

Lab Exercise 1

Simple Ladder Logic

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Objectives

This exercise is designed to provide working knowledge of the Allen Bradley ControlLogix, Micro800 (and the Connected Components Workbench), or MicroLogix/SLC-500 (and the RSLogix software). The PLC is programmed for simple logical operations using ladder logic diagrams and the appropriate software tools. Lamp loads and switches are used to simulate input/output conditions and the ladder logic programs are verified for correct operation.

I. Wiring the Lights and Switches

Connect the lights and switches to the I/O modules. Typical connections to the modules are shown in Figures 1 - 12 (Note: **these are not the actual connections; you need to figure that out**). Use the appropriate figures depending on the PLC (ControlLogix, Micro800, or SLC-500). A diagram of the switches and lights is shown in Fig. 7. Use the following connections:

Tag/Symbol/ Variable			ControlLogix	SLC	MLogix	Micro 800	
	Slot	Channel	Address	Address	Address	Channel	Address
Start_PB	1	00	1:I.Data.0	I:1/00	I:0/00	0	_IO_EM_DI_00
Stop_PB	1	01	1:I.Data.1	I:1/01	I:0/01	1	_IO_EM_DI_01
SW3	1	02	1:I.Data.2	I:1/02	I:0/02	2	_IO_EM_DI_02
SW4	1	03	1:I.Data.3	I:1/03	I:0/03	3	_IO_EM_DI_03
LA1	2	00	2:O.Data.0	O:2/00	O:0/00	0	_IO_EM_DO_00
LA2	2	01	2:O.Data.1	O:2/01	O:0/01	1	_IO_EM_DO_01
LA3	2	02	2:O.Data.2	O:2/02	O:0/02	2	_IO_EM_DO_02
LA4	2	03	2:O.Data.3	O:2/03	O:0/03	3	_IO_EM_DO_03
LA5	2	04	2:O.Data.4	O:2/04	O:0/04	4	_IO_EM_DO_04

Double-check your wiring before you apply power !!

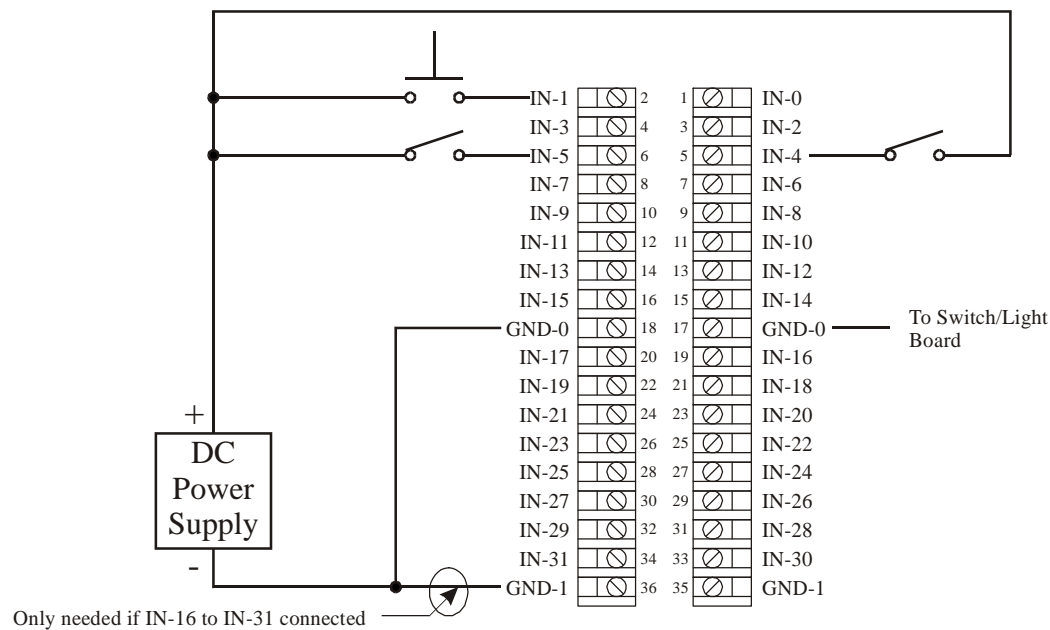


Fig. 1. Example ControlLogix IB32 DC Input Module Connection Diagram.

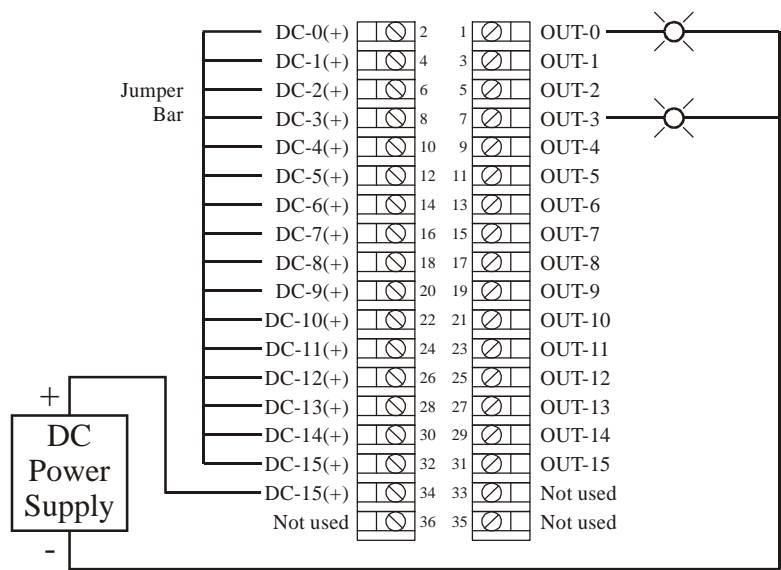


Fig. 2. Example ControlLogix OB16I DC Output Module Connection Diagram.

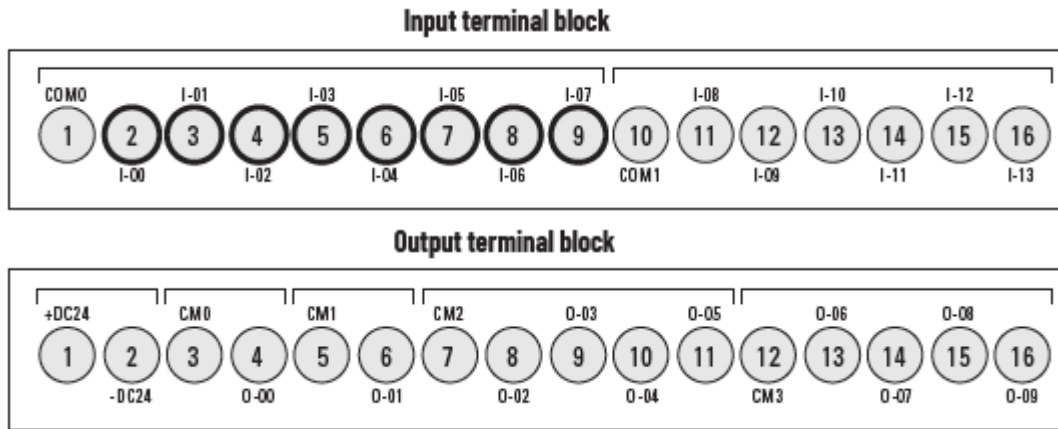
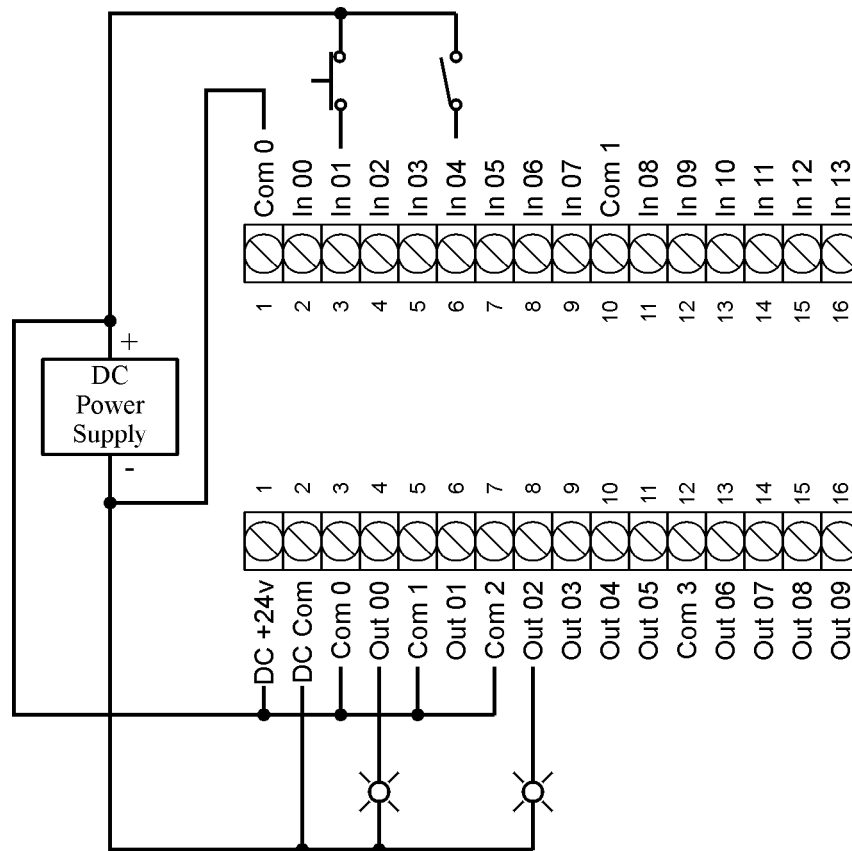


Fig. 3. Micro 850 terminal block layout (From Rockwell Automation).



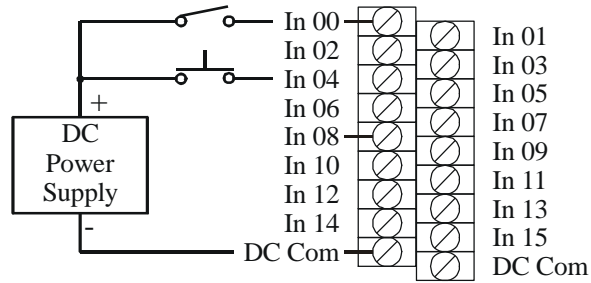


Fig. 5. Example SLC-500 IB16 DC Input Module Connection Diagram.

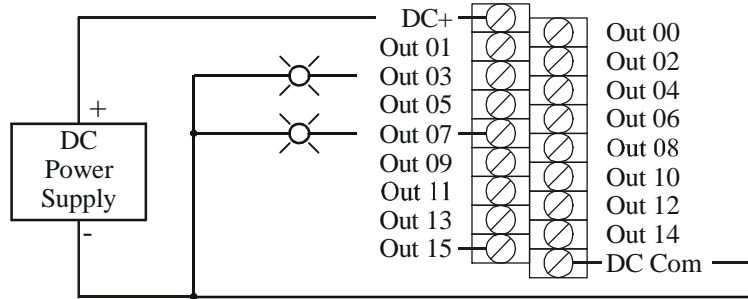


Fig. 6. Example SLC-500 OB16 DC Output Module Connection Diagram

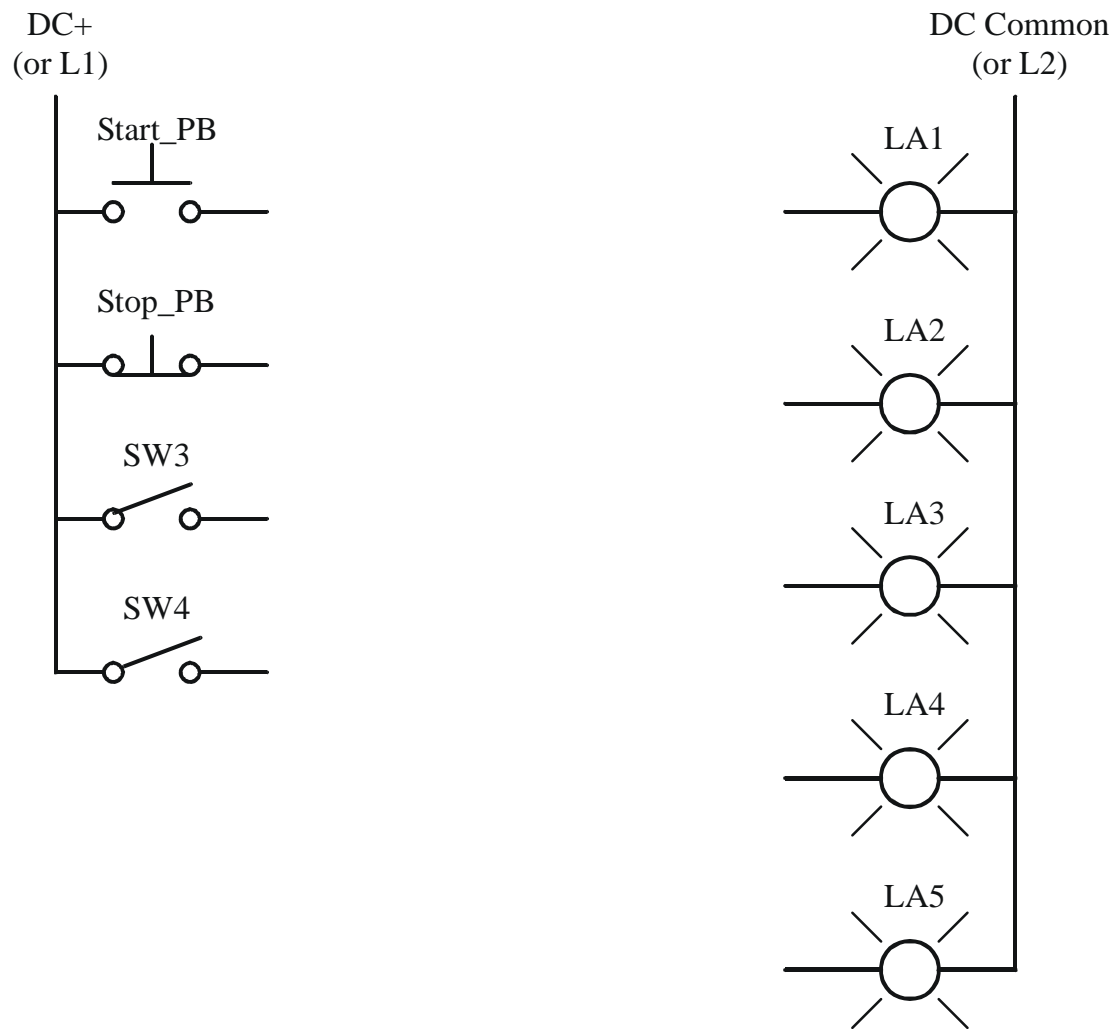


Fig. 7. Switch and light board connections.

II. Series Operation (Logical AND)

Two switches in series are used to control a lamp load. The circuit and the corresponding ladder logic is shown in Fig. 8. The input and output addresses are shown in the ladder logic. Follow the instructions in part A of the appropriate software programming guide (Studio 5000, CCW, or RSLogix500) to set up the processor project. Then follow the procedure in part B.1 to program and test the ladder logic.

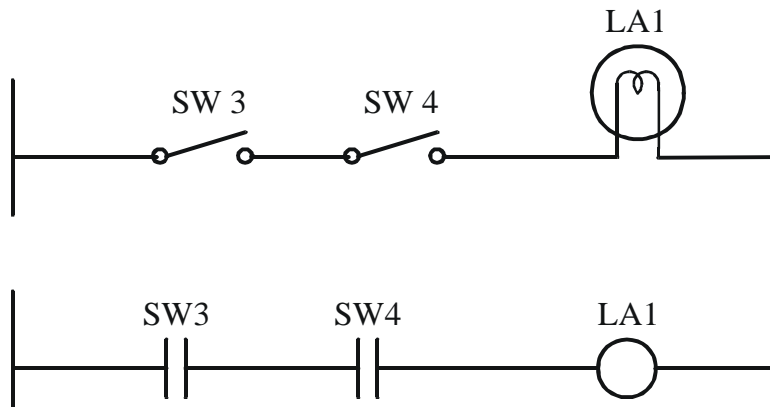


Fig. 8. Series switch circuit and its ladder logic equivalent.

III. Parallel Operation (Logical OR)

Connect two switches in parallel, as shown in Fig. 9, which is a logical OR condition. The instructions to program the PLC are in part B.2 of the appropriate software programming guide. Demonstrate the PLC operation to the instructor.

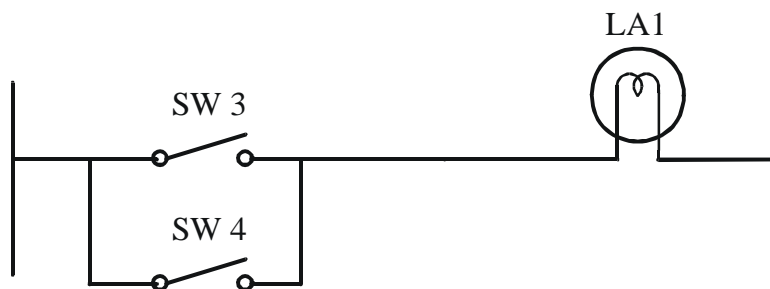


Fig. 9. Parallel switch circuit.

IV. Motor Start/Stop

Using the Start_PB and Stop_PB switches and one lamp, implement a motor start/stop circuit. The start switch is a normally open pushbutton switch and the stop switch is a normally closed pushbutton switch. Demonstrate the PLC operation to the instructor.

V. Timer Operation

Devise a ladder logic program to do the following:

- a. When a switch is closed, one lamp lights.
- b. Five seconds later, another lamp lights.

The instructions to program the PLC are in part B.3 of the appropriate software programming guide. Demonstrate the PLC operation to the instructor.

VI. Counter Operation

Devise a ladder logic program to do the following:

When a switch is closed five times, one lamp lights.

The instructions to program the PLC are in part B.4 of the appropriate software programming guide. Demonstrate the PLC operation to the instructor.

VII. Flashing Lights.

Devise ladder logic using two lamps and two timers to make the two lamps flash alternately. Choose any on/off period. Use one of the switches to turn the flashing lights on and off. Demonstrate the PLC operation to the instructor. You will need to use this ladder logic for anything flashing/beeping/cycling and so it appears in many contexts.

VIII. Turn Signal.

Devise ladder logic using SW3 and SW4 and timers to produce a turn signal indication (like the old Thunderbirds) with the five lamps. If SW3 is on, the lights should flash to show a left turn. The sequence should be ●●●●○, ●●●○, ●●○○, ●○○○, ○○○○, ●●●● (where ○ means a lamp is on and ● means lamp off). If SW4 is on, the lights should flash to signal a right turn. The right turn sequence should be ○●●●●, ○○●●●, ○○○●●, ○○○○●, ○○○○○, ●●●●●. If both switches are on, then no lamps should flash. The patterns should repeat as long as either switch is on. Each "pattern" in the sequence should be displayed. There should be a time interval for which **no** outputs are on. Choose any reasonable timing intervals. Demonstrate the PLC operation to the instructor.