

## Troubleshooting

Problem	Solution
Can't move center point.	One or both endpoints are at maximum rotation. Move endpoints closer together.
Servo arm doesn't shake when I set center point or endpoint.	Try jiggling servo arm. Friction in linkage may be holding arm off center.
In Setup Mode, servo arm won't move by hand.	Turn transmitter on.
After turning receiver on 4, 6 or 9 times, servo doesn't respond.	Reset Mode Counter: 1. Turn transmitter on, then turn receiver on. 2. Turn receiver off, then turn transmitter off.

## Specifications

Voltage	Torque, oz-in	Speed, sec	Comments
4.8	40	0.26	
6.0	50	0.16	
8.4	60	0.13	Optimum voltage
12.6	70	0.12	Operation may reduce life to that of a standard servo

Dimensions 1.59 in L x 1.40 in H x 0.79 in W

Weight DS300BB: 1.6 oz  
DS300MBB: 2.0 oz

## FMA limited warranty for servos

FMA, Inc. warrants this product to be free of manufacturing defects for the term of 90 days from the date of purchase. Should any defects covered by this warranty occur, the product shall be repaired or replaced with a unit of equal performance by FMA or an authorized FMA service station.

### Limits and exclusions

This warranty may be enforced only by the original purchaser, who uses this product in its original condition as purchased, in strict accordance with the product's instructions. Units returned for warranty service to an FMA service center will be accepted for service when shipped postpaid, with a copy of the original sales receipt or warranty registration form, to the service station designated by FMA.

This warranty does not apply to:

- Consequential or incidental losses resulting from the use of this product.
- Damage resulting from accident, misuse, abuse, neglect, electrical surges, reversed polarity on connectors, lightning or other acts of God.
- Damage from failure to follow instructions supplied with the product.
- Damage occurring during shipment of the product either to the customer or from the customer for service (claims must be presented to the carrier).
- Damage resulting from repair, adjustment, or any alteration of the product by anyone other than an authorized FMA technician.
- Installation or removal charges, or damage caused by improper installation or removal.

Call (301) 668-7614 for more information about service and warranty repairs.



## Digital Adjustable Servo

High speed, high torque, wide voltage, "finger-programmable" servo

Model DS300BB with ball bearings

Model DS300MBB with metal gears and ball bearings

## Features

The DS300 Digital Adjustable Servo is a new approach to servo design for radio controlled models. It provides the high speed, high torque and holding power of a digital servo, but you can set up and operate it without any special equipment.

- Set the servo's center point, endpoints and reversing simply by moving the servo's arm with your fingers. You get the advantages of a digital servo without the expense of a programming device. Plus, it eliminates trial-and-error clevis adjustments.
- Multiple Digital Adjustable Servos will drive one control surface—in perfect coordination—without a match box.
- Adds advanced features to non-computer radio systems, since programming is in the servo:
  - Your transmitter doesn't need servo reversing. Reverse the servo's direction by swapping its endpoints by hand.
  - Your transmitter doesn't need endpoint adjustments or ATV. You set the servo's throw to the correct distance by rotating it with your fingers.
  - Your transmitter doesn't need memory to retain servo characteristics for different models. Servo settings are stored in the servo, not in the transmitter.
- Operates from 2.5V to 12.6V. Ideal for use with 1s, 2s and 3s LiPo packs. This is the first RC servo to operate over such a wide voltage range without a voltage regulator. Paired with a voltage-capable receiver, a Digital Adjustable Servo can be driven directly from an electric airplane's motor battery (up to 12.6V), bypassing BEC current limitations.
- Servo position update rate is 125Hz, which provides smoother, faster response than 50Hz rate on most other servos.
- Built-in digital filter reduces radio noise and provides smoother response to small stick movements. As a result, the servo consumes less power. Turn filter off if it isn't needed.

## Precautions

- Follow all instructions in this manual to assure safe operation.
- If you have not assembled and operated a radio controlled model before, obtain help from an experienced modeler. You will need guidance to successfully assemble, test and operate radio controlled models. One of the best ways to obtain help is to join your local radio control club.
- In some areas of the country, you cannot legally operate radio controlled models except at approved fields. Check with local authorities first.
- Observe frequency control. If someone else is operating a radio controlled model on the same channel as your transmitter, do not turn on your transmitter—even for a short time. Your transmitter has a channel number marked somewhere on its case. When a model receives signals from two transmitters on the same channel at the same time, it cannot be controlled and will crash—possibly causing personal injury or property damage. For safety, most RC flying fields have formal frequency control rules. Follow them carefully.
- Do not operate your radio control transmitter within 3 miles of a flying field. Even at a distance, your transmitter can cause interference.

FMA, Inc. • 5716A Industry Lane • Frederick, MD 21704

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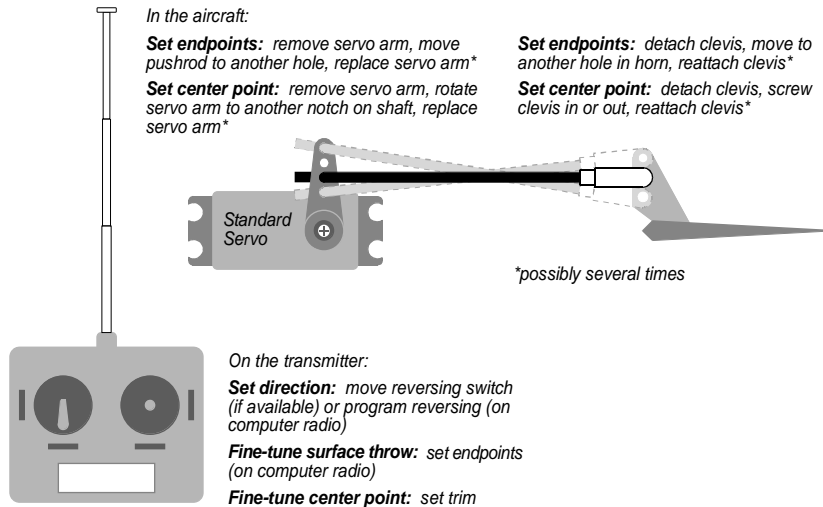


## Parts

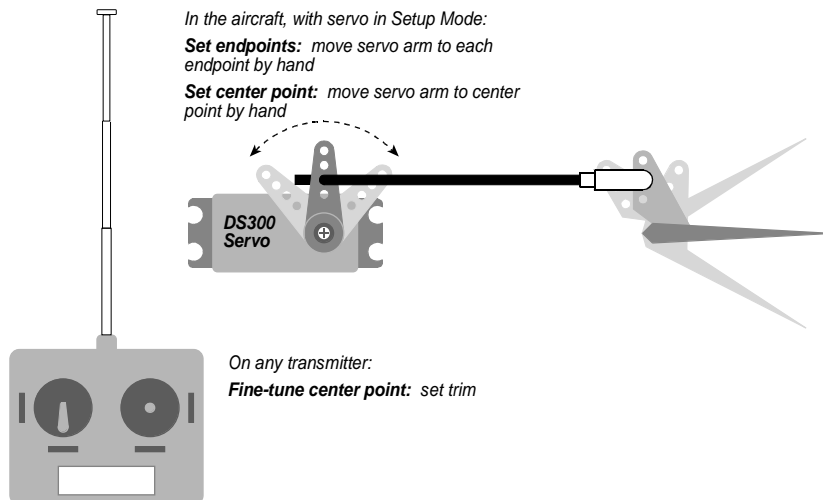
- DS300 servo
- 4 mounting grommets
- 4 mounting screws
- 4 brass spacers
- 1 2-point servo arm
- 1 4-point servo arm

## How the Digital Adjustable Servo is different from a standard servo

Setting up a standard servo often involves time-consuming trial and error:



In contrast, setting up an FMA Digital Adjustable Servo is straightforward and very quick:



4. Set one endpoint:
  - a. For the channel controlling the servo, move the transmitter stick to one extreme and hold it there.
  - b. While holding the transmitter stick at the extreme, rotate the servo arm, by hand, to the position corresponding to the stick position.
  - c. After a short delay, the servo arm shakes 2 (for Endpoint A) or 3 times (for Endpoint B), indicating the endpoint is now set.
5. Set the other endpoint:
  - a. For the channel controlling the servo, move the transmitter stick to the other extreme and hold it there.
  - b. While holding the transmitter stick at the extreme, rotate the servo arm, by hand, to the position corresponding to the stick position.
  - c. After a short delay, the servo arm shakes 2 (for Endpoint A) or 3 times (for Endpoint B), indicating the endpoint is now set.
6. Repeat steps 3 through 5, if needed.
7. Turn off the receiver. The servo returns to Normal Mode.
8. Turn off the transmitter.

**To reverse the servo's direction:** Repeat the instructions for setting the endpoints and center point (above), but move the transmitter stick in the opposite direction in steps 4 and 5. In other words, swap the servo endpoints corresponding to the transmitter stick position selected.

**CAUTION:** Do not fly when any Digital Adjustable Servo is in Setup Mode. After setting up the servo, always turn off the receiver, then turn off the transmitter.

### To turn the Digital Filter on or off:

1. Enter Digital Filter Mode [6]: Turn the receiver on for one second and off 5 times, then turn the receiver on and leave it on (6th time).
2. After a few seconds, the servo arm shakes 1 or 2 times:
  - 1 shake = Digital Filter is now on.
  - 2 shakes = Digital Filter is now off.
3. Turn off the receiver. The servo returns to Normal Mode.

If the Digital Filter is not in the state you want, repeat steps 1 through 3.

### To restore the factory defaults:

1. Enter Factory Default Mode [9]: Turn the receiver on for one second and off 8 times, then turn the receiver on and leave it on (9th time).
2. After a few seconds, the servo arm returns to center, then shakes  $n$  times, where  $n$  is the software version number.
3. Turn off the receiver. The servo returns to Normal Mode.

### Using multiple servos to drive one control surface

Install servos without linkages. Accurately center servos by resetting them to factory defaults. Without changing servo centering, install linkages so control surface is roughly centered. Put servos in Setup Mode [4] at same time. Set servo center points and endpoints by moving control surface (apply equal force at control horns; be careful not to break control surface).

## Setting up the servo

This section provides complete instructions. At first glance, they may seem complex. Don't be concerned—once you learn how, setting up the servo is quick and easy, and you won't need the instructions at all.

**Tip:** If you haven't used FMA's Digital Adjustable Servos before, we recommend this approach:

1. Experiment with one servo outside the aircraft, free of the linkage, using the instructions in this section. Start by resetting the Mode Counter (as described below). Enter Setup Mode to set different endpoints and center points. Learn what the different servo arm "shakes" mean. Try reversing the servo's direction.
2. After you install all the servos in the aircraft, you might find it easiest to work with one servo at a time. Connect one servo to its receiver channel, set up that servo, then disconnect it. Repeat for the other servos.
3. Once you've mastered servo setup, you can connect them all to the receiver and enter Setup Mode for the entire group. You'll still have to adjust one servo at a time, but you won't have to enter Setup Mode for each servo. Keep in mind that if you set the Digital Filter or reset to the factory defaults, all connected servos will be affected.

### To reset the Mode Counter:

1. Turn on the transmitter, then turn on the receiver.
2. Turn off the receiver, then turn off the transmitter.

Reset the Mode Counter if...

- You lose count when attempting to enter a mode.
- You attempt to enter a mode, but the servo doesn't respond as expected.

### To set the endpoints and center point:

1. Enter Setup Mode [4]:
  - a. Turn the receiver on for one second and off 3 times, then turn the receiver on and leave it on (4th time).
  - b. After several seconds, the servo arm shakes 4 times, indicating the servo is in Setup Mode.
2. Turn on the transmitter.
3. Set the center point:
  - a. For the channel controlling the servo, center the transmitter stick.
  - b. Rotate the servo arm, by hand, to the center position.
  - c. After a short delay, the servo arm shakes 1 time, indicating the center point is now set.

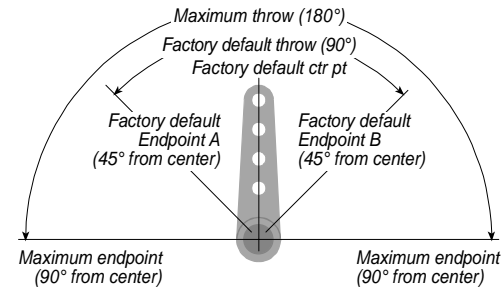
**Tip:** The gear train makes it difficult to move the servo arm a small distance to the point where you want it. Instead, first move the servo arm away, then back to the set point.

*continued*

## About the Digital Adjustable Servo

You need to know a few things about the servo before you set it up.

**Endpoints and center point.** Maximum servo arm throw is 180° (90° on either side of center). Factory default servo throw is 90° (45° on either side of center).



Adjusting the servo involves rotating the servo arm by hand (complete details are in "Setting up the servo"). You can position the endpoints anywhere within—but not beyond—the 180° span. The center point is always midway between the endpoints. When you move the center point, the endpoints move with it. Precautions:

- If both endpoints are set to their extremes, you cannot move the center point. If you rotate the servo arm under these conditions, it will return to midway between the endpoints.
- If both endpoints are *not* set to their extremes, you can move the center point in either direction. However, the endpoints limit how far you can move the center point (the endpoints cannot move beyond their extremes).

**Gear train.** Servo manufacturers warn against turning the servo arm by hand—doing so may damage the gear train. The Digital Adjustable Servo, in contrast, is designed to allow you to safely turn the servo arm *when the servo is in Setup Mode*. However, do not force servo arm rotation beyond the hard stops at the maximum endpoints, and do not manually rotate the arm when the servo is not in Setup Mode.

**Servo arm.** You'll have to apply a little force to rotate the servo arm in Setup Mode. For easiest adjusting, install a 2-point, 4-point or 6-point servo arm, rather than a round arm. Also, a long arm is better for fine adjustments than a short arm.

**Supply voltage.** The Digital Adjustable Servo operates on any voltage between 2.5V and 12.6V. It is optimized for 8.4V, so it can be operated directly from a 2s LiPo pack. It can also be driven directly from a 1s LiPo pack (3.7V) or a 3s LiPo pack (11.1V). You still have the option to power the servo from a 4.8V or 6.0V NiCd/NiMH pack.

Keep in mind that supply voltage affects servo speed and torque. The higher the voltage, the higher the speed and torque. Speed and torque specs are on the last page of this manual.

If your radio system will be powered by other than a 4.8V or 6.0V pack, you must check the receiver's specifications to determine whether it will reliably operate at the voltage you have chosen. Most FMA receivers operate from any voltage between 4.8V and 12V. FMA's M5LV, optimized for operation from a single LiPo cell, can be powered by 2.5V to 8V.

**Operating without a BEC.** High speed, high torque servos may exceed the current capability of the Battery Eliminator Circuit (BEC) in an electric aircraft's Electronic Speed Controller (ESC). Digital Adjustable Servos make it possible to operate the radio system directly from

*continued*

the motor battery (subject to the 12.6V limit and with a receiver that operates at that voltage). This eliminates BEC current limitations and enables you to drive control surfaces with stronger, faster servos. You won't need to add the cost and weight of a voltage regulator as long as the motor battery outputs less than 12.6V.

To power the receiver and servos directly from the motor battery:

1. Disconnect or cut the red (+ voltage) wire from the ESC's throttle connector. This removes the receiver voltage output from the BEC. You'll still need to attach the throttle connector to the receiver for speed control.
2. Connect the motor battery to the receiver. The servos receive their power from the receiver, as usual.

**Modes.** The Digital Adjustable Servo has four modes:

- **Normal Mode:** servo responds normally to transmitter stick positions. When you are not configuring the servo, it is in Normal Mode.
- **Setup Mode:** enables you to set the servo's center point and endpoints. The servo responds to transmitter stick positions, but you can rotate the servo arm by hand.
- **Digital Filter Mode:** sets the Digital Filter on or off.
- **Factory Default Mode:** returns the servo to its factory default settings.

You tell the servo what you want to do (for example, enter Setup Mode) by turning the receiver off and on a certain number of times while your transmitter is turned off. The servo's Mode Counter keeps track of the number of times the receiver is turned on. Here's how the counter works:

- If the receiver is turned on and the servo does not immediately detect a signal from the transmitter, the servo adds 1 to the Mode Counter, then stores the count in non-volatile memory. When the Mode Counter reaches a specific number *and the receiver remains on*, the servo does the following:
  - If Mode Counter = 4: puts servo into Setup Mode.
  - If Mode Counter = 6: changes Digital Filter state (from on to off, or from off to on, depending on its previous state).
  - If Mode Counter = 9: resets servo to factory default center point and endpoints, and turns Digital Filter off.
- If the receiver is turned on and the servo immediately detects a signal from the transmitter (that is, the transmitter must be already on), the servo sets the Mode Counter to 0, then stores the count in non-volatile memory. You would do this, for example, if you lose modes of how many times you turned the receiver on when resetting to the factory defaults. With the Mode Counter at 0, you can start the on-off sequence again.

#### IMPORTANT

A servo's Mode Counter adds 1 to its count *every time* you turn on the receiver *without* a transmitter signal. Thus, it is possible to unintentionally accumulate a count (even over a period of months), which may put the servo into one of its other modes when you expect it to be in Normal Mode. If you turn on the receiver when the transmitter is off, and—after a short delay—a servo shakes at least once, it is not in Normal Mode. To prevent this from happening:

- Unless you are intentionally setting up the servo, always turn on the transmitter first, then turn on the receiver. Also, always turn off the receiver first, then turn off the transmitter.
- Periodically reset the Mode Counter (instructions are in "Setting up the servo").

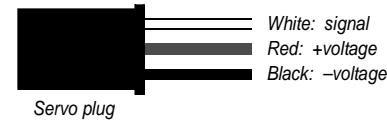
## Installing the servo

**Note:** If you haven't used an FMA Digital Adjustable Servo before, you should learn how to set it up before you install it in your aircraft. Go to the next section for set-up training, then return here to install.

**Tip:** If you can't reach the servo's arm after it is installed, you have a couple of options:

- Set up the servo outside the aircraft, then install it. This isn't as good as setting up the servo in place, but may enable you to set the endpoints and center point to about the right locations.
- Operate the servo without adjustments. In this case, it works like any other servo. Before installing the servo, reset it to the factory defaults (which removes previous settings you may have made).

1. Mount the servo using the supplied grommets, spacers and screws.
2. Connect the servo to the receiver. Check receiver documentation for correct polarity.



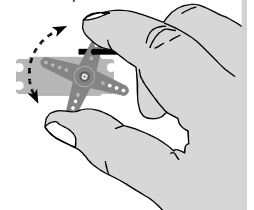
3. Restore the factory defaults (see "Setting up the servo" section). This returns the servo to its optimum center point, with a 90° throw (45° on each side of the center point). (By starting with a 90° throw, you'll have plenty of margin for adjusting the endpoints.)
4. Configure the linkage so that maximum surface (or throttle) throw requires the servo arm to move about 90°. Connect the linkage to the servo arm.

The servo is now ready to be adjusted. Detail instructions start on the next page. Condensed instructions are below.

## Quick set up

1. Turn receiver on and off 3 times (1 second cycle), then turn it on. Servo shakes 4 times to indicate it is in Setup Mode.
2. Turn on transmitter.
3. Rotate servo arm by hand to desired center point. Servo shakes 1 time to confirm.
4. Set one endpoint: Move transmitter stick to one extreme and hold it there while you rotate servo arm to corresponding endpoint. Servo shakes 2 or 3 times to confirm.
5. Set other endpoint: Move transmitter stick to other extreme and hold it there while you rotate servo arm to corresponding endpoint. Servo shakes 2 or 3 times to confirm.
6. Turn off receiver (servo returns to Normal Mode), then turn off transmitter.

Rotate to set center point or endpoint...



then servo shakes to confirm...

