Electric Power / Controls

Courseware Sample

85251-F0

Lab-Volt®

ELECTRIC POWER / CONTROLS

COURSEWARE SAMPLE

by
the Staff
of
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Introduction

Programmable Logic Controllers (PLC's) represent state-of-the-art microprocessor-based electronics that make up technologically advanced control systems with applications in virtually every segment of industry where automation is required.

The present manual includes five Job Sheets that introduce students to PLC control of the Electro-Mechanical – DC Motor Application, Model 3293. Throughout the manual, students will learn how to program, connect, operate, and troubleshoot different configurations.

The corresponding Lab-Volt Instructor Guide (P/N 85251-30) provides answers to all questions and activities found in this manual.

Courseware Outline

PLC APPLICATIONS – ELECTROMECHANICAL SYSTEMS USING DC MOTORS

Sample Job Sheet

Extracted from

PLC Applications – Electromechanical Systems

Using DC Motors

FAMILIARIZATION WITH THE ELECTROMECHANICAL – DC MOTOR SYSTEM

Motion Control

The sub-field of automation pertaining to position and/or speed regulation is called motion control. Motion control is widely used in the packaging, printing, textile and assembly industries. It also plays an important role in robotics and CNC (computer numerical control) machine tools.

A typical motion control system contains:

– A motion controller (e.g. a PLC).
– A drive or amplifier to transform the control signal (often desired velocity or torque signal) into a higher power output.
– An actuator such as a hydraulic pump, air cylinder, linear actuator, or electric motor for output motion.
– A feedback sensor such as an optical encoder, or proximity switch to return the position of the actuator to the motion controller.
– Mechanical components (gears, bearings, lead screw, etc.) to transform the motion of the actuator into the desired motion.

Electromechanical Systems

The Electromechanical System – DC Motor from Lab-Volt is designed to study PLC programming in the context of a motion control application. Figure 1-1 shows the PLC and the DC Motor drive used to control the position and the velocity of a sliding block moving on a lead screw driven by a DC motor.

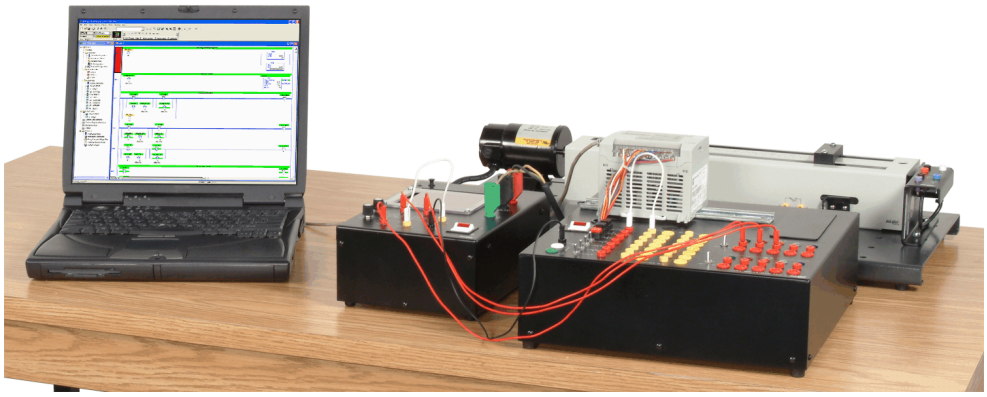

Figure 1-1. The Electromechanical System – DC Motor.

FAMILIARIZATION WITH THE ELECTROMECHANICAL – DC MOTOR SYSTEM

Lab-Volt's Electromechanical – DC Motor System

The Electromechanical – DC Motor System from Lab-Volt includes two modules:

- DC Motor Drive (P/N 3209)
- Electromechanical – DC Motor Module (P/N 3293)

Figure 1-2 shows the DC Motor Drive from Lab-Volt. The DC Motor Drive output voltage is used to control motor speed (which is proportional to the armature voltage). The output voltage is proportional to the discrete (0-±10 V) dc signal applied to the SIG terminal when the EN (enable) terminal is powered. This signal can be provided by an external device or by the SP terminal located on the module. Two knobs permit the setting of two different motor speeds (SP1 and SP2). The signal at the SP terminal can be either SP1 or SP2 in forward (+) or reverse (-) mode, depending on the speed and direction terminals state.

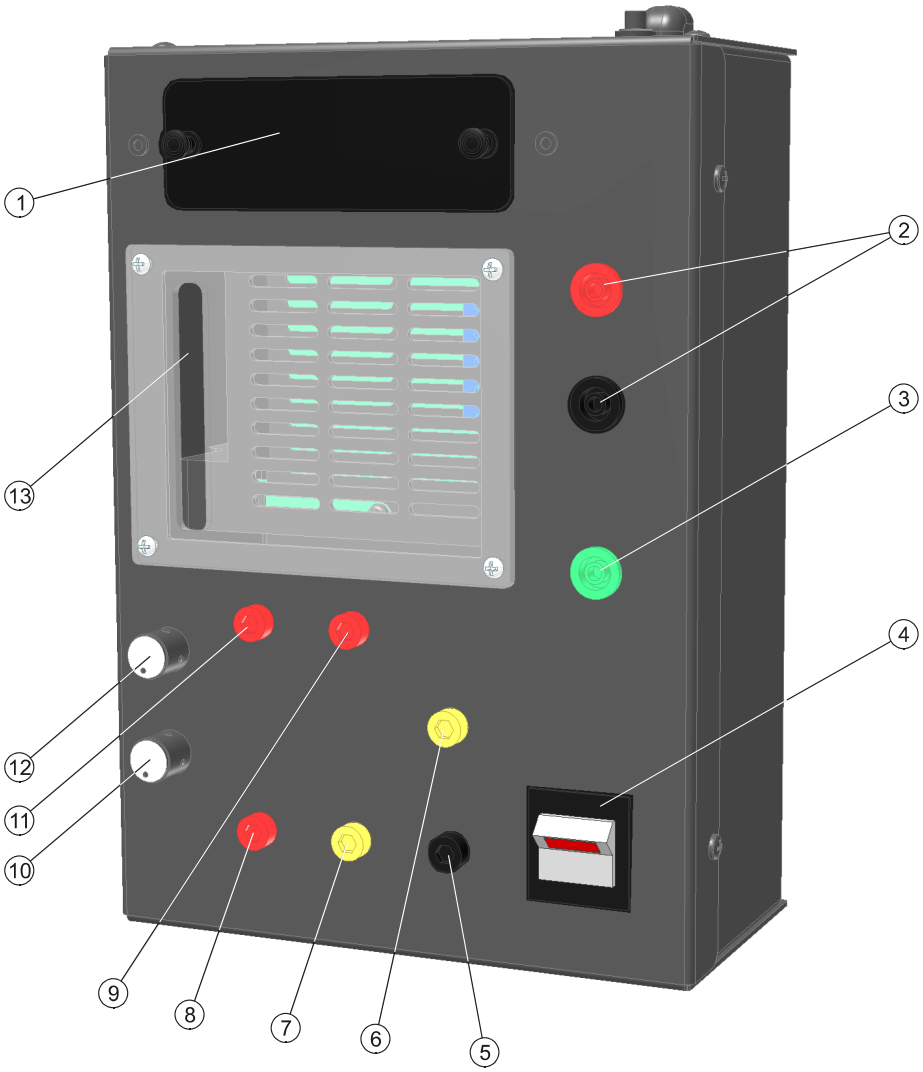

Figure 1-2. DC Motor Drive, Model 3209.

1. Fault Panel.
2. DC Motor Power Supply Terminals.
3. Ground Terminal.
4. ON/OFF Switch.
5. Common Terminal.
6. Speed Signal Terminal (Out).
7. Speed Signal Terminal (In).
8. Enable Terminal.
9. Direction Selection Terminal.
10. Speed 2 Control.
11. Speed Selection Terminal.
12. Speed 1 Control.
13. DC Motor Drive Tuning.

Figure 1-3 details the tuning trimpots of the DC Motor Drive. The factory settings are shown. It is recommanded to keep these settings throughout the manual.

DB (Dead Band): Sets the minimum speed level required to initiate control voltage output.

RESP (Response): Determines the dynamic response of the control.

IR (Compensation): Used to stabilize motor speed under varying loads. DC motors generally lose speed with greater loads. This is because larger currents (I) must fight the motor's armature resistance (R) of the motor, hence producing a greater voltage drop.

RCL (Reverse Current Limit): Sets the maximum amount of DC current that the motor can draw in the reverse direction.

FCL (Forward Current Limit): Sets the maximum amount of DC current that the motor can draw in the forward direction.

MAX (Maximum Speed): Used to set the maximum output voltage of the control that is proportional to the motor speed.

FACC (Forward Acceleration): Determines the amount of time (0.1 to 15 seconds) needed to go from zero to full output voltage in the forward direction or from full to zero output voltage in the reverse direction.

RACC (Reverse Acceleration): Determines the amount of time (0.1 to 15 seconds) needed to go from zero to full output voltage in the reverse direction or from full to zero output voltage in the forward direction.

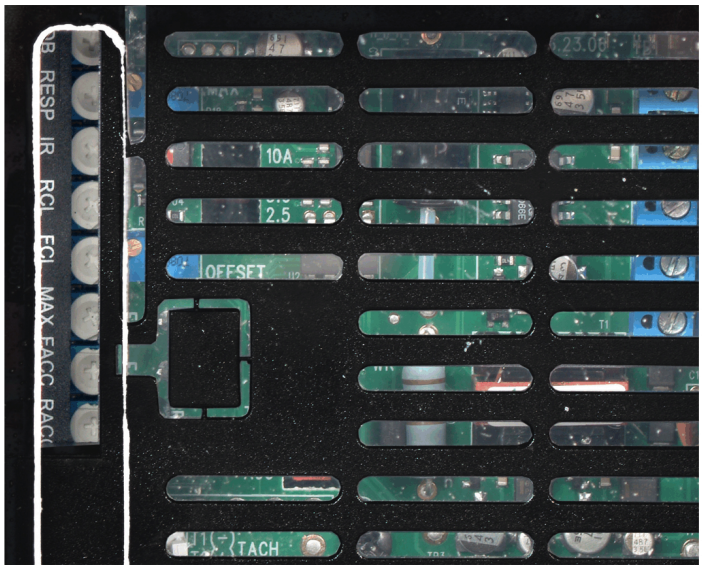

Figure 1-3. Trimpot Adjustments (Factory Settings Shown).

Figure 1-4 shows the Electromechanical – DC Motor module. It consists of a DC motor driving a lead screw on which a sliding block is installed. Two magnetic limit switches detect when the sliding block approaches the start or end position.

> **Note:** *The Electromechanical – DC Motor is designed with a gap on both sides of the lead screw that lets the sliding block rest safely in case of overtravel.*

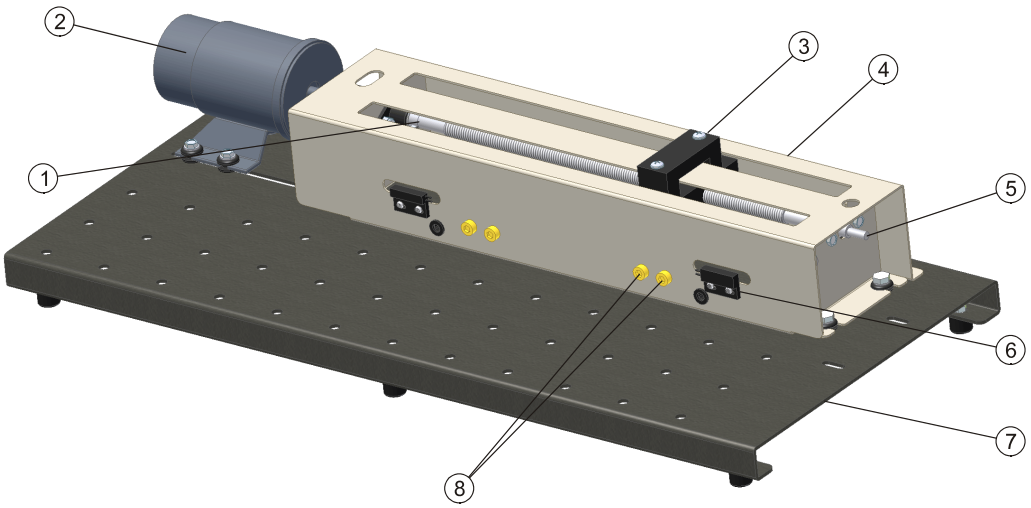

Figure 1-4. Electromechanical – DC Motor Module.

1. Leadscrew.
2. DC Motor.
3. Sliding Block.
4. Cover.
5. Rod End.
6. Magnetic Contact.
7. Application Base.
8. Magnetic Limit Switch Terminals.

The system control section operates with low voltage signals (24 V dc). The PLC is programmed and monitored using a computer running a ladder programming software.

FAMILIARIZATION WITH THE ELECTROMECHANICAL – DC MOTOR SYSTEM

OBJECTIVE

- Test the operation of some basic system components.

PROCEDURE

CAUTION!

Make sure you are wearing appropriate protective equipment when performing the jobs. You should never perform a task if you have any reason to think that a manipulation could be dangerous for you or your teammates.

Familiarization with the DC Motor Drive

☐ 1. Connect the DC Motor Drive to the PLC module, as shown in Figure 1-5. All toggle switches must be turned off (down position).

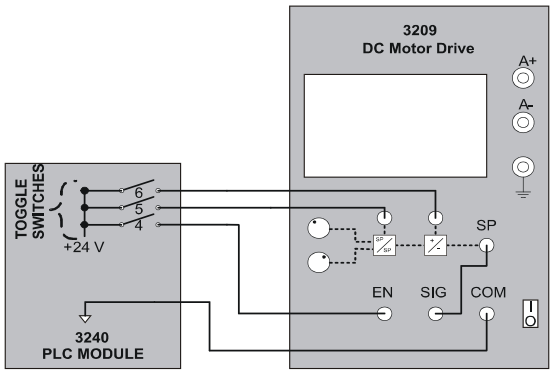

Figure 1-5. DC Motor Drive Test Circuit.

PLC Module Port	Connected To
Switch 4 (Toggle)	Enable (EN)
Switch 5 (Toggle)	Speed (SP1/SP2)
Switch 6 (Toggle)	Direction (+/-)

Table 1-1. Job Sheet 1 Electrical Connections.

☐ 2. Connect your voltmeter between the speed (SP) and the common terminal. Turn on the DC Motor Drive. Does the voltage change when you turn the SP1 knob?

☐ Yes ☐ No

Does the voltage change when you turn the SP2 knob?

☐ Yes ☐ No

☐ 3. Turn on the Speed (SP1/SP2) toggle switch to activate speed 2. Does the voltage change when you turn the SP1 knob?

☐ Yes ☐ No

Does the voltage change when you turn the SP2 knob?

☐ Yes ☐ No

☐ 4. Turn on the direction (+/-) toggle switch to activate the reverse direction. What happens to the voltage?

_____

☐ 5. Connect the voltmeter to the DC Motor Power Supply Terminals. Do you observe an output voltage?

☐ Yes ☐ No

Note: *A cable must be installed between the SP and the SIG terminals to act as a jumper.*

CAUTION!

High voltage can be present at the DC Motor Drive output terminals.

Turn on the enable (EN) toggle switch. Do you observe an output voltage now?

☐ Yes ☐ No

☐ 6. Set the DC Motor Drive to different configurations and measure the voltage both at the SP and at the output terminals. Is the output voltage proportional to the SP voltage?

☐ Yes ☐ No

☐ 7. Turn off all toggle switches.

Familiarization with the Electromechanical – DC Motor Module

☐ 8. Connect the Electromechanical – DC Motor module to the DC Motor Drive output terminals. Set the two speed knobs to different values.

> **Note:** *When the sliding block overtravels and leaves the lead screw threads, you can gently push it back on the threads while the DC motor is turning in the opposite direction at a reduced speed.*

Turn on the enable switch. The motor should start to rotate, initiating the sliding block movement in the forward direction (following the markings on the scale.) Turn on the direction switch. Does this make the sliding block move in the reverse direction?

☐ Yes ☐ No

Turn on the direction switch. Do you perceive a change in the speed at which the sliding block is moving?

☐ Yes ☐ No

☐ 9. Connect the multimeter to the magnetic limit switch terminals located close to the DC motor. Set the multimeter to check contact continuity. Energize the motor in the reverse direction until the magnet attached to the sliding block actuates the switch.

Next, connect the multimeter to the other magnetic limit switch. Energize the motor in the forward direction until actuation of the magnetic switch.

☐ 10. Disconnect and store all leads and components.

Name: _____ Date: _____

Instructor's approval: _____

Instructor Guide

Sample Job Sheet Extracted from

PLC Applications – Electromechanical Systems

Using DC Motors

JOB SHEET 1 FAMILIARIZATION WITH THE ELECTRO-MECHANICAL – DC MOTOR SYSTEM

ANSWERS TO PROCEDURE STEP QUESTIONS

☐ 2. Yes.

No.

☐ 3. No.

Yes.

☐ 4. A negative voltage is produced.

☐ 5. No.

Yes.

☐ 6. Yes.

☐ 8. Yes.

Yes.