

Toyota 3.4 Swap Wiring Theory and Execution by theMonch

Like everyone else attempting this swap, I also was intimidated by the thought of the wiring and looked for a solution by throwing money at the problem. Since ORS was out of business and I was not aware of ToyOnlySwaps.com's existence, I decided that I was going to tackle it myself. There were plenty of people out there claiming to have done it and I just kept telling myself ..."well if they can do it, why can't I?" Afterwards I was so happy I went this route because not only did I save a nice chunk-of-change by doing it myself, but I also now have a new level of understanding of my truck's and the 5VZ-FE's inner workings for future troubleshooting.

For the record please note that every combination of donor and recipient will be a little different and most of the examples I give in the document are from my own personal experience with a '97 5VZ-FE T-100 4WD 5-speed donor being put into a '88 3VZE 4Runner 4WD 5-speed recipient.

Are you up to the task?: Make sure you are capable of handling the wiring. You should have a good sense of general automotive knowledge on what does what and why, especially in regards to the engine management system (EFI, ECM). You should also have decent soldering skills and some previous wiring experience. (car stereo, etc.) Making good solid connections is pivotal in performing this wiring job.

Understand what Toyota did in the first place: Because most Toyota trucks (and most vehicles in general) usually have a few different engine options available, the wiring is designed in a way that makes it easier to fit different power plants at the factory with little effort. This is achieved by having three different main harness components throughout the vehicle. The first is the engine harness. This harness is responsible for all of the engine's electronic fuel management components. The second is the dash harness. This harness is like it sounds primarily found under and in the dash itself and connects to all of the electronic components such as the combometer (gauges), climate controls, stereo etc. The third is the body harness. This connects through the vehicle chassis for lights, stereo speaker wiring, power windows, etc. This "componentized" harness structure allows for different engines and their corresponding ECM and engine harnesses to be fitted while maintaining a common set of body and dash harnesses. For example a second generation Tundra is available with both a 4.7 and 5.7 liter engines. So the wiring is engineered so both engines can be fitted and mate with the wiring in the rest of the truck without the need for completely different harnesses. There is also one more noteworthy harness, the battery harness. This smaller harness will contain the battery positive and ground leads as well as the alternator lead. In the case of the 5VZ it should also contain the starter trigger wire.

Whats involved to make it work: Now that you have an understanding of what the different harness' are and their primary purposes we can advance on to what is involved in the swap. What you will be doing is swapping in the 5VZ-FE and its associated engine wiring harness and ECM into your truck. Since what you have never came with a 3.4 from the factory, you can't simply just plug the 3.4 engine harness into your existing dash harness. (wouldn't that be nice!) Now this is where the fun starts. The 3.4 engine harness passes through into the engine compartment with a number of connectors on the end. This will vary depending on if you are using a manual or automatic engine harness. Some will plug directly into the ECM itself (3 in my case), and there are few (usually two) that are left over. These left over connectors are the engine-to-body connectors. Once you have your old engine, engine wiring harness and ECM out of the way you will realize that there were a few (usually 2) body-to-engine connectors that are left behind. The mating of these connectors from the donor engine harness to the recipient dash harness is where the majority of the conversion wiring takes place.

For example this is what I had once I assessed what connectors were "widowed".

A. The two connectors coming from the 5VZ-FE engine wiring harness. These are commonly labeled IE1 and IE2 in most Toyota Electronic Wiring Diagrams (EWD). Your application may vary, but these are common.

B. The two connectors coming from the recipient's dash harness. These are commonly IH1 and IH2 on

the 90-95 4Runner and 88-95 Pickups. but again can vary by year and model. For example these were N3 and N5 on my '88 4Runner 3.0.

C. I also had a fifth connector that came directly from the ECM and mated with the donors dash harness directly. I believe this connector might be T-100 donor specific, but cannot be sure. This connector I identified as E4(A) from my EWD.

In addition to these connectors I knew that I needed the OBDII port from the donor. I also realized after the donor was pulled that the wiring for the EVAP systems on a T-100 is part of the dash harness and not part of the engine harness like I believe all of the 4Runner and Tacoma examples I have seen are. So I cut that at the firewall connection.

Go get your Wiring Diagrams: Before beginning it's a good idea to get familiar with your particular EWD's. If you download your EWD's from the TIS website (highly recommended) you will have a number of PDF documents. TIS breaks each vehicle's EWD's into separate systems (i.e. air conditioning, ABS, back-up light, etc.) Each of these systems is usually contained within a separate PDF document. They usually also include an "Overall" document as well as a few general documents such as "Abbreviations", "How to use this manual", "component locations", etc. Make sure when you are downloading your EWD's that you get everything available. It is also not a bad idea to download the repair manuals as well for both your donor and recipient. Might as well get your money's worth! I also downloaded the EWD's that corresponded to the adjacent years as well. (i.e. my donor was a 97 T100 so I downloaded the EWD's for '96, '97, and '98) I did this because I have read that sometimes your wiring might not be exact and having the adjacent documentation added a level of security. I will repeat what I have read before and say that "this will be the best money you will spend on your swap". TIS has documents back to 1990 vehicles, so if you have a recipient that is older (like my '88 4Runner) you will need to obtain the EWD's from somewhere else. I ordered mine directly from my local Toyota dealership. It took a few weeks for it to come, but it was correct.

Identify and Label what connectors you have: The first step in creating your new wiring diagram will be to identify all of your involved connectors in your EWD's by connector label. The EWD's that you should have downloaded from the Toyota TIS website will have an "Electrical Wiring Routing" section. This is sometimes referred to as "connectors grounds and splices" as well. In here you will see graphical representations on the wiring harnesses and the connectors that they use. Toyota uses an alpha-numeric labeling system for most years. (i.e. IE1 or IH1)

Once you have your connectors identified then it is time to identify the wiring going to them. This is best achieved by identifying the "pin-out" for each individual connector. In the Toyota EWD's you will notice that there are diagrams of the individual connectors that are used in regards to each EWD's systems. These diagrams are usually found in the last few pages of each EWD. There might be multiple diagrams for the same connector (i.e. multiple IE1's). This is common for connectors that might have different pin-outs depending on the particular vehicle. For example if your donor was available with two different engine options that were both available with automatic and manual transmissions, then it is common that there will be four different pin-out diagrams for the same connector. It is also important to understand if you are working with a male or female connector as the diagram will show the pin-out for both. If your connector slid into the other half it is considered a male and if it slides over the other half, it then is a female connector. This is important because depending which connector you are looking at the pin-out will be a mirror image of the other half.

Now that you have your connector pin-out diagrams you have a direct reference point that corresponds with the Toyota EWD's.

Make a good connector pin-out chart for reference: At this point I was extremely happy to see that what I actually had and was able to identify coincided. So I decided that this would be a good point to document it. I made a chart that listed out the individual wires' colors in relation to their pin-out location on the connectors. (i.e. IE1 pin 1 - red w/ yellow stripe) I also noted the gauge of the wire. Most of the wiring you will be dealing with will be of the same gauge, but there are a few such as the ignition power wire,

that will be of a larger gauge. Also make note of pin positions that have no wire. I did this with a few XXXXX's. Once done you now have a chart that will enable you to identify your wiring from both donor and recipient with never leaving your couch. I made my diagram in Excel with a separate worksheet page for each connector. This allowed me to retain a digital copy that I could reproduce as well as print out copies to make notes on that could later be added to the digital copy when verified. You could easily do this with pen and paper as well.

Down and dirty EWD work: Ok we now have all of our connectors identified and their associated pin-out wiring. It is now time to crack open your EWD's and start identifying the wires with what function they perform. If you have the digital copies this will be a little easier than with hard copies. You can use Acrobat's search function to locate them. I did most of my work utilizing the "Overall" EWD. This document, like it sounds, has all of the wiring together in one place.

One wire at a time: Start with your donor's first connector. We'll use IE1 for example. Then start with pin 1 of that connector. As I referenced above pin 1 on IE1 holds a red wire w/ yellow stripe. So now you know what you are looking for "1 IE1" in your overall diagram. The connector label (IE1) will usually be in a box and the wires' pin-out (1) will be a small number next to it. You have to be careful to make sure you are finding the correct connector and pin location for your application. For example you might find four "1 IE1" instances in the document. One for 3RZ with automatic trans, one for 3RZ with manual trans, one for 5VZ with automatic trans, and in my case the 5VZ with manual trans. You can look to the top of the page to make sure you are finding the instance for your specific application. You can also use the color of the wire to make sure you located the right one. For example, once I found what I thought to be the correct instance, I verified this by confirming the wire color abbreviation. In this example R-Y. All of the other instances had different color identification that did not match what I had. Bingo...there's one down!

What does it do?: Not that you have your location in the EWD see what the wire connects. In my case the wire went between the "Data Link Connector 1" and the "ABS ECU". Now it's time to deduce what function the wire performed. First take what you know of the connector. It comes from the engine harness and goes into the passenger compartment. Since I know the ABS ECU to be in the passenger compartment, and the data link connector to be located out in the engine bay, I can now safely label this back in my chart as "From Data Connector 1 to ABS ECU".

Repeat this procedure for each pin location on your connector and then subsequently for each of the other connectors. Try to give your wiring labels in your chart as much info as is available. For example if the wire is running from the ECM to the EFI fuse location on the fuse block, also make reference to the ECM pin label (i.e. B+). Once you are done you now know what each wire does/did for all of your connectors.

Putting it all back together: Alright, your almost home! Now it's time to rebuild each system. This is where all your homework pays off. Armed with your wiring connector chart pick a particular system and try to reassemble it. I chose to start with some of the easier stuff to "get into the swing" of it. The more wires you can assign or eliminate makes it easier for some of the harder systems later. Going back to my pin 1 IE1 example from before I know that it is ABS related and that not hooking it up will have no effect on my swap. I then make note of this in my chart and move on.

Let's look at another easy one, the tachometer. I then peruse my chart looking for reference to the tach. I first find the "IE2 pin 12- black" which I labeled "from igniter to tach (combometer)". I then keep looking and find "N5 pin 6 - blue w/ white" which was labeled "from tach (combometer) to igniter. Holy shit! If I attach these two wires together the tach should work. It is simple victories like this one that will keep you going. And again the more systems you identify the less wires are left for some of the harder systems.

There will be quite a few easy ones like the tach such as: the coolant temp gauge to coolant sender, the oil gauge to oil sender, the check engine light to the ECM check engine light trigger, etc. Once all of these easy ones were out of the way along with the wires I decided were not used in my swap, I was surprised how little was left over.

While doing this "rebuilding" of systems I documented it by drawing the connections between the connectors and labeling the "to and from" wire color. Again, I did this in Excel with pretty colors and all, but can easily be done on paper as well.

I also tackled some of the "unique to T100" donor stuff up front. Like I mentioned earlier, my donor's EVAP wiring was not part of the engine harness, so I had to splice it back in. I knew that whatever EVAP canister I decided to go with, that it would be mounted in the passenger side of the engine compartment. I also knew that all of this wiring ultimately winds up at the ECM passenger side as well. I confirmed this with my wiring chart and was able to create a pigtail from my conversion harness that was routed out to the engine compartment for attachment to the EVAP systems. Most of you won't have this problem, but I thought I would mention it so it would help stimulate a diagnostic mindset that you must adapt to be successful with your wiring endeavor.

Once I was done "putting it all back together" I noticed that there were a few systems that I was a little unsure of. I decided to leave these systems unconnected initially so I could confirm their exact function back on the vehicle. The 4WD indication light was one of these. It turns out that the switch on the transfer case just closed a ground circuit that provided the ground that triggered the indicator light itself and provided a ground to the ECM to tell it the truck is in 4WD. It was much easier to figure this out on the vehicle.

There also might be a few connections that you might be tempted to piggy back together. (I know I was) For example, the OBDII connector requires a switched +12 v connection that you won't have a direct connection for since your recipient didn't have OBDII. You could very easily connect this to the same +12 v switched that feeds the ECM. And it most likely it will work. I chose to feed this from an auxiliary fuse block I installed with the proper 7.5 amp fuse that was originally on the donor. This insured me that not only am I not overloading the ECM circuit, but I also have the safety of knowing that my OBDII equipment is properly protected. If I simply piggy-backed this connection it would have been through a 15 amp fuse. It's the little steps like this that will ensure that your swapped Toyota will be every bit as reliable as it has been in the past.

Another noteworthy special connection is the starter trigger wire. This is the wire that attaches to the actual starter or starter relay and triggers the starter to run. This wire should have been part of your 3VZE engine harness. (if you started with a 3VZ) This wire is not located in the new 5VZ engine harness; it is instead part of the battery harness. I remedied this by running a connection from this lead in the battery harness around the front of the radiator support, up the passenger side of the engine compartment and into the passenger kick panel for connection to the original 3.0 body harness. For me this wire was black w/ white stripe. This wire will most likely

Here is a list of systems that were affected in my particular swap and the amount of wires:

- Oil pressure gauge to oil sender (1 wire)
- Coolant temp gauge to coolant sender (1 wire)
- Check engine light to ECM (1 wire)
- Speed sensor from combometer to ECM (1 wire)
- 4WD detection light to 4WD detection switch and ECM (3 wires)
- Tachometer from gauge to Igniter (1 wire)
- Starter trigger wire (1 wire)
- 12v switched power to ECM (1 wire)
- 12v constant power to ECM (1 wire)
- IGN2 Ignition Power from key switch to EFI relay (1 wire)
- COR relay ground from COR relay to ECM (1 wire)
- EVAP pigtail had to be reattached to engine harness at engine-to-dash connector (5 wires)
- A/C magnetic clutch trigger (1 wire)
- Reverse detection from transmission switch to dash harness (2 wires)
- A/C amplifier to A/C control from ECM (2 wires) *Note: I have not wired this to function yet*

Making the connections: Once you feel confident that you know what you need to make things work again, it's now time to decide how you are physically going to connect them. I was lucky enough to have my entire donor, so I chose to cut the female ends of the plugs from its dash harness and the male plugs from the old recipient engine harness. These can be plugged directly into the new 3.4 donor's engine harness as well as the old recipient's dash harness plugs. I also was able to get the OBDII plug from my donor and the plug that went into the ECM from my T-100 donor's dash harness. I now had everything that I needed to make a conversion harness that could be simply plugged into everything. This gave me the ability to do all of my soldering on a workbench (kitchen table) vs. having to do it lying upside down under the dash of a truck.

If you don't have the donor plugs the next best thing would be to get the appropriate plugs from Toyota (most are still available) for the connections to the 3.4 harness and simply cut the old recipient dash harness plugs off and assemble these new plugs directly onto the old dash harness. This option will also make for a pretty clean install since you will not have all that extra wiring and connectors to shove into your kick panel.

The third option is to cut off both your 3.4 donor engine harnesses' connectors and your old recipient dash harness connectors. Then you will be able to directly connect all of the wires. I don't recommend this option because it is the most permanent and also leaves the least room for error.

Congratulations: First congrats for making it through this very long document. I am no writer, but I tried to do my best to keep it readable. Secondly, if you have managed to tackle your own wiring you are now a little bit smarter than the "Average Joe". Thirdly, the payoff of having a 5VZ in an older truck is amazing. Better fuel economy, better running, easier to work on, and most importantly...more power! Especially when coupled with the TRD supercharger and the fuel upgrades from URD. But that is another story....