

LABORATORY SESSION 2

BASICS OF PROGRAMMABLE CONTROLLERS

PART II



Courtesy of Allen-Bradley

PURPOSE

Most industrial processes require the completion of several operations to produce the required output. Manufacturing, machining, assembling, packaging, finishing, or transporting of products requires the precise coordination of tasks. The majority of industrial control processors use *sequential* controls. Sequential controls are required for processes that demand certain operations be performed in a specific order.

The purpose of this session is to become familiar with a few simple typical industrial applications of the PLC, such as transporting of products, controlling motor starters and sequential control systems requiring timers and counters.

1. Stop/Start & Limit Switch Circuit

A simple process flow diagram for moving packages to a certain position is illustrated in Figure 2.1.

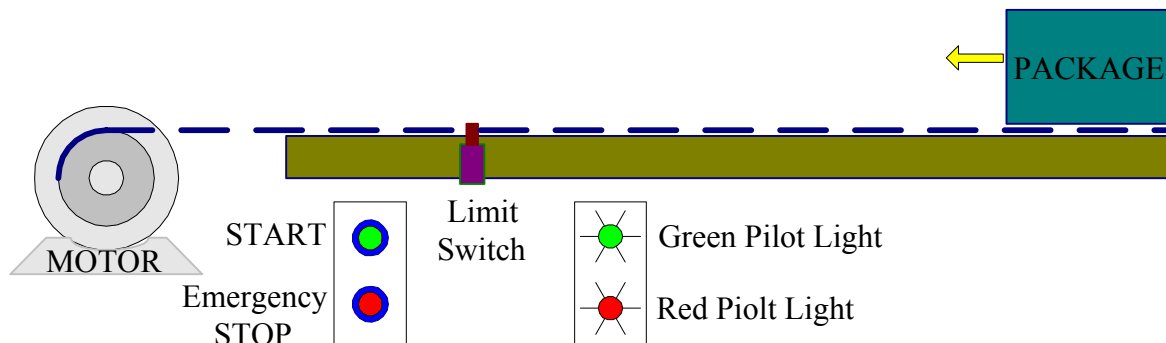


Figure 2.1 Process flow diagram.

The ladder program shown in Figure 2.2(a) is designed for the following sequential task:

1. Start pushbutton is pressed.
2. Table motor is started.
3. Package moves to the position of the limit switch and stops.
4. An emergency stop pushbutton is included to stop the table for any reason, before the package reaches the limit switch.
5. A red pilot light indicates the table is stopped.
6. A green pilot light indicates the table is running.

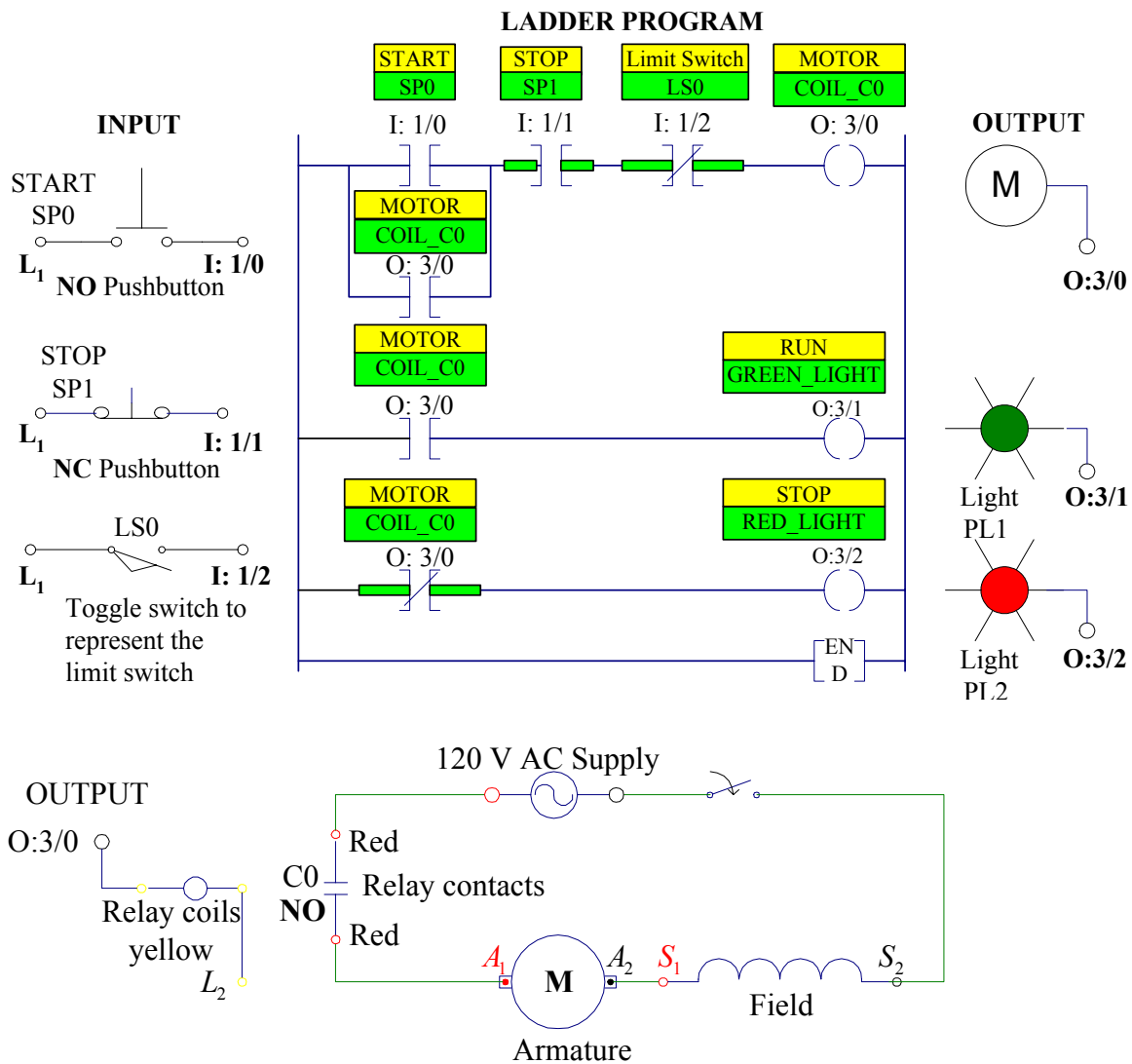


Figure 2.2(a) Ladder program for the process flow diagram
 Figure 2.2(b) Electric circuit for the table motor

PROCEDURE

Program the ladder diagram shown in Figure 2.2(a) using the RSLogix 500 software and connect the input/output circuits. Use the contactor C0 (18 Amps) to energize the armature of the motor. Connect the motor armature in series with its field winding via the contactor red terminals to a separate 120 V AC source as shown in Figure 2.2(b). Connect its yellow coil terminals to the related output address and the return supply L₂.

After your I/O circuits and ladder logic program have been checked by the instructor turn on the Processor Main Power and the 120 V supply to the motor. Follow the procedure in Laboratory Session to download the program to the SLC-500 and demonstrate its operation in Test and Run modes.

TURN OFF THE MAIN POWER.

2. Motor Starter Control

In most industrial applications we generally find the PLC controlling motor starters. Starters are required for dc motors and induction motors to limit the starting current and protect the armature winding. A universal motor (ac series motor) is used in this experiment. Although the above motor may be started directly from the rated voltage, it is required to start the motor with a resistor (~ 60-125W) as shown in Figure 2.3(b). The starter resistor is to be shorted out after 8 seconds.

The ladder program shown in Figure 2.3(a) is designed for the following sequential task:

1. Start pushbutton is pressed. Reference input SP0 (I:1/0) is closed, the output Coil_C0 (O:3/0) is energized. Contactor C0 closed and the motor starts with the resistance in the circuit.
2. Contact (O:3/0) across pushbutton closes sealing in the output Coil C0.
3. Contact (O:3/0) in the second rung closes and the timer is energized.
4. After 8 seconds TMR is enabled closing the timer contact (T4:0.DN) in the third rung. This will energize output Coil_C1 at (O:3/1). The contactor C1 across the resistor is closed, shorting out the resistor.
5. The stop pushbutton SP1 stops the motor releasing the holding contact across the START contact.

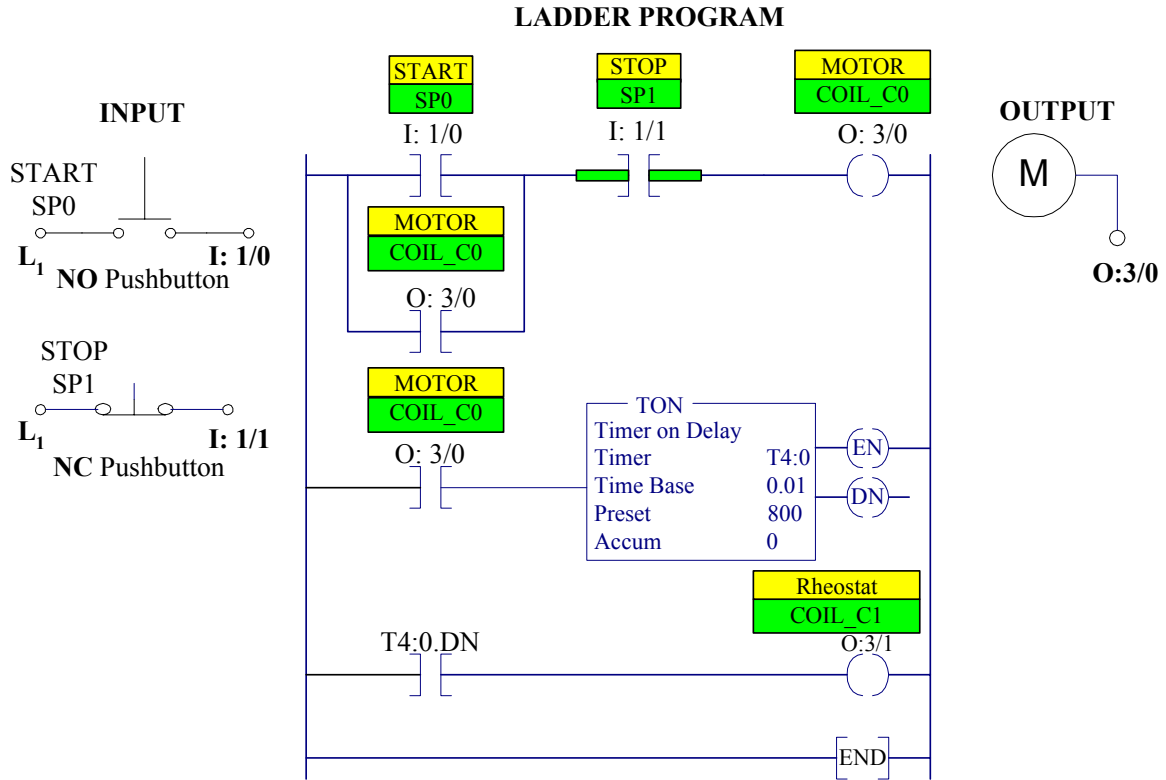


Figure 2.3(a) Ladder program for the motor starter control

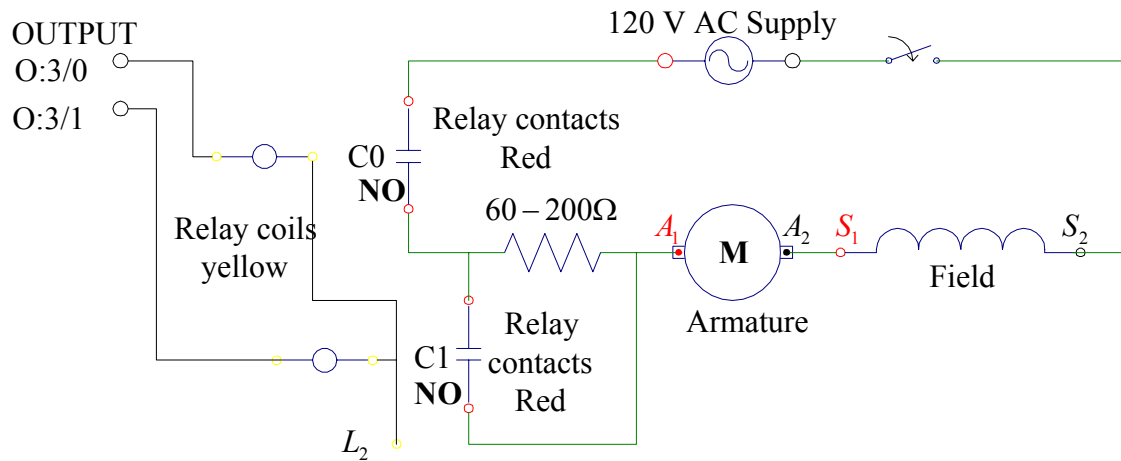


Figure 2.3(b) Electric circuit for the motor starter control

PROCEDURE

Program the ladder diagram shown in Figure 2.3(a) using the RSLogix 500 software and connect the input circuits. Use the contactor C0 (18 Amps) for the motor circuit. Connect the motor armature in series with its field winding via the contactor C0 red terminals to a separate 120 V AC source as shown in Figure 2.3(b). Connect its yellow coil terminals to the appropriate output address and the return supply L_2 . Connect contactor C1 red terminals across the starter resistor and its yellow coil terminals to the related output address and the return supply L_2 .

After your I/O circuits and ladder logic program have been checked by the instructor turn on the Processor Main Power and the 120 V supply to the motor. Follow the procedure in part 2.5 and 2.6 to download the program to the SLC-500 and demonstrate its operation in Test and Run modes.

TURN OFF THE MAIN POWER.

3. A simple counter application

The programmable controller includes both down counters and up counters. The up counter counts from zero up to the preset count where some action takes place. The down counter goes from a preset number down to zero where the action occurs. A conveyor motor diagram is shown Figure 2.4, illustrating the application of an up-counter. The counter counts the number of cases coming off the conveyor. When the total number of cases reaches 10, the conveyor motor stops automatically. A proximity switch is used to sense the passage of cases.

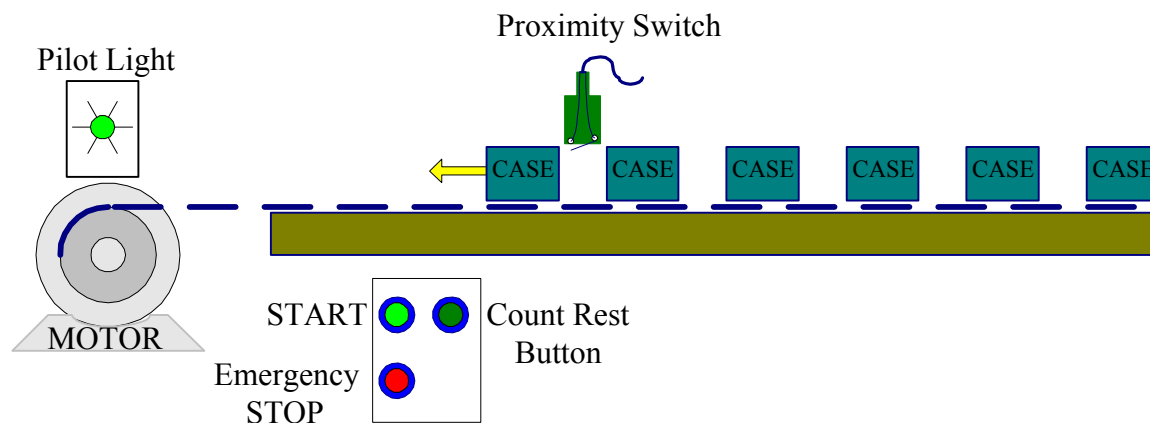


Figure 2.4 Processor flow diagram

The sequential task is as follows:

1. START button is pressed to start the conveyor motor.
2. Cases move past proximity switch and increment the counter's accumulated value.
3. After a count of 10 the conveyor motor stops automatically and the counter's accumulated value is reset to zero with SP2.
4. The conveyor motor can be stopped manually without loss of the accumulated count.
5. The accumulated count of the counter can be reset by means of the COUNTER RESET button.

REPORT REQUIREMENT

Obtain a hardcopy of your ladder logic diagram for each case study including Exercises 1 and 2. Include them in the report (refer to section 2.9). Outline the step-by-step sequence of operation and discuss the observations made during the operation for each case study.