# Notes on RC Servos

## 1 Introduction

Remote Control Servos (RC Servos) are intended as actuators for remote-controlled model vehicles such as aircraft and cars, where they typically actuate functions such as throttle, control surfaces and steering.

An RC servo is a complete self-contained angular position servo. It requires an electrical power supply and an input position reference signal, and produces an angular position on the output shaft. Figure 1 shows a typical RC Servo.


**Figure 1: A Typical Analogue RC Servo**

An analogue RC servo contains all of the components needed to form a complete position control loop, implemented in analogue electronics. There is at least

- a DC motor;
- a reduction gear train and output shaft;
- output shaft angular position sensor (usually a potentiometer);
- input position reference signal conditioning circuitry; and
- analogue control circuitry.

The input position reference signal is converted to a position reference voltage and compared to the feedback voltage that represents the current angular position of the output shaft. Any difference is amplified and drives the motor so that the error is minimised.

## 2 Power Supply

Most RC servos require a power supply between 4.0 VDC and 6.0 VDC, at a few hundred milliamps. Do not exceed the voltage specified by the manufacturer, as the motor will overheat and may be destroyed.

## 3 Input Reference Signal

An RC servo receives its position command in the form of a series of pulses, with the reference *position* encoded as the *duration* of the pulses. This could be called pulse duration

modulation (PDM). The input position reference signal is shown in Figure 2. It consists of a 50 Hz pulse train, where each pulse has duration 'P' between 1000 µs and 1000 µs. A pulse of 1000 µs duration commands the servo to move to one extreme position, and a pulse of 2000 µs duration commands the servo to move to the other end of its travel. The commanded position varies linearly between these extremes, so that a 1500 µs pulse corresponds to the servo's mid-position.

The input reference signal voltage *must not exceed* the power supply voltage.

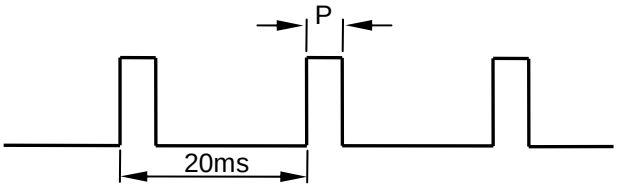


**Figure 2: Position Reference Input Pulse Encoding**

## 4 Output

The output of an RC servo is the shaft position. Given a continuous position reference input pulse train, the servo will adjust the motor current in an attempt to hold the output shaft at the commanded position. The current drawn therefore depends on the load.

An RC servo will typically have slightly less than 180° of mechanical rotation on the output shaft. Of this, perhaps 90°-120° can be electrically commanded.

## 5 Hitec Model HS-425BB

The RC servo that we are currently using is Hitec model HS-425BB. This is a standard-sized analogue servo that is fitted with two ball races on the output shaft; both the output shaft and internal gears are plastic.

The model HS-425BB has the basic specification shown in Table 1. The connector pinout is given in Table 2.

**Table 1: Basic Specification - Hitec Model HS-425BB**

| Quantity | Value |
|---|---|
| Dimensions | 36.6 x 19.8 x 40.6 mm |
| Weight | 45.5 g |
| Voltage | 4.8 to 6.0 V DC |
| Speed | 286°/sec @ 4.8V |
| Torque | 0.32 N.m @ 4.8V |
| Min Pulse Width | 900 µs |
| Max Pulse Width | 2100 µs |

**Table 2: JR Servo Pinout**

| Function | Colour |
|---|---|
| +0.0 V DC | Black |
| +4.8 V DC | Red |
| Position Ref Pulse | Yellow |

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