

# Astro-Physics Mach1GTO

## Removing and Re-installing the Motor / Gearbox

Removal and re-installation of the servo motor / gearboxes on the Mach1GTO is not difficult. The mount was designed so that the Dec motor / gearbox could be substituted for the RA motor / gearbox in an emergency out in the field to keep you tracking in the unlikely event of a motor problem. The instructions apply equally to either axis.

### REMOVAL

1. Remove the telescope, counterweights and counterweight shaft from the mount. DO NOT try to remove a motor / gearbox with the telescope attached!
2. Remove the mount from your pier or tripod, and take it to a table or work bench.
3. Remove the four 1/4-20x1" Socket Head Cap Screws that hold the two axes together using a 3/16" Allen (Hex) wrench. Separate the two halves, and set each axis on your work surface with the large hub containing the worm wheel facing down and the cable connector on the motor / gearbox pointing up. For the RA axis, you may want to place something under the polar fork and pier adapter to keep the axis from tipping over.
4. On the face of the motor / gearbox that has the cable connection are four #2-56x5/16" Socket Head Cap Screws in the corners of the plate. Remove them using a 5/64" Allen (hex) wrench and set them aside.
5. Carefully lift off the cover plate with the cable connection and drape it over the reduction gearbox end of the motor / gearbox to get it out of the way. Be careful not to strain the wiring.
6. Look inside the motor cavity. It is very important that you note exactly how things are arranged. In particular, note the following:
  - The motor / gearbox is attached with two specially machined shoulder bolts. DO NOT remove them until you have read through the following! At the bottom of each shoulder bolt is a flat washer.
  - There is a flat piece of spring steel spanning the two shoulder bolts. Carefully note the position and orientation of the spring with respect to the shoulder bolts and the small "hump" from the axis at the center. Note also that the spring is on top of the flat washers, and below a machined step about half way up the shoulder bolt.
  - It will be much easier to leave the shoulder bolts and spring in place as much as possible when removing and re-installing the motor / gearbox as opposed to removing them completely from the box.
  - The bolt near the reduction gearbox (the one that would have been closest to the cable connection) will be referred to as the RIGHT bolt, and the other one as the LEFT bolt in the remainder of these instructions.
7. Loosen, but do not remove the shoulder bolts using a 5/32" Allen wrench. Start by loosening the RIGHT bolt on the reduction gearbox end, then loosen the LEFT bolt. You will feel the motor / gearbox come loose against the axis.
8. Again, starting with the RIGHT bolt, carefully finish unscrewing the shoulder bolt. When the bolt comes free of the threads, the spring will want to push it over, so to speak. You can allow this bolt to tip over, but try to keep the spring and washer relatively in place. Let the shoulder bolt lean against the motor, and try not to let it come all the way out of its thru-hole in the bottom of the box. Grab hold of the motor / gearbox with your left hand and place your index finger inside the box. You have two objectives in doing this: 1 - making sure the motor / gearbox does not fall off and 2 - using your index finger to keep the LEFT shoulder bolt from being knocked over by the spring. (The motor won't hold this screw for you.) Now, finally, unscrew the LEFT shoulder bolt and the motor / gearbox will come off of the axis. If you will be setting the motor gearbox down and thereby removing your index finger, first push the shoulder bolt that your finger is steadying back into the thru-hole a bit further to keep it from falling over. If the bolt doesn't stay in place, it isn't a catastrophe. It is just a bit easier if you don't have to line it all up again.
9. If you will be shipping or transporting the motor / gearbox, it is recommended that you push both shoulder bolts all the way in and put a #10-32 nut on the end of each bolt (on the outside of the motor / gearbox) to hold them in place during transit. We also recommend that you replace the cover plate with the cable connector for transit.

## RE-INSTALLATION

1. If the cover plate with the cable connector is on the gearbox, it should be removed first as outlined above. If #10-32 nuts have been added to prevent the shoulder bolts from coming out during transit, please remember to remove them before trying to re-install the motor / gearbox.

2. Push both shoulder bolts through their respective thru-holes so that they protrude out the bottom of the motor / gearbox. Take hold of the motor / gearbox as described above using your index finger to keep the LEFT bolt from being knocked all the way over, and carefully work the motor / gearbox into position on the axis.

*CAUTION: When starting the two shoulder bolts in the steps below, please be careful NOT to cross-thread them!*

3. Start with the LEFT shoulder bolt that your index finger has been supporting, and, after carefully lining it up with the tapped hole on the axis housing, start it and turn it in by hand for several full revolutions.

4. Carefully line up the RIGHT shoulder bolt, and start it into its tapped hole. You should feel resistance from the spring as you stand this bolt up straight to start it into its threaded hole in the axis housing. Turn it in, also by several full revolutions.

5. Make sure of the following:

- Each end of the spring should be on the axis side of its shoulder bolt - not on the motor side.
- Each flat washer should be in place below the spring.
- The spring should be pushed down all the way so that it is sitting on the flat washers at the bottom of the box, and is below the step in each shoulder bolt.

6. **The next steps are to set the Worm Gear - Worm Wheel Mesh:** Gently rock the motor / gearbox from side to side and from front to back to be sure that the worm is fully seated in the wheel.

7. Tighten the LEFT shoulder bolt first. *It is critical for proper worm mesh to tighten the LEFT bolt first.* Tighten the bolt in small increments. As you tighten, wiggle the box slightly so that it finds its center as the bolt is gradually tightened. Once the bolt has made full contact, tighten about another 1/8 turn.

8. When the LEFT bolt is tight, tighten up the RIGHT bolt, also about 1/8 turn past the point of full contact. When you have the RIGHT bolt properly tightened, check the LEFT bolt to be sure that it still feels tight.

*NOTE: These are not lug nuts that hold the wheel onto your car. If you are unsure how tight to make the attachment bolts, I would suggest that you err on the side of caution and don't risk over tightening. It is easier to do this whole re-meshing process over making everything a bit tighter the second time around than it is to undue the damage from too heavy a hand on the wrench. We have found that a good practice is to use the long end of the wrench in the bolt head, so that you only have the short end for leverage. Make it as tight as you can with this short lever, and then reverse the wrench and tweak the tightness by no more than 10 additional degrees.*

9. **Finishing up:** Once the attachment bolts are both sufficiently tight, replace the cover plate with the cable connection, and the re-installation of the motor / gearbox and the re-meshing of the worm gear and worm wheel is complete.

10. Reassemble the two axes and go enjoy some clear dark skies!