

Mechatronics

PLC Applications

Traffic Lights

Job Sheets - Courseware Sample

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By the staff of Festo Didactic

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

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








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Safety and Common Symbols

The following safety and common symbols may be used in this manual and on the equipment:

Symbol	Description
	DANGER indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
	WARNING indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
	CAUTION indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
	CAUTION used without the <i>Caution, risk of danger</i> sign  , indicates a hazard with a potentially hazardous situation which, if not avoided, may result in property damage.
	Caution, risk of electric shock
	Caution, hot surface
	Caution, risk of danger
	Caution, lifting hazard
	Caution, hand entanglement hazard
	Notice, non-ionizing radiation
	Direct current
	Alternating current
	Both direct and alternating current
	Three-phase alternating current

Safety and Common Symbols

Symbol	Description
	Earth (ground) terminal
	Protective conductor terminal
	Frame or chassis terminal
	Equipotentiality
	On (supply)
	Off (supply)
	Equipment protected throughout by double insulation or reinforced insulation
	In position of a bi-stable push control
	Out position of a bi-stable push control

We invite readers of this manual to send us their tips, feedback, and suggestions for improving the book.

Please send these to did@de.festo.com.

The authors and Festo Didactic look forward to your comments.

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To the Instructor

Lab-Volt's *Programmable Logic Controller, Basic Principles Using the Programming Software* student manual (P/N 36017) allowed familiarization with PLCs and ladder programming. This was accomplished with the help of Lab-Volt's Programmable Logic Controller Training System (Model 3240).

The aim of the present series of PLC applications is to integrate the basic principles previously acquired by designing small-scale systems that can be found in the real world. Through practical examples, students will gain a strong know-how of the PLC field of study.

Each manual of the PLC applications series concentrates on a specific example of PLC application that evolves along a path of increasing complexity. With each manual, new components are added to the PLC module to create different opportunities to learn.

This Instructor Guide provides the instructor with complete solutions to all procedure questions found in the corresponding student manual. The instructor should be familiar with PLCs to recognize erroneous results. It is advised that a complete runthrough of each job sheet be included in the instructor's preparation for class. Each Job Sheet has several performance objectives. The instructor should ensure that each student understands them.

Sample
Extracted from
Job Sheets - Student

Sample
Extracted from
Job Sheets - Instructor

Basic Traffic Light System

ANSWERS TO PROCEDURE STEP QUESTIONS

□ 3.

TIMING DIAGRAM (LEADS TO TRANSITIONS TABLE)

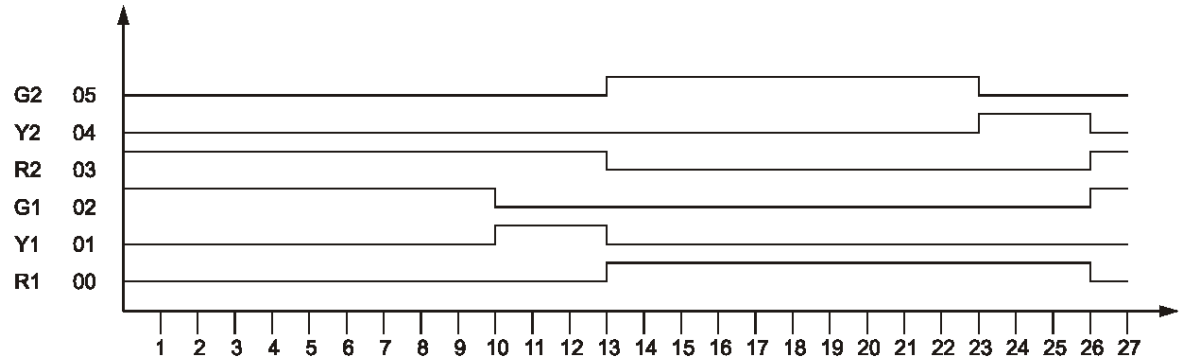


Figure 1-1. Timing Diagram of Job Sheet 1.

26 seconds

4 states

□ 4.

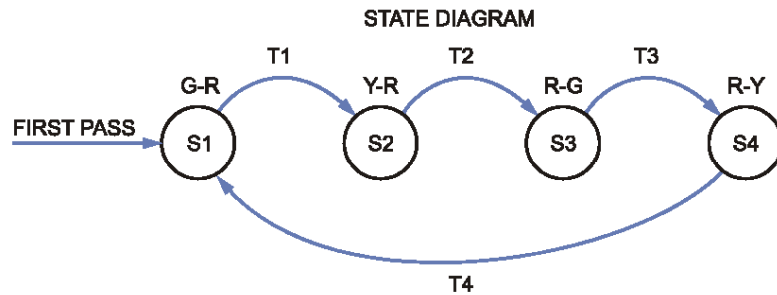


Figure 1-2. State Diagram of Job Sheet 1.

4 transitions

T1: FROM State 1 TO State 2 UPON TIMER.ACC ≥ 10s

T2: FROM State 2 TO State 3 UPON TIMER.ACC ≥ 13s

T3: FROM State 3 TO State 4 UPON TIMER.ACC ≥ 23s

T4: FROM State 4 TO State 1 UPON TIMER.ACC ≥ 26s

□ 5.

State	G2	Y2	R2	G1	Y1	R1
1	0	0	1	1	0	0
2	0	0	1	0	1	0
3	1	0	0	0	0	1
4	0	1	0	0	0	1

Table 1-2. State table of Job Sheet 1.

□ 6.

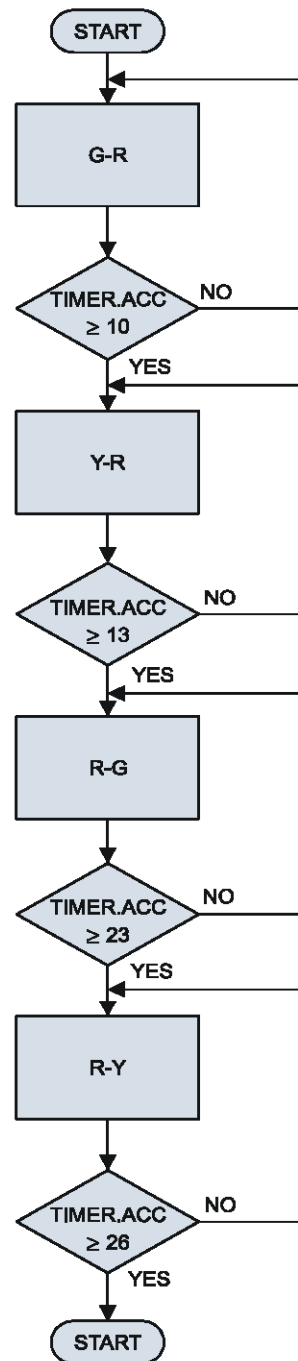


Figure 1-3. Flowchart of Job Sheet 1.

□ 7.

$$S1 = (S1 + S4 \cdot T4) \cdot \overline{S1 \cdot T1} = (S1 + S4 \cdot (TIMER.ACC \geq 26)) \cdot (\overline{S1} + (TIMER.ACC < 10)) + \text{First Pass}$$

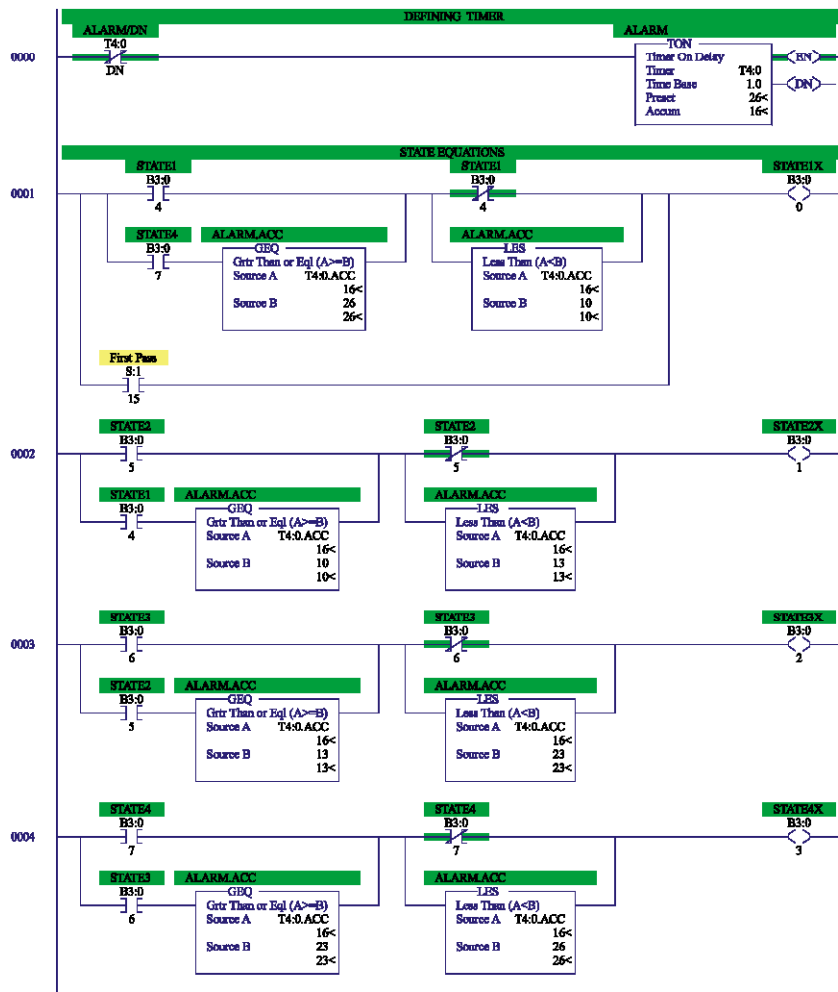
$$S2 = (S2 + S1 \cdot T1) \cdot \overline{S2 \cdot T2} = (S2 + S1 \cdot (TIMER.ACC \geq 10)) \cdot (\overline{S2} + (TIMER.ACC < 13))$$

$$S3 = (S3 + S2 \cdot T2) \cdot \overline{S3 \cdot T3} = (S3 + S2 \cdot (TIMER.ACC \geq 13)) \cdot (\overline{S3} + (TIMER.ACC < 23))$$

$$S4 = (S4 + S3 \cdot T3) \cdot \overline{S4 \cdot T4} = (S4 + S3 \cdot (TIMER.ACC \geq 23)) \cdot (\overline{S4} + (TIMER.ACC < 26))$$

- Notes:
- $\overline{TIMER.ACC} \geq x = TIMER.ACC < x$
 - Putting the "First Pass" variable in the first state equation is equivalent to setting the system in state 1 during initialization.

□ 10.



(a)

Figure 1-4a. Ladder Program of Job Sheet 1.

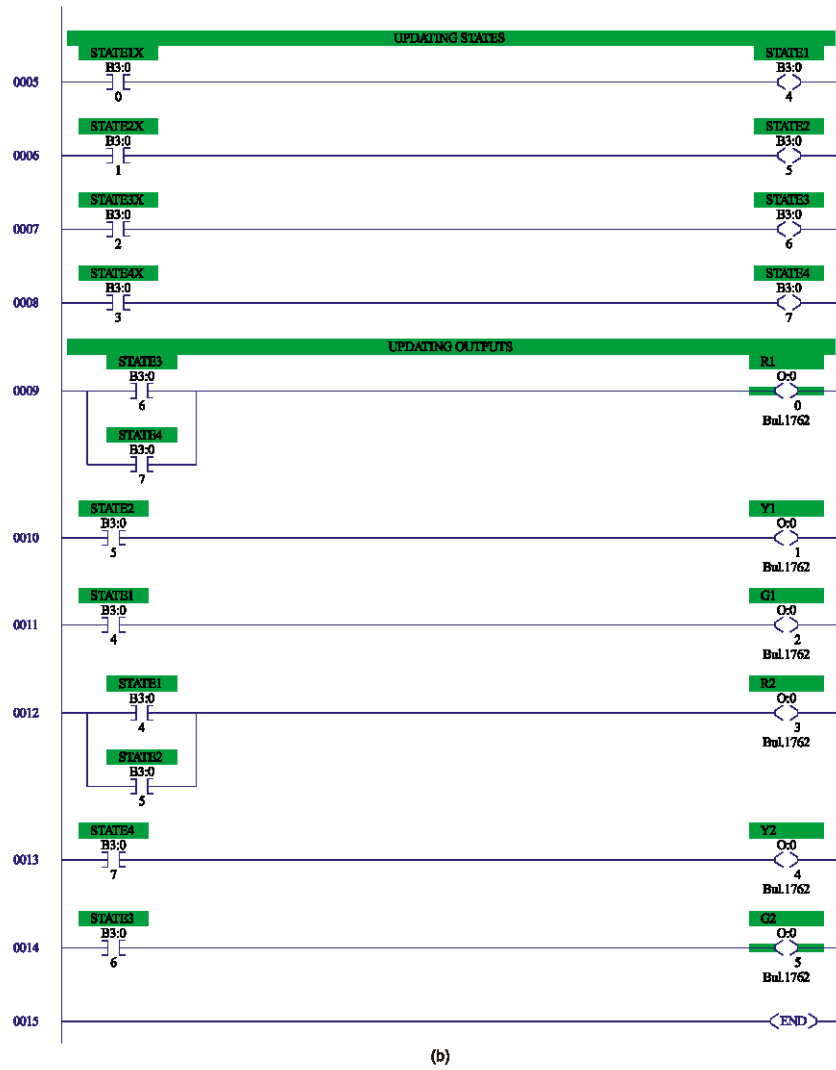


Figure 1-4b. Ladder Program of Job Sheet 1 (cont'd).

