



- Home ●
- FIRST STEPS**
- Getting Started ●
- Are Helis Hard To Fly ●
- Best Helicopter ●
- HELI HELP E-BOOKS ●
- TYPES OF HELIS**
- Toy RC Helicopters ●
- Micro Coaxial Helis ●
- Electric Helicopters ●
- Nitro RC Helicopters ●
- Gas RC Helicopters ●
- Turbine RC Helis ●
- HOW THEY WORK**
- Helicopter Controls ●
- Flight School ●
- ACCESSORY INFO**
- RC Flight Simulators ●
- RC Radio Gear ●
- RC Heli Gyros ●
- RC Heli Tools ●
- RC Field Box ●
- RC LiPo Batteries ●
- SITE INFO**
- Heli Site Feedback ●
- Site Search ●
- Contact Me ●
- About Me ●
- What The Heli Is New ●
- Privacy Policy ●
- MISCELLANEOUS**
- RC & Aviation Links ●
- GO SHOPPING ●

UNDERSTANDING RC SERVOS DIGITAL, ANALOG CORELESS, BRUSHLESS

As we have briefly discussed, RC servos convert electrical commands from the receiver back into movement. A servo simply plugs into a specific receiver channel and is used to move that specific part of the RC model. This movement is proportional meaning that the servo will only move as much as the transmitter stick on your radio is moved.



[Indramat](#)

Indramat Servo parts and service Low prices, fast shipping anywhere



[Motion, Pro-Dex OMS](#)

Pro-Dex OMS motion controllers for Ethernet, USB, RS232, VME & PCI bus

Ads by Google

Servo Basics

All RC servos have a three wire connector. One wire supplies positive DC voltage – usually 4.8 volts. The second wire is for voltage ground, and the third wire is the signal wire. The receiver “talks” to the servo through this wire by means of a simple on/off pulsed signal.

Sizes

Servos basically come in 3 different sizes (micro, standard, and giant or 1/4 scale) to accommodate the type of RC models they are being used in. There may be slight variations depending on the specific

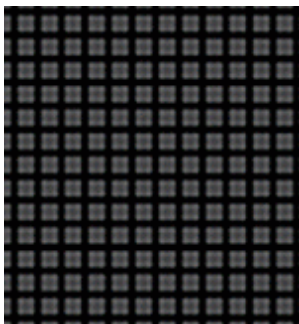
[?] [Subscribe To This Site](#)



RSS



Google



application but for ease of explanation, these 3 sizes cover more than 95% of all the servos out there.

Speed and Torque Ratings

Other than physical size, the next item that all RC servo specifications indicate is speed and torque.

Speed is a measurement of the time it takes the servo to rotate a certain number of degrees. This has been standardized in most specifications to 60 degrees; In other words, the time it takes the servo wheel to turn 60°. The smaller the number, the faster the servo is.

For example a 0.12 sec/60° servo rating means it will take 0.12 seconds to rotate the servo arm or wheel 60°. This would be twice as fast as a standard speed servo that is rated in the 0.24 sec/60° range. A RC helicopter tail rotor specific servo will have speeds as fast as 0.06 sec/60°.

Torque determines the maximum amount of rotational force the servo can apply. This specification is measured in ounces per inch (oz-in) or in kilograms per centimeter (kg-cm). The larger the number, the more force the servo can exert. A typical standard servo will have a torque rating around 40 oz-in. A high torque specific servo can have torque values well over 200 oz-in.

So what exactly does 40 ounces per inch mean?

Well if you had a servo arm that was one inch long on your servo it would be able to produce 40 ounces of pull or push force at the end of the servo arm before stalling. If you had a 1/2 inch servo arm what do you think the force would be? Yup, 80 ounces of force. How about a 2 inch arm, 20 ounces of force - easy huh?

I should also point out that both speed and torque specifications are usually given for the two common voltages used for receiver battery packs. 4.8 volts

for a 4 cell battery pack and 6.0 volts for a 5 cell battery pack. Obviously the 6.0 volt packs give slightly higher speed and torque ratings.

For [RC helicopter](#) use, only 4.8 volt receiver battery packs are generally used because of the gyros. Unlike servos, gyros are not designed to operate at voltages higher than 4.8 volts, and a 6 volt pack will damage most rc heli gyros and electronic flybarless gyro systems.

Digital Servos vs. Analog Servos

Now onto the real meat and potatoes of this RC servo discussion.

Up to just a few years ago, the only RC servos available were analog, but now we have digital. To answer the question of which is better for RC helicopters or planes and cars for that matter – let's look at how each work and the choice will be pretty obvious.

First off, there is no physical or main component difference between a digital servo or analog servo. The servo case, motor, gears, and even the feedback potentiometer all have the same functions and operations in both types.

The difference between the two is in how the signal from the receiver is processed and how this information is used to send power to the servo motor.

Analog Servo Operation

An analog RC servo controls the speed of the motor by applying on and off voltage signals or pulses to the motor. This voltage is constant (the voltage of the receiver battery pack to be exact - 4.8 or 6.0 volts).

This on off frequency is standardized to 50 cycles a second. The longer each on pulse is, the faster the

motor turns and the more torque it produces.

This is the same way the speeds of most motors are controlled. For instance, if you have a ceiling or exhaust fan in your house that is controlled with a variable rotary dial speed switch; the fan motor is not given lower and higher voltages to adjust the speed.

The speed switch simply cycles the 120 volts to the fan motor on and off many times a second. The longer each on pulse is, the faster the fan runs. This is also the same way electronic speed controllers for [electric RC helicopters](#) , planes, cars, and boats work.

Now back to our analog RC servo. At rest, there is no voltage going to the motor. If a small transmitter command is given or some external pressure is applied to the servo horn forcing it off neutral, a short duration voltage pulse will be sent to the motor.

The larger the stick movement or potentiometer movement, the longer this "on" pulse will be in order to move the servo quickly to the desired position.

Remember me saying that these voltage pulses are sent 50 times a second. This means that in one second, there are 50 windows that last 20 milliseconds each ($50 \times 20 = 1000 \text{ ms} = 1 \text{ second}$). The longer each on voltage pulse is in each of these fifty 20 millisecond windows, the faster the servo motor turns and the more torque it produces.

I just included this info for those of you who really want to know what makes a servo tick. You don't have to understand all that however, as long as you understand that during small amounts of stick movement or when external forces are applied forcing the servo off its neutral or holding position; only a short duration voltage pulse will be sent to the servo motor every 20 milliseconds. With large

stick movements, a long voltage pulse will be sent every 20 milliseconds to the servo motor.

As you can imagine, a short power pulse every 20 milliseconds doesn't get the motor turning that quickly or allow it enough time to produce much torque. This is the problem with all analog servos; they don't react fast or produce much torque when given small movement commands or when external forces are trying to push them off their holding position. This area of slow sluggish response and torque is called deadband.

Much of RC control, especially with RC helicopters is done with small quick stick movements moving the servo back and forth in very small increments. There are also many changing loads on the rotor system (both main and tail) that are always trying to force the servo off its hold position as well. Don't forget about the [gyro](#) either. The new [heading hold gyros](#) or [electronic flybar systems](#) are sending hundreds of small correction changes to the RC servos every second.

If I did a good job at explaining all this, you should realize by now that much of RC helicopter control and movement actually happens within the deadband area of an analog servo.

This is not really that big of deal for slow human response times, but as I mentioned, a problem for lightning fast gyros and electronic flybars or advanced 3D pilots with cat like reflexes.

Digital RC Servo Operation

Digital servos to the rescue! Like I said before, a digital servo has all the same parts as an analog servo, even the three wire plug that plugs into the receiver is the same. The difference is in how the pulsed signals are sent to the servo motor.

A small microprocessor inside the servo analyzes the receiver signals and processes these into very high

frequency voltage pulses to the servo motor. Instead of 50 pulses per second, the motor will now receive upwards of 300 pulses per second. The pulses will be shorter in length of course, but with so many voltage pulses occurring, the motor will speed up much quicker and provide constant torque.

Incidentally, if you have ever wondered why digital servos "sing" when very light force loads are placed on them, what you are hearing is the short high frequency voltage pulses acting on the motor.

The result is a servo that has a much smaller deadband, faster response, quicker and smoother acceleration, and better holding power. You can test this very easily by plugging in a digital servo and an analog servo to your receiver. Try to turn the servo wheel off centre on the analog RC servo.

Notice how you will be able to move it slightly before the servo starts to respond and resist the force - it feels a bit spongy.

Now do the same thing with the digital RC servo. It feels like the servo wheel and shaft are glued to the case - it responds that fast and holds that well.

Now nothing is perfect and this increase in speed, torque, and holding power does come with a small disadvantage. **Power Consumption!**

Yup, digital servos are power hungry. All those hundreds of power pulses per second use up more battery power than an analog servo would. This really is not that much of a problem these days since battery packs have at least double or triple the capacity of what the same size/weight pack had just a few years ago.

So yes, digital RC servos are much better than analog. You can still fly a RC helicopter with analog servos, but once you switch over to digital, you will likely never go back. Don't forget about that

heading hold gyro – he needs to be paired with a fast digital servo to work correctly – no exceptions!

One last point I should clarify with this whole analog/digital RC servo discussion. Remember those speed and torque specifications I talked about earlier... You will find analog servos that have better speed and torque ratings than some digital servos; so why not get one of them over a more expensive slower digital?

Remember, the analog servo is slow to respond and provides little torque during small, fast command inputs. Those good looking specifications are given at full stick movement when the servo has ramped up to full speed and torque. The slower spec digital servo in this case will still provide much more speed and torque where it is needed most.

Coreless & Brushless Servo Motors

Most low cost and standard servos (analog or digital) use what is called a 3 pole electric motor. This is just a standard 3-pole wire wound DC motor – the most common type of DC motor in existence. One step up from the 3 pole is the 5 pole servo motor. As you can imagine, two more wire windings will give a 5 pole motor quicker acceleration and more torque on start up.

You know by now the faster the servo ramps up to speed and the more torque it produces; the better it is for most applications. Well, improving the electric motor itself will produce more speed and torque too; coupled with digital technology, the resultant speed and torque are indeed impressive.

Coreless Servo Motors:

A standard 3-pole wire wound servo motor uses a steel core with wires wound around the core, this core is then surrounded by permanent magnets.

As you can imagine, the core and all that wire

weighs a fair bit. When voltage is applied to turn the motor, it has to first overcome this weight to get things turning – it is slow to accelerate. Once up to speed, it also continues to turn for a while when the voltage is removed – it is slow to decelerate.

In a Coreless design, the heavy steel core is eliminated by using a wire mesh that spins around the outside of the magnets. This design is much lighter resulting in quicker acceleration and deceleration. The result is smoother operation, more available torque, and faster response time.

Brushless Servo Motors

The latest advancement is to use a small brushless DC motor in the servo. This is the exact same principle and has the same advantages as larger brushless DC motors that are used in electric RC helis, planes, and cars. There are no brushes that add drag or can wear out.

Brushless motors are more efficient, provide more power, speed, and acceleration - once again raising the bar on the level of speed, torque, response time, and smooth operation.

RC Servo Bearings, Metal Gears, & Water Resistance

These last few points are pretty basic.

Bearings:

You will notice when servo shopping, many specifications list if the servo has bearings and the number of bearings – usually 1 or 2. These bearings are used on the main servo output shaft instead of a simple bushing.

The advantages of having ball bearings on the output shaft in a servo are pretty much the same as I talked about in the [Bearing Section](#) of [best RC](#)

[helicopter](#) features – less friction and slop. Because of the many vibrations and mechanical loads placed on the servo in RC helicopters, non bearing servos do develop slop very quickly and of course this makes control more sluggish and vague feeling.

Most quality RC servos, even lower cost ones these days will come with at least one bearing – this will be located on the servo output shaft where it exits the servo, this is where most of the side loads will occur. Better more expensive servos will use two bearings to further improve overall slop free performance.

Metal Gears & Metal Output Shafts:

Having metal gears or output shafts on servos in a RC helicopter is generally overkill and will add unnecessary weight and cost. Metal gears are used on servos that will see very high resistance and torque loads that could strip or crack the more commonly used plastic gears and output shaft.

This is something we generally don't have to worry about with helis until we start getting into very large ones that will produce significant loads on the servo. On the other end of the size spectrum is small electric helis that use micro servos. Because the servo gears are so tiny, they are not hard to break or strip in the event of a crash.

A perfect example of a servo that would see constant high stress loads would be the steering servo of a RC off road car or buggy. I have a nitro [T-Maxx](#) RC monster truck that use to eat steering servos.

I bit the bullet and spent a good chunk of change on a hi-torque digital servo with metal gears, metal output shaft, and metal servo arm. That was several years ago and this servo is still running strong to this day.

Water Resistant/Dust Proof RC Servos

Some servos are sealed to prevent water and dust from seeping inside. The case halves have gaskets, there is an o-ring around the output shaft, and there is silicone sealant where the wires exit the servo case.

Now this is obviously a good servo feature for RC boating or for your monster truck when you drive it through the old mud hole. It is however unlikely you will be flying your heli under the water, in the mud, or in a dust storm. If you are, you have bigger problems to deal with than contaminated servos.

That said - water resistant/dust proof RC servos do make sense with [nitro RC helicopters](#) or any nitro model that exposes the servo to [nitro goo](#) . If your RC servos are coated in nitro goo, it will eventually seep inside the servo. This won't be a problem for the gears, but will play havoc with the circuit board and electric motor over time.

Phew! I didn't think the humble little RC servo would take so much time to talk about. Servo technology will continue to evolve as well as the applications they are used in. Hitec's [RoboNova I](#) and Futaba's [RBT 1](#) humanoid robots are examples of this.

Now that you know all about RC servos, I will leave you with a video that shows exactly how each RC servo component is placed and works. The person who put it together did a very good job on the animation.

PAGE PROTECTED BY **COPIESCAPE** DO NOT COPY

Share this page:

 Google	 Yahoo! Buzz	 Facebook	 MySpace
 STUMBLEUPON	 Technorati	 del.icio.us	 Tweet this!

©Copyright 2008-2010 RCHELICOPTERFUN.COM
All Rights Reserved

Building Your Own Web Site Is Fun With SBI - Click On The Link Below

POWERED BY: SITE BUILD IT!