

GS-1

Gyro Servo
(Standard Version)

Users Manual

www.dunehaven.com

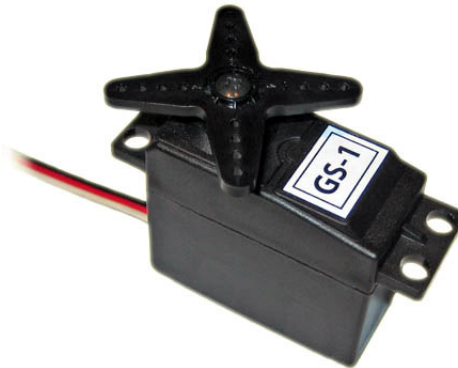
Written by
Scott Armitage

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Overview

The GS-1 has the features of an R/C hobby servo combined with gyro stabilization. The gyro helps to keep the servo pointed in the same direction even when the servo moves around. It can be very useful for camera mounts to keep the camera pointed in the same direction while the camera platform moves, such as in aerial photography.

The GS-1 comes in two versions: a standard version and a continuous-rotation version. This manual describes the standard GS-1 model. If you need a servo capable of rotating endlessly at a constant rotation speed, you may prefer the GS-1 *CR*. See dunehaven.com for information on the GS-1 *CR*.



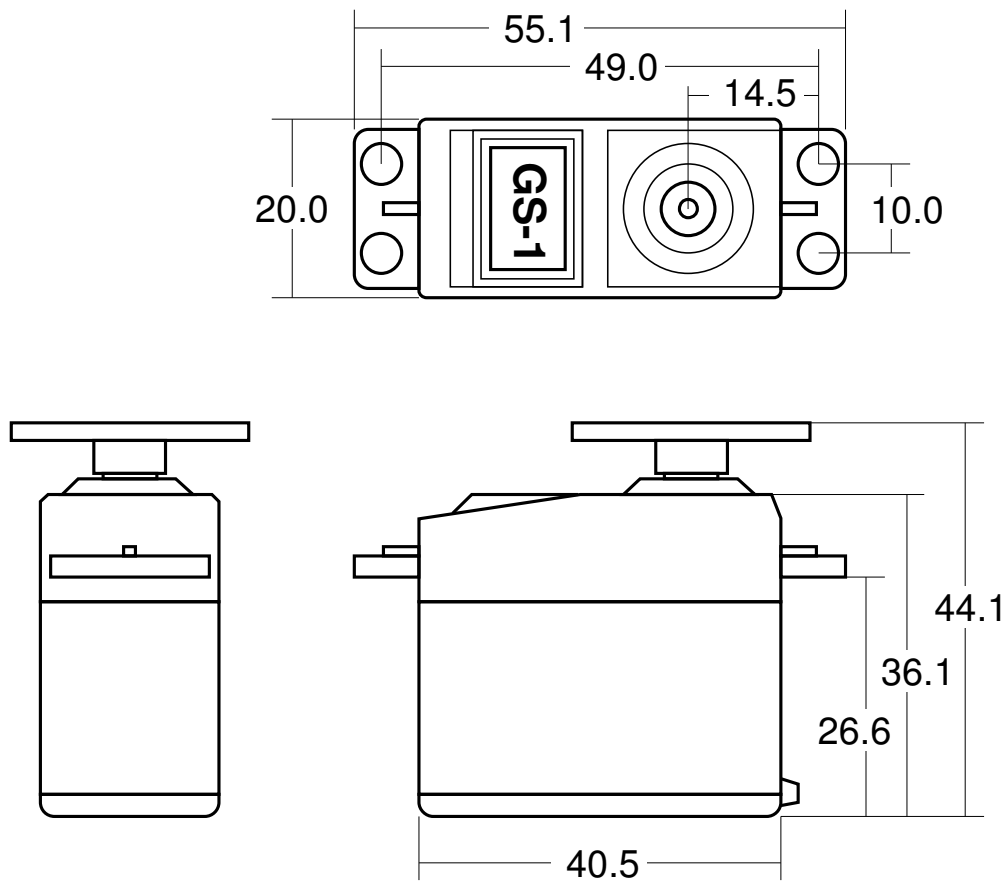
The GS-1 is the size of a standard-sized R/C servo and it is physically compatible with other popular standard servos.

Features

The GS-1 has the following features:

- MEMS gyro to compensate for servo movement
- Microprocessor control
- Automatic gyro drift compensation
- Slow slewing on power-up to desired position

Dimensions



All dimensions in mm

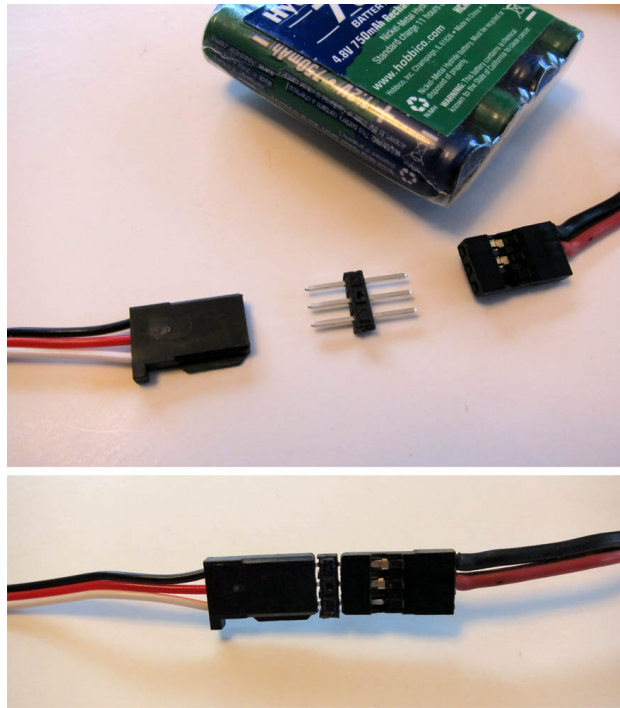
- 180 degree motion based on standard PWM control
- Ball bearing on output shaft
- Nylon gears for smooth operation
- 37 grams (1.3 oz) weight

Installation

Mount the GS-1 by its mounting flange with the included screws or small bolts. It is recommended that all four mounting holes be used. Do not support any significant amount of weight from the servo shaft if the failure of the servo could result in damage to your camera or to other objects or people.

Plug the GS-1 into an R/C receiver like any other servo. The GS-1 is compatible with receivers operating at 4.0V to 6.0 V. If you prefer, you can plug the GS-1 into a “servo tester” and control it without an R/C radio.

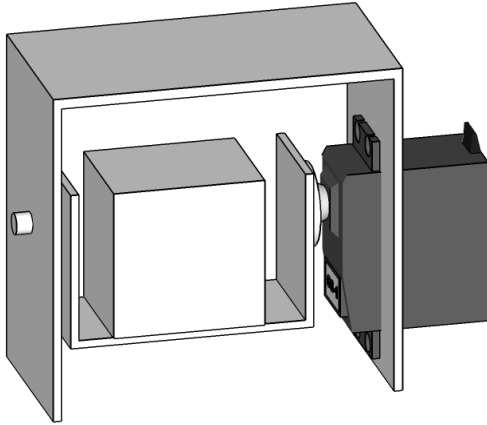
Alternately, the GS-1 can be connected directly to a battery without an R/C receiver or servo tester. In this case, plug the GS-1 into the 3-pin “GS-1 Battery Adapter”. Connect the battery to the pins on the other side of the adapter. Make sure the (-) side of the battery (usually a black wire) lines up with the black wire of the GS-1.



Never connect the GS-1 to a battery of more than 6.0V.

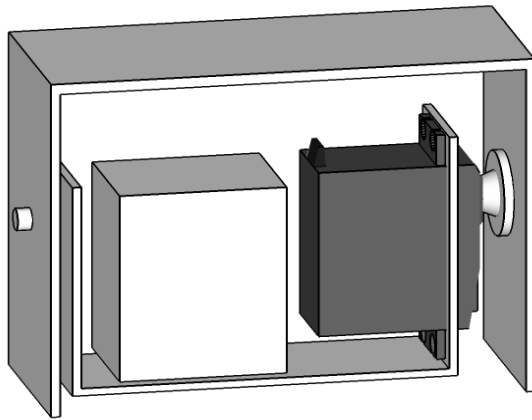
Mounting Orientation

The standard GS-1 expects that the body of the servo does not move when the servo horn turns. This is the case with most aerial photography tilt mechanisms, for example, but it is not the case for most pan mechanisms. In other words, when the servo turns, the servo must not sense its own rotation.



Correct Mounting

Servo does not turn as servo output shaft turns



Incorrect Mounting

Servo turns as servo output shaft turns

In addition, the GS-1 assumes that there is no gearing between the servo and the object the servo is controlling. See the section on “Adjusting Gyro Gain” for more information about changing this.

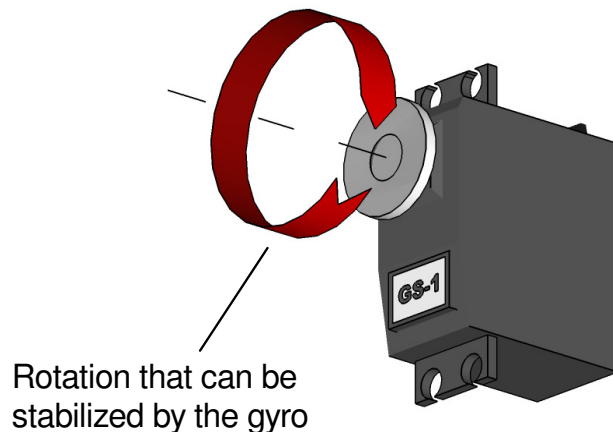
Startup

When power is applied to the GS-1, there is a two second delay before the GS-1 starts to function. At the end of this two second period, the GS-1 calibrates itself for “zero rotation”. To work properly, the GS-1 must not be moving at the end of this two second period. The two second duration was chosen to be a convenient amount of time to let you set the camera platform on a stable surface while it calibrates itself.

If no PWM control signal from an R/C receiver is detected, the GS-1 will assume that it is only connected to a battery and will drive the servo shaft to the center of its rotation. This is similar to connecting to an R/C receiver driving the servo with a 1500 us pulse width signal.

Usage

When not moving, the GS-1 performs like a conventional servo. When the body of the GS-1 is rotated about the axis parallel to its output shaft, the GS-1 will attempt to cancel out that rotation.

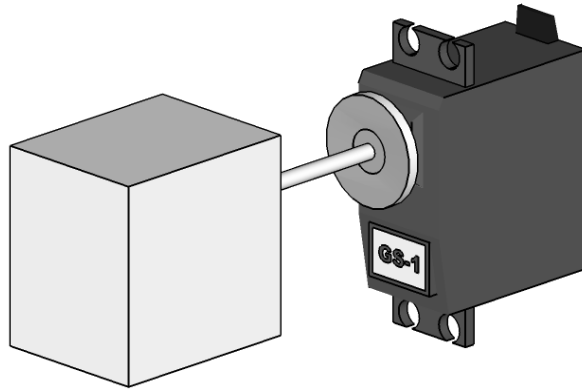


There is a minimum and a maximum rotation speed that it will handle. The motor inside the GS-1 takes a short period of time to spin up from a start or to change directions. This means that the gyro stabilization will not keep up if the servo moves back and forth too quickly.

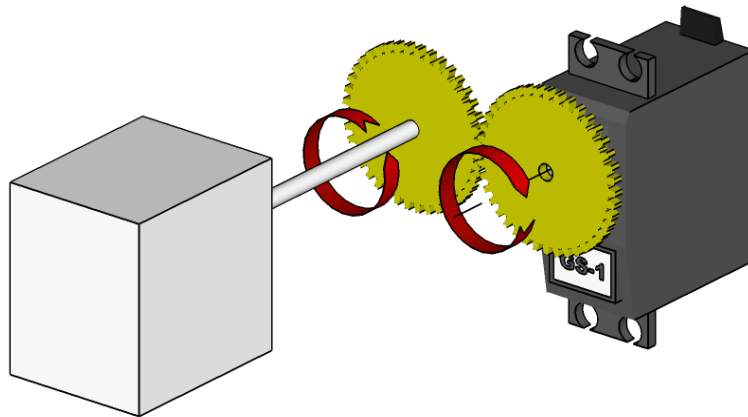
Also, if you turn the servo too slowly it will not track properly. This is because all gyros are subject to drift. In order to compensate for this, the GS-1 ignores any gyro signal that changes slowly (such as drift). This means that if you turn the GS-1 90 degrees and hold it there for a few seconds, it will start to "forget" the 90 degree rotation and slowly rotate back. For aerial cameras suspended from a kite or balloon this is not an issue, since when those camera rigs swing to one side they swing back again in a second or two. The situation is different for planes or helicopters, however, since they can hold a bank or tilt to one side for a longer time.

Adjusting the Gyro Settings

As shipped, the GS-1 is adjusted for use in a system that directly connects the output shaft of the GS-1 to the object being controlled as shown below. This is the most common configuration and no additional adjustment is needed in that case.



The standard configuration will not work properly if the servo rotates gears. However, it is possible to change the behavior of the GS-1 so that it accommodates configurations with gears such as in the picture below.



In addition to adjusting for differences in gearing, the GS-1 can be adjusted for how it returns to its normal, non-gyro based position after a period of time. This is called the re-centering speed.

If the GS-1 is used in a situation where the GS-1 is subject to all three types of rotating motions (pan and tilt and roll), use the faster re-centering speed. An example would be a camera rig suspended from a kite or a balloon where the camera may be swinging in a figure-eight motion.

If the GS-1 is used to correct for a motion where the camera must ignore slowly changing motions, also use the fast re-centering. An example would be a camera rig mounted on a

vehicle and stabilized in the panning direction, where you want to remove rapid direction changes but you also want the camera to keep pointing forward as the vehicle turns.

If the GS-1 is used in a situation where the GS-1 is stabilizing a motion that persists for a longer time, use the slow re-centering. An example would be a roll-stabilized camera mounted on a motorcycle that may have a sustained bank around a turn.

Note: GS-1's manufactured prior to November 10, 2011 do not have the fast/slow re-centering feature and always have the fast re-centering.

The following describes how to adjust the gyro. Please see:

<http://www.vimeo.com/4381443> for a short video showing the effects of these adjustments.

To adjust the GS-1 for the use of gearing, locate the two small holes in the bottom of the plastic case. Two adjustment pots are positioned behind the holes. Use a flat bladed screwdriver of 2.0 x 0.5 mm (maximum) to adjust the pots, such as the Wiha 26020.

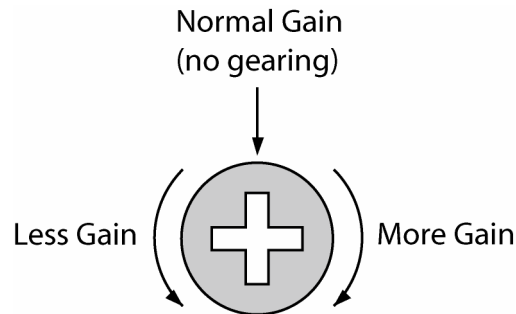
Note: Be very careful not to turn with too much force or you may break the stop at the end of the pot's rotation. Hold the screwdriver by its shaft rather than by its handle when adjusting the pots to prevent turning the pots with too much force.



One adjustment pot changes the gyro gain. The other adjustment pot changes the gyro direction and re-centering speed.

Gyro Gain Adjust

If gears are used and the gears are of different sizes, the gain pot must be changed. If no gears are used or they are of the same size, leave the gain pot in the center of its rotation (this is the factory default). Turning the gain pot clockwise will make the gyro have more effect. Experiment with different gain pot positions until you are satisfied with the result.

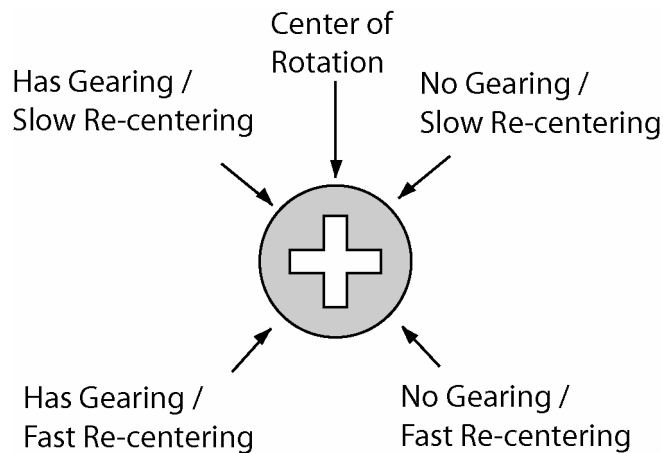


Gyro Direction / Re-centering Speed Adjust

When two gears are used, move the direction pot to the fully counter-clockwise position. For no gearing, leave the pot in its full clockwise position (this is the factory default). Turning the pot to its full clockwise or counter-clockwise position will also set the gyro for fast re-centering.

To set the gyro for slow re-centering, turn the pot $\frac{1}{4}$ turn towards the center of rotation from its end position (see figure below). Please note that the calibration discussed under "Startup" is more critical when using slow re-centering.

Note: There are only two settings for re-centering speed.



FAQ

Does the GS-1 eliminate all movement of the camera?

The GS-1 cannot remove all rotational movement, but in many situations, such as remote aerial photography, it will remove most of the movement. This can greatly improve the ability to keep the camera pointed in the desired direction, but it will not make the camera completely motionless.

How much rotational motion can be compensated for?

There is no specific limit to the amount of motion that can be sensed and corrected, however, the servo is limited to a range of 180 degrees. For example, if the servo was 10 degrees away from one of its stops, the gyro could only correct for 10 more degrees of movement in one direction before reaching its limit.

Can I multiple GS-1's for controlling the tilt, roll and pan of a camera?

Yes. For camera rigs suspended from a flexible suspension, such as from a kite line or a balloon, the pan axis may not be as stable as tilt and roll. In this case you may wish to consider using a GS-1 *CR* servo for pan if your application requires slowly panning in circles.

Can I use the GS-1 where the servo is mounted 90 degrees to the rotation axis of the object being moved (e.g. worm gear or bevel gear drive)?

The GS-1 is not compatible with these types of mountings.

Can I use the GS-1 for flight stabilization of a model aircraft?

The GS-1 is not designed for controlling flight surfaces.

Can I use the GS-1 for camera stabilization in a model plane or helicopter?

Yes. If you expect the aircraft to have a sustained bank, you may find that the slow re-centering adjustment works best.

What batteries are compatible with the GS-1?

You need a battery of 4.0V to 6.0V or a voltage regulator that outputs 5.0V. Do not connect directly to LiPo batteries. A good choice for a GS-1 battery is the HydriMax Ultra 750 (Model HCAM6301). It is easiest to use a battery designed for driving an R/C receiver with a 3-pin servo connector. The GS-1 comes with a battery adapter for these types of batteries.

Support

Questions regarding the GS-1 can be sent via email. See the Contact link at www.dunehaven.com.

Legal

The design of the GS-1 system is Copyright © 2009-2011 Scott Armitage. This includes the electrical design, the circuit board layouts and all software designed for the system. You may not reverse engineer, decompile, or disassemble any GS-1 software nor may you reverse engineer the GS-1 hardware for any reason.

Limited Warranty

The GS-1 system is warranted to be free from defects in materials and workmanship for a period of one year from the date of purchase. This limited warranty covers normal use and does not cover abuse or use not in accordance with this manual.

Under no circumstance will the seller be responsible for any incidental or consequential damages, which may occur during the use of the product, or as a result of the product's failure to perform. In all cases, the customer's sole remedy for a product failure is limited to the repair or replacement of the product.