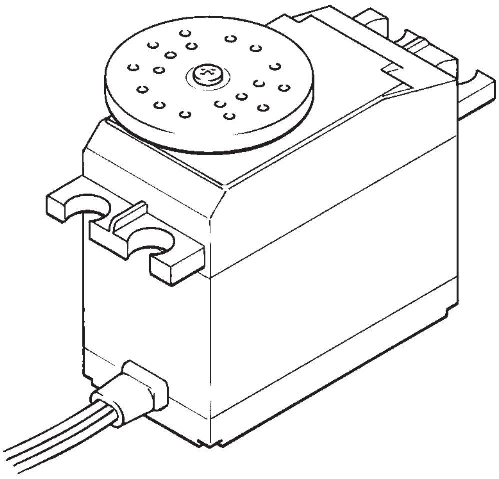
THE PULSE DURATION MODULATION (P.D.M.) SERVO

P.D.M. servos are commonly used in applications that require accurate positional control. They can be driven to any angular position between two points and be held in that position. There are two basic types. One rotates a maximum of 90° and the other 180°.

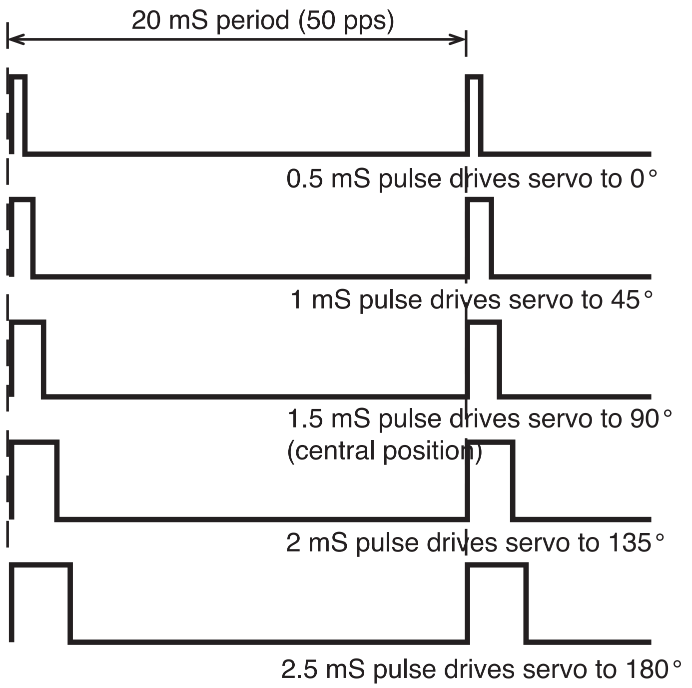


They have three connecting wires. Two are used for the power supply. This is typically 5 volts. (If you want to battery power a servo then a 6 volt battery pack will work and not harm the servo.) The third wire is where the control signal is fed into the servo. The control signal is a continuous train of pulses that conforms to the following specification.

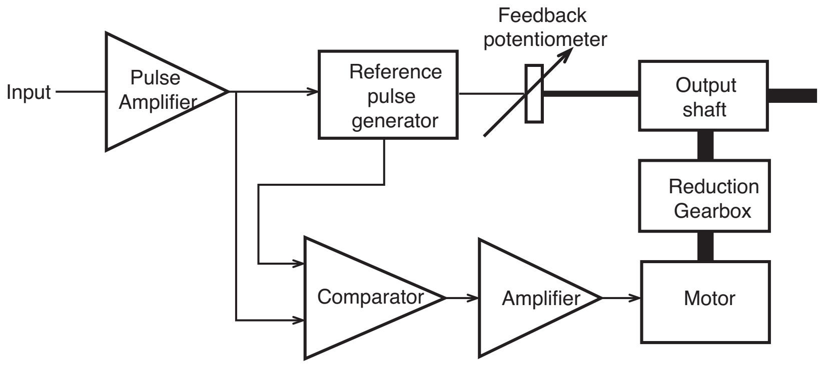
Pulse train period =	20 mS (50 pulses per second (pps))
Pulse duration =	0.5 to 2.5 mS (180° servo) 1.5 to 2 mS (90° servo)

The duration of the pulse controls the position of the servo. A pulse duration of 1.5 mS will drive the servo to its central position and hold it there. A shorter pulse duration will drive the servo to a new position in one direction, whilst a longer pulse duration will drive the servo to a new position in the opposite direction.

Consider a 180° servo:



P.D.M. servos use continuous feedback to achieve this control. Inside the device is a motor, a gearbox and a control circuit. This is a block diagram of the servo's internals.



Internal Operation

The motor is connected through a reduction gearbox to the servo output shaft. (The rotating disc on the top of the servo case)

The output shaft connects to a feedback potentiometer. When the motor drives the output shaft it also turns the potentiometer. The potentiometer forms part of the reference pulse generator circuit. When it turns it changes the duration of the pulse produced by the reference pulse generator.

When an input pulse is fed to the servo it is amplified and then fed to one input of the comparator. It also triggers the reference pulse generator. The pulse produced by the reference pulse generator is fed to the other input of the comparator.

If the durations of the two pulses fed to the comparator are equal then there will be no output from the comparator and the motor will not turn.

If the input pulse is shorter in duration than the reference pulse there will be an output from the comparator. This will cause the motor to turn and drive the output shaft to the left. This will also turn the feedback potentiometer. As the feedback potentiometer turns, the output pulse from the reference pulse generator becomes shorter. When this is equal to the duration of the input pulse the motor will stop as there will no longer be an output from the comparator.

If the input pulse is longer in duration than the reference pulse there will be an output from the comparator. This output will be opposite in polarity to when the input pulse was shorter than the reference pulse. This will cause the motor to turn in the opposite direction and drive the output shaft to the right. This will also turn the feedback potentiometer. As the feedback potentiometer turns, the output pulse from the reference pulse generator becomes longer. When this is equal to the duration of the input pulse the motor will stop as there will no longer be an output from the comparator.

If the pulse duration remains the same then the servo will hold its position. Any load that moves the servo output shaft will also turn the feedback potentiometer. This will cause the servo to drive back to its position.

There are four principal advantages with using p.d.m. servos over stepper motors for positional control.

1. The servo uses little power unless it is changing position.

2. The motor will work against any force that tries to drive the servo away from its position.

3. Because the motor drives through a reduction gearbox, quite a lot of torque is available at the output shaft; often better than 2Kg/cm.

4. Because the servo uses continuous rather than intermittent feedback it cannot lose its position and there is no need to use a datum point to check its position.