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Fixing the Transfer Case

The Legal Stuff First:

I take no responsibility for anything that happens as a result of the information posted here in this page. You are on your own. Use it at your own risk. As Jeff notes below. It is allot of information. Read everything and read it as many times as it takes until you understand it and the risks associated with it. This is all information gathered by various people trying to assist others by passing along what they have learned. If you have any information that may be relevant please email it to me at dsmith@radio.fm. I typically post everything I get ,BUT foul language found in documents will be removed if I deem it to be offensive and i feel that it is just not needed to properly convey a point. IF it si more than a word or two I will not post it. If I find it after it is posted I will remove it.

One last note. When cutting and pasting from this page you will have to change the test color as it is set to white and will not show up in MS-WORD.

Here is a PDF file from snap on right click here and save it to your computer. It is approximately 450kb

Jeff's note - This is a very long, detailed section. Please read through it thoroughly before attempting any of the procedures.

The Problem

Today I discovered my 93 Ranger would not engage 4WD. Pressing the dash button did nothing other than click; no dash light came on and no change in transfer case. I may have detected a slight change in idle speed as the button was pressed...anyone have any experience with this problem? Any and all suggestions appreciated.

The Solution by drbob

The diagnostic on your 4WD system is somewhat

complex. Main components are the controller in the LR wheel well, the switch assembly on the dash with the indicators, the transfer case selector motor and limit switches. Any one of these can be guilty. Since these really are too expensive to replace on a hunch, think seriously about getting a copy of the diagnostic procedure from the factory service manual. Perhaps your dealer will help you out with the pages, or perhaps you should pick up the manual. Last I looked, this is about \$80 but worth it.

If you want to do a little pre-invest stuff, look at the motor on the transfer case. Several users have reported that the motor has rotated a bit, to the point where the limit switches may not be engaged in the 2WD position. Since the controller is 'smart' it won't try to move the motor unless it knows the current position.

Procedure:

Disconnect the negative lead on the battery. 4 Bolts get the balancer, then the motor comes loose. Be extremely careful as you unplug the motor leads, and also the harness that goes to the switch assembly next to it. The routing of the leads is important, so you might want to make a sketch so you can get them exactly the same as they were from the factory.

Inside the transfer case, the motor drives a rotary cam to one of three positions. You want to turn the cam so the arrow points directly to the 2WD position. You'll be able to see the indicator when the motor is out, so this will make more sense then.

Now, move the motor so that the cam will be engaged by the motor ok when the motor is reinstalled. As you'll see, the end of the motor will only fit one way on that selector cam-- just make sure the motor will line up when it's put back in the 2WD position.

With the motor reinstalled and all the wires hooked up and tied down correctly, replace the balancer, re-connect the battery, and give it a try.

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This is a message from sjwoody at Ford Truck Enthusiasts Forums

The Ford Truck Enthusiasts Forums owners cannot accept any responsibility for the contents of the email.

This is the message:

Hope this helps.....

Notes from SJWoody

The following applies to 1991 to 1994 and maybe some 1995 Ford Explorer transfer case electric shift motors. Please read the entire article before beginning work. These procedures worked for me,

and were written several weeks after the job was accomplished. The information I had at the time of work came from www.glue.umd.edu/~singletn/web/pages/tcase.html, which I believe doesn't exist anymore. If there are any errors, they are mine and are likely due to the lag in time of this writing from the actual work done. This is an effort to consolidate the information from my 13 pages of hard copy of the site listed above, plus my own experience. Please let me know of any omissions or improvements that can be made. I am not a professional auto mechanic, but as mentioned earlier, these procedures worked for me. Before approaching the problem with the transfer case motor, consider that there are four possible issues, which may come up during the repair.

1. The motor brushes and commutator may be contaminated and need cleaning.
2. The actuator stop has a rubber or plastic bumper, which has likely become brittle and has fallen off the post it's mounted on.
3. The limit switch plate (printed circuit plate), and contact fingers for the plate may need corrosion cleaned from the contacts using a pencil eraser and an aerosol contact cleaner.
4. The limit switch plate may have just rotated, since the mount screws only apply pressure to the cover, and don't positively lock the plate in position.

The following description covers the first three

issues. These seem to be the most common problems with the system. The fourth issue will be addressed at the end of the article. There are two major components to the assembly: the motor, and the actuator (or, gearbox). To remove the assembly from the transfer case, begin by removing the vibration dampener. This isn't necessary, but will make working on the motor assembly much easier. Remove the motor assembly from the transfer case as follows:

1. Disconnect the negative battery cable. Disconnect the harness connector at the shift motor assembly. (Note how the harness is routed. A quick picture with the digital camera may prove useful on reassembly).
2. All wires will be disconnected at this point except the brown wire leading to the speed sensor. Some people have just cut the wire and spliced it back after completing the repair. This isn't necessary. With a pair of hemostats, small pair of needle-nose pliers, or just a really small screwdriver, you can remove the red plug inside the connector. With this plug out, carefully pry the locking tab to the side of the pin and pull gently on the wire. This should release the pin from the connector. On reassembly, simply push the pin back into the connector until you hear the "click", and then reinstall the red plug.
3. There is a bracket on the back end of the motor, opposite the actuator. Remove the single bolt that holds this bracket to the transfer case.
4. Remove the three hex (not torx) bolts holding the assembly to the transfer case. Remove the motor assembly from the transfer case and take it to a

workbench for further work.

NOTE: At this point you can see the shaft sticking out of the transfer case. Its triangular shape has a pointed end, which should be pointing at the 2H marker on the transfer case. The following describes work on the motor only:

NOTE: Before you begin, use a marker to make alignment marks on the motor cylinder cover, end caps, actuator housing covers, and everywhere something separates from the assembly. Also, mark where the triangular "socket" is pointing. This is located on the backside of actuator and is the female portion that fits on the shaft sticking out of the transfer case. These marks will greatly simplify reassembly.

1. Carefully remove the two long screws holding the bracket to the back of the motor. These also hold the motor assembly together.
2. With some effort, you need to overcome the magnetic pull on the armature. Pull the cylinder cover from the motor.

NOTE: Do this carefully, as the brushes and springs will pop out of position as you pull apart the motor. Don't lose the springs!!! As the cover separates about an eighth of an inch, look inside and you will see the brushes and how they ride on the armature contacts (commutator).

3. With the cover off, use emery or crocus cloth (or fine sandpaper) to clean the contacts where the brushes ride. These contacts will likely be very black.

Restore the contacts back to their shiny copper color. Blow off any residue with low-pressure air, or by mouth.

4. After cleaning, a second pair of hands will make reassembly much easier. Have a helper hold the brushes retracted against the springs in their slots while you slide the armature back into position. As you get close to position, rotate the armature to the left to engage the worm gear. (I was able to do this alone, but it took some effort and a few tries to get it right).

5. With the armature and brushes in position, rotate the armature until the female socket points to the mark you made earlier on the back of the actuator. Reinstall the cylinder cover, bracket and long screws.

The following describes work on the actuator:

1. The cover for the actuator is held on with three proprietary (tamperproof) torx screws, size 20T. I was able to remove mine with a small pair of vise grips. Others have described using a Dermal to cut a slot for a straight blade screwdriver, or purchasing the proper bit (who wants to do that?). The screws can be replaced with standard 8x32 screws of the proper length. These screws don't positively lock the cover in place. They only provide pressure, through the washers, to hold the cap down in place. Make sure you make alignment marks on the cover before removal.

2. Remove the cap, and the gear inside. With the gear out you will likely see a small post on the

backside with what looks like hardened grease on it, and similar pieces floating around inside the case. This is what's left of a translucent colored plastic stop bumper that was mounted on the post. Clean this out and replace with some 5/16 fuel hose or vacuum tubing. Make sure you carefully trim this replacement bumper to the same height as the post. I used a razor blade.

3. Clean the contact fingers and the printed circuit with a pencil eraser and wash clean with contact cleaner.

4. Reassemble using your alignment marks.

At this point your motor and actuator should be fully assembled. Take the unit back to your vehicle and reinstall using the reverse procedures as shown in the first section. This is where a picture would have been useful for the wire routing. Fortunately for me, I had a second Explorer in the driveway that I could use as a guide. Line up the triangular shaft in the transfer case with the socket in the actuator. You may have to wiggle the whole unit to get the mount holes to line up once the shaft is engaged. Make sure you have the speed sensor and retaining bracket lined up properly. The bracket is held in place by two of the actuator mount bolts.

Issue number four, as described at the top of this article, says that the limit switch plate may have rotated, since the bolts only provide pressure to the cap. I have no experience with this and will quote from the article I have, written by drbob: "

The first task is to get the shift motor to some

known position. The easiest is probably to the 2WD position. The manual then gives a matrix of switch positions vs. motor positions to go through. Using the ohmmeter on the terminals of the eight-pin harness connector at the shift motor, look for the following conditions. Do this testing on the connector terminals of the transfer case with the harness disconnected.

In 2WD position, pin 10(yel/wht) should show continuity with pin 6 (violet) and continuity with pin 8 (brn/wht) and should show no continuity with pin 7 (white) and no continuity with pin 9 (org/wht).

In the 4WD/Low position, pin 10 (yel/wht) should show continuity with pin 6 (violet) and continuity with pin 7 (wht) and show no continuity with pin 8 (brn/wht) and no continuity with pin 9 (org/wht)

These cover the two extreme positions in the rotation of the transfer case shift motor. To move the transfer case motor, apply 12V to the following terminals: +12V to pin 3 (yel) with -12V (ground) to pin 2 (org). Reverse polarity of these connections to rotate the motor to the 4WD/Low position. Again, make these connections with the harness disconnected. It is extremely important that you make exactly the correct connections when you do this. Accidentally shorting through one of the switch contacts or the speed sensor with 12 volts will destroy them.

The color codes on the harness wires provide the best identification of the correct circuits. This connector is a square plastic outside shell with a round barrel inside, and a circular ten-pin array. Pin

one is in the center. Looking at the motor connector from the control wiring harness end, the pins are numbered as follows:

```
      3   2
     4     10
    5     1   9
     6     8
      7
```

(very bad html version of ASCII art)

It appears from the manual drawing that those two key shots in the motor connector are opposed at the bottom as shown in the above diagram; you should still confirm the harness color codes before applying any voltage to shift the motor. Also remember that the transmission needs to be in neutral when you do the shift. Keep the 12V power attached only for the time needed to shift the case...maybe 5 seconds max.

Once you've forced the motor to the extremes of it's travel, you can install the cover and position sensor assembly in whatever position you need to get the switch logic detailed above. This may take a bit of time and patience, but is still cheaper than a few hundred bucks spent replacing the whole motor/sensor assembly. If the controller is confused, disconnect the battery for a minute or two so the controller can "forget" that it doesn't know where the motor is."

Contributed by Alfredo C.

My Explorer remains in 4x2, and nothing happened when I tried 4x4 or Low Range buttons. I did all the tests described in the article, and I concluded that the problem was the transfer case sensor.

I took apart the whole case. I verified that the white wheel with the printed circuit (photo 1) had been unstuck from the central axis. I solved this problem with some dots of Loctite.



Additionally, I am sending another photo of a transfer case without the electronic engine showing the indicators of 4H, 4L, and 2H positions.



Contributed by J. L.

I just "rebuilt" the transfer case actuator motor on my '93 Explorer with 81k miles based on information from that section of this site. I had the classic symptoms - push the 4wd button, one click from the back of the passenger compartment, one more click about 3 seconds later, no engagement. Thanks to your page, I saw that many others have had exactly the same problems, so I decided to try to fix it myself. I thought I'd pass on my observations.

I definitely recommend removing the assembly from the car, even though that involves cutting the brown wire. It's much easier to work on the motor and actuator at a bench with a vise. I also recommend removing the harmonic balancer assembly - removing four extra bolts provides much better access to the motor.

I had to use a dremel to cut slots into the heads of the proprietary torx screws, which were well frozen into the actuator housing. I even had the proprietary 20T torx bit, which promptly became mangled along with the screw heads, even after I soaked everything overnight with penetrating oil.

The rubber tubelike stop in my actuator was completely disintegrated and gone from around the metal post in the actuator . I replaced it with a short piece of 5/16" fuel line. It must have been white - I was finding little pieces of it as I disassembled the actuator. At first I thought it was hardened grease or a broken plastic part that may have been jamming the worm gear, then I realized based on the little curved pieces that it must have been what was left of the stop.

With the problems with the proprietary screws, I had about 5 hours in this job, start to finish. Even without that problem, working at leisurely pace, I'd allow 3 hours if you're going to clean up the motor (armature and brushes, etc.) and get into the inside of the actuator to check/replace the rubber stop. I did not approach this as "take off the motor, play with it a little, bolt it back up, and see if it works", as some others did to fix problems like positioning. I wanted to eliminate every possible cause of failure that I could. When I put it back together, it worked perfectly!

I jacked up the driver side of the explorer from the side and supported the frame with jackstands behind the front wheel and in front of the rear wheel. That provided plenty of access and headroom - I would think better than either jacking up the front or the rear.

Contributed by Jim S.

Based on the information I found on your site, I was able to easily repair my '93 automatic Explorer with an inoperative push-button 4WD control. After carefully reading the "Transfer Case" page over about six times, I put the car up on jackstands, pulled the negative wire on the battery, and got started. I first unplugged the motor from the wiring

harness (those clips don't *have* to be broken - just push down on the tab that says "PUSH" and the connector will come apart with a little effort.)

First, I removed the harmonic damper (the weight on the left rear of the transfer case). Then I removed the four bolts holding on the motor assembly -- three around the round part to the right (where the position sensing switch wires come out), and one to the left of the motor housing. As described above, note the routing of the wires. Remove the bracket that the main harness connector was supported by. Notice how it holds the speed sensor in the transfer case, and holds the wires to the motor and the position sensing switches up off of the harmonic damper.

At this point, gentle pulling/wiggling on the motor assembly will allow you to pull it straight back and off of the short, cam-shaped shaft that is hidden behind the round part to the right. As mentioned above, you will then see that molded into the transfer case housing are very clear indications of what direction the narrow end of the cam (the "pointed" end) should point to for 2H, 4H, and 4L. Also, so everyone is clear, it appears that there is a seal around the shaft where it comes out of the transfer case, so not a drop of fluid is visible. Everything was clean and dry.

Being the careful sort, at this point I used a pencil to mark the inside of the motor assembly where it slides on the shaft: I drew a line where the "point" of the female receptacle pointed, in case I rotated it by mistake, so I could re-align it. I had no intention of turning the shaft (it was pointing at "2H" when I

removed the motor.)

Back to the motor: Three wires will still be connected to the transfer case. I just lowered the motor assembly onto a box under the car so I wouldn't have to splice any wires, and worked under the car. As described above, remove the bracket from the bottom of the motor (it is held on by two nuts). At this point, I wasn't sure just how the motor came apart, so I'll describe it in more detail than above for those of you ready to try this fix: The motor has a rear, flat cover, which is the piece right under the bracket you just removed. Then there is a cylindrical piece (with two permanent magnets glued to the inside), that surrounds the armature. The front "face" of the motor cover is the remainder of the assembly. The cover and the cylinder are held in place by two long bolts, which are actually the same bolts that hold the bracket on -- once the bracket is off, you will see two 8-mm hex heads that you unscrew to open the motor. (These are long bolts with threaded studs on top -- the bracket was bolted onto the studs.)

If I do this again, I'll use a marker to mark the alignment of the end of the motor cover, the cylinder, and the rest of the assembly before removing the bolts. (I had to twist them around until I got the alignment right when I was ready to reassemble.)

Anyway, I removed the bolts, eased off the cover, and found that the magnets in the cylinder exert quite a pull on the armature when you are trying to remove the cylinder. I wound up removing them

together. Strangely, I don't remember having to turn the armature to remove it. I must have, though, because I did not have to rotate the motor to line up the female slot on the motor assembly with the shaft on the transfer case when I was done.

The brushes mentioned previously are mounted in a plastic plate that is part of the rest of the assembly. I knew from reading above to watch for the brushes and springs popping out, so I removed the armature very slowly. Not that you know right where the brushes are, you can look in the crack between the cylinder and the rest of the assembly as you remove the armature and you'll be able to identify the brushes easily and watch for those springs to pop out.

The contacts on the armature were filthy black, which seemed to me to verify that what the others above said was true -- they just needed cleaning to work again.

After cleaning as described by others (I also used Qtips to clean all the black bits of dust out of the brush holders, etc.) I was able to put in the springs and brushes one at a time (there are two) and hold them retracted as I started to replace the armature. The copper wires from the side of the brushes protrude out the slots in the brush guides - this will be clear once you see it. As I tried to replace the armature, it wouldn't just push in... now what? Oh, yes, turn it (the end is threaded; it's a worm gear). Nothing. After looking again, I saw it was a *left-hand* thread, so you have to turn it counterclockwise to reinsert it. Went right in, no

problem.

At this point, I could carefully hold the armature in place and turn it each way, and verify that the female slot was oriented correctly to slide back on the transfer case, since I had marked it on removal.

Then I just slid the cylinder back on (pushing on the end of the armature so it wouldn't pull out and pop the brushes out), put on the rear cover, inserted the bolts and wiggled them to find the holes at the other end, and reassembled the whole thing.

I debated trying to run the motor while I had it off the transfer case, but decided that I might slip up and damage some of the other components, and since it seemed that the contacts were filthy, and I had them cleaned, I just decided to gamble, so I reassembled everything, reconnected the battery, dropped the car, crossed my fingers, and tried it out.

Everything seems to work perfectly!!

I don't know how long it will last, but my sincere appreciation to those of you who took the time to write all the text above: you helped me save about \$450 (what a friend with another Explorer just paid last year for a new motor). I offer these notes to perhaps give someone else a few more details, and give you the confidence to try this repair yourself.

Comments from Tom J.

All of the things posted are true and correct and one other thing before they go and replace the motor is that the contacts on the armature get dirty after much use and are very easy to clean by taking the two screws out of the motor and pulling it apart. Care must be taken and don't lose the two load springs to the Brushes. Use very fine emery cloth on the contacts where the Brushes ride. The armature screws back into the switch housing and care must be taken to make the brushes clear until they are riding on the armature. I restate that care must be taken when removing and replacing the armature with the brushes and load springs for there is to hold back hole to keep the brushes from slipping out of their guide. If you are poor as some of this Oklahoma dirt as I am and can walk and chew gum at the same time I am sure that you will find that this will save you the cost of replacing the motor or having it rebuilt.

Contributed by Greg D.

My third visit to the 4wd shift motor to remedy a no-shift condition over the six years and almost 200K miles was greatly helped by the info submitted by previous contributors. Here are a few

things I learned:

1. The multi-pin connector can be disassembled, eliminating the need to cut the wire permanently attached to the transfer case. Just get some needle nose pliers or large hemostats (is any toolbox complete without them?) and carefully pull the red center piece out of the male end of the plug. Then, gently pry the plastic retainer away from the wire you want (not too far!). To remove, pull the wire out the back of the connector.

2. Mark the location of the round plate with the wires going into the switch housing so you can reassemble it into the same position when you're finished. Use a good pair of vice grips to loosen the small screws with the proprietary head which hold the round plate to the switch housing. I replaced mine when reassembling with 8-32 screws cut to fit. Be sure to use star lockwashers on the screws, since a good mechanical and electrical connection is needed here!

3. The round body of the motor itself comes apart in three pieces. Once the long motor bolts come out, pull the motor apart. Yes, the brushes and the springs immediately fall out of their holders, but getting them back in is easy. After cleaning up the part of the motor where the brushes ride (use fine sand paper or an emery board), hold both of the brushes against their springs, and insert the motor armature shaft into the housing. Then, slide the round motor housing over the shaft while holding the shaft/brushes in place with your finger by reaching down into the motor body and preventing the magnetic force from pulling it out. Then, install

the end cap of the motor and reinstall those long bolts.

4. To test the motor, leave the large round driven gear out of the switch housing, and hook the wires up as described by drbob, and watch the motor hum along wonderfully. Reverse the leads, and watch it go in reverse. After you're finished feeling good about the motor running so well, lubricate the worm gear, and the teeth on the driven gear. Slide the driven gear in and it will engage the worm gear. Run the motor to one of the stops and reassemble the cover plate to the position you previously marked.

Well that's it. So far, no problem with the fix. I had previously tried other fixes, but really believe that the dirty contacts where the brushes ride inside the motor were the real problem.

Contributed by Richard F.

I was having some trouble with my 1991 Ford Explorer transfer case and talked with a service tech up here in Alaska about it. He told me about a test you can perform to the processor board that is located in the rear left access panel next to the jack and rear windshield washer container. It has 2-wire harness pin connectors attached to it on the left side. If you remove the 2-wire harness pin

connectors and turn on your ignition switch. Now you can push the white square button on the bottom edge of the processor board and it will turn on a red LED right next to the button. If the red light flashes this means you have a problem with your actuator motor assembly. If the red light stays bright this means you have a problem with the processor board. I found a problem with the actuator motor assembly. I followed the instruction from your web page on Transfer case problems. I found it helpful but would like to add some info to it. I didn't need to remove the harmonic balancer nor drain the fluid. The 4 bolts that hold the actuator to the case were removed, the magnetic pickup sensor and I cut the one brown wire going into the case. I opened up the actuator and removed the armature. Cleaned it up with some 400 grit carborundum paper and washed it down with some CRC contact cleaner. I pull the brush holder springs out and put a little more tension on them because they seemed to only apply a little tension to the brushes that were worn to a length of about 1/4". I polished up the armature shaft where it comes in contact with the bronze oil impregnated bushing with the 400 grit carborundum paper. I install some graphite grease on the worm drive shaft and gear and bushing surfaces. I installed some RTV sealant on the cork gaskets before assembling. I removed the 3 -8/32 X1/2 " anti-theft screws on the gear cover and cleaned the face of the gear with the foil trace circuits on it and the 5 copper contact surfaces on the cover with CRC contact cleaner and 400 grit paper. I used some RTV sealant on the cork gasket before installing the cover. I also installed some RTV sealant on the 5

wires that go through the cover rubber grommets that don't do a good job at keeping out the fine dust that was found on the contact surfaces within. This I feel is the root of the problem! Now I cleaned up the transfer case and actuator surface where it meets the case and installed some ATV sealant on it and bolted it back together. I install a #14-16 pin connector male and female on the wire I cut and put some heat shrink tubing over it to seal it up. After 1 hour of tinkering I am back on the road. Wala- a simple push of the button and I was in 4 wheel drive again. The first snowfall in Alaska this year has now come and I am ready for it. With 4 studded tires I can drive on the glacier roads at 55MPH and feel safe.

Contributed by Chad C.

I have a 1993 Ford Explorer and I was not able to shift into 4-wheel using the push button today. I thought that Ford might have a page that I could use to start to trouble shoot from. Accidentally, I came across your page and read the tranfer case section. Using that information I started at 10:30 tonight and now at 12:00 A.M. I just finished my test drive and everything is working great. You may want to add the following to your page. When troubleshooting a push-button problem use the following steps before removing the motor. 1.

Using a VOM (Volts-Ohm-Meter) test continuity between pins 10, 6 and 8 (2-Wheel). To determine others 4L, 4H reference previous sections. If you have continuity the brushes and armature need to be cleaned in the motor. If not you can move the motor +/- 15 degrees that should produce the continuity you need. In my case I did have continuity, so I removed the motor cleaned the armature and brushes.

Contributed by Jim B.

With the harmonic damper removed and all 4 motor mounting screws removed, remove motor and then slip back over the indicator cam. If 3 bolt holes on main body line up with holes in transfer case then motor position is in line, otherwise it's off.

With motor removed from transfer case, mine would only attempt to turn 5 or 10 degrees when engaged. Went to Auto Zone and bought a set of "tamper proof bolt" torx bits (cost \$17). Took off round cover and removed cam gear. Small piece of tubing (which is a stop) was badly worn. Also contacts on cam face were dirty. Cleaned contact and used a small piece of 5/16 fuel line for stop. Reassembled and works perfectly!

Contributed by Gerry S.

I would like to commend on this site for it saved me \$\$\$\$. I had a similar situation in the "Fixing the Transfer Case" section. I recently had my transmission rebuilt on my 93' Explorer. Shortly afterwards, I noticed the 4X4 wasn't working. No lights, no sounds, when pressing the button. I figured that when they rebuilt my transmission they forgot to hook something up. I took it back and it sat in their shop for 2 days before determining everything was hooked up and it was nothing that they did. They did say to take it to the dealership and if they were found at fault they would flip the bill. I took it to the dealership. They called me a couple hours later and told me they need some more time to diagnose the problem that it wasn't something simple like the switch or fuse and I authorized the extra hour for troubleshooting. They called me the next day and told me it was the shift control module and the total bill would be \$700 parts & labor. I wasn't going to authorize anything over the phone so I did some researching. I found your site and read it over a few times. I went down to the dealer a little more knowledgeable than before and questioned their techniques and pricing for this job. I asked to see the service manual and time breakdown. I must have won the argument as I left the dealership without paying a dime, but I still have an inoperative 4X4. Following your instructions, I was able to find the problem (limit

switches) and fix the problem myself in less than an hour.

I would like to add comments though:

I would completely remove the shift motor/switch controller for ease of cleaning the brushes and switches. It is a simple process to take the 3 permanently fixed wires to speed sensor out of the wire connector. This can be done by removing the yellow "lock ring" out of the center of the plug and pressing back on the plastic tabs on the pin for the wire you want to remove.

Cleaning the motor brushes and commutator is straight forward. Putting back the armature was a little difficult with the brushes in place, as I didn't have any extra hands. My tip: use wire ties or something similar to hold brushes in place while replacing the armature in housing then cut them off.

Make sure you mark the switch cover before removing. I found removing the cover required a special torx bit, which I didn't have. I had to punch out the center of the bolt to remove that piece that was preventing me from using my regular torx bit.

Contributed by Glen S.

We just completed the "Transfer Case Motor Brush Cleaning" outlined in your FAQ. The information was incredibly valuable, especially the comments in Jim Schneider's section. To make the repair even easier we have a few comments to add (all for a '91 Explorer 4x4):

1) Harmonic Balancer Removal is NOT necessary (at least on a '91 Explorer) Although Jim Schneider and others suggested this removal, we successfully detached & reinstalled the motor assembly WITH the balancer in place without any hinderance. In other words, removing 4 bolts and disconnecting 1 connector is all that's needed to remove the motor.

2) 10 pin harness disconnects without damage Although incredibly deceiving, the tabs on this connector must be pushed DOWN to disconnect rather than pulled up as it initially appears. The tabs have a thin slot, so that when the tabs are pushed down the slot sneaks UNDER the knob (which is T shaped in cross section). It sounds confusing, but will make much more sense when looking at it. Reconnecting is made easier by lightly widening the thin 'tab slot' with sandpaper.

3) Motor dissection and brush cleaning easier than it sounds The only tricky part, which is greatly aided by an additional set of hands, is pushing the brushes outwards while installing the armature. Still not tough, but might take a few tries. The only thing to lose is the two springs, but they stay in place rather well and the brushes are attaced by wires.

4) In the big picture, it seems that there are several

repair procedures depending on your situation a) Motor Brush Cleaning (we did this) b) Motor Alignment (even after completing "a" we still don't see where there enough play in the motor mounting to allow varying the alignment) c) Motor Position Sensor Debugging (ie. checking the continuity of various pins combinations on the 10pin harness) d) Shift Computer Reset (press little white button on controller inside truck above left-rear wheelwell) e) Other more insidious problems

And this exchange found in my inbox

From Michael T.

My system does the following: pressing the dash button causes a short series of clicking noises at the back of the vehicle, but nothing else happens. I've not taken mine in to be looked at. Have you?

From Barry N.:

Mine had the same problem - read on in the cut/paste below (especially the URL and my experience here relates only to the electric motor on the t-case and assumes you have no problems with your hubs, 4WD computer controller or other related components).

I'm not sure how familiar you are with this so I'll go through it as much as I understand it. There is a little electric motor on the transfer case (similar to ones used on electric windows) that is used to engage the 4WD and as Dr. Bob explains, there are a lot of things that can happen with it. Mine hadn't worked for quite some time but after fooling with it and somehow getting it to work intermittently, I decided to have my mechanic look at it. First he took the motor out by unplugging the connectors and cutting the red wire that's hard wired in. Then he took the cover to the motor off with a safety torque tool (why they would want to keep people from being able to take this motor apart is one of the many roadblocks Ford likes to throw in our way). Then he took some fine steel wool and cleaned up the contact surface. When he removed the contact surface, there was a very short piece of plastic tubing serving some purpose (I can't remember exactly what) but this had practically disintegrated. He just replaced this with a piece of rubber tubing and we were onto putting 12V to it (be careful here as Dr. Bob says) and it worked fine, put it back together and its still working today.

Comments from Hubertus

Tried your cure for the transfer case problem described in your maintenance note. The symptoms were identical to the ones described: only a faint double click from the controller, but no action. I removed the control motor, turned the selector cam

a few times and replaced the motor. Everything worked fine afterwards! **However beware, this may not be a final fix!**

I took the car on a desert tour through the Namib Desert in Namibia two weeks later. Surely after working without a hitch for almost three weeks, the problem reoccurred in the middle of a sand dune field and could not be fixed using the prescribed procedure. Only almost totally deflated tires and courageous driving in the 2wd mode saved me!

Comments by Gary P.

Be sure to mark everything before disassembly so that it will go back together as it was. Especially the little cover plate for the switch contacts. They must go back to the original position so that the timing is correct. If not for this site, I would have probably gone to Ford for the \$400 fix. Instead I did it myself, as the others did, for free.

Notes from a Happy Customer

Living in New England, the weather can quickly bring winter snows upon us. I have a 1992 Explorer with the electric transfer case. Two days ago, during our first (6 inches in 3 hours) winter storm, my wife and I had to go out for the evening. We took the

Explorer because we needed the four-wheel drive to get around. You can imagine the disappointment when repeated pushing/pounding/cajoling of the buttons produced no result. We made it through the evening barely but came home "very" concerned about the reason for not having the four-wheel drive.

Yesterday morning, I decided to have a look on the NET to see if there was anything available with technical guidance. Ford does not have a TSB on the problem, so I looked for other information and found your site. The article on fixing the Transfer Case described exactly what had happened to me. I decided to call my local garage anyway to have the vehicle checked out. They immediately told me it was the motor (having replaced several for other owners) and the cost to replace it would be in the range of \$400. I then called the Parts Counter of my local dealer to see if they had any in stock because the instructions in your article make the change out seem quite easy. The dealer had 12 in stock (I can't imagine why) and indicated they could change it early next week. Price was \$250 for the part but they had it on sale for \$189.

I picked up the motor just in case and went home to work on the Explorer. Starting at 7:15, I rolled it up on the ramps, pulled the balance wheel, unhooked the electrical connector (the tabs are supposed to break off aren't they?) and pulled the motor off of the transfer case. I took a screwdriver and rotated the motor slightly counterclockwise and with my trust 8-year-old daughter in the driver's seat, determined that the motor was now working fine. Slapping it back in was a breeze and I was

back in business. The vehicle was back down off of the ramps at 8:15 completely operational. Total cost \$0.00. Tools required: 13mm, 11mm socket, pliers, screwdriver, 2 band aids (for me) and one assistant to push the buttons ensuring the motor continued to function during the fitup.

It is interesting that neither my mechanic nor the dealer even hinted that adjustment might solve the problem. Both were very willing to toss the original motor and install a new one. Your article saved me \$200 for a do-it-yourself job and \$400 for a neighborhood mechanic. I was afraid to ask what the dealer would have charged. Maybe Ford should consult you for a future TSB issue.

Another Testimonial from Russell S.

A few weeks ago, I had trouble with the electronic 4X4 shift on my 1994 Ford Explorer. I was about to change the shift motor until I found out the cost. Retail it was over \$300.00 and wholesale it was just under \$200.00. That changed my mind on just a simple parts change out. I got under the Explore and was going to do a simple continuity check of the motor only to find out that there were not two or three wires in the wiring harness, but 10. Without a detailed wiring diagram, I had no idea which wire went where. A couple of nights later, I was surfing on the Net and came across your site

and your explanation about the motor losing its neutral reference. The next Saturday I went out to try your fix. I found the motor was indeed about 15 degrees off when the unit was in two-wheel drive. I tried to turn the motor with a large screwdriver, but I could see that the gearing was working against me. Not wanting to admit defeat, I pulled the end cap off the motor and rotated the armature until the motor mounting bolt holes lined up with the shifter when the unit was in 2 wheel drive. I put everything back together and just knew that I had fixed the unit, only to find out that I still had no shifting.

The next weekend I took the Explorer into my local Ford Dealer to have the warranty work on the remote mirrors taken care of. While I was in there, I asked if they had a wiring diagram I could look at. They were nice enough to furnish me one. I looked it over and thought that maybe I had a wiring or switch problem. I pulled small door off the inside of the left rear wheel well and started to check the wiring. The controller is the top one of the two in this location. Prior to starting the wiring/switch troubleshooting, I pulled the negative battery terminal of the battery. Two of the connectors to the controller are easy to get at so I checked them first. Everything checked out OK on those two. You can check the neutral safety switch, the shift buttons and some of the other wiring. The other connector requires the removal of the whole interior panel, or a lot smaller hands than I have. After checking the first two connectors, I decided to put things back together and wait for another day to take out the whole interior panel. I hooked that battery back up and started the engine to make sure everything was OK. Out of desperation, I

checked the shift buttons and found everything working. The only thing I can figure is that when you re-center the motor, you have to disconnect and reconnect the battery so the controller can reestablish its center location.

The unit still works just fine after about a month. I've told my wife not to shift on the go, but to stop and shift. I'm not sure that relates to the problem, but since it was new it has made a bang when some of time when you shift out of four-wheel drive on the go. Two things I would never order on a new vehicle again are electric shift and antilock brakes.

Thanks for your help. I fixed the unit for \$0.00 instead of \$300.00 plus.

Contributed by Micheal C.

Having the same familiar problem with the four wheel drive transfer case motor (push the 4x4 button, hear a few clicks from the drive side rear wheel, then nothing) so after reading your site decided to try fixing it myself. The whole job took about two hours.

I took the advice of one of your contributors and didn't cut the brown wire. The wire can be easily remove, as he said, from the harness by removing the red center ring with needle nose pliers. Once

the ring is removed gently insert a small thin screwdriver between the black tab and the brown wire pin and pull on the wire from the back of the harness. I also did this with the green and blue wires from the transfer case sensor. Wasn't sure how the sensor came out of the transfer case, pull on it a little but it wasn't moving, though it best just to remove the wires from the harness. (Just write down the color of the wires they're next to so you can reinsert them correctly).

Before I disassemble the motor I mark the casing in various spots to make sure every was put back together correctly. I found the plastic stop in 3 pieces (looks like harden yellow grease) I cut a piece of rubber tubing and place this over the screw like stop on the actuator. I wash down all the electrical components with contact cleaner and used Qtips to wipe away the residue. Reassemble was a little difficult because of the brushes but I did get it together after a few tries.

I didn't remove the harmonic balancer at first but couldn't get the motor to line up on the transfer case. Once the balancer was removed the motor slipped easily in place. Took the car for a test spin, press the button and presto, I have my four wheel drive back. The only things I can recommend that before you start this job. Pick up 3 (8x32) bolts to replace those stupid torx screws (easily removed with vise grips), CRC electrical contact cleaners and RTV silicon gasket cement.

Contributed by Clark B.

I have one piece of advice to add. The site explains very well how to clean the motor once it is off and how to reinstall, but little is told about taking it off and which end of the motor to remove first.

1) After removing the motor and unclipping the wire harness there are three wires left. Two wires go into a small magnetic sensor to the far right of the motor and just to the left of the brown wire. This sensor comes out, but you must pull it out. Its not screwed in but is held in place by a small rubber ring. Simply pull straight back and it will come out.

2) When removing the motor's end cap (the part that looks like a cola can, not the circular part with wires going inside), you must pull straight back. Mine had a worn adhesive ring around both caps (one on either end of the 'can'). I removed the nuts holding the metal piece that attaches to the transfer case then removed the two long screws. >From that same end, I forced the cap off. Apparently when removed the cap came off at an angle. **DO NOT REMOVE THIS END!** This cap has a 1 inch washer held in place by 6 very brittle metal tabs. Three of the tabs broke either on there own or from the angle of removal. The small 1 inch nut now roams free in my electric motor and you can hear it rattling when engaging or disengaging. I plan to buy a similar washer and put both on, this will force the 1 inch washer into the cap thus stabilizing the worm gear. This is very important, if I had removed

the end cap which is attached to the round housing with wires, it would have come off straight and not broken these tabs. Be very careful.

Contributed by Joe M.

I also had a 4X4 select problem, no response at all. Thanks to your website it was easy to cure the problem. I would like to share my experience. Mine occurred at about 95,000 miles on a 1994 Ford Explorer Limited. About the only time I use 4X4 is retrieving my boat from a steep slippery ramp.

I read every contribution several times, and especially appreciated having the knowledge how to disassemble the 10 pin connector at the motor without cutting the brown electric clutch wire.

I have a couple of items to contribute. I also agree the brush carbon buildup on the armature is the root cause of the problem since I could not get the motor to move in either direction when applying power directly to the motor 10pin connector prior to removing the motor assembly.

After disassembly and cleaning the armature, use a couple of rubber bands to hold the brushes in place until the armature is reinserted. Then simply cut them off.

Disassembly of the speed sensor also revealed a disintegrated nylon bumper. I used 3/8"OD X 1/4"ID poly water line, it was a bit snug on the bumper screw, but matched the dimensions of the disintegrated bumper closer than 5/16" gas line. It was also necessary to burnish the inside case die cast patterns that protruded enough to possibly snag the nylon bumper.

I do feel that Ford misaligned the Shift Position Sensor assembly too close to the 2wd endstop during manufacture. This caused the bumper to disintegrate as it was forced against the 2wd stop. This then contributed to the excessive carbon buildup on the armature since the motor is still trying to go past the end stop.

I moved the Shift Position Sensor about 5 degrees Counter Clockwise away from the 2wd end stop, reinserted the motor assembly on the selectorshaft, then turned the selector shaft clockwise until the motor mount holes matched the transfer case bolt holes. The result is the motor will no longer jam up against the 2wd endstop.

A second problem I had was the rear ABS warning light came on. The cause of that problem is the rear speed sensor mounted on top of the rear differential assembly. This must be a high failure item because I found the same problem on my son's 1994 Ford F150.

Contributed by Chris H.

I went through this problem of repairing the shift motor on the transfer case on 91 Explorer. One post here mentions that you need to cut the brown wire leading directly into the transfer case to separate the motor from the transfer case. DO NOT DO THIS! I have the Ford Manual and there is a much simpler way to do this, and you will not be risking a loose connection where you splice the wires back together.

When you unplug the wire harness from the shift motor, look into the motor side of the harness. You will see a little circle of plastic surrounding the center pin. (Red in color on my truck but I can't guarantee it's always going to be red) Fashion a tool to pull this plastic piece out: straighten out a paper clip. Make a 90 Degree bend at one end forming a tiny hook. The bent part should only be about 1 mm or the thickness of a dime. Using this hook pull out the red plastic piece from the center of the large black plug. Don't lose it. This plastic piece locks all the pins in place. Once the red piece is out, release the tab on the center pin of the plug (the brown wire) with a small screwdriver or pick and pull the wire out of the back of the wire harness. Now the brown wire is separated, and you can remove the shift motor from the transfer case without cutting wires.

Contributed by Ed & M.

Having the same familiar problem with the four wheel drive transfer case motor not operating I followed most of the previous efforts fairly close. The brushes looked good, the copper looked fine, the nylon washer/bushing was beat up so I replaced it with a 1/4 inch piece of gas line with the same inner and outer diameter. (I wondered why I had kept that piece of gas line.) Relubed the gear checked the motor with 12 volts from the battery and it worked great either way. Installed on the transfer case and drove it off the ramps. Successfully went into 4x4. Took several efforts to get it to disengage. Then I had the same problem as before I started. Light in back blinked. Motor didn't function. Crap. The next weekend took 12 volts and motor did not work. Took motor off the case and the motor worked. Put it on and it didn't work. Looked for pinched wires or any other thing that could cause this. No joy. Removed motor. It worked. Reinstalled and it didn't. Backed off the bolts and it worked. Tightend and it didn't. Removed motor installed thin washers and almond colored rtv (it has to be almond) between motor and case and tighted it up and it works fine. 4x2, 4x4 and 4x4 low. Will take it to the desert tomorrow for final checkout.
