Experiment 25 PID Controller Used in DC Servo Motor Speed and Position Control

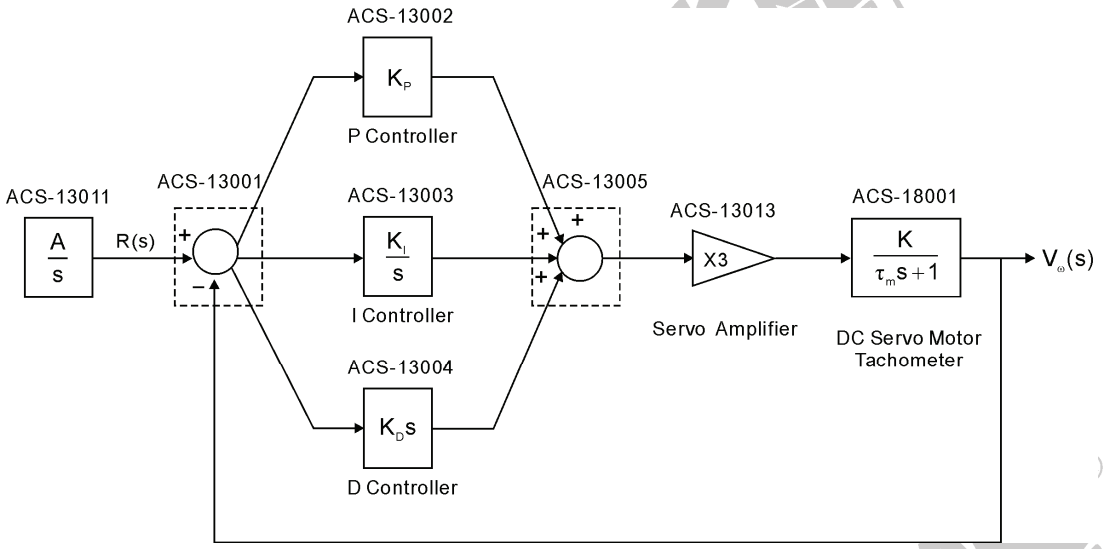
OBJECTIVE

1. To understand the operating principle of PM dc motor speed and position control.
2. To build a practical dc servo motor speed control system with PID control.
3. To build a practical dc servo motor position control system with PID control.

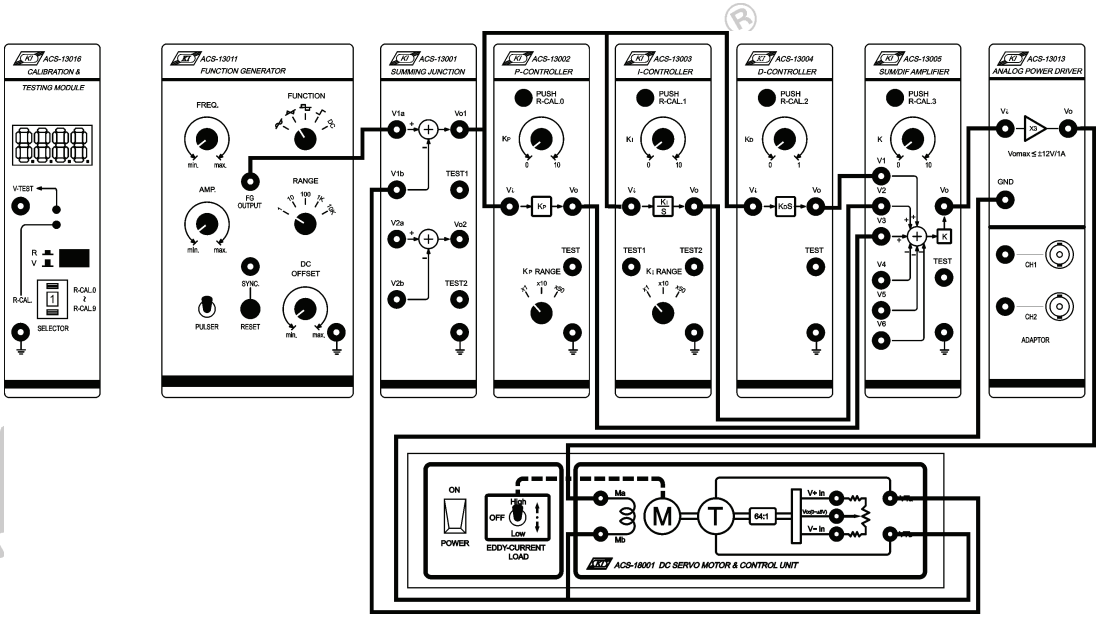
PROCEDURE

A. PID Controller Used in DC Servo Motor Speed Control

1. Complete the connections by referring to the block diagram and wiring diagram shown in Figure 25-1.



(a) Block diagram



(b) Wiring diagram

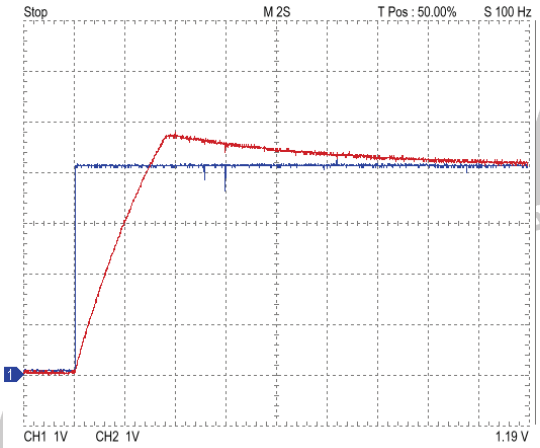
Figure 25-1

2. On ACS-13011, set FUNCTION selector switch to Pulse position, adjust DC OFFSET and AMP control knobs to generate a 4Vpp pulse (low level = 0V) at FG OUTPUT terminal.

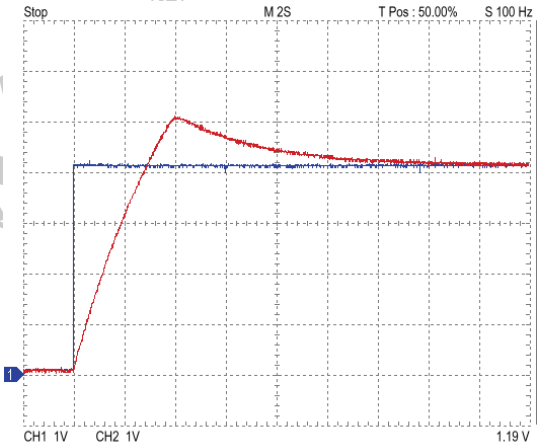
3. On ACS-13005, set K=1.

4. Using the trial-and-error method, appropriately adjust K_P (ACS-13002), K_I (ACS-13003) and K_D (ACS-13004) to make the dc servo motor speed control system operate in stable. The response curves are shown in Figure 25-2.

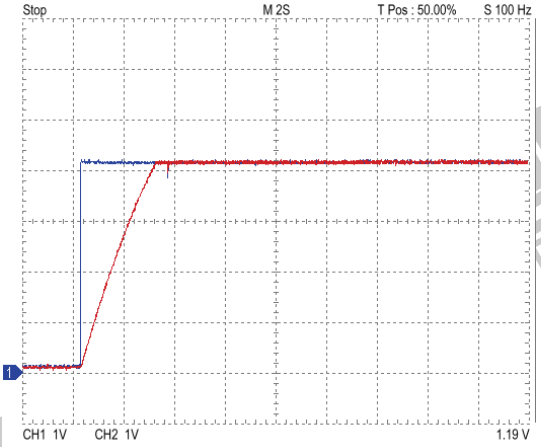
Note: Before pressing the R-CAL pushbutton switch to set parameters, disconnect the connecting wire to motor coil terminal Ma.



(a) K_P=18, K_I=3, K_D=0.15



(b) K_P=10, K_I=3, K_D=0.15



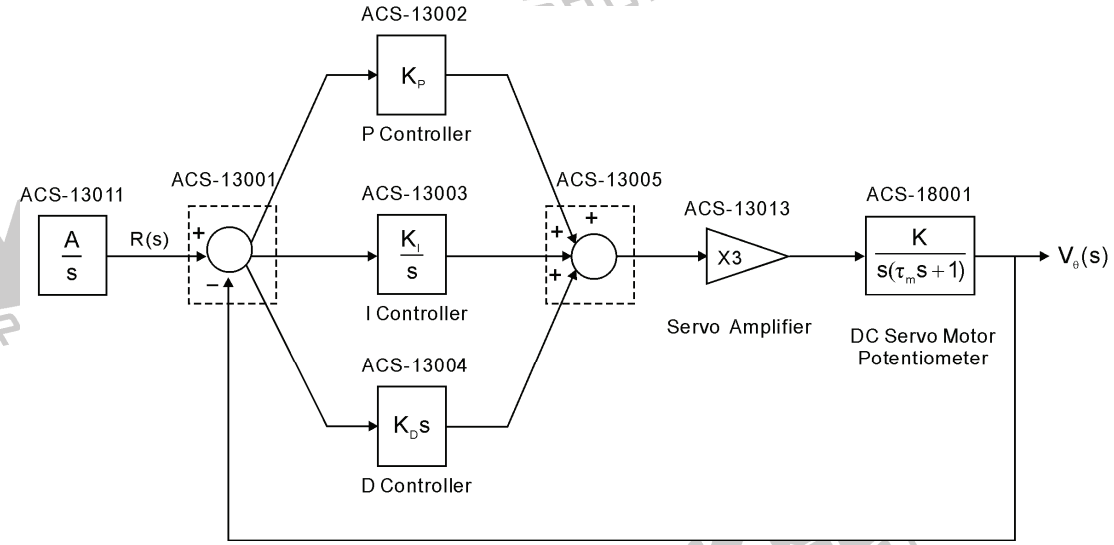
(c) K_P=40, K_I=0.4, K_D=0.4

Figure 25-2

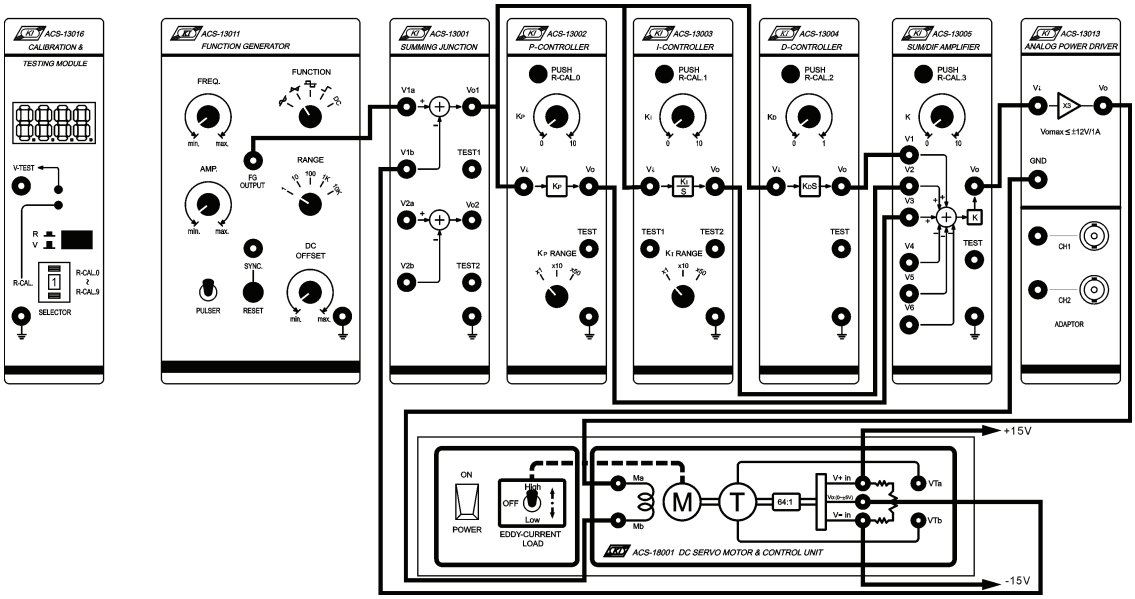
5. Modify the connections of Figure 25-1 by replacing ACS-13013 Analog Power Driver with ACS-13014 PWM Driver. Repeat Steps 2 to 4 and compare the recorded steady-state errors and transient responses for different drivers.

B. PID Controller Used in DC Servo Motor Position Control

1. Complete the connections by referring to the block diagram and wiring diagram shown in Figure 25-3.



(a) Block diagram



(b) Wiring diagram

Figure 25-3

2. On ACS-13005, set K=1.

3. On ACS-13011, set FUNCTION selector switch to Pulse position, adjust DC OFFSET and AMP control knob to generate a 4Vpp pulse (low level = -2V) at FG OUTPUT terminal.

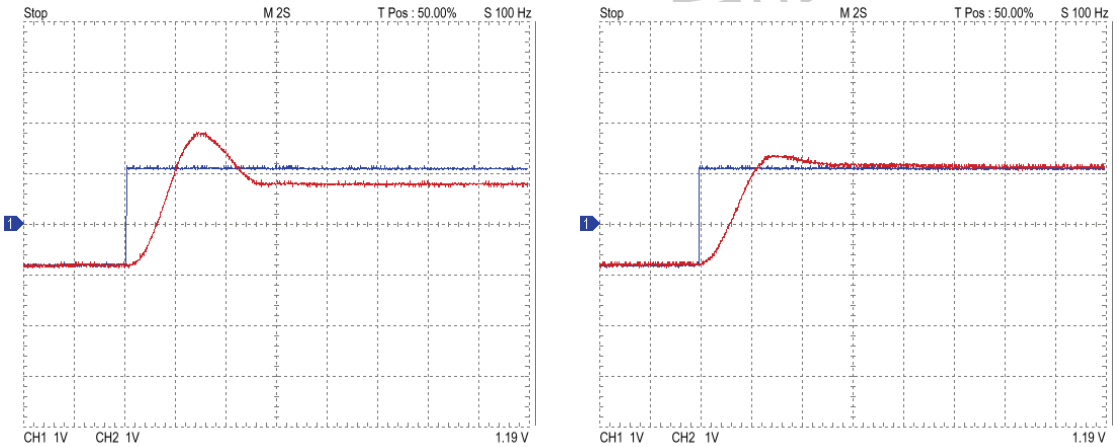
4. Set K_I (ACS-13003) and K_D (ACS-13004) to 0. Adjust K_P (ACS-13002) to make the system have 15%~25% overshoot.

5. Increase K_D (ACS-13004, D controller) to dismiss the overshoot.

6. Repeat Steps 2 and 3, maintain no overshoot and increase K_P as large as possible.

7. Increase K_I (ACS-13003, I controller) to decrease the steady-state error.

8. Repeat Steps 4 to 7 until the requirements are satisfied, as shown in Figure 25-4.



(a) K_P=4, K_I=0, K_D=0; 15%~25% overshoot

(b) K_P=4, K_I=0, K_D=1

Figure 25-4

9. Modify the connections of Figure 25-3 by replacing ACS-13013 Analog Power Driver with ACS-13014 PWM Driver. Repeat Steps 4 to 8 and compare the steady-state errors and transient responses for different drivers.