This document was cobbled together by IH8MUD user Xprmntl, from many different posts and threads, largely made by co-users Raventai, FJBen, Photoman, Landtank, Gauge, & Beowulf, and possibly others. Xprmntl has not done this repair, yet, so will not take responsibility for gross omissions and errors present. This document was put together as a more complete guide for himself and others, if and when needed.

How an E-locker Works

When the driver toggles the electrical locker (E-locker) actuator switch for one or both differentials, the locker ECU sends power to the actuator motor which turns a drive gear that winds up one of the two wait springs. Attached to the driven gear is a metal programming plate, with contacts opposite to it that ride on the plate. The center contact always remains in contact with metal on the plate, but the two outer contacts break continuity when plastic-coated areas come in contact with them, designating "locked" or "unlocked" positions. The locker ECU senses these signals (breaks in continuity) and turns off the power to the motor. The majority of the time, the actual locking mechanism (splined apparatus within the axle) is not lined up at the exact time when the actuator motor turns on. The purpose of the wait springs is to store the energy from rotation of the locker motor and "wait" for the alignment to happen. For locking, the wait spring applies force through the differential shift fork until the splines line up, allowing meshing or lock (this alignment can only happen if there is "slip" or difference in rotation of the vehicle wheels). The rear locker only has 5 splines, so can take up to a fifth of a turn of differential rotation to initiate lock. The front locker is fine splined, so tends to lock easier. A similar chain of events happens in reverse for unlock, but the wait spring is needed here to store the release energy for a time when the locking splines are not under torque from "driveline windup." For this all to work properly, the programming plate (attached through the wait springs to the final gear and the "shift lock fork shaft") that the locker ECU monitors, must be clocked properly to deliver the proper force to the wait springs. A good video that shows the working of an e-locker can be found here: http://www.youtube.com/watch?v=xoniaipOCdU

Overhauling the Differential Actuators

Before removing the Differential Lock Actuator, make sure the problem is not an electrical issue like a malfunctioning toggle switch or locker position switch. Does rotation of the dashboard switch produce voltage to the actuator motor? The locker position switch on the axle can be tested for continuity with an ohm meter. If it is not working, cleaning with contact cleaner may restore function. Or it might be just a blown 30A fuse (labeled "diff"). Note: The differential indicator lights in the instrument panel are powered from a separate 10 amp source ("gauges" fuse), so the limit switches on the lockers and the lights in the instrument cluster can work independently of locker motors. Also check all electrical connectors, including the dash switch. If the differentials work, but your dash lights are "flashing," it is likely a bad position sensor. The factory part is 84222-12010 which runs ~$90. After-market replacements are about 1/3 the cost, for instance NAPA Pt# NS6421 or BECK/ARNLEY Part # 2011788.

Testing the locker is sometimes best accomplished by putting the axle in question up on jack stands. Turning one wheel by hand with the locker engaged will show whether the locker will engage and/or disengage. Having someone actuate the locker while you're under the vehicle will allow one to hear whether the actuator motor is working.

Toyota services the lock actuators as an assembly, thus none of the internals can be purchased separately. If you damage the actuator or find it damaged you must repair the part or replace the whole actuator which is expensive. For the most part, the actuator can only go back together one way, ***careful observation of how it came apart will get it back together*** except for one thing on the rear: the relationship between the "final gear" and "shift lock fork shaft" should be measured before disassembly (if this is not possible, use what was measured in this write-up.

Tools needed: Metric socket set (10, 12 &14mm), flathead and Phillips screwdrivers, rubber mallet, adjustable wrench or set of open-end metric wrenches, grease(non-conducting wheel bearing grease or similar), ohm meter with alligator

clips or a helper to hold, a fine scale ruler or better yet a dial caliper (for taking length measurements), a permanent marker and/or metal scribe and RTV silicone (Toyota FIPG recommended) for sealing.

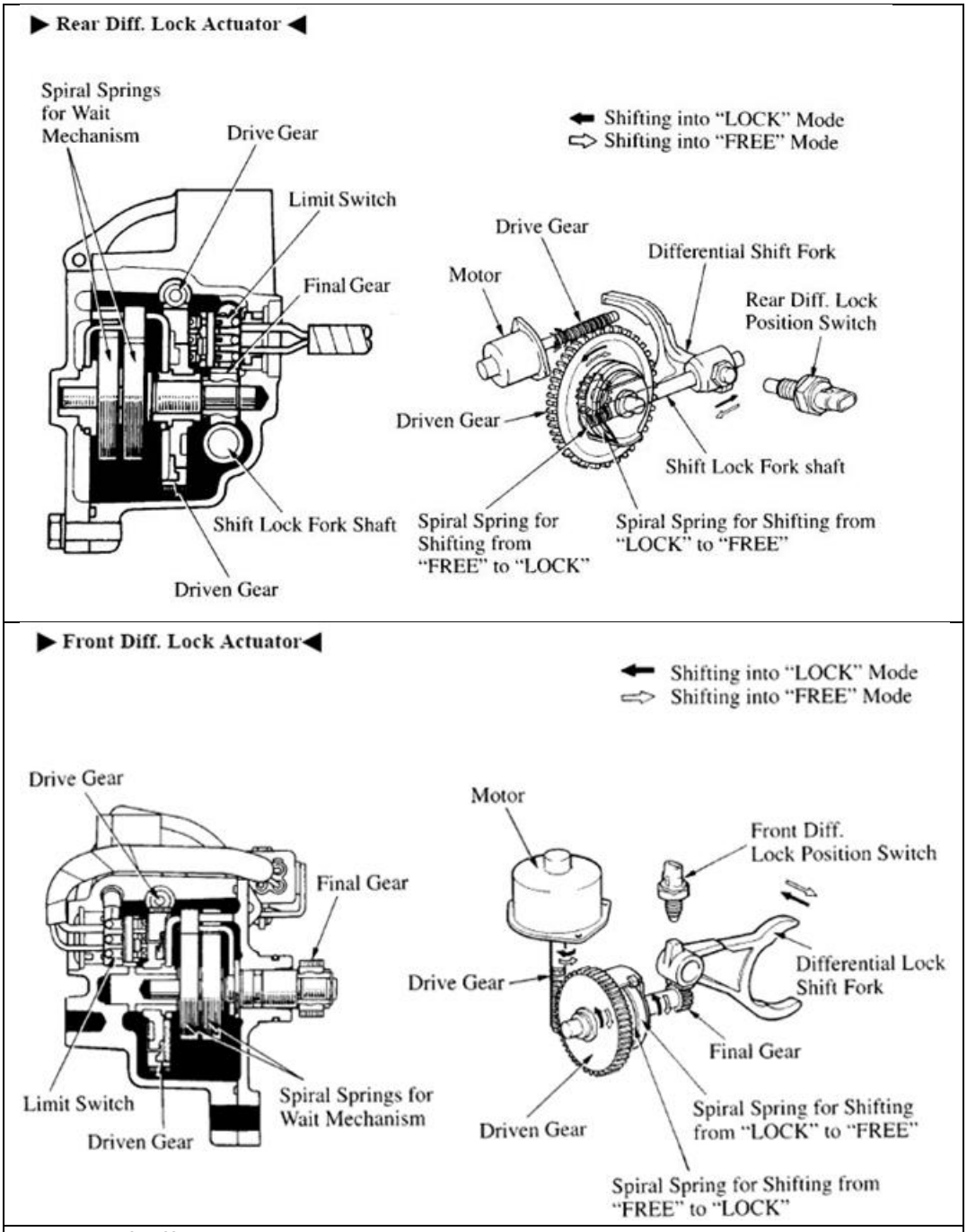

Diagram of differential lock actuator

Removing Differential Actuators

Note, the rear will likely leak differential fluid when the actuator is pulled, but the front is mounted higher so it may not. The rear locker is best removed with the locker in the "locked" position, whereas the front is best removed "unlocked."

Remove the metal shield (rock guard) around the locker actuator (three, 14mm bolts). Remove the indicator sensor from the axle—this will require an open-end or adjustable wrench. Remove the bolts from actuator main housing (the front

has two 12 mm nuts and a bolt, whereas the rear has four 12mm bolts). Disconnect the two wire harness connections (locker and sensor). For the rear, figure 1, there is a cover under the area where the indicator sensor was located that must be removed (three, 10 mm bolts). Gently pry this cover off as it is sealed with RTV. Under the cover, there is a 10 mm bolt that attaches the actuator rod to the shift fork (that moves the locker) that must be removed.

On the front actuator, for reinstallation, the final gear must be oriented properly with respect to the output shaft and must be aligned to the assembly—see reinstallation instructions at bottom as a guide. If alignment marks not present, use a permanent marker or metal scribe to make markings in the vertical directions across the final gear and shaft end.

Figure 1. Rear locker actuator with axle cover plate removed, exposing shift fork connection.

Once the Differential locker is removed, note and/or mark the "differential lock shift fork" position. Move the shift fork back and forth (may need a screwdriver for this) to see if it is binding up. You may also need to spin the wheel (or brake rotor, if wheel removed) to align the internal splines on the locker. Move it back and forth until it moves freely. Make sure to return the fork to the original position for reinstallation!

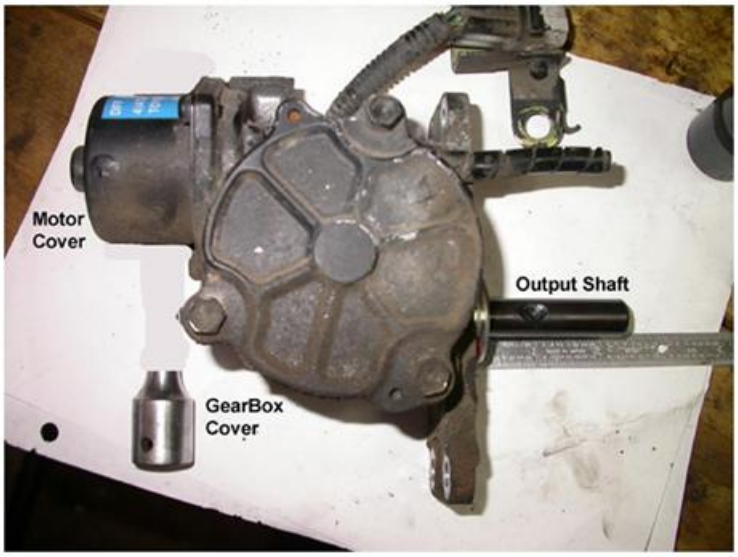

Figure 2. Rear differential lock actuator

Figure 3. Front differential lock actuator

Disassembly

It's a good idea to clean the assembly prior to tear down, and to work on it somewhere where small parts will not be lost. If you do not know what the issue is inside the actuator, it is often best to open the motor assembly first, before the gear assembly. Remove the 3 Phillips screws from the motor cover, and *slowly* pull the cover off as a lot is about to happen. There is an O-ring underneath that may stick, which needs to be salvaged in one piece or one will have to be sourced (US equivalent to a metric o-ring is often difficult). As the cover is removed, the motor armature may stay in the actuator or may stick to the 4 magnets glued in the cover. If the armature comes out with the cover, the motors brushes and springs will be dislodged. It would be a good Idea to take a look at these as they come apart to help with reinstallation. There are two small springs behind the brushes that will push themselves out and fall away from the assembly. DO NOT LOSE THE SPRINGS. The motor brushes are attached by very thin braided copper wires, so be careful with these as they are fragile. You can either reinstall the motor now, or wait until the final assembly (see last paragraph). Sometimes the motor magnets come debonded with the housing, and therefore must be placed back in position and glued (see figure 7). Try to maintain the orientation and positioning of the magnets, as any inversion of the magnets or repositioning can result in motor nonfuctionality or reverse the motor running direction.

Hopefully, the motor armature stayed in place when the cover came off. Take note of how it is assembled. Gently rotating the armature toward the lock position may help it stay in place during the rest of the maintenance.

Next, check the output shaft limits using continuity checks of the R9 connector plug, figure 4.

Figure 4. Locker actuator connector, R9

With the locking tab up, the two rows of pins are:

3 2 X	3 green/red	2 green	X Blank
6 5 4	6 green	5 yellow	4 black

The connections used to limit motor travel are 4, 5 & 6: 4 is common, 5 open when unlocked and 6 open when locked.

Check for continuity between 4 & 5 and 4 & 6; if both have continuity, then the actuator is either in transition, neither locked nor unlocked, or over-traveled (beyond the plastic areas). Start by finding the proper "unlocked" position of the actuator (continuity between 4&5). If the armature remained installed, rotate the motor to retract the "shift lock fork

shaft," otherwise just slowly push on the shaft, until the point continuity is just broken between pins 4 and 5. Measure the total amount of exposed shaft for the "unlocked" position (should be ~2 3/8" but may be as low as 2 3/16" for well-used actuators). Now rotate the motor (or pull the rod gently), in the opposite direction to extend the shaft until continuity breaks between 4 & 6. This is the "locked" position (which should measure ~ 2 7/8").

Now remove the main cover, 3 bolts (rear) or 2 bolts (front). For the front, the C-clip holding the final gear will have to be removed—note drive gear orientation and position for proper reinstallation. If it is not marked with an alignment guide as shown in the installation directions in figure 11, then mark it as depicted. Inside the main cover there are wait springs, driven gear, final drive, and programming plate that should come out as a single assembly--try very hard to keep these parts as a single assembly. For reassembly purpose, as you are removing the cover, it is smart to put an alignment mark on the large toothed gear and the side of the casing for reassembly alignment. Depending on which model rear actuator one has, there may be a split in the fork shaft (purpose unknown) that can fall out. If present, clean and replace.

Look everything over thoroughly, noting and repairing any problems or damage.

Figure 5. Rear actuator internals

Figure 6. Front actuator internals

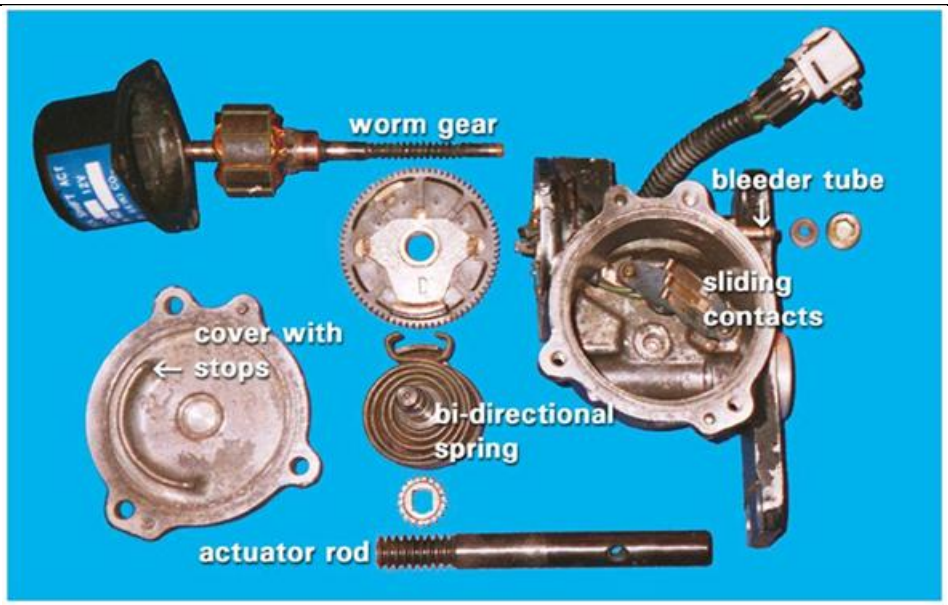

Figure 7. Completely torn down rear actuator.

Put a dabs of grease in where the armature shaft contacts the motor cover and where it contact the main housing on the other side of the drive gear, also on center of the main cover that supports the cross shaft and matching spot in the housing. Grease the drive gear, driven gear, final gear and shift lock fork shaft, also grease the o-rings and their grooves to help sealing, and a thin layer of grease (non-metallic, non-conductive) on the programming plate where the contacts ride

Make a mark with a sharpie or grease pencil on the housing directly above where the contacts are so that it will be visible during assembly; also note where the plastic areas are on the programming plate and mark this onto the back side of the driven gear so it is also visible during assembly (the plastic areas are about 120 degrees apart, the contacts normally travel in this small arc not the larger 240 degree arc)

For both front and rear actuators, install the wait spring/final drive, etc, assembly in the housing with the contact mark approximately in the middle of the two plastic area marks. For the rear actuator, insert the “shift lock fork shaft” until the rings or gears on the shaft are approximately centered in the housing; then temporarily install the cover, rotate the motor (if installed) or push the shaft in and out while watching for continuity, like above (it may take a few strokes for the contacts to cut through the grease and make good contact). Take measurements of locked and unlocked positions. If these measurements don’t match the initial measurements, take the cover off, lift out the final drive assembly and rotate it one or more teeth over as required, reassemble and re-measure, repeat until your measurements match.

Reinstall the greased o-ring on the cover and tighten the three bolts. Recheck limit measurements for rear actuator.

If the motor armature came out, you’ll need to hold the two brushes and springs out of the way while the armature is replaced. This can be done by making some clips out of stiff, light gauge wire (or thin string), or easier still, loop the brush contact over the mounting to hold the brushes back (figures 8-10). To install the armature, first grease the hole the the drive end inserts, then slide the armature in place and rotate it when the drive gear contacts the driven gear to let it seat, then pull the clips (or brush leads) to let the brushes slide into place. If magnets were dislodged during disassembly, arrange and reglue as shown in the figure 7. To find which pole is present on the face of the magnet, you can use a permanent bar magnet with known poles (N attracts S), or a compass. A pair of like magnets will attract each other back to front. Once you have paired the magnets it's important to glue them directly across from each other in the cap as depicted (glue suggestions include JB Weld, 3M Scotch-Weld DP-110, RTV, and cyanoacrylate). Reversal of this arrangement will cause the motor to rotate opposite to the intended direction (this, however, can be remedied by swapping wires, if removing the newly glued magnets is difficult). Install the o-ring and the motor cover, making note of the two, small locating nubs pressed into the sheet metal of the cover, as it is possible to install the cover incorrectly if these nubs are not matched to the holes in the main housing.

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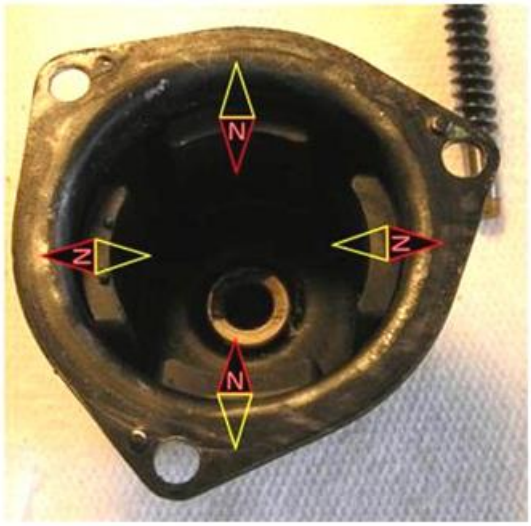


Figure 7. Orientation and position of magnets for proper function

Figure 8. Springs and brushes after motor armature removal

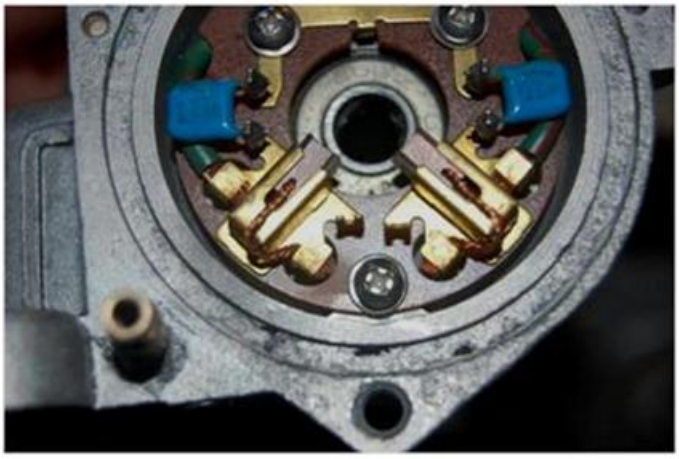


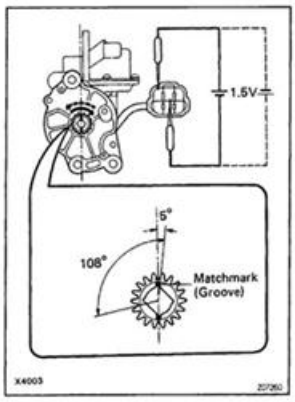
Figure 9. Holding back brushes with wire lead looped over mount

Figure 10. Pulling back the springs and brush with wire & string

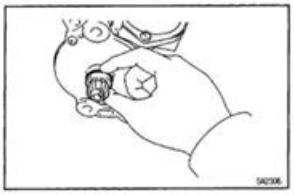
Plug the locking assembly into the harness and run it in with the dash switch, in and out a couple of times, to ensure functionality before reinstalling (remember the shifter needs to be in low range, or have "Pin 7 Mod," for it to work). It is not a good idea to apply voltage directly to the actuator without the logic of the controller, as this has the potential to cause over-travel and stretch the wait springs. If you must, use a small 9V battery, as the motor will have less torque and ***should*** stall before too much stretching of the wait springs occurs.

Installing rear assembly: Make sure the rear differential actuator and switch are both in the "Locked" position (when unlocked, the fork shaft isn't exposed enough to place the bolt into the shift fork). Replace the mounting bolts and fork shaft securing bolt.

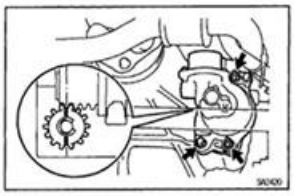
Installing front assembly: Make sure the front actuator and switch are both in the "Unlocked" position. Pay close attention to the mesh of the final gear to the shift fork and assemble as shown in figure 11.



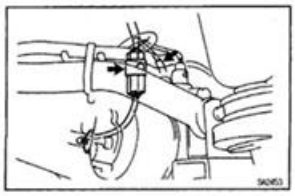
(b) Using a dry cell battery, align the matchmark on the actuator pinion with the center line of the actuator.
NOTICE:
- If the pinion of the actuator is not in the specified place, the actuator is difficult to be installed.
- Don't supply the battery voltage between terminals.
- If the matchmark comes to the extension limit of the rotation, don't electrify moreover.



(c) Install a new O-ring to the actuator.
(d) Apply a light coat of gear oil on the O- ring.
(e) Apply MP grease to the gear part of the actuator.



(f) Install the actuator- to the differential with the 2 nuts and bolt, so that the outermost rack tooth of the shift fork shall fit matchmark of the pinion of the actuator-.
HINT: Don't damage the O-ring of the actuator.
Torque: 26 N·m (270 kgf-cm, 20 ft-lbf)



(g) Connect the connector and tube.
HINT:
- The depth of the insertion of the bleeder tube into the hose is approx. 15 mm (0.59 in.).
- Take care that water or the equivalent shall not adhere to the connector and hose.

Figure 11. Front differential lock actuator installation

CENTER DIFFERENTIAL LOCK