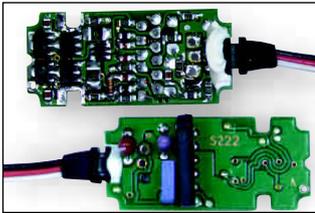


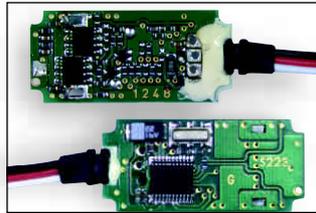
# Futaba Digital FET Servos

## The Significant Operational Advantages of a Digital Servo.

Over the last few years, servos have changed tremendously with size, rotational speeds and torque ever improving. The latest development, known as the 'digital servo', is yet another step forward. Digital servos have significant operational advantages over standard servos, even coreless versions, but with these advantages also come minor disadvantages, and this fact file will try, in simplified terms, to explain the positives and negatives of Digital Servos. It will also dispel some myths.



The 'Standard Servo' has custom logic chip and timing components with standard 30 strand lead.



The 'Digital Servo' has a Quartz crystal controlled microprocessor, FET amplifier and heavy duty 50 strand lead.

To start with, a 'digital servo' is the same as a standard servo, except for a microprocessor, which analyses the incoming receiver signals and controls the motor. It is incorrect to believe that digital servos differ drastically in physical design to standard ones. Digital servos have the same motors, gears and cases as standard servos and they also, most importantly, have a Feedback Potentiometer (Pot) just like their standard counterparts.

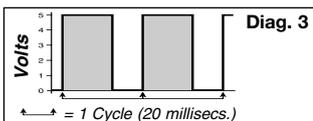
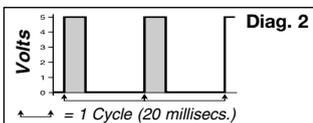
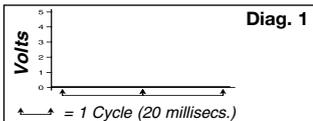
Where a digital servo differs, is in the way it processes the incoming receiver information, and in turn controls the initial power to the servomotor, reducing the deadband, increasing the resolution and generating tremendous holding power.

In a conventional servo at idle, no power is being sent to the servomotor. When a signal is then received for the servo to move, or pressure is applied to the output arm, the servo responds by sending power/voltage to the servomotor. This power, which is in fact the maximum voltage, is pulsed or switched On/Off at a fixed rate of 50 cycles per second, creating small 'blips' of power. By increasing the length of each pulse/blip of power, a speed controller effect is created, until full power/voltage is applied to the motor, accelerating the servo arm towards its new position.

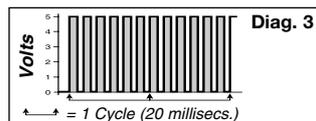
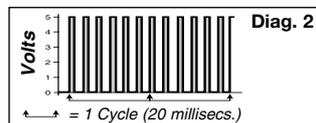
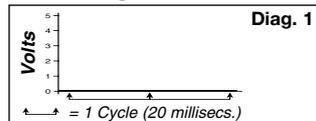
In turn, as the servo positioning pot tells the servo's electronics it is reaching its required position, the power blips are reduced in length to slow it down, until no power is supplied and the servomotor stops.

The 3 diagrams below each show two cycles of 'on/off' power pulses/blips. **Diag.1** - is idle. **Diag.2** - has a short time/pulse i.e. a low power command to the motor. **Diag.3** - is a longer pulse, power 'on' for longer, more power.

### Standard Servo



### Digital Servo



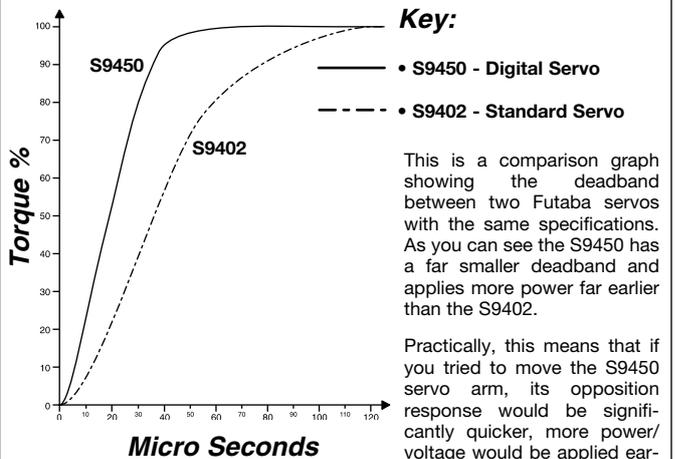
As you can imagine, a quick blip of power 'On', followed by a pause, does not give the motor much incentive to turn, whereas leaving the power 'On' for a longer period of time does. This means that a small control movement, which in turn sends small initial pulses to the motor, is very ineffective, and that is why there is what is termed a 'Deadband', i.e. sluggish or virtually no movement around the centre of a standard servo, in relation to a small Tx stick movement.

## The Distinct Advantages of a Digital Servo.

- First, it is able, via its microprocessor, to receive the incoming signal and apply preset parameters to that signal before sending its pulses of power to the servomotor. This means the length of the power pulse/blip, and therefore the amount of power sent out to activate the motor, can be adjusted by the microprocessors program to match its function requirements and therefore optimize the servo's performance.

- The second, is that a digital servo sends pulses to the motor at a significantly higher frequency. This means that, as opposed to the motor receiving 50 pulses/sec., it now receives 300. Although the length of the pulses is reduced in a direct ratio to the higher frequency because the power is being turned on/off to the motor more frequently, the motor has more incentive to turn. This also means that not only does the servomotor respond faster to the commands, but that increases or decreases in power for acceleration/deceleration are able to be transmitted to the servomotor far more frequently. This gives a digital servo an improved deadband, a faster response, quicker and smoother acceleration/deceleration, and better resolution and holding power.

## Comparison between Digital and Standard Servos



This is a comparison graph showing the deadband between two Futaba servos with the same specifications. As you can see the S9450 has a far smaller deadband and applies more power far earlier than the S9402.

Practically, this means that if you tried to move the S9450 servo arm, its opposition response would be significantly quicker, more power/voltage would be applied earlier, resulting in greater holding power/torque and more accurate positioning.

## Just One Disadvantage

The downside to these significant advantages - 'well, there's got to be one' - is power consumption. Naturally, with power being transmitted to the servomotor more frequently, together with increases in power being supplied to the motor earlier, the overall power consumption must go up.

However, with batteries in general gaining monthly in capacity for the same size and weight, increased current drain as a trade off for significantly better performance, is no longer a problem. The key point to remember with digital servos is to install the largest capacity battery that space/weight will allow. Always install a battery monitor to check the operational capacity and, wherever possible, top up the charge before every flight, just to be sure.

Digital servos are the future for model control, and anyone who has used them says the difference is so significant that they would never return to standard servos, if there is a digital one available to fit the application. To quote turbine display pilot Steve Elias, 'Digital servo response and precision is like flying on rails. After flying digital servos, analogue versions are like controlling custard'.

## So If You Need:

- Higher resolution - less deadband, more accurate positioning
- Faster control response - increased acceleration
- Constant torque throughout the servo travel
- Increased holding power when stationary

**Digital Servos Are The Only Solution!**