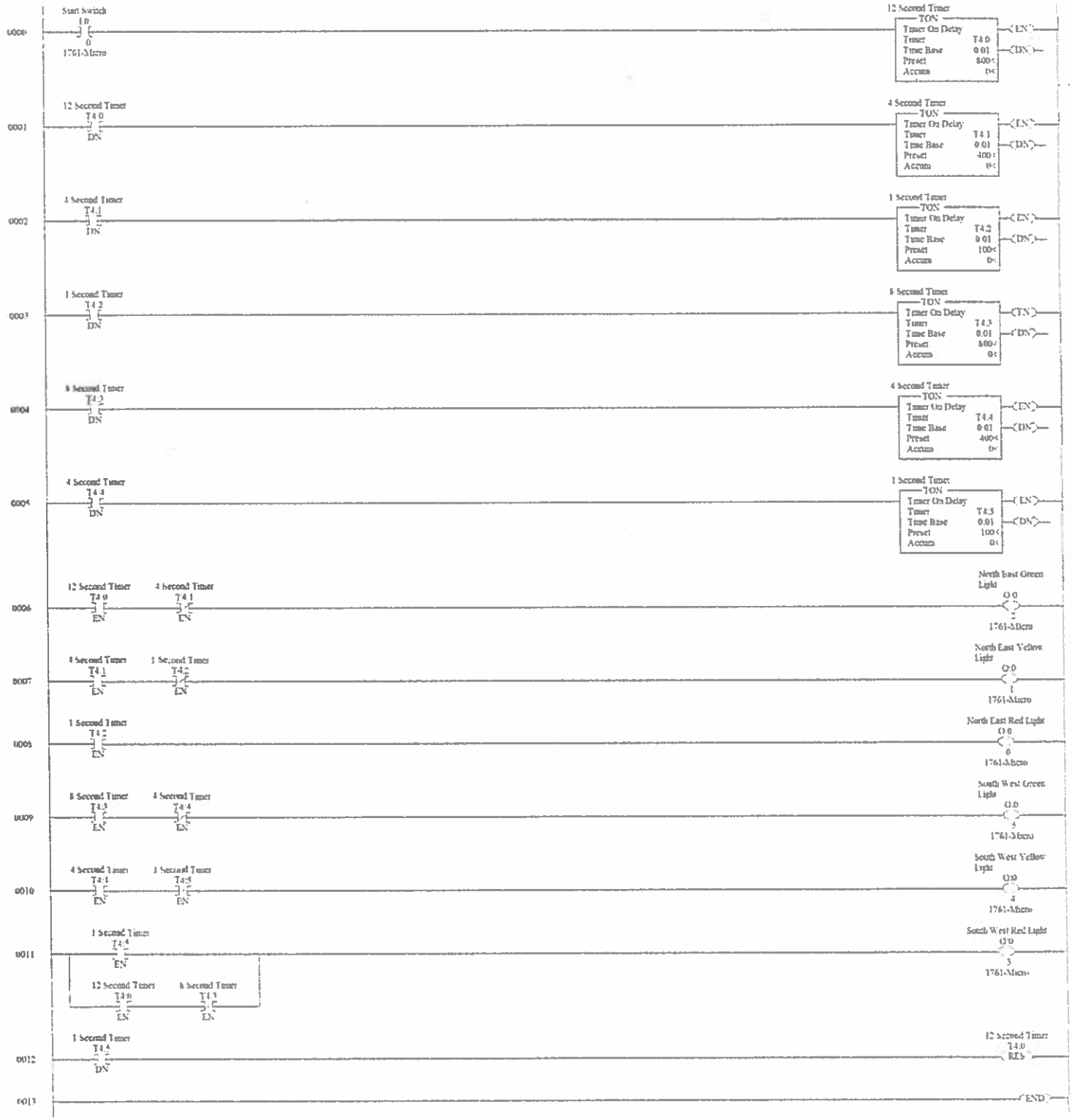
Procedure:

1. Use cascading timers for the NW/SE direction according to the following:
   a. Red NW/SE light using PLC output 5, set to a 8 second timer
   b. Yellow NW/SE light using PLC output 4, set to a 4 second timer
   c. Green NW/SE light using PLC output 3, set to a 8 second timer
2. Use cascading timers for the NE/SW direction according to the following:
   a. Red NE/SW light using PLC output 2, set to a 8 second timer
   b. Yellow NE/SW light using PLC output 1, set to a 4 second timer
   c. Green NE/SW light using PLC output 0, set to a 8 second timer
3. Add a one second delay between the Red and Green lights so that all traffic directions show that the Red light is "on" before the Green light goes "on".
4. Press switch 4 using PLC input 0 to start the cycle.
5. Create and download your program.
6. Make all power and I/O patch cord connections.



TRAFFIC LIGHT TIMERS AND DELAY E6

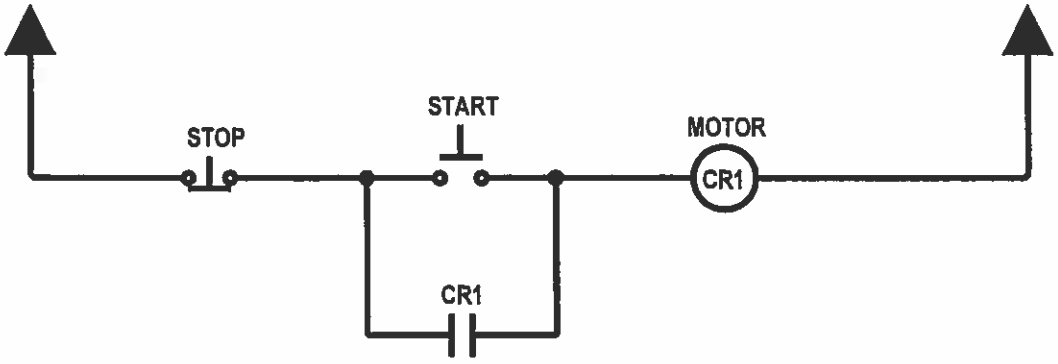
LAD 2 - MAIN_PROG --- Total Rungs in File = 14



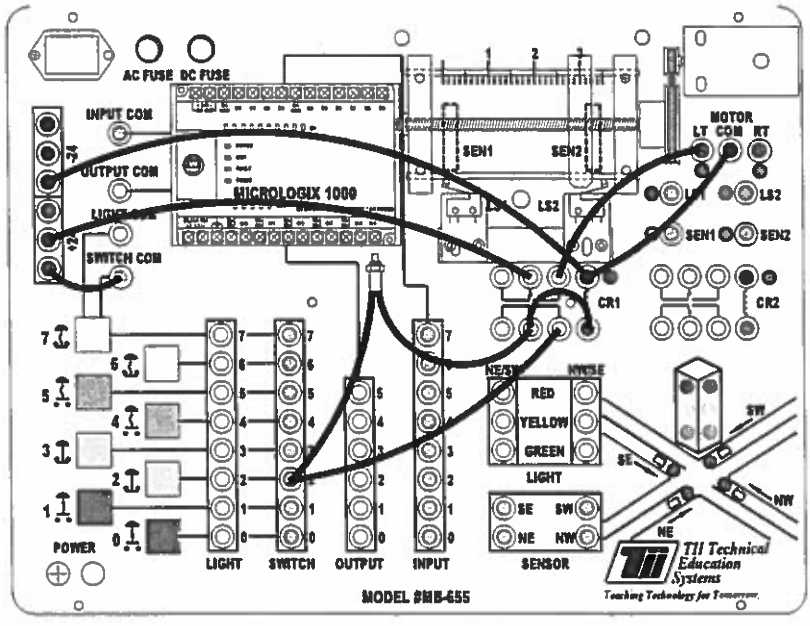
Exercise E7: Three-Wire Motor Control

Problem:

Use a relay and normally open independent switch to create a Three-Wire Motor Control circuit as shown in the schematic below.



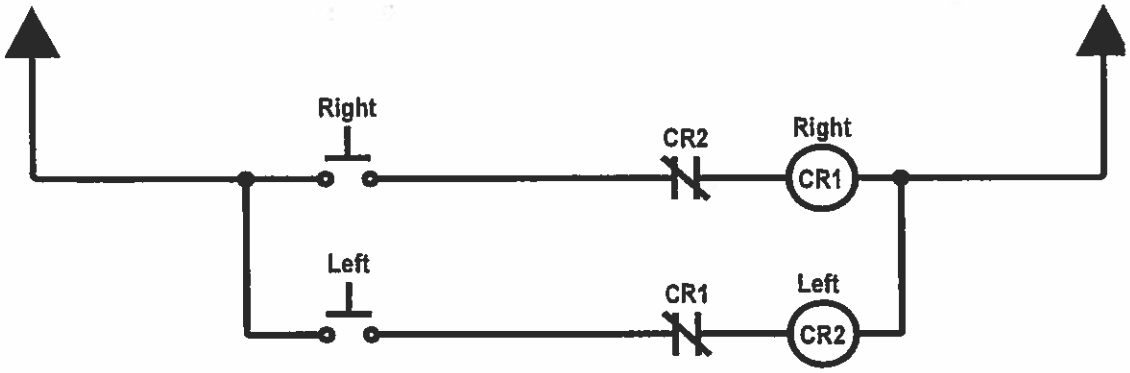
1. Position the Carriage to the far right side of the stand.
2. Connect the independent switch to switch two and relay CR1 on the panel.
3. Connect switch two on the panel to relay CR1.
4. Connect the motor LT jacks to the relay.
5. Make all power and relay patch cord connections.
6. Press the pushbutton on the independent switch to latch relay CR1.
7. Observe the motor motion and Carriage movement. Notice the relay acts as a motor starter.
7. Press switch two on the panel to unlatch relay CR1.
8. Observe the motor motion and Carriage movement.
9. What would you do to introduce sensors/limit switches into this problem?



Exercise E8: Reversing Motor Motion

Problem:

Use two relays and two switches for motor directional (forward and reverse) control as shown in the schematic below.



Procedure:

1. Connect switch 0 through the normally closed contacts of CR2 to the coil of CR1.
2. Connect switch 1 through the normally closed contacts of CR1 to the coil of CR2.
3. Push switch 0 to start the motor motion and move the Carriage to the right.
4. Push switch 1 to start the motor motion and move the Carriage to the left.
5. Push switch 0 and 1 together and the motor motion will be based on which switch was pressed first.