Simple Circuits Control RC Servos

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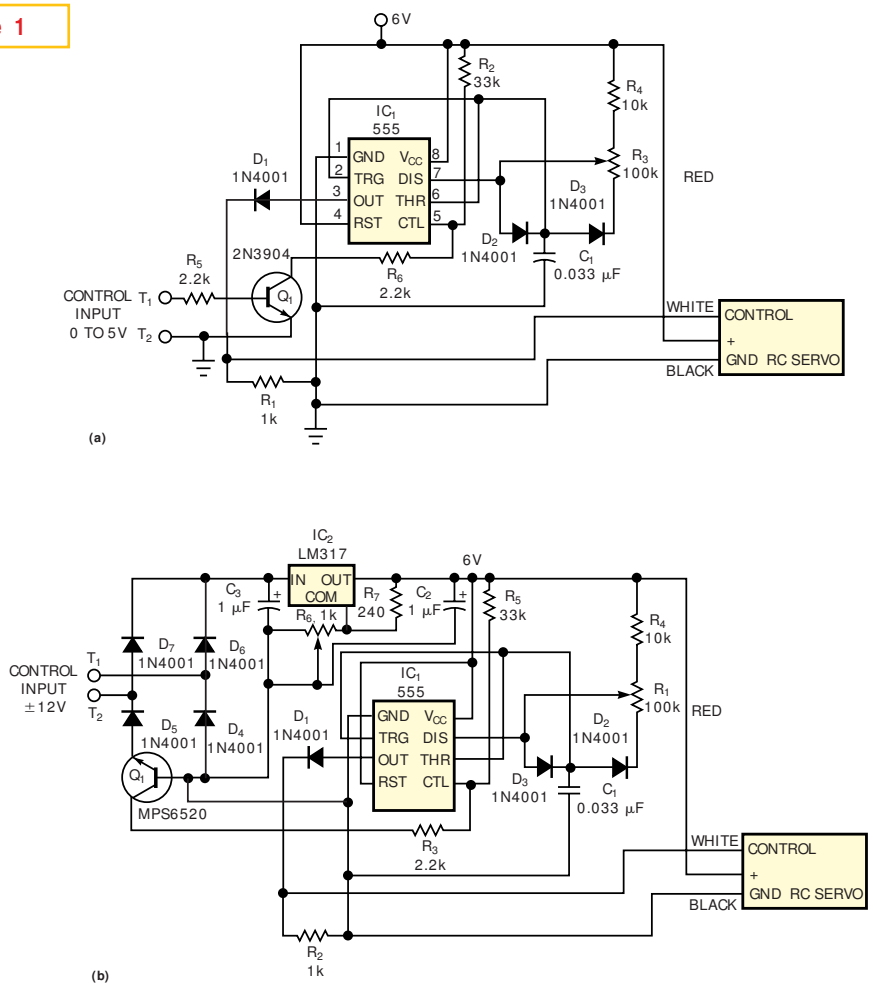
DEVELOPERS OF ROBOTIC DEVICES sometimes need to actuate rotational elements between two positions over a range of several tens of degrees. Such motion control is particularly useful for opening doors, actuating valves, or controlling the movement of small robotic arms or legs. Two alternatives to produce this type of actuation are a solenoid and a motor attached to a gear train. Solenoids require careful mechanical design to effect the conversion from linear to rotational motion and to achieve consistent position control between two positions. Motor-based systems require careful positioning of limit switches. An alternative to these two approaches, embodied in the circuits of **Figure 1**, involves the use of radio-control (RC) servomechanisms. Common RC servo devices are available in a variety of size, speed, and torque specifications. The range of motion of a typical RC servo is 190 (**Reference 1**). Because these servos must fit into RC cars, airplanes, and boats, they are usually small—especially considering their torque. The angular position of the servomotor shaft is related to the pulse width of an input control signal.

A technique for controlling the output of an RC servo between two positions uses a 0 to 5V digital signal (**Figure 1a**). The circuit requires a 5 to 6V power source. D_2, D_3, R_3, R_4, and C_1 configure the 555 IC to operate in astable mode at a frequency of approximately 285 kHz. R_3 controls the pulse width of the output data stream over 0.3 to 2.5 msec. This setting sets the maximum counterclockwise position of the servomotor with the control input set at 0V. When the control input is at 5V, the output pulse train contains a 75-µsec pulse. This pulse sets the servomotor at its most clockwise position. To calibrate the servo using the circuit in **Figure 1a**, you first set the control input at 5V. With this input, the shaft of the servo reaches its maximum clockwise position (which the ratio of R_2 to R_2+R_6 controls). With the control input set at 0V, R_3 controls the rotational limit of the actuated assembly in the counterclockwise direction.

The circuit in **Figure 1b** controls the movement of an RC servo between two preset positions, using an input signal of +12 to −12V. In this case, the input control signal supplies the current that the servo and control circuit require. The bridge rectifier comprising D_1 to D_4 and

Figure 1



Simple circuitry uses pulse-width modulation to control an RC servomotor, using a 0 or 5V control signal (a); a self-powered version (b) uses a ±12V control input.

the base-emitter junction of Q_1, with the aid of some filtering by C_3, provides the input voltage for the three-terminal regulator, IC_2. R_6 and R_7 bias the regulator to produce a 6V output, which the servomotor requires. Transistor Q_1 produces a signal of 0 or 5V, depending on the polarity of the input voltage. The circuit in **Figure 1b** supports the entry of the Carleton School Board of Ottawa (**Reference 2**) in the 1996 Canada First Robotics Competition (**Reference 3**), in which competitors developed a remotely controlled robot that plays a specialized game of basketball. The receiver unit provides control servomotors in the robot with several bipolar outputs.(DI #2338).

References

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