How to wire up a 1uz-fe

By

Nigel Wade

This is how you wire up an EFI Engine. The 1uzfe, 2uzfe, and 3uzfe wiring guide (including diagrams). A comprehensive and detailed guide with over 13,000 views on the oldschool.co.nz forums.

Nigel Wade is a New Zealander who grew familiar with the engine and it's wiring as a hobby and decided to share his knowledge to benefit others.

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1 Lets begin

Firstly congratulations on your purchase, it's a good motor, pretty famous. This document originated in the forums of lextreme.com, it was then moved to oldschool.co.nz where it was further developed.

I guess your reading this because you're wiring it up with the factory ecu, or you want some information on how to wire in an aftermarket ecu. Have a read, if you run into trouble join the oldschool.co.nz forum and send me a message (pm). I don't get alot of messages these days, so I'm guessing the thread and this document pretty well covers the topic.

> *If you have never done this before, you will have to learn new things to wire an engine up. You will make mistakes, connect the wrong wires, feel lost.*

You can learn this. You can get an engine running it doesn't take special abilities just, patience, time and knowledge. Here's the knowledge, I'm sure you can make the time. The patience is something your on your own with ... if you get overwhelmed take a break come back to it. Take good notes as you go, it's too much to remember. Go easy on yourself it's a big job and you won't do in just one day, least not the first time.

I can do in four hours now, the first time it took me three weeks and I stuffed up alot of things. A friend and I sometimes wire engines up together, it's really helpful having someone else around to check your work as you go. Look, this is not an intelligence thing, it's a follow the process thing, if you can make toast and coffee you can do this.

There are a few odd rumours out there; I'll take a stab at a couple of them now;

- EFI is too complex: fair enough, it is complex but it only takes thinking. It's not like 'woman kind of complex'. It's very learnable, for the most part it's just connecting wires together according to a map.
- It is generally not true that it takes 5 wires to connect up a 1uz, .. well .. not if you want it run well.
- You can't just 'connect it all up' it's best to tidy up the loom and customize the shape and configuration of the loom, for the car it's going into,
- They don't run without the automatic gearbox: This is rubbish, its just a rumour.
- Tip: in order to run the engine in manual configuration, you'll remove quite a bit of loom when cleaning out very little of that is actually the auto loom.

- Tip: don’t leave cut wires hanging around in the loom, seal them with a cap like half on heat shrink that’s pressed closed.

- Terms:
    - S1 = stage one on the key, this is normally called ACC.
    - S2 = stage two, second position on the key. I often call this ‘switched power’ normally called ‘IGN’
    - S3 = Start, assumes Stage two is also live and stage one is not. Third position on the key, momentary action.
    - I’m fond of these terms; it’s easier for me not to abandon them.

2 Quick and Fast

2.1 - Quick and Dirty, this is what you connect + thoughts

2.1.1 In the ecu loom:

- +12V wired to pin (BATT)
- (M-REL) drives the Main EFI Relay: switches it on.
- (+B) and (+B1) both get 12volts when the Main EFI Relay is switched.
- Main EFI Relay appears to be working fine.
- (E11) is grounded.
- (E2) is grounded.
- (E02) is grounded.
- (E01) is grounded.
- (STA) gets a 12volt input from starter relay when the engine is cranking.
- (IGSW) gets a switched power 12volts from the ignition switch.
- You might want to find the check light (W) and use as an earth for a light (switched power on the other side), tells you if the ecu is on or not.

2.1.2 In the wiring loom:

- Find the injector power wire, and connect that to relay / switched power. It's usually a striped wire. In the older motors it's Black/Orange, newer engines it's Blue/Red.
- Find the power to the igniters, connect that to a relay / switched power, usually the same colour as the injector power wire.
- Sometimes: the sensor power wire is loose in the loom, find it, give it switched power.

2.1.3 Neutral Start Switch

If the loom is in factory condition, and your running the auto this wire connects to the shifter so you need to interact with it. The wire contains 12v+ in neutral.

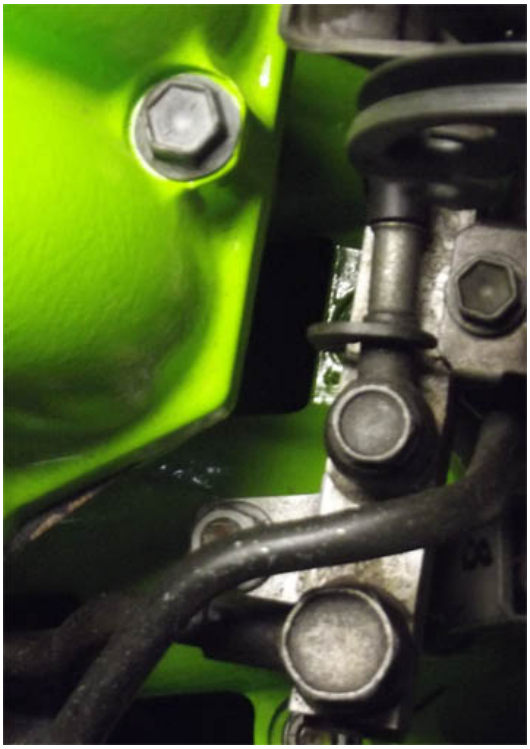
2.1.4 Cold Start Injector

One installer commented;

> *"i cant see toyota doing something so silly relying on cold start injector :every 1uz I've done (500) ... I've never seen this and I've seen many 1uzs with no cold start injector connected and they still start 90% perfect the cold start makes it start that 10% better"*

He's actually wrong, I've seen a very early (1989) quad cam 1uz-fe engine that has a huge cold start injector under the upper inlet manifold, and it used it. The motor would

not start without the injector, at least on the ecu which came with it. The thing was massive, it is a 1000cc injector silver metal thing, with a fuel line off the drivers side billet fuel rail.



The fuel line is mounted like this, and then travels under the upper part of the intake manifold. We tried to take a picture but they were useless.

One installer commented;

> *"if the ecu relied on coolant temp and throttle and all the other minor sensors then u will never get in limp mode the engine will just turn off that's why the ecu has limp mode features this is so if the not so important sensors fail u can still drive home there is no way anything (just for start) can be temp related otherwise u will get problems, with the above rule."*

He's dead right, you can run a motor with hardly any sensors, including the temp sensors, but bear in mind the ECU's water temp sensor sets injector and timing parameters, expected reduced power and possible fouling of the plugs. However TPS as a measure of volume control, and the AFM or MAF is .. well a good idea if you want to drive it and have it run right.

2.2 Anti-Flooding Feature

One installer commented;

> *"nearly all Toyota ecus have a built in safety so it doesn't flood cylinders now the igniters send a signal back to the ecu saying yes we have fired the spark plugs so*

now u can fire the injectors. This is so if there is no spark the injectors will not keep pulsing and flood the cylinders so basically u need spark before u get injection but the ecu will pulse the injector once or twice right at the start of the crank to get engine to start and if it doesn't get a signal from the igniters after the 1 or 2 pulses of the injectors it then shuts the injectors down"

I call bullshit on this. There is no flood control, the computer does not know when the engine has 'fired' or not 'fired' there is no feedback from the spark plug (obviously), it only knows when it's sent a signal to igniter to fire (and that there was a response of rpm), it however has no idea whether the engine actually fired (spark event occurred) of whether the coil charged and discharged. It 'could' know, but that would require more advanced programming of the knock sensors with the engines in there current configuration (using them to detect firing events, if they are even capable of it, which I doubt).

2.3 Just to get it running

One installer commented;

"now u have to realise the engine only needs few sensors to run. i don't know why people have this idea that everything needs to be connected for it to just start? crank and cam and igniters are probably the only thing u need just to start engine, TPS would help. it might run funny but it should start"

He's dead right. You don't need much to make the engine run. I really don't have anything to add on this, I'd only repeat what he wrote.

2.4 - The Method: this is how you wire up an engine.

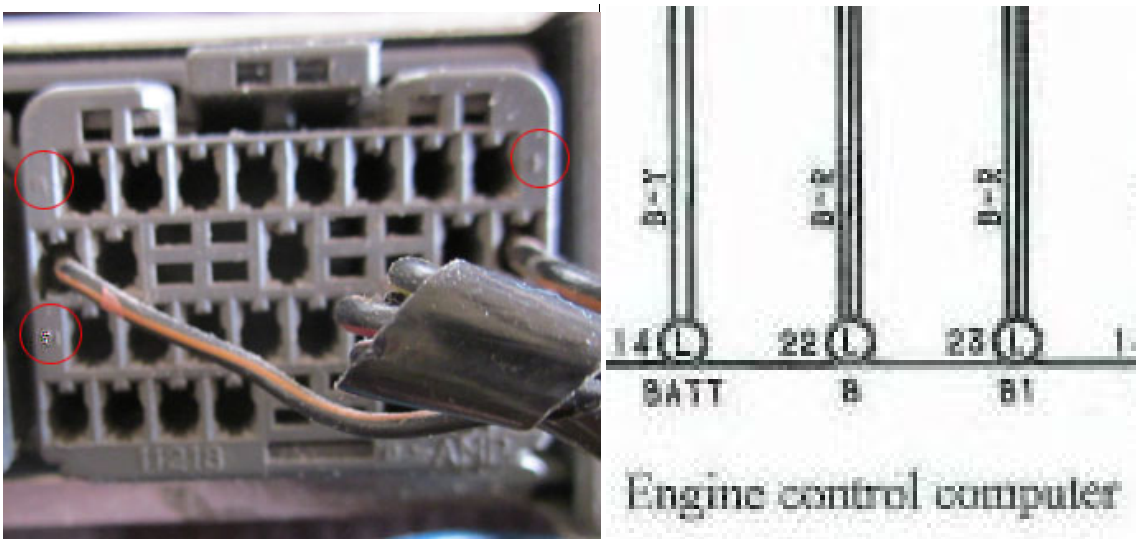
The method for wiring up the engine, when I do it, is a blend of the quick and dirty method. And what follows below when I get into it. Usually I start by noting the colours of the EFI and igniters wires and then I pull on them, to find them in the loom.

I then look over the ecu, and note the wire's I'm familiar with. I mark them using masking tape (because it's the only tape which works), and put a question mark at the end of my note. So if I write B1 and I'm not **100% certain** it's B1, I put 'B1 ?'.

Once I'm done playing guessing games I find a diagram which matches the engine. Sometimes I can get pretty far just on guessing. I rarely ever complete a wire up on guessing, you really will need a diagram which matches the engine. The method for finding one is to either get lucky and find the right one, or find diagrams and attempt to match them to the ecu.

2.4.1 The Method for counting the pins is:

Count the pins on the ecu with a pointer like a jewellery screw driver use the numbers on the plugs to help with that. Match those numbers to the numbers for plugs in the diagram, the pin tables and those code letters. Also, you need to match what you're seeing on the ECU and its plugs to the diagram you have and the engines loom, make sure its all connected how it should be. As it happens the ECU plug and the diagram exert match perfectly.



This is the 4th plug on a 1992 Celsior ecu, there are only five, six wires left once the install is completed. The little red circles show you the location of the pin numbers. Some plugs are counted right to left, and other plugs left to right. Some pins are blank from factory. Sometimes there is only one number on a row. I find counting the pin locations out quite frustrating sometimes.

The method is, go wire by wire, connecting what needs to be connected. Use the diagram as a reference. I read off the pin locations by counting them in the plugs using the numbers and plug locations, when I have a correct diagram for the engine which I can trust this is an easy job. When I don't, and this does happen from time to time, I have to trace the wire back to its final location on the engine. This is done by removing all the plastic casings, tape, etc. And the pulling on the cable from the ecu end, it will tension in the loom, then you can find it further up and repeat. It sounds stupid but as long as you're gentle it's very effective.

2.4.2 Get it right: this is no time for mistakes

You cannot afford to make a single mistake. So don't. You need to know that you did can be trusted, which means when it doesn't start or something is wrong later you can trust the work you have done in an arrogant sort of (time saving) sense. When it's not

obvious you need to think about the wire. i.e. where is that going?, is it needed? (re: auto vs manual trans).

Be brutal, remove what you don't need and connect the important wires, as you locate them or at least mark them (I use masking tape and a fine permanent marker). Don't just find them, then forget about them. If you work carefully, and in a focused way, you will have no trouble completing the task. If your all over the place and scattered, this thing will be hard to finish.

Starter Wire (second largest black wire) should really be on the other side of an 80amp relay, tripped of the ignition key. Remove the plugs that don't plug into the ecu any wires obviously of no use, etc, with care. (E.g. the 1UZ-FE donor cars dash plugs)

As you go join your wires to the 'new' cars loom, or a custom board, or whatever suits, you pick. You should really / it is good practise too add fuses to some parts of the loom here is a good list to start with:

- An 80 fuse on the main line supplying the relays (constant power)
- The switched power to the alternator
- The constant power to the alternator
- ECU switched power, and ecu memory (BATT)

If it's an older car, and the wiring is 'old' put a fuse between the relays and the key (why trust the key not to short out) eg. the wire that trips the relays like the coil relay and the relays the sensor's power is on. Wouldn't hurt to put a fuse between the check engine light and power, fuses are cheaper than lights: but you really don't need too.

- 'dot' the corners on the lex diagrams makes them easier to read
- take good notes as you go, to stop re-work, and make diagnostic easier
- If you do careful, thoughtful work you can trust it.

2.4.3 Do you need four relays ?

- One for Starter solenoid wire. (travels with Knock Sensors @ rear water bridge plug) 80amp relay best.
- One for Injectors (all alone). switched on S2/IGN on while S3/Start key position
- One for the Coils and igniters (all alone).. switched on S2/IGN on while S3/Start key position
- One for the fuel pump. (MREL) a ECU pin that is switched on S2/IGN on while S3/Start key position but off when engine not running (5sec delay ?) - i.e. stops fuels pumps in a crash.

2.4.4 A few fuses too,

- The sensor wire power, probably two separate wires, or more fuse each one.
- put 10amps on the o2 heater wires if it's a four o2 model engine,
- Around 7amps for any other sensor power wires.
- I like to fuse the ecu's power supply as a good practice thing. It has thermal fuses in it though.

2.4.5 The dash plug in the ecu's end of the bundle.

So once you've done every wire on the ECU, turn to the ones linked to the dash plugs. The plugs which do not plug into the ecu contain the main sensor power wire, which is usually a striped wire, same colour as the injector and igniters power wire. There is also the oil (idiot) light, the water temp (dash) and a few other thing in there. Often there are two, one is white, the other is grey. I think it's the white one which is for the dash.

2.4.6 You will need to add in a plug

You will need to install a plug into the engines wiring harness to take the input wires, and the output wires. The input wires are things like the injector power feed, the igniters power feed, the starter solenoid wire. The output wires are things like water temp, oil temp or pressure, etc.

I have been down the track of purchasing plugs for electronic stores and high quality ones from suppliers at high costs. I strongly suggest going to a wreakers yard and cutting a high quality plugs from under the dash of a late model cars. I prefer Euro's because the plugs are worth around $100 each new, but a Japanese car is fine. A 10 pin plug will be fine, along with a very heavy duty single pin plug for the starter solenoid cable. I sometimes install a second plug, rather than doubling up the usage. I use the second plug for low current things like the check engine light (W) and water temp, and such.

2.4.7 Important to get the Check Light Running ASAP

- As soon as you can, get the check engine light running,
- When the ECU is on, it should stay solid, and blink when diagnostic mode is entered.
- The PIN 'W' is the earth connection usually a small plug like a 16 pin one,
- The power is switched (S2) or (IGN) on the key,
- Get the other wire for the light (small 12v light) on that,
- It will take a moment to light up, or blink.

2.4.8 The ECU must be ok for the light to blink

It's a NOT good sign but if won't run and everything's wired up right. The ECU could be damaged, it must at least flash the check light when powered up right. When in diagnostic mode (TEI and E1 pinned out on diagnostic plug or connected via a switch or manually).

I've yet to see an install that does not produce one or two check codes, (FC and FCR not connected for example), there always be a code to pull, make it your mission to get that working first. So you know the ecu is ok, on (most important), and working because it doesn't follow that the ECU is undamaged until it 'actually' runs (the motor) and/or produces codes. To engage the ecu's diagnostic mode connect TE1 and E1 [E1=engine earth]. W acts as earth for the light, and switched power on the other side of the light.

2.4.9 Your motor do it your way.

Look it's your motor, do it your way. It's not for me to tell you what you should or shouldn't do. If you want to use crimpable joins and speaker wire to connect it up go for it, .. um .. it might randomly stop running at some point, but your welcome to try it. I like to seal up Toyota's joins by re-doing with solider and heat shrink, that's because I'm kind of anal retentive. I like to get my wire from the looms of wreaked cars because it's high quality and cheap. I never use crimp able joins, I can solider. You don't 'have' to do it my way, do it the way that makes the most sense for you in your situation.

I like to make sure the heat shrink well exceeds the join great for the 4x4 and hilux guys / off road people to seal the loom for water and mud immersion and for jet boaters.

If you're doing this for a client: respect their budget.

Who wants to save a buck, reduce the work load and leave plugs in like the old dash plugs, and the diagnostic plug, tidy coiled and taped, nicely done. I seal up lose wires by capping them with heat shrink and cable tie / tape them to the main loom. Description's on masking tape which seems to last the best.

If you're doing this for a client: do a good job.

The ecu should be free of codes if possible: some codes are no problem like 78, 14, 34, 35, 71, 42. But others are a huge issue. It must not be in the default map mode/limp when done, if it is then the job is not completed. As noted before it is best to join wires with generous amounts of heat-shrink either side, and use solider, or better. Not crimp-able joiners. *It's an engine not a car stereo.*

Take some pride in your work, and yourself. If you can wire a motor up that's specialist knowledge which is transferable to EVERY other kind of engine that's something to be proud of.

2.5 - Toyota wiring follows a certain kind of logic,

Toyota wiring follows a certain kind of logic, here is that key to that logic. Each pin usually does something; it's not always something important. You can just de-pin or remove the auto trans by snipping the wires. A few pins are sometimes blank across various engines as various things are there or not, but the core stuff is always there, like crank sensors (which sense where the motor is in its revolution), and the two cam sensors in each head, injectors. The motor does not always need everything else to run: to run well it would, but not to just 'run'. I think to think about the sensors like this: they are all just resistors (not totally true). Some are VITAL, some are just needed, and some are not even needed.

2.5.1 Primary Sensors

- Crank Sensor, (NE)
- Cam Sensors (both of them G1 and G2)
- ... the engine's ecu will not even think about starting without these.

2.5.2 Secondary Sensors

- Air Temp (in the MAF or AFM),
- Air Volume sensor,
- ECU water temp sensor,
- O2 sensors (primary or sub),
- TPS
- Fuel pressure sensor (in fact I dont think this even returns an error most of the time)
- ... the engine's ecu will allow it to run, but will return an error and fall into limp mode; but still run just fine.

2.6 Missing the fourth plug ? a Dirty fix.

One installer commented;

> *You don't need plugs for the ecu. There are ways around the problem. You may run separate pins in shrink tubing. You can just can extract pins from a broken harness that is usually available at wreckers for nothing. Or pins can be bought in electronic components store. BLS series fit ok.*

He's Dead right, you can just de-pin some random ecu plug and as long as those pins fit well, you can then put heat shrink over them and pin them up onto the ecu. that would work well if your short the 4th plug that many people often find missing. Recently had a late night phone call from a guy that lives about 400km's away from me, (he's here on this forum) he was missing the fourth plug that traces off to things like constant power, and switched power, that one ends up having like 4-5 pins used.

He did exactly this, in fact he de-pinned un-needed stuff from other pins and used those pins to get it up and running. Fact is, apply enough hot glue/silicone and you pretty much have a plug when it dries. (ok, that is well dodgy though) He runs this plug still, five months later he said 'you wouldn't want to remove it from the ecu but damn it all, it works just fine.

3 The Pin & Acronyms

Below in the section is some really important information. The description column matches up to the tiny little codes under the circled letters in the factory diagram same with the lex extreme diagrams, those codes Like 'G+' all mean something, for example THW is water temp, etc. The last column, details how a 96 motor was converted from Automatic, to manual, you, can also used that information in relation to the letter codes, and whether or not they were used to assist and help converting other year 1uz's, perhaps other engines too.

> *The following 'pin tables' and the order of them the plug numbers and pin locations are specific to a particular ecu. This is not a 'how to' this is a description of specific wires. Unless your engine matches these tables in which case you're really lucky and have at it.*

3.1 The factory diagrams

The factory diagrams spread the plug letters, and the pin numbers all over the place, making them hard to read and work with. It doesn't matter what letter the plugs are/use, whether it's a four plug 92 onwards, or two huge 40 pin ones, or three (old school majestic) ECU, the description column still applies to the function it performs. Up to the point VVT-i came along, and the OBD2 code system (1997?), in which case there are a few additions but the below information is still very helpful.

It's a head - ache trying to read them when you're working with them, highlighters help, use the pins to guide your work and they will tell what each letter code means and does, the information below should help you work any diagram, because every DECENT DIAGRAM *cough* has those on it.

3.2 Using the letter codes below

The tables below are useful for wiring up any Toyota engine. These codes are common wires for the most part, each 1UZ-FE engine is wiring up using codes like THW and STA, to explain what a pin on the ECU is doing,

When you have the correct diagram for your engine, these codes and the explanations of them below. You can go off; wire up an engine knowing what each pin does by referring to this. Once you start you'll see what I'm explaining is actually quite easy, and time consuming. It takes me hours to trace, and mark all the wires, it takes me hours to connect everything up after I'd done that, it's kind of boring work actually.

NOTE: the long description for pin 1 (FPR) is correct the output is 0.004 volts which is too low to trip a relay. Ideally you want the ecu to turn the pump(s) on and off depending on whether or not the engine is running. If you have a crash you want the pump(s) to stop. This is the pin you do that from, but the output is too low to do that, you need the Fuel Pump Controller to do this.

4 Pin Functions.

4.1 16 pin

The order of this information, it's plug numbers and pin number are specific to a particular ecu.

Pin	Descrip	Long Description	Used / Or Not
1	FPR	output is actually 0.004 volts to low to trip a relay.	NO
2	THG	Deleted EGR Gas Temp Sensor	NO
3	W	Check Engine Light (pin 10) on Custom Plug One	YES
4	FC	Fuel Pump controller	No
5	TE1	Spliced to (pin 12) on Custom Plug One	YES
6	OIL	Traces into Auto Loom / Oil Temp Auto	In place
7	KNK1	Top left Knock Sensor	YES
8	PGR1	Pin 1 Evap Valve Left Side Engine	NO
9	PR	Pin 1 Fuel Pressure Control Valve	NO
10	THW0	Off into Air Conditioning Loom	NO
11	KNK2	Top Centre Knock Sensor	YES
12	L	(+) Gear Selector Indicator (Low) (Auto)	In Place
13	2	(+) Gear Selector Indicator (2nd) (Auto)	In Place
14	R	(+) Gear Selector Indicator (R) (Auto)	In Place
15	EO3	Earth Right Side Head	YES
16	E1	Earth In Common - both O2's (the working ones) - Data Link E1 - Sheilding to Both Camshaft Sensors	YES

- **(Core Wire: A must connect)**
    - The engine will not run without this wire.
- **(Core Wire: B must connect eventually)**

- The engine will run without this wire, but in default map. You should sort this out.

- **(NOT A Core Wire)**
  - The engine will run without this wire, perhaps not with the Automatic Gearbox, with a manual you don't need this.

***Note**: it makes me uncomfortable to not say this: TPS and the o2's do need to be there for it to run well, so does the MAF, the Idle Control stepper motor, etc. But, it'll start and run without them (MAF is questionable with some models).*

4.1.1 FPR Fuel Pump Relay,

... (NOT A Core Wire) –FPR - Across Fuel Pump Relay, - this does not trip a relay, the output I measured today was 0.004 volts not enough to trip a normal relay.

One installer commented;

> *FPC/FPR would control fuel pump computer. They are to be inspected with oscilloscope, you will find 5v pwm signal there. There are ways of setting these outputs to control your pump without stock fuel computer*

An uncomfortable error: One guy emailed me saying:

> *I wired the FPR (Pin1 on 16pin connector) trigger into the fuel relay which was fine in the event truck had an accident or stalled fuel relay is shut down. However I had also wired in the FC (Pin 4 on 16 pin connector) trigger in the circuit open relay thinking that the "Fuel Controller" was required, by only having a single speed pump in the hilux when the ecu triggered FC in theory to by pass the resistor and pump at high speed i was in fact cutting out the fuel pump completely. Only an issue when under load.... and when is a 1uz fe not under load?? you would have to be a nanna. Trick for young or not so young wannabe car conversion experts like myself. Hence the reason it would rev slowly up to 6500 rpm but when punched – Death*

Mistakes are easy to make. I think it's best to leave all the marking (masking tape) identifiers on the wires until your sure it's all running just fine.

4.1.2 THG Gas Temp Sensor

... (NOT A Core Wire) - THG Deleted EGR Gas Temp Sensor - this is normally in the body loom with the extra o2's sensors that are located after the Cat-converter. Rare to get this sensor. No a needed sensor, motor runs fine without it,

4.1.3 W Check Engine Light

... (NOT A Core Wire) - W Check Engine Light - this is an earth wire. Apply power from stage two on the key (IGN) second position, to the other side of a 12v light using W as the earth for the light. this will give you a check engine light. When you earth out TE1 to the engine this light will flash and give you codes (refer to diagnostic how too for more information)

4.1.4 FC Fuel Pump controller

... (NOT A Core Wire) - FC Fuel Pump controller - you dont need this wire, this is 'half the speed wire' it sends a signal to the fuel controller ECU to half the pumps speed at idle, this does not trip a relay, the output I measured today was 0.005 or 0.003 volts not enough to trip a normal relay.

4.1.5 TE1 - diagnostic

... (NOT A Core Wire) - TE1 TE1 is the diagnostic switch in the ECU, earth this out and the ECU goes into diagnostic mode,

4.1.6 OIL Auto Oil Temp sensor

... (NOT A Core Wire) - OIL Traces into Auto Loom / this is the Oil Temp sensor wire for the Automatic transmission - you dont need to use this wire,- I connect this when running the auto

4.1.7 KNK1 Top left Knock Sensor

... (Core Wire:B must connect eventually) - KNK1 Top left Knock Sensor - there are two knock sensors in the engine's valley. You need both there, they are not known to fail,

4.1.8 PGR1 Evap Valve

... (NOT A Core Wire) - PGR1 Evap Valve Left Side Engine,

4.1.9 PR Fuel Pressure Control Valve,

... (NOT A Core Wire) – PR Fuel Pressure Control Valve,

4.1.10 THW0 Air Conditioning

... (NOT A Core Wire) - THW0 goes into the Air Conditioning Loom,

4.1.11 KNK2 Top Center Knock Sensor,

... (Core Wire:B must connect eventually) - KNK2 Top Center Knock Sensor,

4.1.12 L(+)Gear Selector Indicator (Low)

... (NOT A Core Wire) - L(+) Gear Selector Indicator (Low) (Auto) Use if running the Automatic Gearbox through the 1uz ecu, otherwise delete,

4.1.13 2(+) Gear Selector Indicator (2nd)

... (NOT A Core Wire) - 2(+) Gear Selector Indicator (2nd) (Auto) Use if running the Automatic Gearbox through the 1uz ecu, otherwise delete,

4.1.14 R(+)Gear Selector Indicator (Reverse)

... (NOT A Core Wire) - R(+) Gear Selector Indicator (Reverse) (Auto) Use if running the Automatic Gearbox through the 1uz ecu, otherwise delete,

4.1.15 EO3 Earth Right Side Head,

... (NOT A Core Wire) - EO3 Earth Right Side Head,

4.1.16 E1 Earth In Common,

... (Core Wire:A must connect) -E1 Earth In Common, - to be clear: from the pin/plug this wire connects to the earth wire E1 which terminates on the (engine?: One of the cylinder heads) so .. any old earth will do, the correct one is best.

... - both O2's (include the rear two if you have four o2's),

... - Data Link E1,

... - Sheilding to Both Camshaft Sensors.

4.2 22 Pin

The order of this information, it's plug numbers and pin number are specific to a particular ecu.

Pin	Descrip	Long Description	Used / Or Not
1	VC	TPS – pin 4	YES
2	NCO(+)	Over drive direct clutch speed sensor (AUTO)	No
3	NCO(-)	Over drive direct clutch speed sensor (AUTO)	no
4	SP2 (-)	Speed Sensor	no
5	NE(+)	Crank - tested - connected	YES
6	NE(-)	Crank - tested – connected	YES
7	VTA1	TPS pin 3	YES
8	VG	Mass Air Flow Meter Pin 2	YES
9	SP2(+)	Speed Sensor	YES
10	G1(+)	Pin 1 Camshaft position sensor left bank	YES
11	G1(-)	Pin 2 Camshaft position sensor left bank	YES
12	VTA2	Traction Control – pin 4 sub TPS	NO
13	OXL1	Pin 3 left O2 sensor	YES
14	HTR1	O2 sensor pin 1 – (right)	YES
15	HTL1	O2 sensor pin 2 – (Left)	YES
16	G2(+)	Pin 1 right camshaft sensor	YES
17	G2(ES)	Pin 2 Crankshaft position sensor (shared in	YES

		common with NE	
18	**THA**	Mass Air Flow Meter Pin 3 (checked out ok)	YES
19	**OXR1**	Right O2 sensor pin 3	YES
20	**THW**	Engine Coolant Temp Sensor right front pin 2	YES
21	**EVG**	Pin 5 Mass Air Flow meter	YES
22	**E2**	Common Sensor Earth - Mass Air - ERG - the 34pin plug, on pin 31 - engine coolant temp - sub (traction control) throttle - TPS pin 1 - Vapor Pressure Sensor	YES

Break down of the codes above.

4.2.1 VC TPS – pin 4,

… (Core Wire:B must connect eventually) - VC TPS – pin 4,

4.2.2 NCO(+)Over drive direct clutch speed sensor

… (NOT A Core Wire) - NCO(+) Over drive direct clutch speed sensor (AUTO), - I dont connect this unless running the auto

4.2.3 NCO(-) Over drive direct clutch speed sensor

… (NOT A Core Wire) - NCO(-) Over drive direct clutch speed sensor (AUTO), - I dont connect this unless running the auto

4.2.4 SP2 (-)Speed Sensor

… (NOT A Core Wire) - SP2 (-) Speed Sensor, - I dont connect this unless running the auto

4.2.5 NE(+) Crank Sensor

… (Core Wire:A must connect) - NE(+) Crank - test - connect,

4.2.6 NE(-)Crank Sensor

… (Core Wire:A must connect) - NE(-) Crank - test – connect,

4.2.7 VTA1 TPS pin 3,

… (Core Wire:B must connect eventually) - VTA1 TPS pin 3,

4.2.8 VG Mass Air Flow Meter Pin 2,

... (Core Wire:B must connect eventually) - VG Mass Air Flow Meter Pin 2,

4.2.9 SP2(+) Speed Sensor

... (NOT A Core Wire) - SP2(+)Speed Sensor, - I dont connect this unless running the auto

4.2.10 G1(+) Camshaft position sensor left bank,

... (Core Wire:A must connect) -G1(+) Pin 1 Camshaft position sensor left bank,

4.2.11 G1(-) Camshaft position sensor left bank,

... (Core Wire:A must connect) -G1(-) Pin 2 Camshaft position sensor left bank,

4.2.12 VTA2 Traction Control – pin 4 sub TPS

... (NOT A Core Wire) - VTA2 Traction Control – pin 4 sub TPS

4.2.13 OXL1 left O2 sensor

... (Core Wire:B must connect eventually) - OXL1 Pin 3 left O2 sensor,

4.2.14 HTR1 O2 sensor pin 1 – (right),

... (Core Wire:B must connect eventually) - HTR1 O2 sensor pin 1 – (right),

4.2.15 HTL1 O2 sensor pin 2 – (Left),

... (Core Wire:B must connect eventually) - HTL1 O2 sensor pin 2 – (Left),

4.2.16 G2(+) right camshaft sensor,

... (Core Wire:A must connect) - G2(+) Pin 1 right camshaft sensor,

4.2.17 G2(ES) right camshaft sensor,

... (Core Wire:A must connect) - G2(ES) Pin 2 Crankshaft position sensor (shared in common with NE),

4.2.18 THA – Air Temp (AFM/MAF Pin 3)

... (Core Wire:B must connect eventually) - THA Mass Air Flow Meter Pin 3 (checked out ok),

4.2.19 OXR1 Right O2 sensor

... (Core Wire:B must connect eventually) - OXR1 Right O2 sensor pin 3,

4.2.20 THW Coolant Temp Sensor

... (Core Wire:B must connect eventually) - THW Engine Coolant Temp Sensor right front pin 2,

4.2.21 EVG Mass Air Flow meter

... (Core Wire:B must connect eventually) - EVG Pin 5 Mass Air Flow meter,

4.2.22 E2 Common Sensor Earth,

... (Core Wire:A must connect) - E2 Common Sensor Earth, NOT the same as E1,this is the sensor earth common wire, it is used only by sensors and must NOT be earthed to the engine, if you do that the signal noise will be so high the engine will run poorly at random places, it will over fuel, and under fuel

... - Mass Air,

... - ERG,

... - the 34pin plug, on pin 31,

... - engine coolant temp,

... - sub (traction control) throttle ,

... - TPS pin 1,

... - Vapor Pressure Sensor YES

4.3 28 Pin

The order of this information, it's plug numbers and pin number are specific to a particular ecu.

Pin	Descrip	Long Description	Used / Or Not
1	HTR2	Heated o2 (bank2)	no
2	OXR2	O2 sensor not in loom	No
3	OXL2	O2 sensor not in loom	No
4	HTL2	O2 sensor not in loom	No
5	PWR (-)	Stops starting when not in park	No
6	PWRL(+)	Return signal for the above	No
7	ODI	Cruise Control (not blank)	No
8	AD	No pin in place	No
9	IGSW	To ECU - turns it on (stage 2 on key)	YES
10	SDL	Data Link connector	No
11	SEL	O2 sensor not in loom	No
12	SPDM	Speedo Signal (output from Ecu	No
13	ACMG	Air Conditioning	No
14	BATT	ECU constant pwr supply (memory)	YES
15	ELS		No
16	BK		No
17	TPC	Vapor Pressure sensor	No

18	PTNK	Vapor Pressure sensor	No
19	L1	Electronic Suspention (none in place)	No
20	AC	For AC	No
21	NEO	For Anti Lock Brakes	No
22	+B	ECU switched power (same circuit as IGSW)	YES
23	N/A	Blank	No
24	MREL	EFI Relay (turn on)	YES
25	EFI (-)	Anti Lock Breaks	No
26	EFI (+)	Anti Lock Breaks	No
27	TRA	Anti Lock Breaks	No
28	3	Auto Trans (3) Light	No

Break down of the codes above

4.3.1 HTR2 O2 Sensor Sub Right

... (Core Wire:B must connect eventually) - HTR2 Heated o2 (bank2) Right one

4.3.2 OXR2 O2 Sensor Sub Right

... (Core Wire:B must connect eventually) - OXR2 O2 sensor Right secondary one,

4.3.3 OXL2 O2 Sensor Sub Right

... (Core Wire:B must connect eventually) - OXL2 O2 sensor Right secondary one,

4.3.4 HTL2 O2 Sensor Sub Left

... (Core Wire:B must connect eventually) - HTL2 O2 sensor Left secondary one,

4.3.5 PWR (-) Stops starting when not in park

... (NOT A Core Wire) - PWR (-) Stops starting when not in park,- I dont connect this unless running the auto

4.3.6 PWRL(+) Return signal for the above

... (NOT A Core Wire) - PWRL(+) Return signal for the above, - I dont connect this unless running the auto

4.3.7 ODI Cruise Control

... (NOT A Core Wire) - ODI Cruise Control (not blank),

4.3.8 AD

... (NOT A Core Wire) - AD No pin in place,

4.3.9 IGSW – Turns Ecu on.

... (Core Wire:A must connect) -IGSW To ECU - turns it on (stage 2 on key) this the wire that takes 12+ to the ECU to turn it on.,

4.3.10 SDL Data Link connector

... (NOT A Core Wire) - SDL Data Link connector - I usually de-pin this wire,

4.3.11 SEL O2 sensor secondary

... (Core Wire:B must connect eventually) - SEL O2 sensor wire (secondary)

4.3.12 SPDM Speedo Signal

... (NOT A Core Wire) - SPDM Speedo Signal (output from Ecu) - I dont connect this unless running the auto

4.3.13 ACMG Air Conditioning

... (NOT A Core Wire) - ACMG Air Conditioning, is this the fast idle wire ?

4.3.14 BATT - ECU constant pwr supply

... (Core Wire:A must connect) -BATT ECU constant pwr supply (memory) use this, dont put it too switched power.

... The 1uz ecu learns, it needs memory / constant power in the ECU to store what it learns. Reset the ECU by disconnecting this wire.

4.3.15 ELS

... (NOT A Core Wire) - ELS no notes on this.

4.3.16 BK

... (NOT A Core Wire) - BK No notes on this, connects to the brake light, receiving 12v+ under braking. Used to bump the idle up 200rpm to prevent stalling under braking when using automatic gearbox.

4.3.17 TPC - Vapour Pressure sensor

... (NOT A Core Wire) - TPC Vapour Pressure sensor,

4.3.18 PTNK Vapour Pressure sensor

... (NOT A Core Wire) - PTNK Vapour Pressure sensor,

4.3.19 L1 Electronic Suspension,

... (NOT A Core Wire) - L1 Electronic Suspension,

4.3.20 AC - Air Conditioning

... (NOT A Core Wire) - AC For AC: is this? the wire the puts the fast idle mode into place ? - I think it is

4.3.21 NEO - Anti Lock Brakes,

... (NOT A Core Wire) - NEO For Anti Lock Brakes,

4.3.22 +B - ECU switched power

... (Core Wire:A must connect) -+B ECU switched power (same circuit as IGSW),

4.3.23 n/a

...blank..

4.3.24 MREL - EFI Relay (turn on)

... (NOT A Core Wire) – MREL EFI Relay (turn on) - this wire comes from an ECU PIN and it goes ro (12+) the EFI replay to turn it on,

... e.g. the relay that provides power to the injectors (only) - turns off when engine not running, I always use this for safety reasons.

4.3.25 EFI (-) - Anti Lock Breaks,

... (NOT A Core Wire) - EFI (-) Anti Lock Breaks,

4.3.26 EFI (+) - Anti Lock Breaks,

... (NOT A Core Wire) - EFI (+) Anti Lock Breaks,

4.3.27 TRA - Anti Lock Breaks,

... (NOT A Core Wire) - TRA Anti Lock Breaks,

4.3.28 3 - Auto Trans (3) Light

... (NOT A Core Wire) - 3 Auto Trans (3) Light, - I dont connect this unless running the auto

4.4 34 Pin Plug

The order of this information, it's plug numbers and pin number are specific to a particular ecu.

Pin	Descrip	Long Description	Used / Or Not
1	SLN +	(Auto) Electric Solenoid #4	No
2	SLU +	(Auto) Electric Solenoid #3	No
3	SLN -	(Auto) Electric Solenoid #4	No
4	SLU -	(Auto) Electric Solenoid #3	no
5	#60	Injector 6 Earth / ECU fires injector from this	YES
6	#50	Injector 5 Earth / ECU fires injector from this	YES
7	#40	Injector 4 Earth / ECU fires injector from this	YES
8	#30	Injector 3 Earth / ECU fires injector from this	YES
9	#20	Injector 2 Earth / ECU fires injector from this	YES
10	#10	Injector 1 Earth / ECU fires injector from this	YES

11	S1	(Auto) Electric Solenoid #1	No
12	IGF1	5 Pin Ignitor pin 1 (on that plug)	YES
13	STA	Tells Ecu engine is being started	YES
14	NSW	Tells Ecu engine is being started	YES
15	#80	Injector 8 Earth / ECU fires injector from this	YES
16	#70	Injector 7 Earth / ECU fires injector from this	YES
17	S2	(Auto) Electric Solenoid #2	YES
18	BLANK	Not in use	-
19	BLANK	Not in use	-
20	ISC4	Pin (3) Idle Control Valve	YES
21	ISC3	Pin (6) Idle Control Valve	YES
22	ISC2	Pin (1) Idle Control Valve	YES
23	ISC1	Pin (4) Idle Control Valve	YES
24	IGT1	5 Pin Ignitor pin 2 (on that plug)	YES
25	IGT2	4 Pin Ignitor pin 2 (on that plug)	YES
26	IGF2	4 Pin Ignitor pin 1 (on that plug)	YES
27	EGR4	EGR Valve (this is blank)	-
28	EGR3	EGR Valve (this is blank)	-
29	EGR2	EGR Valve (this is blank)	-
30	EGR1	EGR Valve (this is blank)	-
31	IDL2	Pin 1 – Idle (cut out as used in traction cntrl)	NO
32	IDL1	TPS - Pin 2	YES
33	E02	Earth Left Rear Cylinder Head	YES
34	EO1	Earth Left Rear Cylinder Head	YES

4.4.1 SLN + (Auto) Electric Solenoid #4

Break down of the codes above

… (NOT A Core Wire) - SLN + (Auto) Electric Solenoid #4, - I don't connect this unless running the auto

4.4.2 SLU + (Auto) Electric Solenoid #3

… (NOT A Core Wire) - SLU + (Auto) Electric Solenoid #3, - I don't connect this unless running the auto

4.4.3 SLN - (Auto) Electric Solenoid #4

… (NOT A Core Wire) - SLN - (Auto) Electric Solenoid #4, - I don't connect this unless running the auto

4.4.4 SLU - (Auto) Electric Solenoid #3

... (NOT A Core Wire) - SLU - (Auto) Electric Solenoid #3, - I don't connect this unless running the auto

4.4.5 #60 Injector 6

... (Core Wire: A must connect) -#60 Injector 6 Earth / ECU fires injector from this by earthing out the wire,

4.4.6 #50 Injector 5

... (Core Wire: A must connect) -#50 Injector 5 Earth / ECU fires injector from this by earthing out the wire,

4.4.7 #40 Injector 4

... (Core Wire: A must connect) -#40 Injector 4 Earth / ECU fires injector from this by earthing out the wire,

4.4.8 #30 Injector 3

... (Core Wire: A must connect) -#30 Injector 3 Earth / ECU fires injector from this by earthing out the wire,

4.4.9 #20 Injector 2

... (Core Wire: A must connect) -#20 Injector 2 Earth / ECU fires injector from this by earthing out the wire,

4.4.10 #10 Injector 1

... (Core Wire: A must connect) -#10 Injector 1 Earth / ECU fires injector from this by earthing out the wire,

4.4.11 S1 - (Auto) Electric Solenoid #1

... (NOT A Core Wire) - S1 (Auto) Electric Solenoid #1, - I don't connect this unless running the auto

4.4.12 IGF1 Igniter

... (Core Wire: A must connect) -IGF1 5 Pin Igniter pin 1 (on that plug),

4.4.13 STA - Tells Ecu engine is being started

... (Core Wire: A must connect) -STA Tells Ecu engine is being started - connect this wire to the start relay **output**, or the black starter SOLENOID wire, not the main cable.
... It must have power, when the engine turning over and starting (if not power, no start / couple of fires that's it).

One Installer Wrote

I would strongly recommend too connect STA/NSW pins as per Toyota diagram. Though the engine starts without both of them connected just as fine.

However, I strongly disagree. I'm sure that STA is the pin that tells the engine that it's being turned over, and without it, the ECU has no idea it's being started. (In my humble opinion). Furthermore I'm sure that NSW must have 12v+ on it, otherwise the engine thinks the Automatic gearbox is in drive, so it refuses to fire at all. However, I am not always correct and if I have a dissenting opinion available I will offer it.

4.4.14 NSW - Neutral Start Switch

... (Core Wire:A must connect / deal with.) -NSW Neutral Start Switch: has 12+ when in neutral - pair with 'STA' wire so 12v+ is present during starting, in a manual conversion, if your running the (factory) auto and the auto loom is present in factory condition the NSW tail out of the loom (near the plugs and NOT part of the auto loom) is meant for the dash display DO NOT connect that to +12v it WILL prevent starting completely, engine wont even fire (more than once) –

4.4.15 #80 Injector 8

... (Core Wire:A must connect) -#80 Injector 8 Earth / ECU fires injector from this by earthing out the wire,

4.4.16 #70 Injector 7

... (Core Wire:A must connect) -#70 Injector 7 Earth / ECU fires injector from this by earthing out the wire,

4.4.17 S2 - (Auto) Electric Solenoid #2

... (NOT A Core Wire) - S2(Auto) Electric Solenoid #2 - I dont connect this unless running the auto,

4.4.18 Blank

... blank...

4.4.19 Blank

... blank...

4.4.20 ISC4 - Idle Control Valve

... (Core Wire:B must connect eventually) - ISC4 Pin (3) Idle Control Valve,

4.4.21 ISC3- Idle Control Valve

... (Core Wire:B must connect eventually) - ISC3 Pin (6) Idle Control Valve,

4.4.22 ISC2- Idle Control Valve

... (Core Wire:B must connect eventually) - ISC2 Pin (1) Idle Control Valve,

4.4.23 ISC1- Idle Control Valve

... (Core Wire:B must connect eventually) - ISC1 Pin (4) Idle Control Valve,

4.4.24 IGT1 Ignitor

... (Core Wire:A must connect) - IGT1 5 Pin Ignitor pin 2 (on that plug),

4.4.25 IGT1 Ignitor

... (Core Wire:A must connect) - IGT1 4 Pin Ignitor pin 2 (on that plug),

4.4.26 IGF2 Ignitor

... (Core Wire:A must connect) - IGF2 4 Pin Ignitor pin 1 (on that plug),

4.4.27 EGR4 - EGR Valve

... (NOT A Core Wire) - EGR4 EGR Valve - ,

4.4.28 EGR3 - EGR Valve

... (NOT A Core Wire) - EGR3 EGR Valve - ,

4.4.29 EGR2- EGR Valve

... (NOT A Core Wire) - EGR2 EGR Valve - ,

4.4.30 EGR1- EGR Valve

... (NOT A Core Wire) - EGR1 EGR Valve - ,

4.4.31 IDL2 - traction control system

... (NOT A Core Wire) - IDL2Pin 1 – Idle This is used by the traction control system, I ignore/remove it,

4.4.32 IDL1 - TPS

... (Core Wire:B must connect eventually) - IDL1 TPS - Pin 2,

4.4.33 E02 - Earth Left Rear Cylinder Head

... (Core Wire:A must connect) -E02 Earth Left Rear Cylinder Head

... (there is an earth point on each head at the back, under the plastic cam end seal, I use these earth points, both of them.

4.4.34 EO1 - Earth Left Rear Cylinder Head.

... (Core Wire:A must connect) -EO1 Earth Left Rear Cylinder Head.

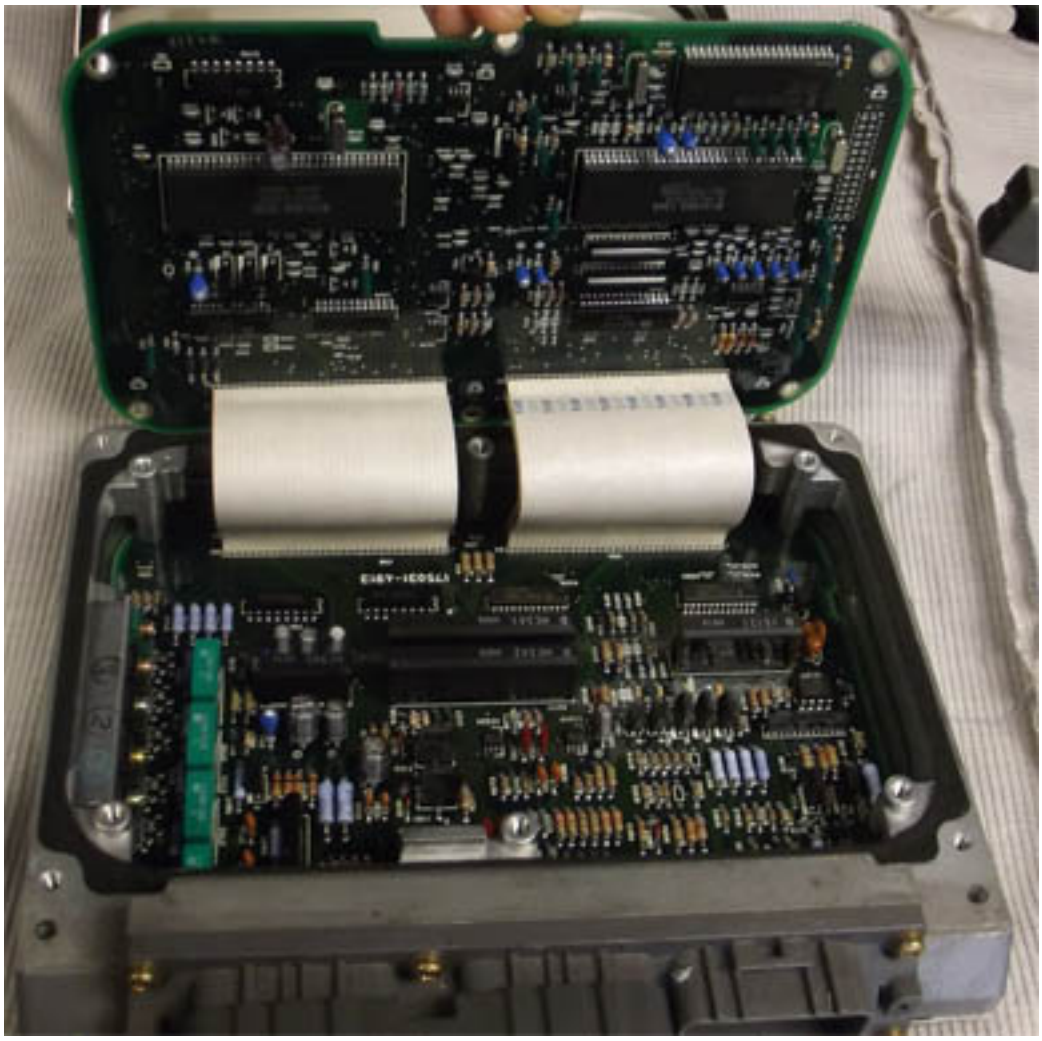
5 The ECU is a learning ecu

NOTE: the 1uz ecu's are learning ecu's, they learn as they go. It takes around 5mins for the ecu to learn an engine, around 2-3wks for it to completely learn an engine (driving conditions). disconnect your ECU from power and it will have to re-learn. That, can sometimes be a very good thing, one client reported huge power gains after a reset due to a prior fault which was fixed, but the ECU was not reset immediately afterwards. When he did, .. like a new engine.

When I say ‘learning’ ecu, I don’t mean to say it’s smart. There’s no AI in it, it doesn’t know when the engine has fired, it assumes alot. The fuel tables are something like 32x32, and the ignition tables are the same. Below is an image of the one of earlist 1UZ-FE ecu’s.

This ecu, if you find it, will never through a code for not having the automatic attached, that plug is a factory fitting. Below is a top image for the same ecu.

Inside the Ecu is some pretty basic circuitry here’s a look at a SC400 ecu, cira 1992?



6 It wont start for no obvious reason

NOTE: when you go to start the engine up for the first time it might not even fire the first time for no obvious reason. So, assuming your sure that nothing is wrong, the fuel lines are the right way around, it has spark, the ecu is on and working then the problem is you didnt crank it over enough, with enough throttle. Do that. Sometimes when you start a motor it fires a couple of cylinders and falls over and stalls. Crank it over again. Give it more throttle say start at 1/4 and ease it up while cranking it to 50%. If it catches and falls over, repeat. If fires say a few cylinders, and they are on oposing banks you've probably got stuck injectors. Tap them while applying 12v+ or soak them in fuel and then tap them. Or take them out carefully and try not to wreak the o-ring at the top or the seal at the bottom.

Or try starting it again, which is what I did today (27/11/2011) with a customer's car, it was catching enough cylinders to run perhaps 3 cylinders at most. I could hear

everything was ok, it just wasn't firing on all 8. I knew I could trust my work I'd been very careful and things had gone really well, right diagram, matched the Ecu. I could tell they were on opposing sides ignition and fuel were ok.

So we hit at say 50% throttle to try to keep it running and rev'ed it up and down, they came free one by one, you could hear them fire, and all of a sudden it was running on all 8 screaming away, it's often like this. I think the cure here was: just by having the voltage slamming into the injectors coil and from the pressure of the fuel there or the fact the fuel is removing the decomposed fuel deposits which cause injectors to stick, could have been carbon on the spark plugs, or flooded cylinders from prior attempts at starting (I doubt this, there is anti-flood protection).

These motors are sitting around in Japan or a wreaker's yard, often for years. The first start can often be a hard one to get there. Once there, they are MUCH easier to start each time from there, till the point they get so easy to start its really a good idea for manual conversion car to require the clutch to be depressed before it will start, for safety reasons.

6.1 A Story

A mate once told me about a car that was so easy to start and so torque-y, that someone working on the car touched the key one slot too far it started and rev'd up, dropped off the axle stands, the employees hand on the pedal (cos thats where he fell) and went backwards in reverse and slammed into a mustang that was in the shop bounced a few times and wedged itself in between a mustang and something else folding both doors around and forwards, nearly talking off the employees legs in the process.

The moral: *if you can install a button that has to be pushed while the key is activated it will improve safety, and make a handy anti-theft feature. I would put it on the NSW or STA pin.*

7 Watch for mechanical failures at start up

If it any stage while trying to start a motor you find you have no oil pressure, or hear obvious knocking noises, **stop**. Fix the problem now before you wreak the engine. Having an oil pressure gauge on an engine your about to fire up is not a must, but it's a damn good idea. Water temp does not matter unless you're planning on running the engine longer than 1-2mins (note a mechanic friend of mine regularly runs engines on a stand for up to 10mins using water from a fast running hose in and out of it, he swears its fine and I trust him, he's a damn good mechanic.)

8 Pulsing, but patterned idle

A pulsing idle is (can) caused by the computer advancing the timing and ICSV (idle control valve) not working for some reason. Idle control is not solely done the idle control valve, it is also done by the computer advancing the timing to control the rpm, the valve is opened based on how much o2 the o2 sensors pick up in the exhaust. So the patterned nature of the up and down idle (pulsing idle, sometimes called a surge which it is not) is caused by the computer advancing the timing and the valve not playing the game when it's supposed too. If you ever have the pleasure of witnessing this it sounds AWESOME, it's like the engine has warmed over cams and is 'hunting and seeking' for idle.

I recently completed a wire up on a customers car. From the first moment we started the car it would seek for an idle in a patterned manner, it would pulse up and down, sounded like a couple of hundred rpm (i.e. 750rpm - 1200rpm). It sounded like a v8 with injection and a mild cam. Actually, I really liked it. But, it's a mal-function and customers have every right to have that addressed and solved. Here's how I solved it.

First, I scratched my head and wondered what the hell I did wrong. I checked the wiring work, without checking for codes or even turning on the ecu. Everything was fine. In fact, I hadn't touched this part of the wiring it was still factory. So I figured it wasn't that (correctly). The day ended and in the evening a friend who knows a hell of alot more about 1uz's than me came over for dinner and afterward over a whiskey we chatted about the idle control systems and how the 1uz actually does it. He reckoned it might be several things, here were his thoughts:

- A bloody huge vacuum leak.
- The o2's error that was coming up for a left bank o2 (primary left)
- a malfunction in the ecu.
- a malfunction in the idle valve.

He reckoned the idle control valve is not needed. In fact you can just block it off and forget about it, because all it does is give you a smoother idle, it will idle fine without it. But, idle control is done by the o2's feeding the ecu information on the A/F ratio to give the ecu a value that it use to set the fuel amount. The idle speed is set by the ecu advancing and retarding the timing quickly to keep the rpm in a range of around 100rpm either side of 600rpm (or so), so 1000rpm is a fast idle. He reckoned the idle valve would prove to be stuck.

The customer in the back ground removed the valve and inspected it, didnt see anything wrong and re-installed it. He then blocked off the idle values rubber tube and the pipe off the intake (after the MAF / AFM) to seal the leak. It no longer surged, but took a slightly fast idle to the ear which sounded like 800 - 900rpm (no rev counter set up).

Right, this confirmed to me that it was the idle control valve. But I wanted to do everything I could to clear the o2 code so I busted my balls testing everything and ended up concluding that the plug for the o2 in question had all the right values at the plug and if anything was wrong it was at the sensor itself. Tested the other plug for reference and got the same value set. Confirmed the o2 errors were out of range values for the sensor or the plug had a bad connection (it cleared later for no obvious reason).

Since my own project involves ITB's and custom upper manifold my factory manifolds had been sitting under a workbench getting dusty for well longer than anyone would really want to admit. Packed the upper into the car for several days in a row until it was time to finish up and deal with it.

- I checked for a vacuum leak, very thoroughly - nothing.
- Removed the nuts and bolts holding the upper manifold being careful not to drop the nuts into the valley (which I _always_ seem to do). Used a magnetic telescope thing to take them out and put them back on. (I'm so careful not to drop stuff into the valley because I just always seem to drop ~something~ down there and anything metal down there could short out the starter cable = bad)
- Lifted the upper manifold up and then removed the idle valve and replaced with the spare from under the bench.
- Problem fixed. perfect idle.

It was obvious right away that the valve was stuck in place. Sure the valve has perhaps 1.5mm - 2.5mm's worth of inward play which felt like it was on a spring. But the good valve was WIDE open in its static position, the stuck valve was more closed than open, and showed signed of corrosion (alloy oxide) in the passage, it also had alot of carbon deposits, more than the other good one which was from and older motor. Suggests motor spent quite a bit of time idling in Japanese traffic.

When i put my mouth to the good valve it was like huffing through an open cardboard tube, easy as. The stuck on was more like three straws, it had resistance. It was clear that neither valve could be easily opened to be for repair. I'm sure that you 'could' they obviously make them 'somehow' but I didnt bother to try.

9 The Details

9.1 How to test the healthiness of an ecu

You can do this it's not without complications. It’s basically the same as wiring it up though. The ecu's only real health indicator is the check engine light, or the diagnostic plug. Other than that it falls down to the performance or lack of (in the sense that you can see something isnt right) or a malfunction. There are more complex methods but those are out of reach for DIY installers.

The diagnostic plug allows you to plug in a piece of equipment which will tell you all about the ecu and how it sees the sensors which is relies on. That will tell you if it's ok. It also involves a full set up, engine, loom, sensors, the works.

You 'could' hook the ecu up to power, hook the check engine light up, and see if it pumps out codes for all the missing parts. (ref diagnostic how too).

To do this you will basically need to wire the ecu up to the loom, or a loom, or a substitute for a loom, in part. You need to hook up earth, and power, and switched power. That’s only a few wires though. Then you will need to refer to the wiring diagram with great care, and make sure your connecting the right wires up. And, run the check engine light. It's dirty, nasty, cheap, bit if the little light blinks in the way it should, chances are it's fine.

It looks a bit like this.

User: 1uze30 on oldschool.co.nz

The other method is to send the ECU to a company like Anything Electronic Ltd http://www.anythingelectronic.co.nz/ they will tell you if it's ok. It will cost money, but they can also fix it.

If your health checking an ecu it must be for a reason, did you drop it ? Don't panic, I've done that quite a few times and they seem to be ok with it, well to a point. It is after all a sensitive electronic device. We had one ecu on a work bench next to a bench grinder for a couple of months. It fell, was put back up at least 3 times I know off, then my mate moved it and it was left on a welding bench for about 6mths.

We expected it to be toast. It works. It's in a hilux conversion right now running just fine, which is amazing. It was installed because the engine came without a loom or ecu, or a few other things, so it was patch up and got running so our friend could run through cert and worry about the details later. He was told to replace it asap, he later used a mega squirt (ms3).

9.2 - Looms and ECU's / Transmissions

9.2.1 Looms and ECU's

The engine will likely come from an importer, or been someone's garage. Often the loom is untouched, not uncommon to find something missing. Don't be put off, but a MAF is a problem they are now expensive ($150 - $250).

If engine has cut loom at the back of the cam cover don’t be put off, a cut loom is more work to terminate at the ecu, because of missing wire. The problem with a cut loom is ecu plugs. You need all of them, and the pins that go into them. You don’t really need a long tail off each pin, some length is helpful.

Its not a big deal, the wiring time isn't doubled, but it is extra hours, as much as an extra 10hrs, if you have the time and don’t mind the extra work it could be more affordable.

Don’t worry about the 'right ecu' for the engine. Except for the VVTI engines, any 1uzfe ecu can be grafted to work with any 1uzfe engine, the issue is more about having the right plugs and the time taken to transfer it. It's the pin configurations, wiring diagrams, and getting it all set up right, if is first wire up, don’t try match up / mis-matched electrics, a big ask for a beginner, for aftermarket ecu installs some of the info here could be useful.

9.2.2 Transmissions

There is a rumour that 1uzfe ecu's which operate the automatic as well will not rev beyond 3000rpm once wired up, untrue. Possibly caused by reverse (speed) inhibitor in some ecu's.

However, I had a long email conversation with one person who was certain his installation was not rev’ing beyond 2800rpm because an inhibitor in the ecu. While at the time of writing this he has yet to tell me he’s solved it, I ended up saying to him: your car has no ecu faults, you’ve made no mistake, it will build rev’s to over 2800rpm, but under load it falls flat. If your car was in my shop I would not even consider an ecu related cause, I’d consider it a load related issue: so vacuum leak, or fuel pump fault, etc. The key point here is if you can build rev’s over the inhibition point it’s something else. It turns out the error he’d made was minor and detailed above in the FPR pin information. It was just a simple wiring mistake, not even really a mistake.

I’ve yet to encounter this fabled failure to rev, others with real experience say its real. I do believe them.

There is a rumour that a stand alone ecu is out there, it was installed into the Crown Majesta (89? or is it 1990 ?), untrue I've seen it, it runs the automatic too. But if I'm wrong and you find that ecu which was paired with a separate ECU to control the transmission. grab it, grab both.

There is a rumour that "you cannot get a 1uzfe to work with a Surf Automatic", also untrue. I've done it. It's three wires, there is more information about this further in the document.

If you can physically mount the auto to a bell housing or adapter plate and have the spline sit nicely in the torque converter it can be wired up to work properly. The problem with the 1uz-fe automatics is that they are not a sliding yoke box. It is possible to convert the 1UZFE range of gearboxes to be a sliding yoke box. I don't think it's worth the effort. I would rather just install the 1UZFE and it's stock gearbox and have a truck type sliding spline drive shaft made up, easier and cheaper, a bit ugly in terms of it being a heavy and expensive driveshaft, but effective and very strong.

9.3 - Working with the Loom Casings and Plugs.

9.3.1 Free the loom

Free the Loom as much as possible from the plastic mouldings/casings, ultimately you want to separate the loom from the engine, there is a catch. Some of the plugs on the 1uz-fe engine *in-so-far-as-I know* might: are not used or any other engines. Well I've hunted through one wreaker's yard once searching for ISCV plug (Idle Solenoid Control Value), and didn't find anything close so, take that as you will.

Here in New Zealand we get alot of Japanese importation from the Automotive industries. We get some really great stuff imported. However by the time engines land into New Zealand, they are usually well cooked. I have yet to see a 1uz engine without a broken plug. The engines which feature in this section of the document was pretty bad for plugs, this plug below is actually burned. I'm not sure what the story is, I guess the engine it came from had a fire?


obviously, it got well baked.

9.4 Here is what most often happens

The injector plugs, because they are at the top of the motor take a pounding from ambient heat, the little clip which holds the plug firmly onto the injector breaks away, rendering the clip useless, the condition a plug which is broken could easily cause a intermittent mis-fire. There are solutions you can buy brand new plugs for about $12.50 each, [edit]$15 each trademe.co.nz (seller:nzefi). Or the 4age (20v) plugs work just fine and are pretty cheap at a wreakers they are generally not roasted either. The billet injection rails (above) are nice, make big power just fine, if I was going to force the induction on a 95 onwards motor I would ditch the cast fuel rails for the billet earlier ones they are as good as anything in the aftermarket.

9.5 Brittle from heat, covered in corrosive dust

The plug above us is an ISCV plug, its missing a chunk, don't do this, be careful with 1uz plugs someone has tried to get the plug of its female counterpart with some sort of metal tool and because the plug is brittle (they always are) it's relieved the stress by coming to pieces instead of coming off, expect the plug to break up if you try that. Despite the fact it's missing a chunk and no longer seals from the environment in the engine bay (which is a harsh) it is still usable, I cannot find a replacement for it.

Look at the state of this coil plug above and that's not the worse one, the other plug was hollow, again, 4age (20v) engines use these exact coils and plugs. Just visit a wreaker and get another plug, chances are it will be just fine. If that fails, start looking to other Toyota cars aged between 1990, and 2000.

There is no real reason why that coil plug could not be used for testing, but why would you. It could induce a fault, causing you to doubt your work (perhaps all of your work, if

you’re new to wiring engines) and make you have the de-moralising task of going over all your work in detail, stuff that, fix the problem and move forward from there, not sideways.

9.6 Heat damage

If you find the engine your about to purchase has alot of broken plugs, reconsider the purchase or negotiate a lower price, if all the plugs are very brittle it does not bode well for the condition of the engine, it might be clean the exporter in Japan, or the importer in New Zealand washes them well, but if plugs are baked so was the engine (over and over), expect possibly of real mechanical problems if the plugs are falling apart in under a firm squeeze.

9.7 Heat damage reasons ?

A another possible reason is Ultra Violet Light damage, or perhaps an engine that spent alot on time in traffic, so it's done 100k in distance and 250k in hours!, sometimes importers stack (already baked) engines up in a open yard, they sit in the sun for months and bake, causing the plugs to become brittle and weak, brittle plugs are not a good sign for the engine, means heat and sun will have effected other seals, cam cover seal to a certain point it’s ok to think the engine might be mechanically fine though.

9.8 Before removing the lower plastic housing

Before you start removed the plastic mouldings/casings/housings and of course, the rest of the loom, consider the above comments on heat damage. Forward (of the engine) end of both plastic mouldings are plugs which may need to be unplugged. These will all be at risk of breaking easily, so will injector plugs passengers side set of plugs are particularly at risk. I'm very wearily of unplugging the four pin plug which carries the crank angle signal, passengers side camshaft sensor, they always seem to crack this plug no matter how hard I try not to. You do not 'have too' remove the entire loom like this, just .. look all I’m saying is be careful, really careful.

9.9 When you've got the loom off

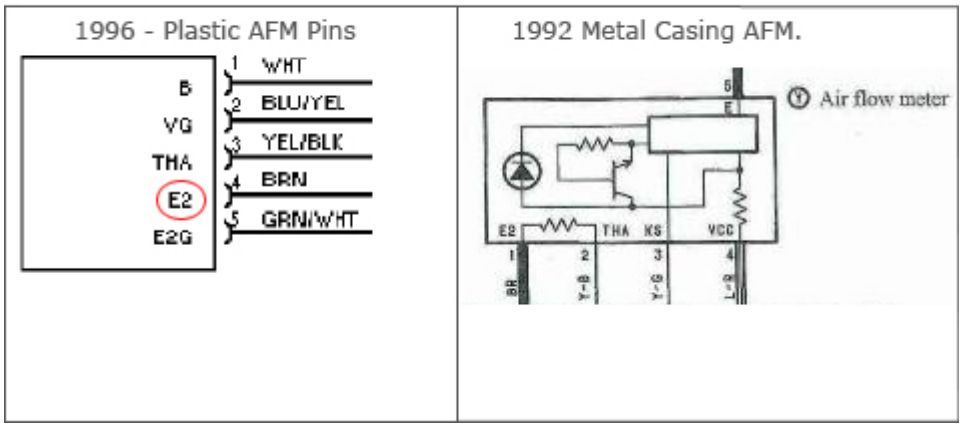
When you get the looms off it will probably dawn on you that it looks like a pretty substantial piece of kit it’s around 80 odd wires, each single wire breaks down to a simple connection like this, battery cable. Each wire is just a single connection it’s not that hard to work out where they need to go.

I don't normally feel the need to remove the entire loom. I tend to just free the loom up to the forward plug on the passenger's side and the water temp sensors. I know above I talk about removing the entire loom. I also write about being very careful doing this because of the age of the plugs and there propensity to break apart. Really try to avoid going too far here.

9.10 Wiring up the MAF / Air Sensor

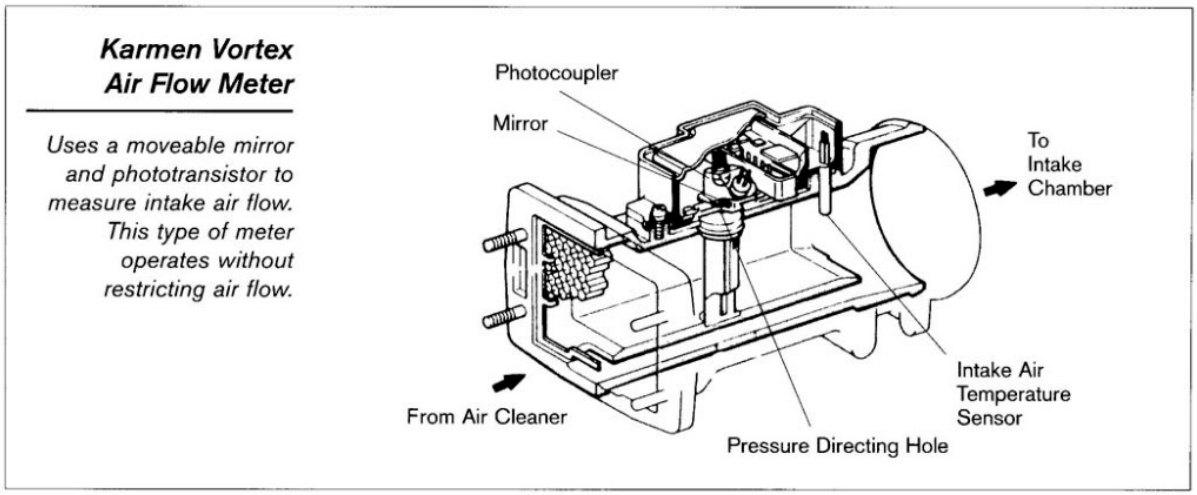
There are two types of 1uzfe mass air sensor, the older pre-95 cast alloy bodied type, and the later model plastic bodied type. The wiring for each it totally different.

Differences Between the AFM types: Different PIN configurations.



Pay attention to the different configurations of the two Air sensing devices on the 1UZ-FE engine. It's easy to look at the wrong diagram and be thinking you've made a mistake or feel confused.

9.10.1 Karmen Vortex Air Flow Meter



The Mass Air Flow Sensors converts the amount of air drawn into the engine into a voltage signal. The ECU needs to know intake air volume to calculate engine load. This is necessary to determine how much fuel to inject, when to ignite the cylinder, and when to shift the transmission (if there is an Automatic one present). The air flow sensor is located directly in the intake air stream, between the air cleaner and throttle body where it can measure incoming air. There are different types of Mass Air Flow sensors. The vane air flow meter and Karmen vortex are two older styles of air flow sensors and they can be identified by their shape. The newer, and more common is the Mass Air Flow (MAF) sensor.

This air flow meter consists of the following components:

- Vortex Generator.
- Mirror (metal foil).
- Photo Coupler (LED and photo transistor).

Which result in a measurement of 'air flow volume'

9.10.2 Karman Vortex Air Flow Meter Operation

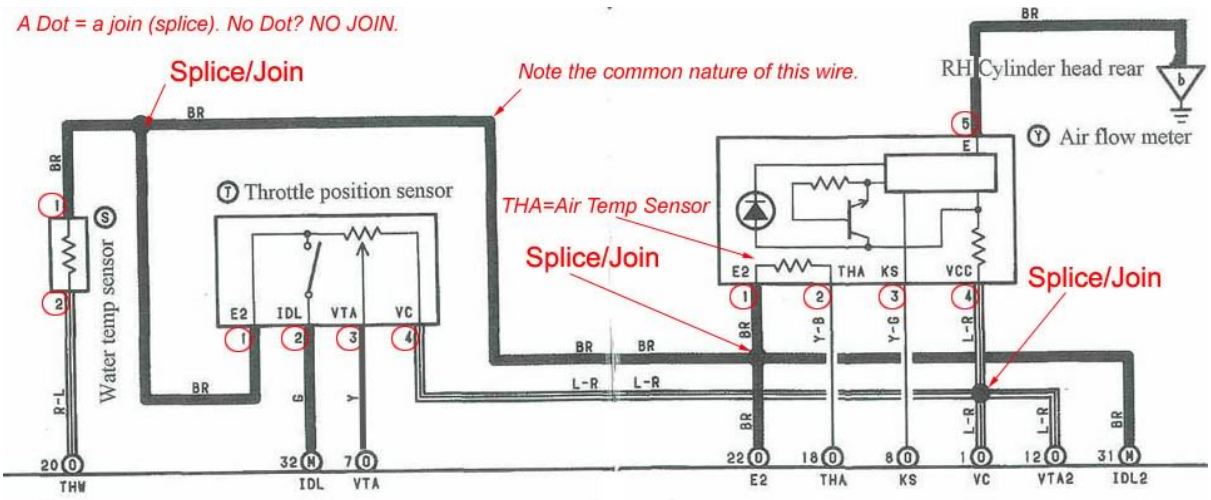
Intake air flow reacting against the vortex generator creates a swirling effect to the air downstream, very similar to the wake created in the water after a boat passes. This wake or flutter is referred to as a "Karman Vortex." The frequencies of the vortices vary in proportion to the intake air velocity (engine load).

note: do not remove the honey comb, it effects the operation of the device. You wont wreak it, but it wont measure as accurately so leave it alone.

The vortices are metered into a pressure directing hole from which they act upon the metal foil mirror. The air flow against the mirror causes it to oscillate in proportion to the vortex frequency. This causes the illumination from the photo coupler's LED to be

alternately applied to and diverted away from a photo transistor. As a result, the photo transistor alternately grounds or opens the 5-volt KS signal to the ECU.

This creates a 5 volt square wave signal that increases frequency in proportion to the increase in intake air flow. Because of the rapid, high frequency nature of this signal, accurate signal inspection at various engine operating ranges requires using a high quality digital multimeter (with frequency capabilities) or oscilloscope.

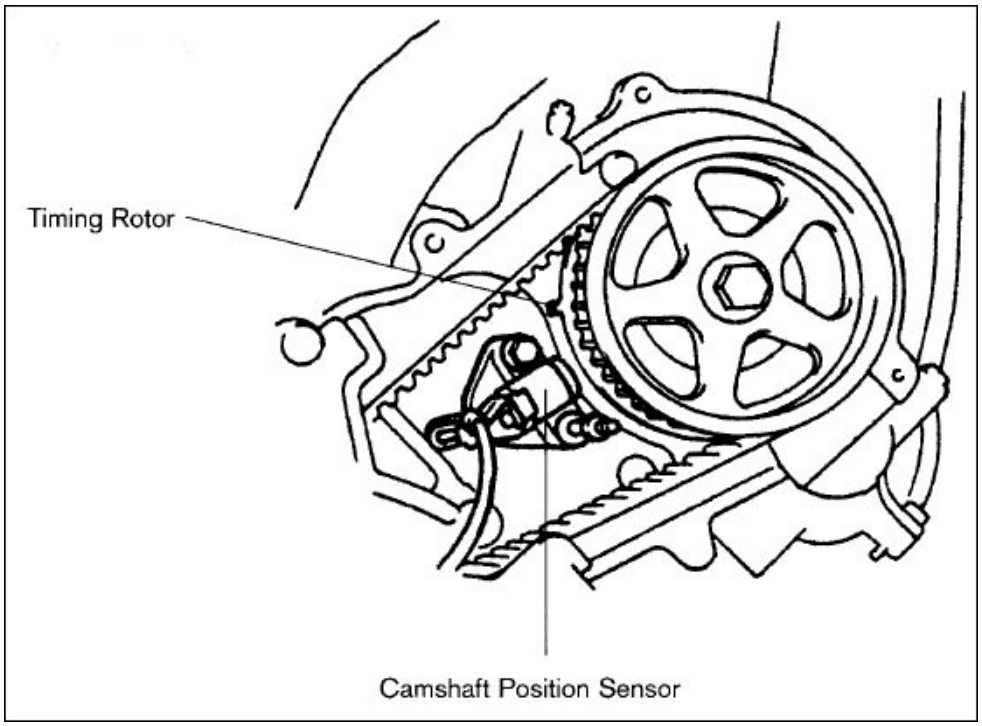


9.10.3 Later Model Plastic Type

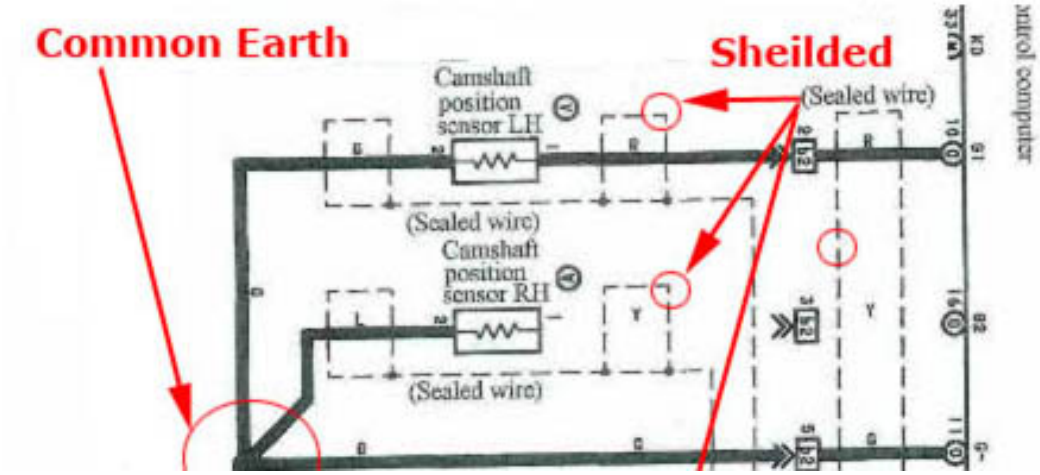
There Air flow meters work by a different principal and are a much cheaper device to make. The air flow cools a piece of metal which is suspended between two wires. There is one difference between them and earlier type is the plug has a different configuration, so pay attention to wiring, as the pins are different.

9.11 Wiring up the Camshaft sensors.

The camshaft sensors are one of three speed positioning sensors. There is a little tag (protrusion) on the camshaft's toothed cam belt wheel which the G and G1 sensors pick up on. So, what does the ecu do with this information? Well by knowing the position of number 1 cylinder and that's in its compression stroke the ecu can use this information for fuel injection timing, direct ignition systems and variable valve timing.

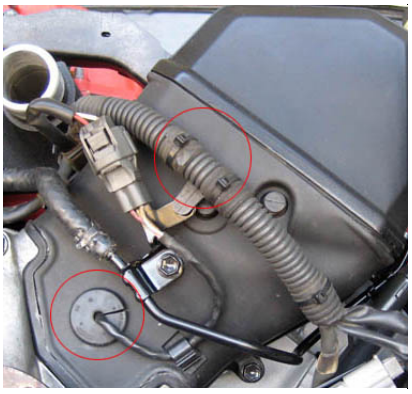


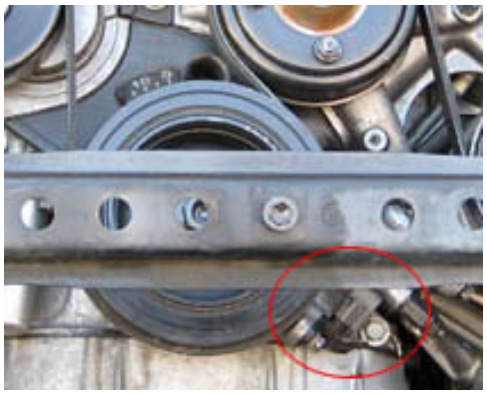
The factory ecu will not run at all without both G sensors being connected correctly. There is a diagram below which shows the connection path to the ecu, I don't normally need to interact with the wiring for them or the crank speed sensor.



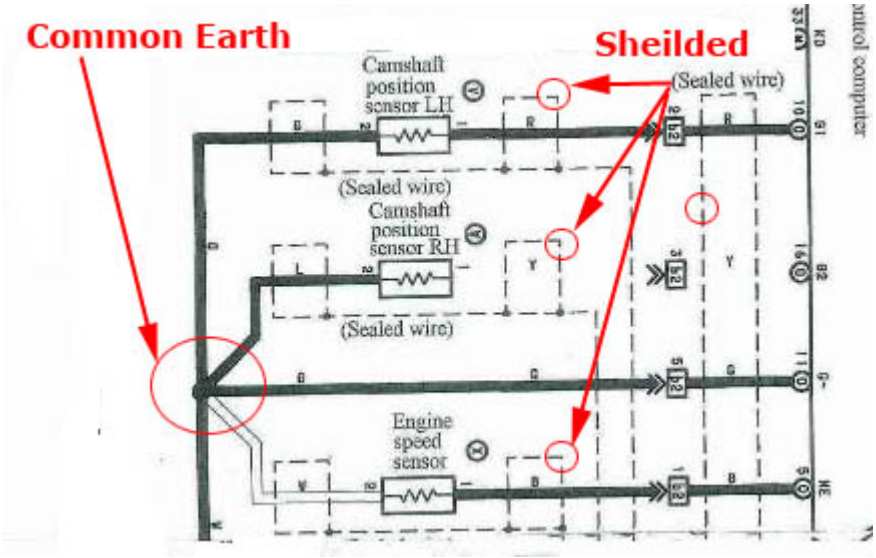
9.12 Wiring up the Crankshaft sensor.

In order to correctly time spark and injection events, the ECU monitors the relationship between the Ne and G signals. With most engines, the ECU determines the crankshaft has reached 10' BTDC of the compression stroke when it receives the first Ne signal following a G1 (or G2). Initial timing adjustment is critical as all ECU timing calculations assume this initial 10' BTDC as a reference point for the entire spark advance curve.





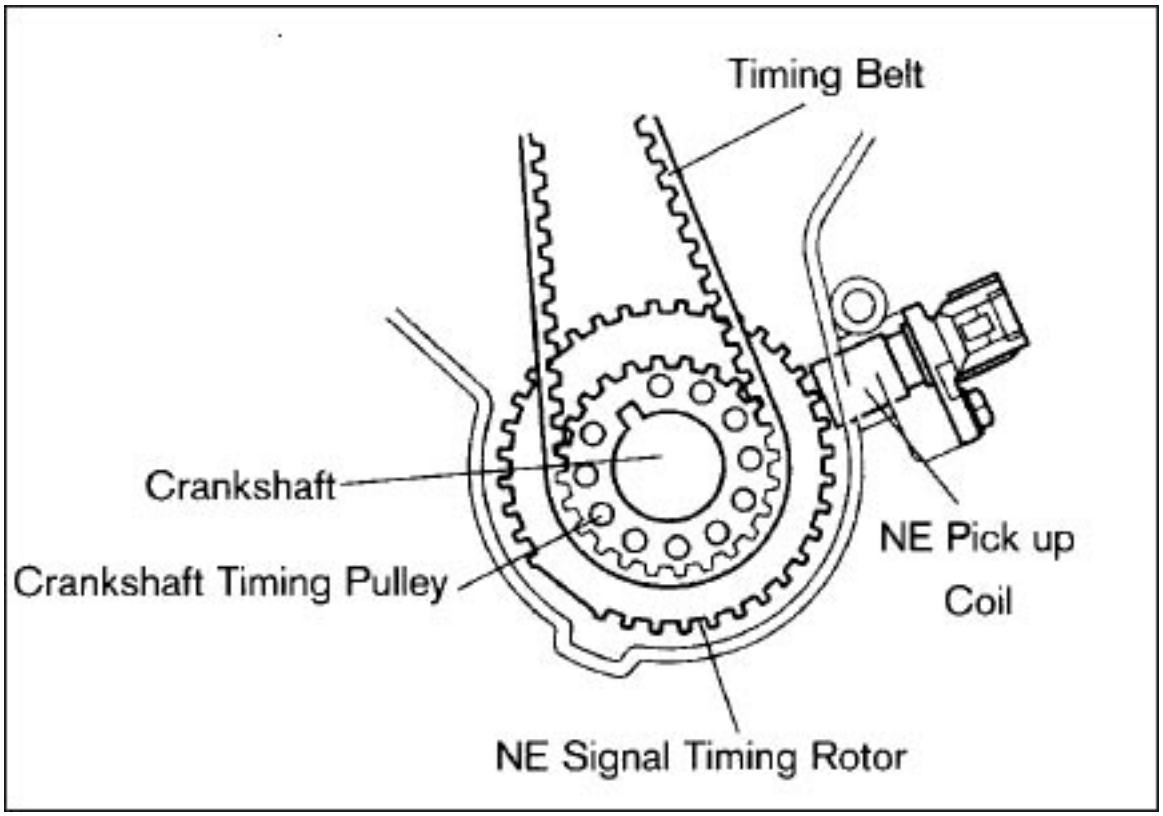
The Crankshaft sensor wiring travels down past passengers side plastic cover, stops at the coil and then continues onward down to the lower pulley. In there is the sensor it's self and a small toothed wheel.



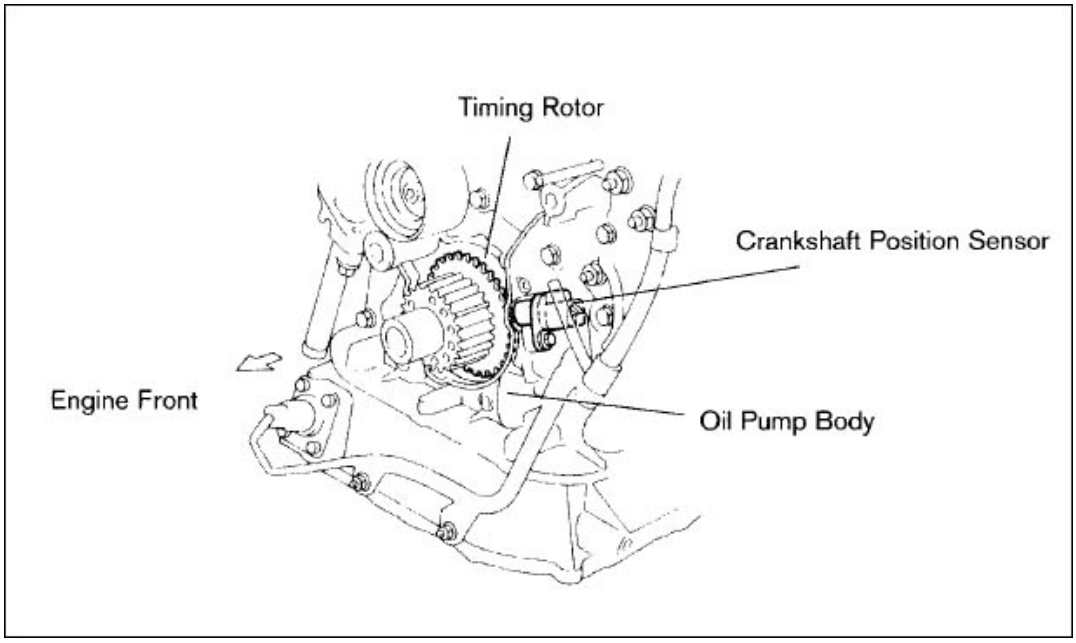
The engine speed sensor is the crank shaft sensor. It travels around in a shielded wire which is basically two wires in a flexible woven wire casing then covered in a plastic casing. The shielding is to protect the signals from interface and at the ECU end needs to be earthed, you can basically collect all the shielded wire up and earth the lot in one go.

Each tooth generates a pulse, in AC wave format. There is no external power source required. As the gear rotates faster there are more pulses produced. The ECU

determines speed based on the number of pulses received and then applies the correct ignition and fuel maps in accordance with air volume (MAP/AFM) and air density measurements (air temp). The number of pulses in one second is the signal frequency.



This is how the NE sensor looks in the factory set up (above and below images). As above there is a toothed wheel, the sensor picks up on a cap and reports that to ecu. The toothed wheel is in fact only an 8 tooth. Which is stuff all definition. In performance engine setups there are 63:1 setups not 7:1. The increased definition allows for the removal of the ‘G’ or camshaft sensors and complete reliance on the NE sensor as a high definition source of crank positioning. Do not replace the factory toothed wheel unless you are replacing the ecu completely for an aftermarket one.



9.12.1 Ignition Timing Strategy

The ECU determines ignition timing by comparing engine operating parameters with spark advance values stored in its memory. The general formula for ignition timing follows:

Initial timing + Basic advance angle + Corrective advance angle = Total spark advance.

Basic advance angle is computed using signals from crankshaft angle (G1), crankshaft speed (Ne), and engine load (Vs or PIM) sensors. Corrective timing factors include adjustments for coolant temperature (THW) and presence of detonation (KNK).

9.13 - Wiring up the O2 Sensors (four?)

In so far as I know there are two kinds of 1uz-fe o2 sensors. The heated four wire kind, and the older two wire kind. Of course you find the older two wire kind on the older engines, pre 1991 (yes there are older 1uz's). The four wire kind have a powered heater in them to get them into a operational range and keep them there. The heating system has to be hooked up for the o2's to work. You do want the o2's working. The are not wide band sensors, just the on/off type. The wide band sensors tell you how much oxygen is left in the exhaust gases, factory sensors do not, they just say to the ecu something like ‘o2 found = add more gas next cycle’ and ‘no o2 = use less gas next time’.

9.13.1 ... four o2's / some engine

If your motor has two o2's on it and they are heated four wire ones. It's quite possible it might need two more. If it's a later model engine (1995 perhaps earlier; onwards) so that's the OBDII engines (note can still pull OBDI codes from checklight). Look some 1uz's have four, and as far as I know do need the other two to get the engine to run in open loop (ie normally). The only way to tell is to look at the loom and if you see two separate bundles of o2's wires then you will need another two sensors to install OR use my work around which it detailed below.

The Ecu uses the difference between the two o2 sensors to determine if the catalyic converter is still working, on each bank of the v8. So, the ECU expects the cat to be there. There idea is for there to be a difference between the two o2 values, so you cannot put them in right next to each other. If your going to use all four put one on or near the header, and one well back after a muffler is ideal to clear the ecu of codes, per side. If you install the o2's near each other you will clear the sub o2 code, but a new code could show up about the condition of the CAT. If you going to do that you might as well just wire the primary o2's to the sub o2 pins and clear the code that way, leaving the non critical CAT code to come up and leave the engine like that. It's not like it's a big deal that way.

These extra o2's are not normally included in with the engine, they are actually bundled into the body/chassis harness because physically they are after the cat.

9.13.2 Two o2 sensors operating as four

You can clear the sub o2 code by connecting OXR2 directly to OXR1 and OXL2 directly to OXL1. I do not connect the heating wires (e.g. (HTR2 to HTR1 and HTL2 to HTL1) there was/is not any point in doing that since it wont clear the code at all. This cleared may have cleared the primary o2 code for the left bank that I was getting in one install.

This gives the ecu two fake secondary o2 sensors (ghost ones), the problem is that there is no difference between them and the primaries, there should be a difference between the values that the primary and secondary o2's put out in a factory engine. However, it clears the code, removes closed loop mode (limp) and hey, thats the goal.

Note: this was tested by two other installers on the 6th and 7th (Dec 2011), both reported that it clears the code and closed loop (limp mode).

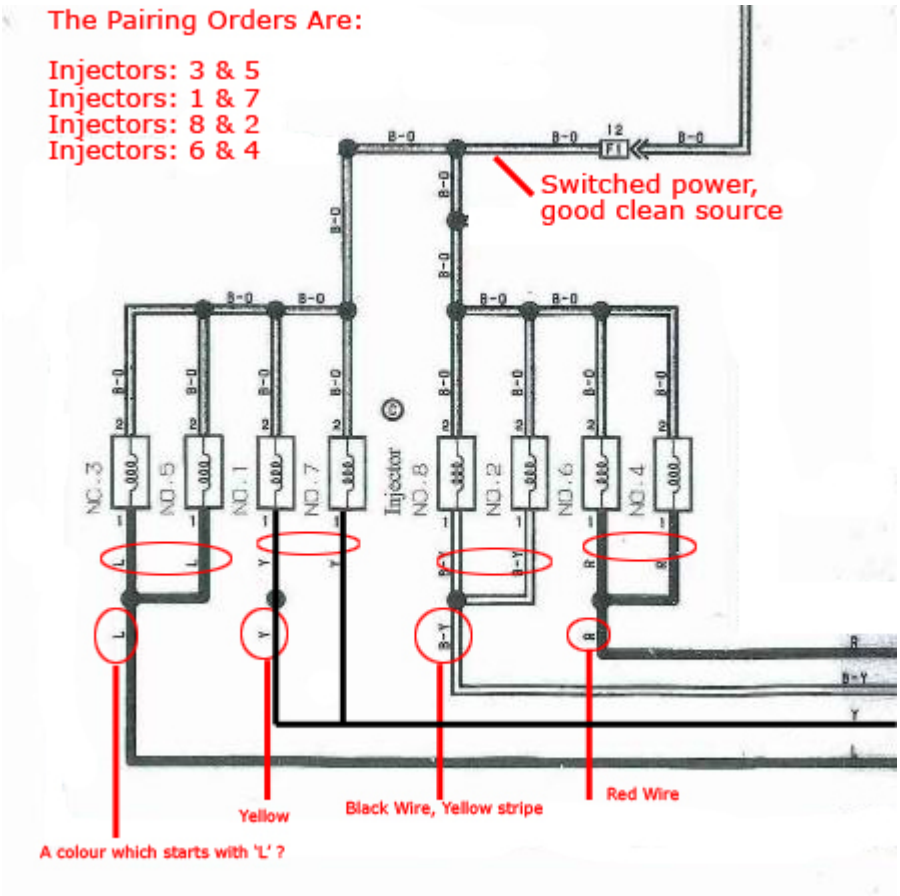
9.14 - Wiring up the Injectors

The injectors are actually really simple, they get a constant feed of positive power from a switched power supply which I like to put on a relay which is switched by the ecu (MREL), but there is no good reason it cannot be off the key.

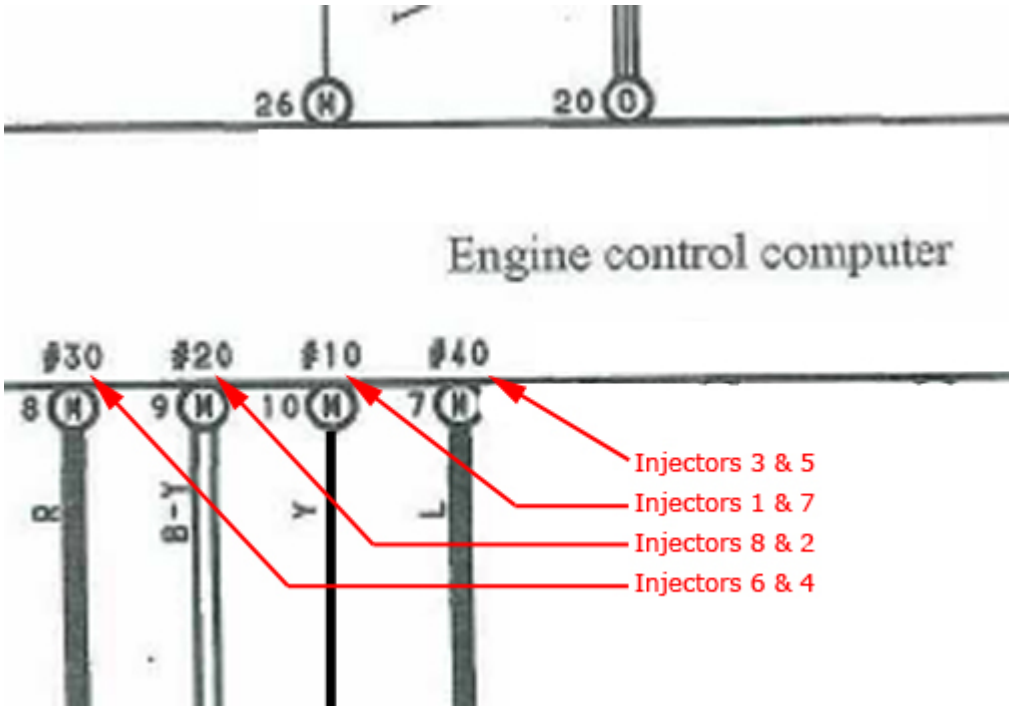
9.14.1 1uzfe injectors.

The 1uzfe injectors are paired from 1989 to 1995, and sequential after that.

The paired injectors are set up like this,



Note the sharing of the cables for the ecu side. The splice is FAR up the loom, if you planning on running sequential injection later move the splice down to very near the ecu when your wiring the engine up.



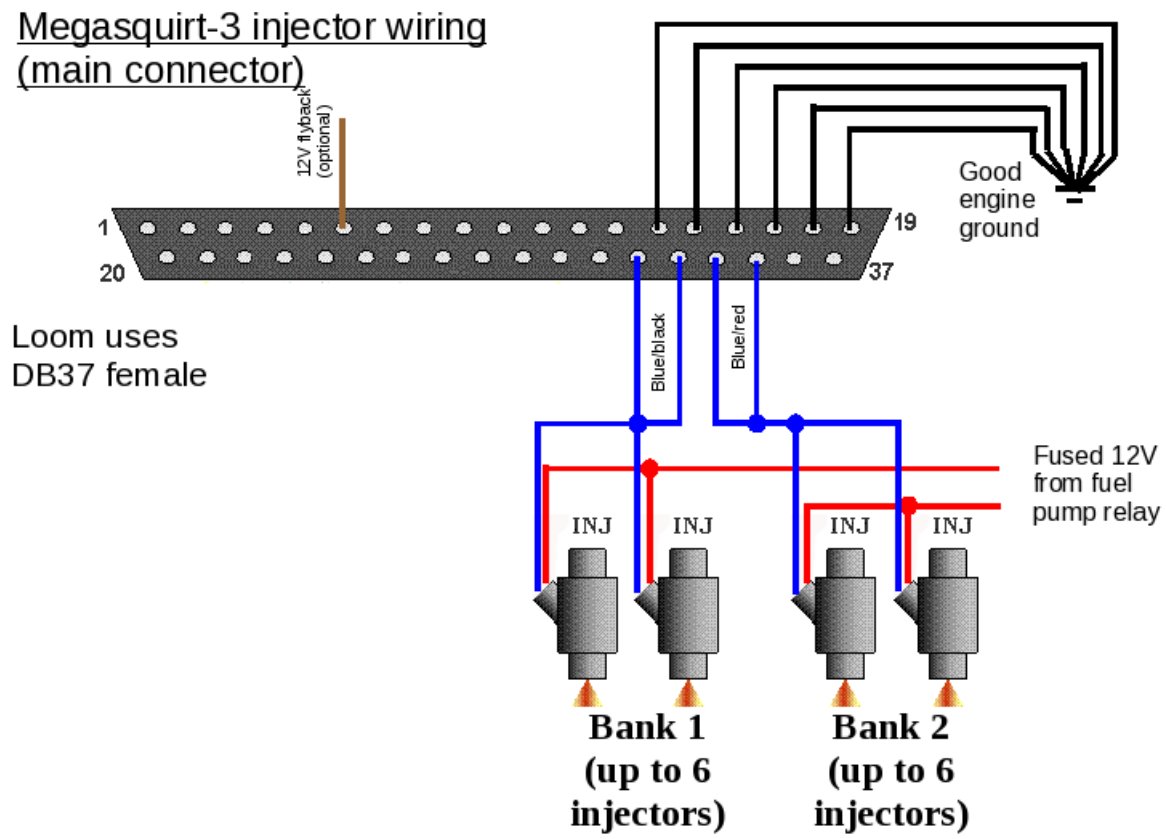
At the Ecu end it looks like this: the pin has the usual plug location, and pin number, but the designation is the special #number, so #30 in this case is injectors 6 & 8.

I'm thinking this is so simple: I'm not doing to bother to do one for the sequential injection setups, on the post 95 or 97 engines, and the vvti engines, there is an image below which shows the set up, I'm sure you understand, dont assume #10 = injector one; it might well, but ya know = check it. It's just #10, #20, #30, #40, #50 etc. OR it's #1, #2, either way it's # something (hash) and a number.

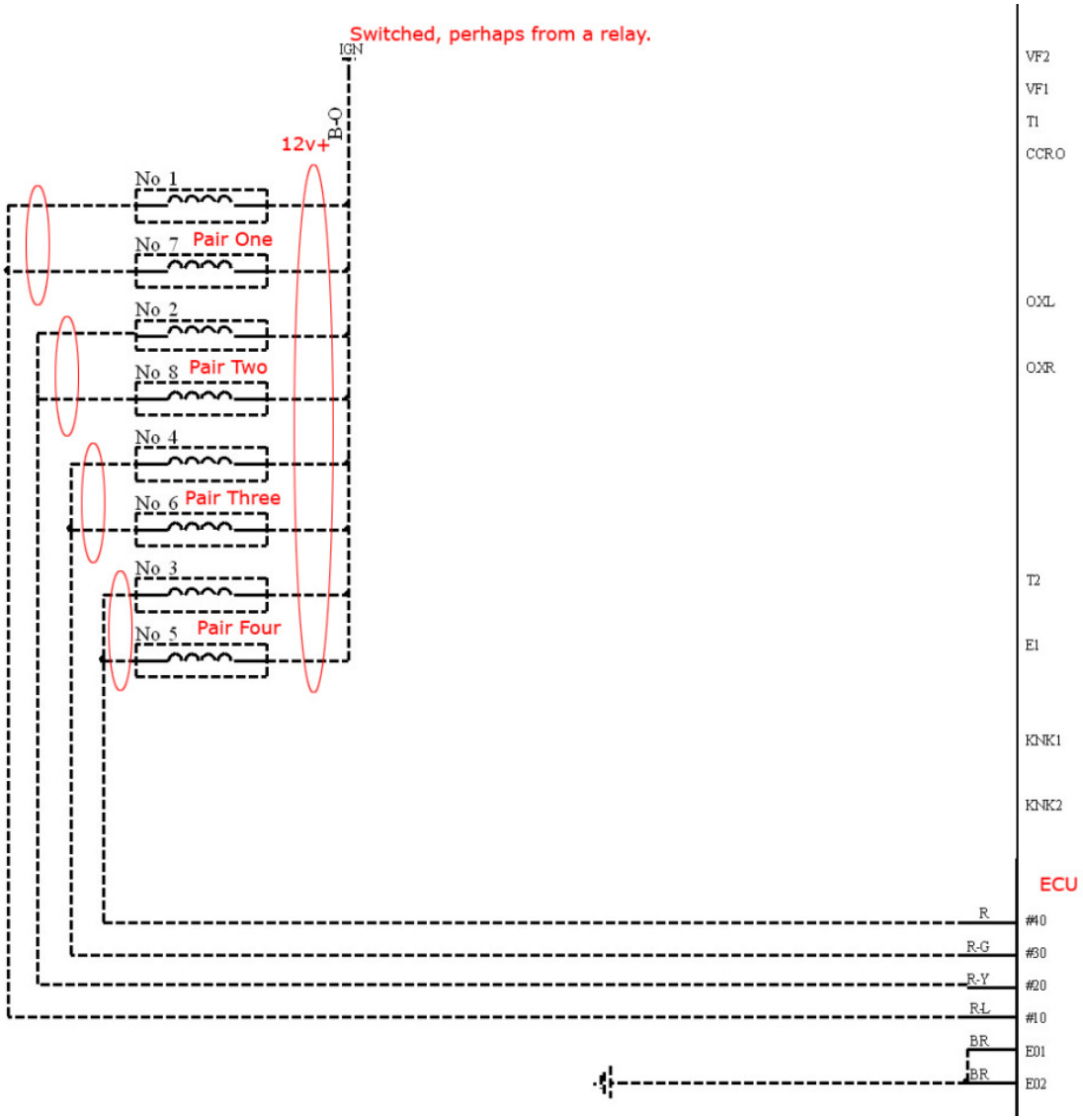
A few more words, the older engines have mostly solid primary colours for the injectors (eg, red, blue, yellow, something else), but that doesn't mean some toyota worker hasn't just grabbed the nearest full spool and used that, so be wary, never assume.

9.14.2 Random fuel and Injector information.

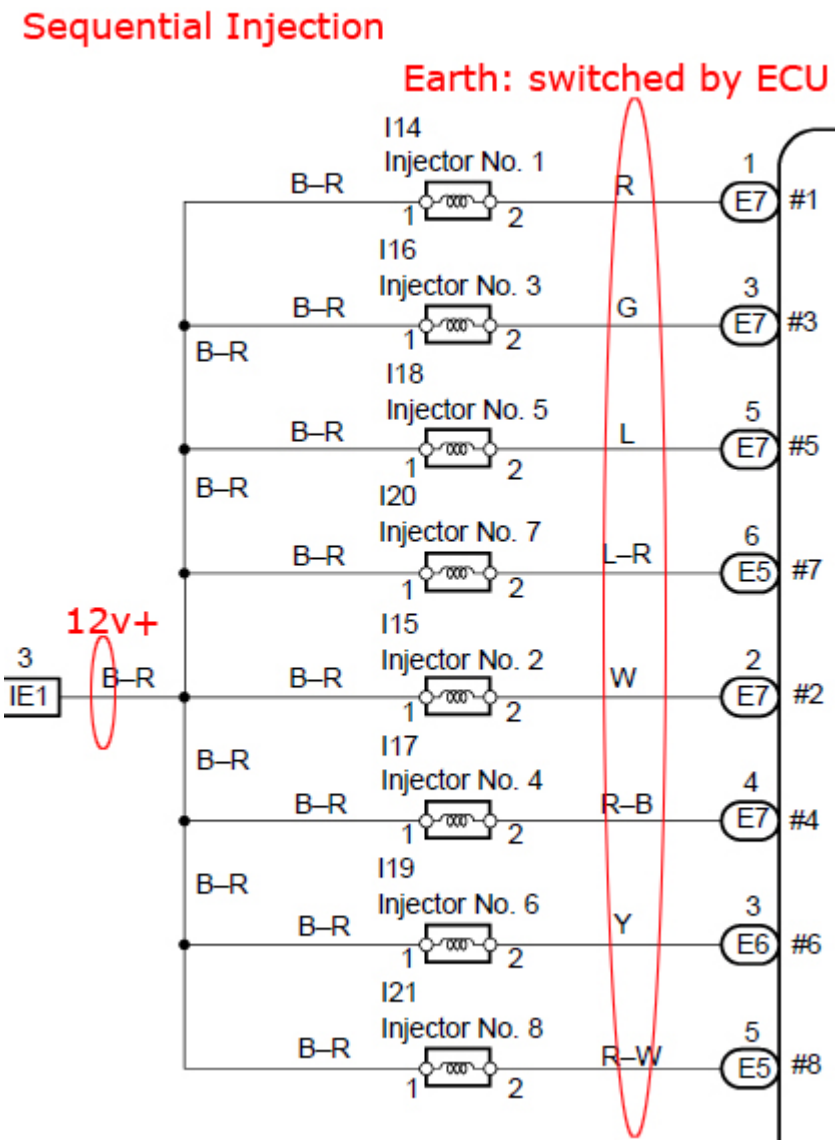
There are various ways to run injectors.
Group fire: where three or more injectors, say four, five, six, are fired at once.



Paired: where only two are fired at once, (heh: hence paired)



Sequential: where each injector is fired separately.



9.14.3 Injector Configurations

People put alot of stock into whether or not an engines injectors are fired in a certain way. And there is some truth too it. The group firing is inefficient. Take the V6 in the Hilux surfs, it's a group fire engine, it uses what we call two 'injector drivers', one to fire one group, the other to fire the other group. This means to put fuel in 3# cylinder it has to put fuel into two others as well. However manufactures take this into account and reduce the amount of fuel being injected for what is pooling up in the air/fuel mix behind the valve waiting for the next 'open event'.

That said: the best foot I can put forward for grouped injection still translates to high fuel usage in the real world. The 3VZ-FE is still less efficient than the 1UZ-FE, I doubt it's just the injection.

Consider the early Holden 304 engine, it has two injector drivers, it group fires 4 injectors to put fuel into one cylinder, I've always mocked them for wasting 75% of the fuel they use by design, it's not a fair statement, but it is shockingly bad design. I mock the ms1 and ms2 ecu's for the same reason.

In the 1uzfe set up there is a pulsation dampener between the fuel pump, and the fuel rail. It looks like a regulator with no hose off it. If you put the fuel hoses on the wrong way around, it will not start.

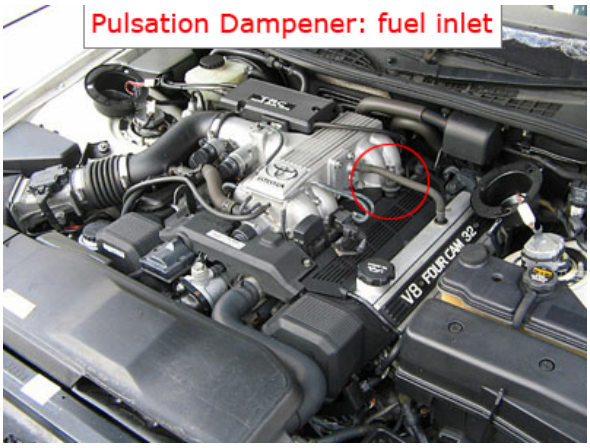
9.15 How to test the injectors

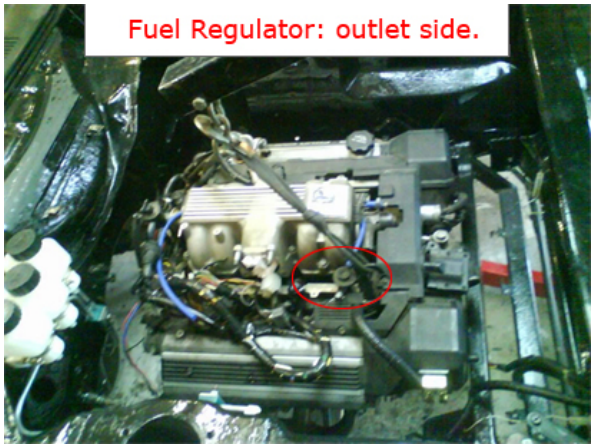
1uzfe injectors are prone to seizing. This is caused by fuel deposits breaking down while the engine is idle and locking the 'gate' up. The method of dealing with this is to either leave the injector sitting in petrol for a few hours or then tap with a few times while running 12v across its two poles in an on/off manner. OR, leave them alone in place and tap the offending injector while the motor is running with a screw driver in a 'sharp' but **NOT** violent manner.

If you think the engine is not starting because of fuel spray aerostat or CRC cold crank while cranking the engine down throttle body into the intake. Beware this can cause burns to your arm hairs if you get a backfire. So take care now if the engine starts and half runs then the spark side of it is ok. Keep the basics in your mind. Motors need: air, fuel, spark and compression to run: bear that in mind and you'll be able to solve the simple problems which come up and have complex causes.

It's an injected engine, but that doesn't mean that it won't suffer from a simple problem. It won't run with no fuel, or spark, or a rag in the intake. Sure, it can suffer from very complex problems too, but it's VERY important to keep the simple stuff in mind too.

9.16 The Fuel Regulator & Pulsation Dampener

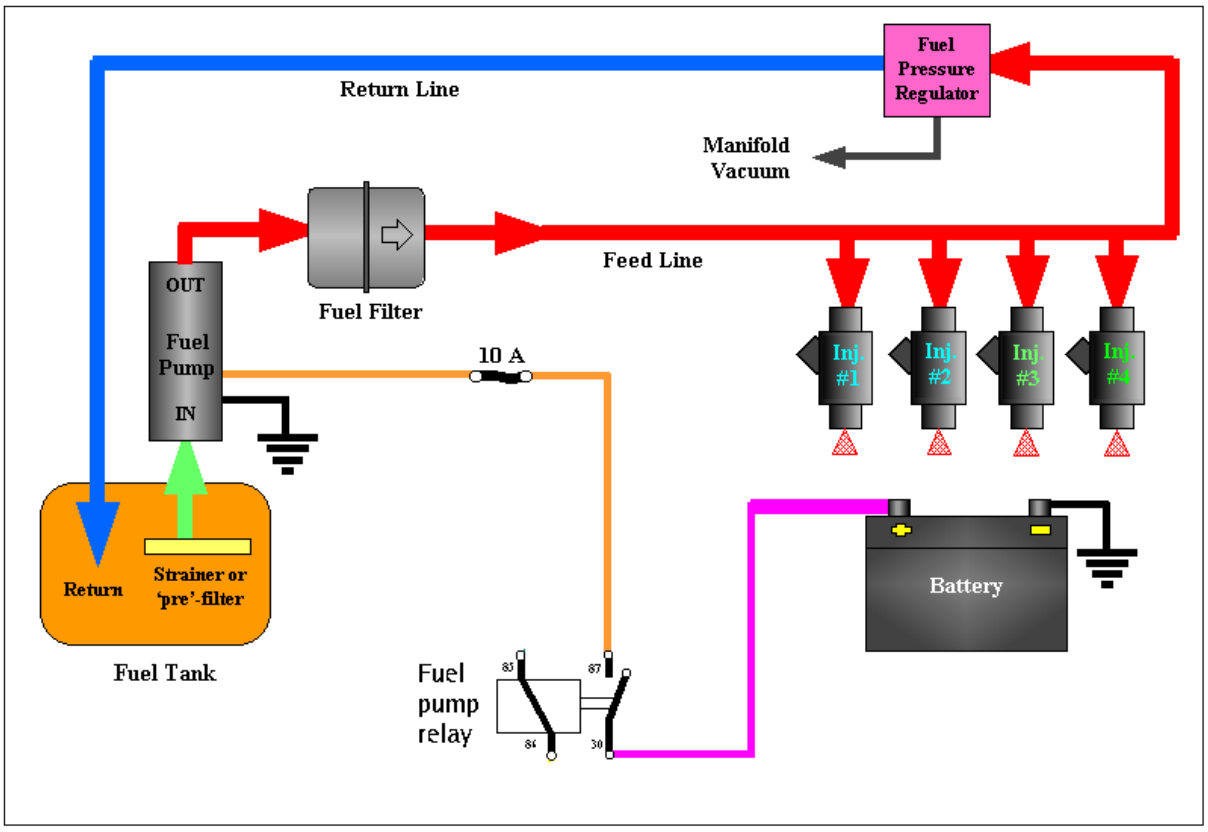




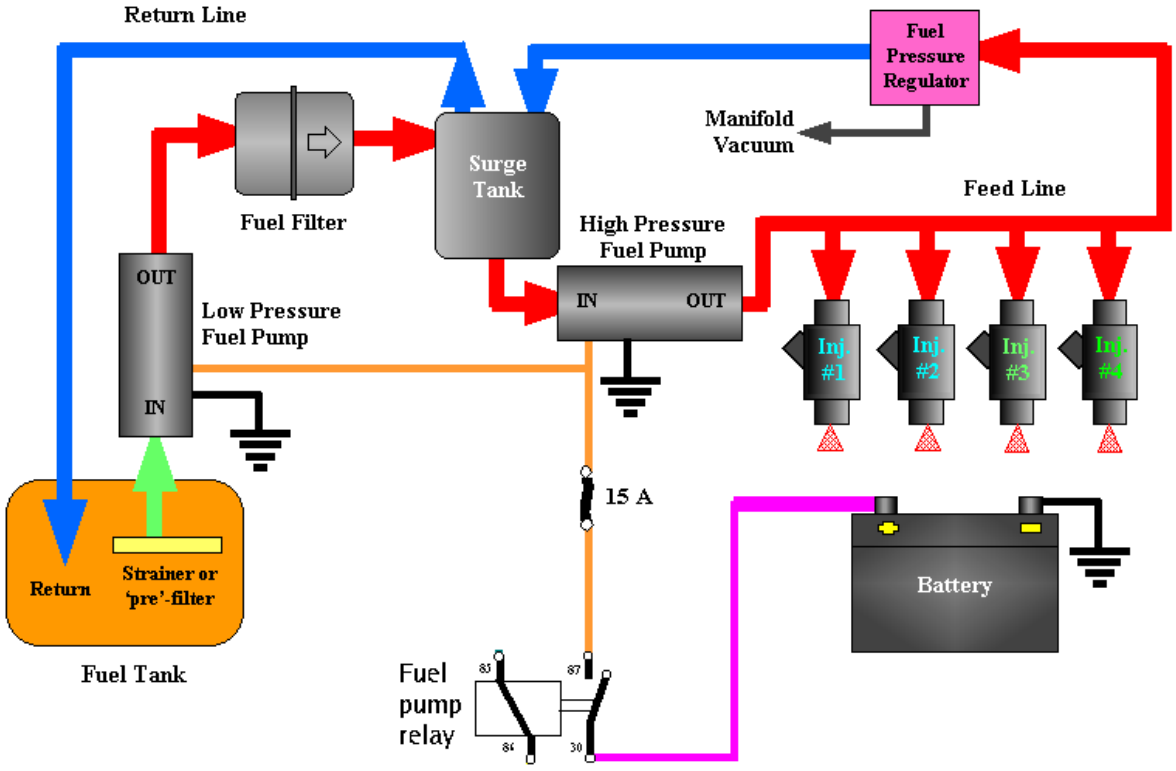
Pulsation Dampener. (it evens out the fuel pulses from the pump, it does NOT impede fuel delivery, or power output (to a point), once your making 300kw's+ you might as well ditch this thing.

How you set your fuel system up is pretty much up to you. Bear in mind that two pumps get pretty noisy in a hatchback. Not to bad in a coupe with a back seat and some sort of barrier to the noise. Under the car is good place for them, but they are open to the elements there. Be realistic, if it's a stock engine, all you need is a decent EFI pump and you do not need a rising rate reg, and a surge tank, it all costs money, it's more things to fail and go wrong, keep it simple: the stock system works well, try it for a while then make changes.

Below we have an image from the megasquirt site which shows the basic fuel system. This image shows how the EFI fuel system is set up. It's simplistic, but it is very important to understand this.



This is the model for a surge tank set up, note the use of a low pressure fuel pump on the surge tank.

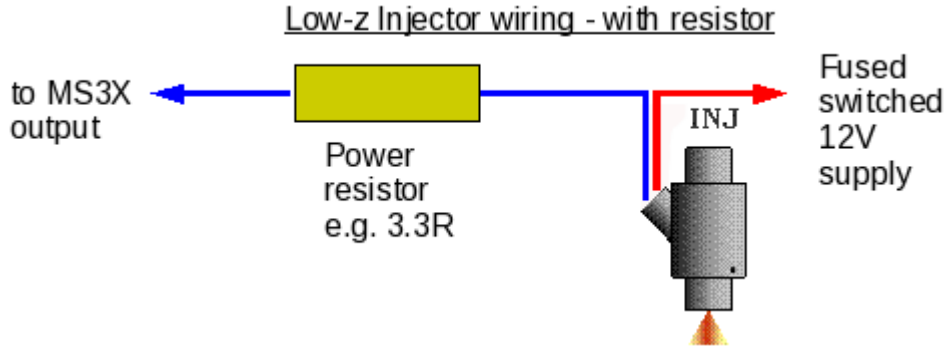


If you use a high pressure 'lift pump' then the fuel will hit the surge tank, find it to be full from the high volume lift pump, and back pressure will form behind the main pump, this pressure will then flow back into the fuel tank via the surge tank's relief line.

Pumps (high volume ones like Bosch 44's) move alot of fuel, so heat will start to soak into the fuel from the pressure and then into the tank. Once the tank starts heating up the heat just keeps getting higher and higher. Expanded fuel is less dense. Hot fuel is dangerous.

I made this mistake myself, the heat in the fuel lines and surge tank was clearly obvious; the hot fuel tank scared the shit out of me, I shut the system down immediately and disconnected the power. It was a big mistake to make, and it's not something a fuel cooler will solve either.

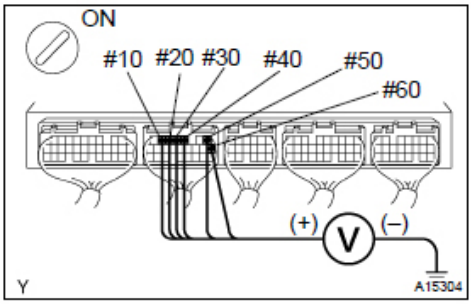
There is where the injector resistor goes, if your replacing the 1uz-fe injectors with bigger ones (assuming), that are low impedance; you have no need for resistors if you set up is stock factory.



If your injectors are playing up, or the engine doesn't seem to firing on all cylinders there are solutions. It's very common for fuel deposits to cause the injector gate to lock up. Sometimes all it takes it to keep rev'ing the motor. Other times you have to tap the injectors while rev'ing the motor. If the injector(s) are really locked up you need to remove them, take the rubber seat off the bottom, and soak them in fuel for a day, then try tapping while switching them on/off (two person job).

If your really sure an injector is playing up, here's a tip from the Toyota manual for someone with some serious electrical gear floating around.

8	Check voltage of ECM terminal for injector of failed cylinder.



PREPARATION:

(a) Remove the glove compartment (See page SF–49).

(b) Turn the ignition switch ON.

CHECK:

Measure the voltage between applicable terminal of the ECM connector and body ground.

OK:

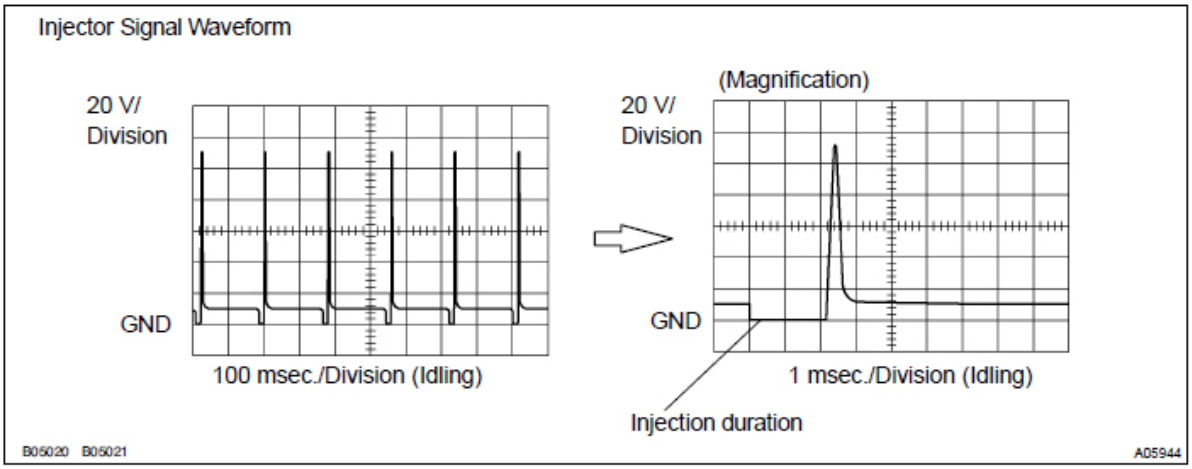
Voltage: 9 – 14 V

Reference: INSPECTION USING OSCILLOSCOPE

With the engine idling, check the waveform between terminals #10 – #60 and E01 of the ECM connectors.

HINT:

The correct waveform is as shown.

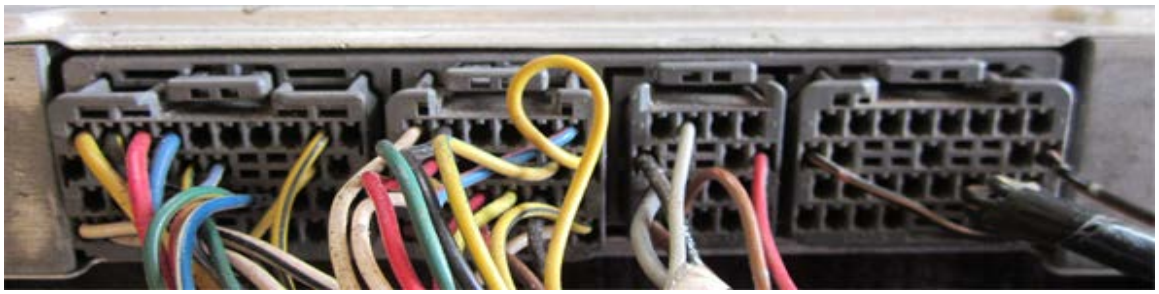


9.17 Wiring up the ECU to turn on.

The Ecu turns on with very few wires. It's all very well completing the wiring necessary to turn it on, but that it no help if you cannot confirm it's on. It does not make an 'I'm on noise'. The correct wires, and pins will vary ecu to ecu. Sorry, your back to the 'get the right diagram issue'. But I work it out something like this: first I guess. I look at the plugs and try to figure it out and take a mental note of the wires I recognise. This is likely not help you much. I'm looking for

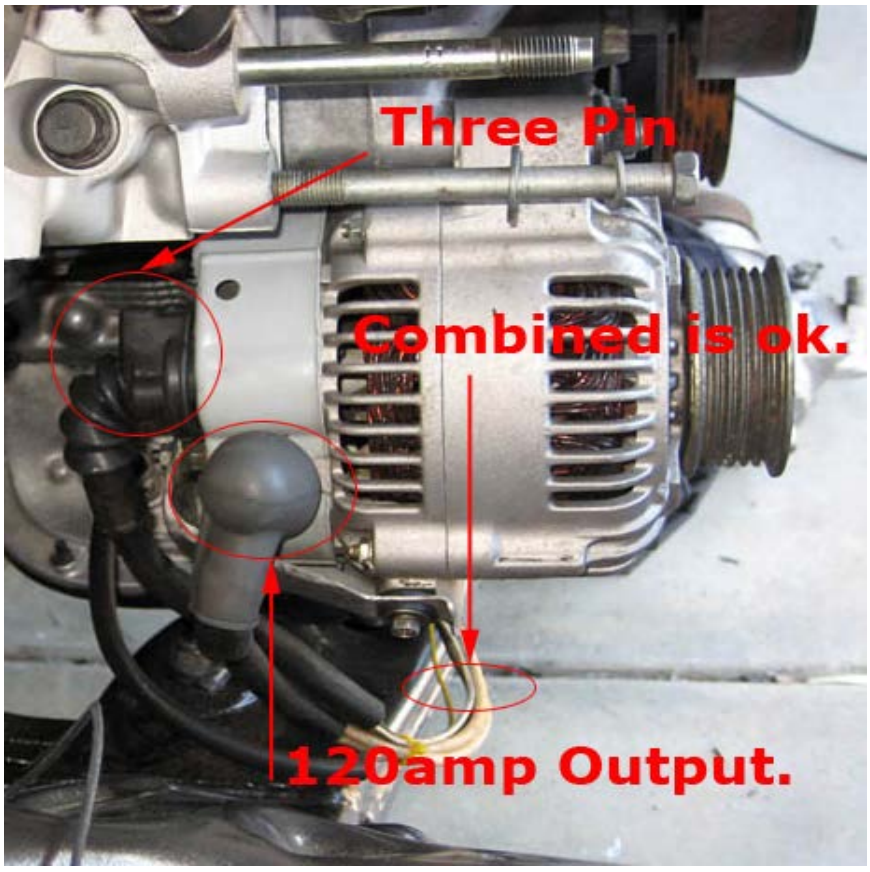
- +12V wired to pin (BATT)
- (+B) and (+B1) both get 12volts when the Main EFI Relay is switched.
- (E11) is grounded.
- (E2) is grounded.
- (E02) is grounded.
- (E01) is grounded.
- (IGSW) gets a switched power 12volts from the ignition switch.

From there I connect the W to a light, and the other ‘pin’ on the light as switched power. However you can also test if it’s on via the MREL output from the ecu (12+). To be honest there isn’t much I can do to help you here beyond saying find the wires and connect them. This is the final wiring set up on a 1992 ecu, note the fourth plug (far right) which has only five wires connected and the rest De-pinned.



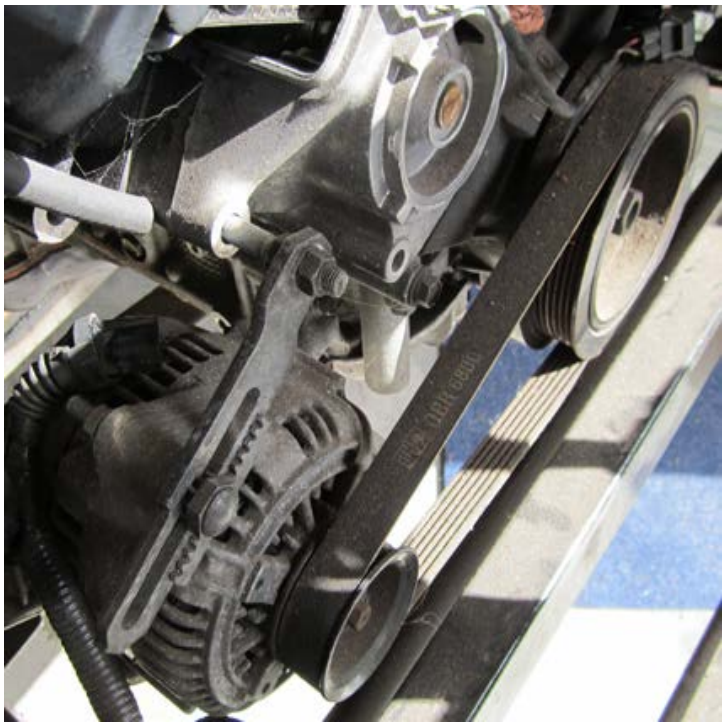
9.18 Wiring up the Alternator.

It might seem like a mystery but they are pretty simple devices. They get constant power, switched power, and have an earth connection for the charge light, which goes off when it’s charging, and is on just before you start the engine. They have no magnets in them so require an ‘exciter charge’ to enable charging. The Switched charge is the exciter it needs a 30amp fuse. Here is where the cables are located from factory.



- White (S)
    - o - Constant 12v feed (might be striped but it's always white as far as I know)
- Yellow Black (IG)
    - o - (this might be another colour, I've seen it red, solid black, yellow black, yellow (solid) blue (stripped) black, blue, use common sense) this is a switched wire that turns the alternator on so thats live when the key is at IGN (or stage two/ign on the key)
- Yellow (L)
    - o - (this one is always yellow as far as I know) when the alternator is on, it will earth out so run a ohms test against the shell to find it if you get confused) Dash Light, one side of the light goes to alt (earth side) and the other side should be live/switched when the key is at IGN (or stage two on the key)

This is another method of mounting the alternator if your not running other belts.



If you get stuck you can work out the wires using this method. Get to fuse holders, put 3 amp fuses in them. Work out the light wire if you can, by elimination applying work to the other two through the fuses expecting to blow a few. You'll figure it out pretty fast from there.

The Alternator has three wires. One has constant power. One as Switched power. One is a earth connection for the alternator charge light so you connect that wire to a 12v light (not an led unless you have a resistor on the power side otherwise it overloads it, and it starts smoking and then flames out, I know .. I did that yesterday with a 12v led) and to the other side of the light you put power. When the ignition is switched to IGN (stage two), you get a charge / battery light come on. When the alternator is working the charge light goes out, if not you screwed up wiring it up, so you've got the wrong wire with a light on it, and the alternator might be working anyway or its not working and you screwed up (if the light is still on when running).

If the alternator is running and working, you should see at least 13volts (13.25 – 13.8 perhaps) at the battery depending on the load from the stuff in the car that's running at the time. It's a 120amp alternator put a decent cable off it. Fuse that cable with a total of 120 - 140amp fuse(s) if you must/want too.

Then I'd disconnect the battery to reset the ECU, and make sure that the acc belt is sufficiently tight. Measure the voltage on the battery with the engine off. Start the vehicle and let the 1UZ ecu set the ICV with the extra alternator load (learning ecu: needs to learn about the load of a alternator that's now offering resistance equal to 1-2hp or more). Check the battery voltage to make sure it is 'actually' charging. If this is a customers car repeat this check again before calling the job as 'done/finished/come get your car now'.

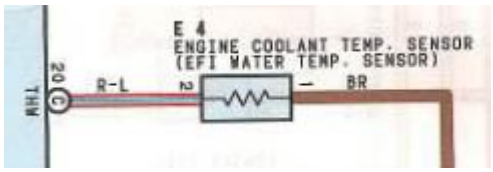
When you locate the wires, mark them properly something like this.

Usually the Alternator plug is FUBAR. It's often brittle, very brittle. Usually broken in someway, or easy to break. If you can leave it on and leave it alone ... do that. Extend the wires as soon as you have a chance and bundle them up in a coil for later use (marked using masking tape at the end of the wires which you will later be connecting. Match the cable types, what I mean is dont put a tiny little gauge extension cable on

these wires, they carry real current, think 5-10amp capable wire not 1-2amp capable wire and it wont fail on you later on down the track. I've felt these wires as warm after 1hr running in the shop once, you want to match the cable types here. Thats not always the case, it is here.

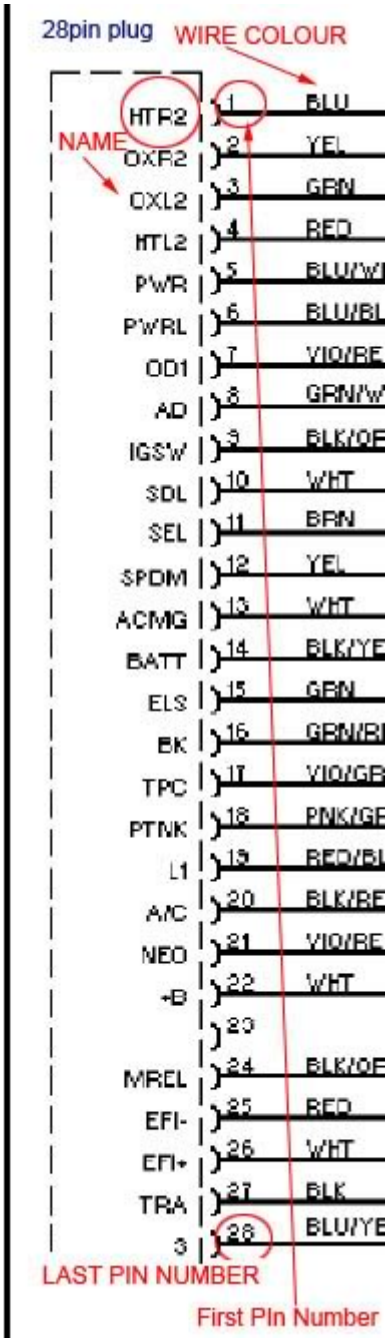
9.19 - Water Temp, Tacho and Pin Order in Plugs

Find the water sensor's in all these crazy lines. There are two water sensor, one for the dash, one for the ecu which has two wires and it looks like this in the factory Toyota diagram. This is a very important sensor which the ecu uses to set idle speed and running warm fuel levels. It is however not a critical sensor.



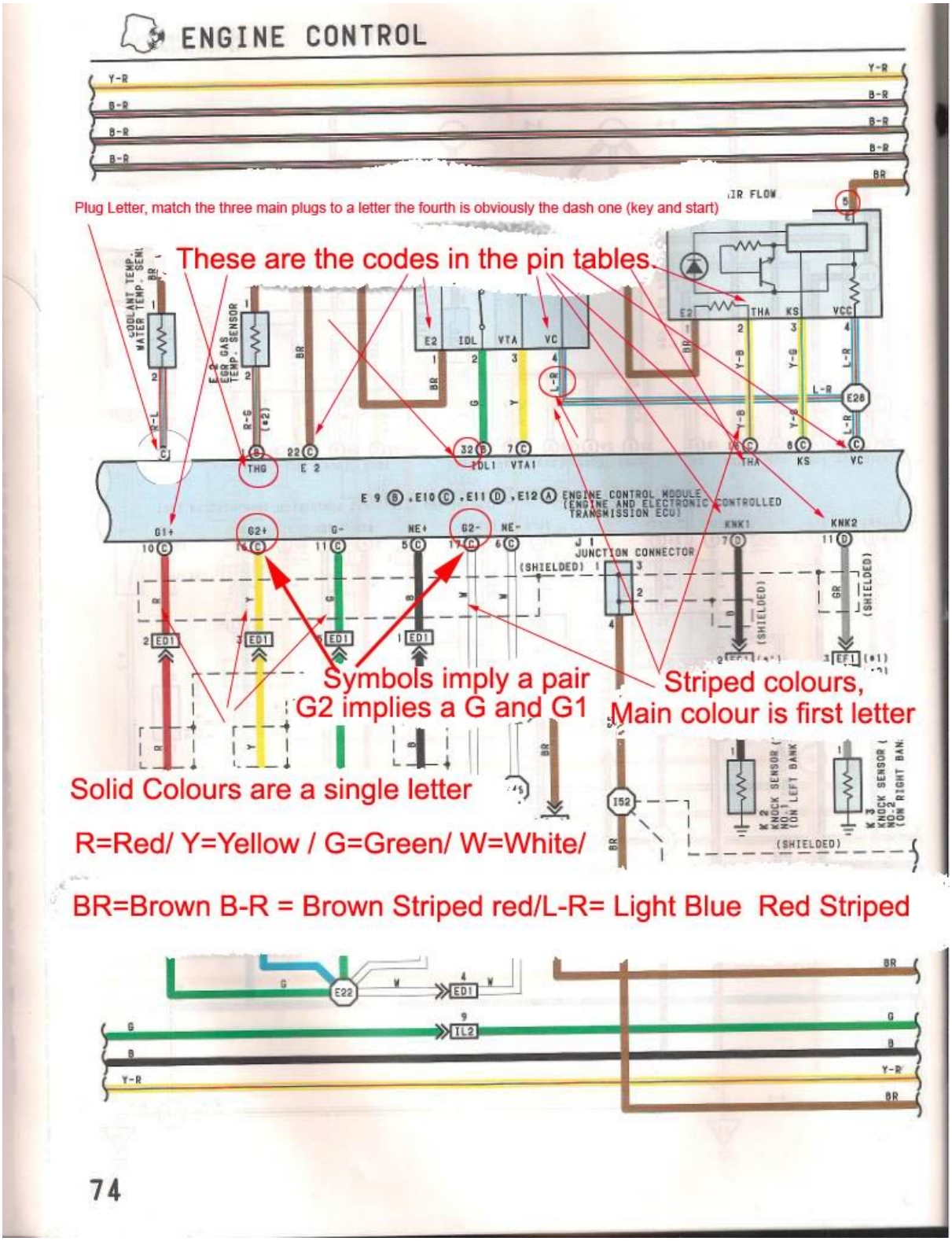
10 Different Kinds of diagrams

For the sake of explaining how to wire up these engines I have picked on a particular diagram and used that to explain how to wire up most things. This particular engine diagram has comes from lextreme. I have also used exerts from Toyota diagrams. I wish to point out the information here tells you what to do, and how to do it. It is not a 'process' document, it's an explanation document. Below explains how you read the lex diagrams, someone made these, they aren't Toyota diagrams.



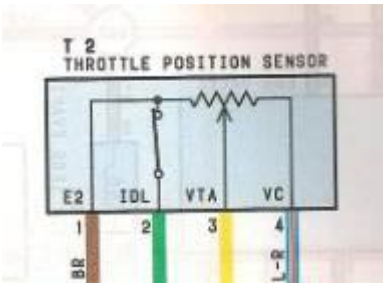
10.1 Toyota Diagrams

Toyota diagrams look alot like this, most of the time. Sensors they are mostly just variable resistors. Not many of the wires are much more than a negative or positive connection, a fair few carry sensor signals which are just variable voltage very few of those sensors are digital (i.e send a pulsed signal).This is a pretty old motor.

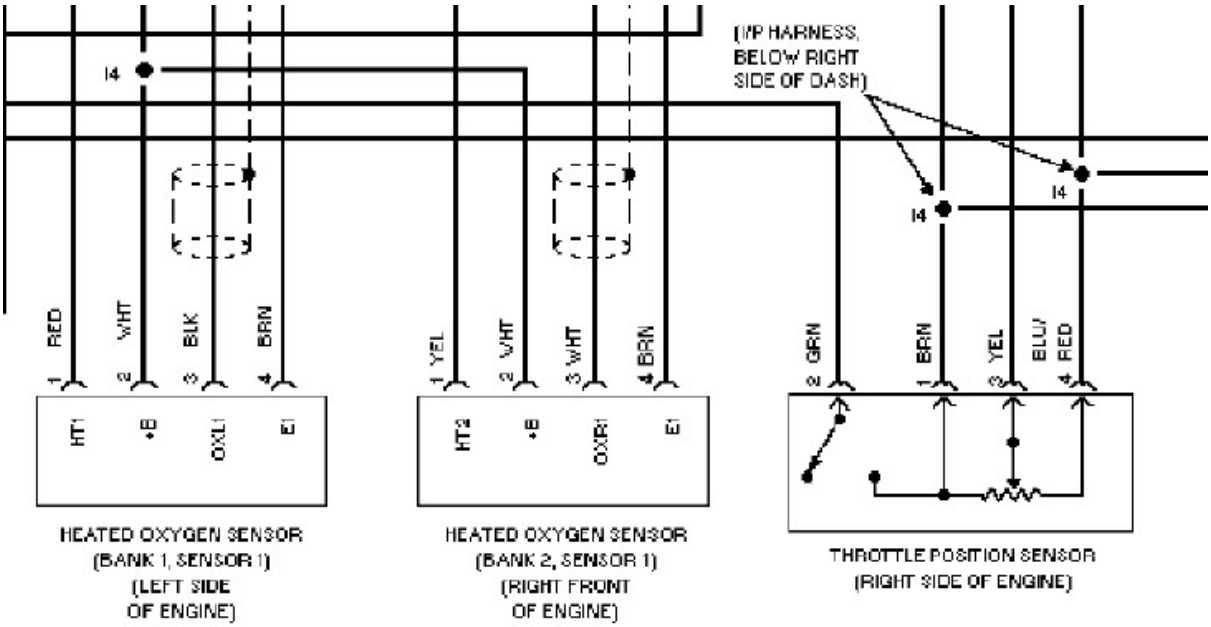


10.2 The difference:

The sensors might be visually different in the diagrams but that doesn't seem to effect one's ability to work with diagram. Although I find my eyes don't like the lextreme ones as much, harder to make out the details.



... in the 96ls diagram that looks like this;

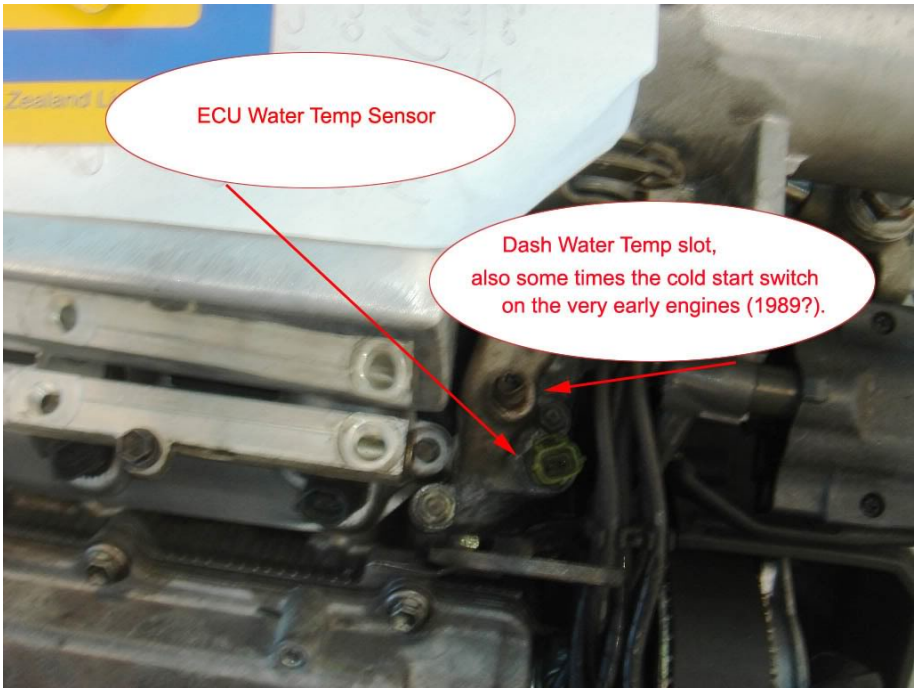


In case you were interested, the TPS sends a signal which is voltage from 5+ downwards (movement being increased resistance) it's basically a freaking stereo volume knob, it's just four wires, earth, then three others that go back to ECU pin's two are spliced in the lex extreme diagram.

10.3 - Water Temp

Water Temp, as above there are two, one for the dash gauge and another for the ECU, they are 400ohms each I tested one of them once, right after start it dropped to

396ohms, then just started failing down until it steadied out around midway. Pretty device simple really.

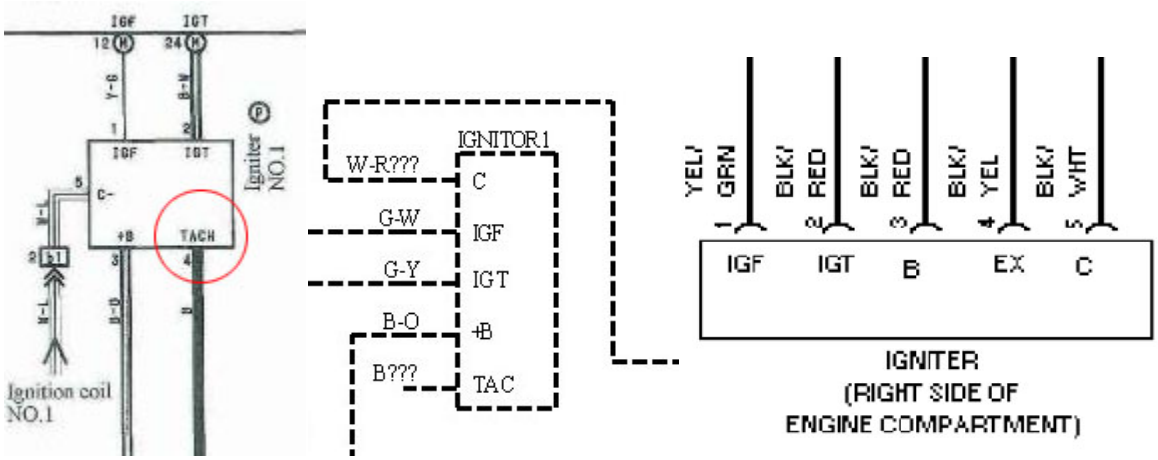


Above is a 1995 engine, however below is a very early 90' engine with the cold start injector single pole switch. There are three water temp sensors on this engine. Two are used only for the engine, the third for the dash. The single pole (black) plug one, is just an 'on/off' switch. It is calibrated to turn off at a certain temp (after warm up, when the engine no longer needs the 1000cc start up injector).

11 Tacho and Igniters

11.1 Tacho

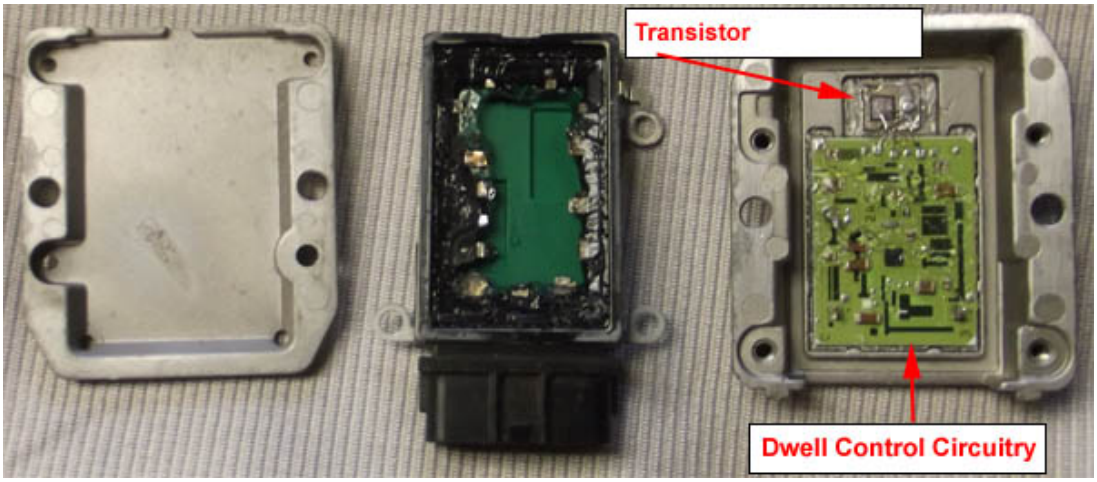
The ‘black but not always solid black’ wire is the tacho signal (*sigh-yeah-I-Know*)’ its located on one igniter plug and usually runs off into the dash plug. It’s output signal, is in a four (4) cylinder format so any digital four cylinder tacho will work off that. on that plug with five wires and it is always solid black and noticeably thinner than the others.



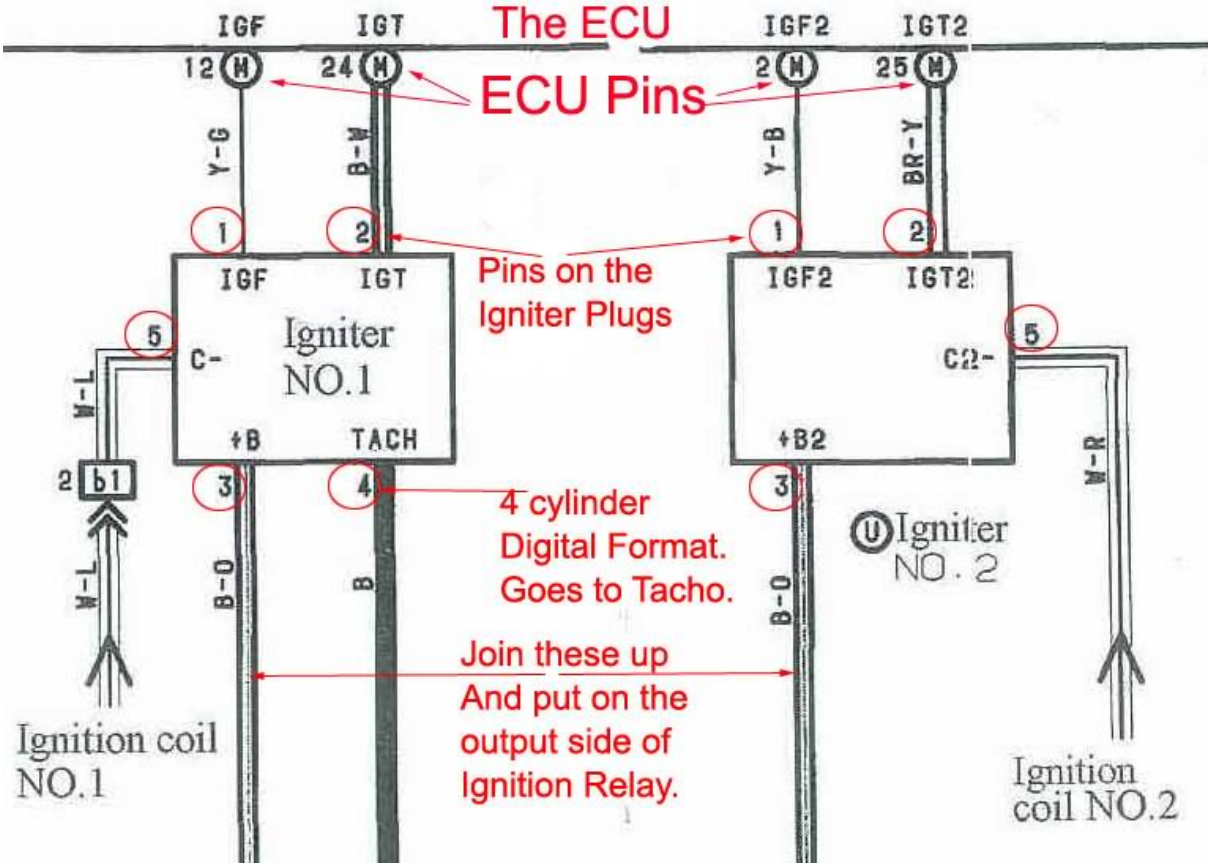
Above are excerpts from three diagrams, each shows the igniter who’s plug carrys the tach signal. You can just swap the igniters around on the plugs, in effect there are two tach signals one from each igniter. This is a good example of why the Lextreme diagrams are kinda crap. See the lack of pin numbers in them.

11.2 Igniters

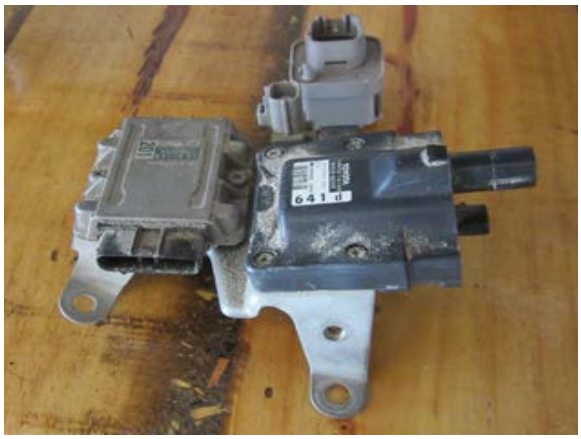
The igniters are what are called ‘smart’ igniters. They have dwell control built into them. Which is both a good and bad thing. The actual igniter itself determines all the coil function and relays back a rpm or tach signal. Which means that using them you cannot alter the dwell using these igniters. Below is an image of what the inside of the igniter looks like.



The above image shows an igniter plug, (the five wire tach/rpm signal one), note the odd number of the pins.



This all seems pretty simple to wire up, it is. The plugs are interchangeable on the igniters, so no1 igniter plug can go on number two and vice/versa. Key Point: you must earth the case of both igniters'. Below is the factory 20v Silver top (cira 1991) igniter and coil mounting which includes the starter relay.



On the factory engine, and on the 4age engine where this bracket earths the igniter, use it (why not?): reshape it, it works well.

The advent of ECU spark management systems provides more precise control of ignition spark timing. The centrifugal and vacuum advances are eliminated; in their place are the engine sensors which monitor engine load (Vs or PIM) and speed (Ne). Additionally, coolant temperature, detonation, and throttle position are monitored to provide better spark accuracy as these conditions change.

The G sensor supplies the ECU with crankshaft position information which comes from the camshafts (camshaft position sensors) is used as a reference for ignition and fuel injector timing. Some engines use two G sensors, identified as G1 and G2.

In example, when the engine is cranked, an alternating current signal is generated by a 24-tooth Ne (crank sensor) pickup and a four-tooth G pickup (Camshaft Sensors). These signals are sent to the ECU where they are conditioned and relayed to the microprocessor.

The microprocessor drives a trigger circuit, referred to as IGt (TR1). The IGt signal is sent to the igniter to switch the primary circuit power transistor on and off. While cranking, IGt fixes spark timing at a predetermined value. When the engine is running, timing is calculated based on signals from engine speed, load, temperature, throttle position, and detonation sensors.

The IGt signal is advanced or retarded depending on the final calculated timing. ESA calculated timing is considered the ideal ignition time for a given set of engine conditions. If the ECU fails to see an Ne or G signal while it is cranking, it will not produce an IGt signal, thus preventing igniter operation. Thus as above, dwell remains in the control of the smart igniters, and the ecu controls the timing.

11.3 Igniter Operation

When the IGt signal goes high, the primary circuit power transistor TR2 turns on, allowing cur-rent to flow in the coil primary winding. When the IGt signal goes low, the igniter interrupts primary circuit current flow, causing voltage induction into the coil secondary winding.

With the ESA system, the time at which the power transistor in the igniter turns on is further influenced by a dwell control circuit inside the igniter. As engine rpm increases, coil dwell time is increased by turning the transistor on sooner. Therefore, the time at which the transistor is turned on determines dwell while the time the transistor is turned off determines timing. Timing is controlled by the ECU; dwell is controlled by the igniter.

Controlling dwell within the igniter allows the same control over coil saturation time as the ballast resistance does with the Conventional EFI ignition system. It allows maximum coil saturation at high engine speeds while limiting coil and igniter current, reducing heat, at lower speeds.

11.4 Spark Confirmation IGf

Once a spark event takes place, an ignition confirmation signal called IGf is generated by the igniter and sent to the ECU. The IGf signal tells the ECU that a spark event has actually occurred. In the event of an ignition fault, after approximately eight to eleven IGt signals are sent to the igniter without receiving an IGf confirmation, the ECU will enter a fail-safe mode, shutting down the injectors to prevent potential catalyst overheating.

The IGt signal is relayed by the igniter to the proper power transistor circuit to trigger the ignition event at the proper coil. The igniter also sends the standard IGf confirmation signal to the ECU for each ignition event which takes place.

12 Wiring the Surf Automatic to run with the 1uzfe

G series Automatic (Hilux) gearboxs

In order to Get a Surf Automatic to work with a 1u engine you need to keep the Surf Engine Ecu, so it can control the automatic gearbox which you've decided to keep for some reason. In order for that to work this means you run two ecu's, because the Surf Automatic (in a 1993) runs from the tandem'd up 1uz engine ecu. You will need to splice some wires but only a few. Basically you trick the Surf ECU to think it's still got an engine. Sure, it throws massive amounts of codes to the surf dash: when its all wired up you put the 1uz check light up to the dash check light so as long as the surf ecu functions its all ok.

.. on the surf ECU you need. (there is some confusion about these pins: you might be able to do this with less pins: look around on the web for more information)
Splice VCC, VC, VTA, VS, IDL, from the 1uz engine to the same on the Surf ECU
Splice THC (water temp) from the 1uz ECU sensor engine to the THC on the Surf ECU
Splice THA (air temp) from the 1uz ECU sensor engine to the THC on the Surf ECU
Splice STA from the 1uz engine loom to the STA on the Surf ECU
Splice ... TPS from the 1uz engine to the TPS on the Surf ECU

13!-Rev Limter (early ecus)

OK. Re: Code 56.

On the early engines with the 26p 16p 22p 26p. On the E11 ECU plug (upside down plug), the blue wire in Pin 14 (not showing on any wiring diagrams I have) needs grounding. This gets rid of the 2500 RPM cut out and clears Code 56.

I can't be sure it's always blue, but on mine it is. A few wires on my ECU have been re-pinned with random coloured wires only on that plug though so could be different

14 - Diagnostic Codes OBD1

NOTE: Not all trouble codes will activate MIL (CHECK ENGINE light)

- Before proceeding, make sure the:
  - CHECK ENGINE light circuit is functional. It should be ON when the ignition switch is ON with the engine stopped.
  - Battery voltage is above 11 volts.
  - Throttle valve is fully closed (Throttle Position Sensor IDL points closed).
  - Accessory switches (A/C, etc.) are OFF.
  - Engine is at normal operating temperature (if possible).

- Turn ignition switch to ON position.
  - Do not start the engine.
  - Place a jumper wire across TE1 and El terminals in engine check connector. (Or connect the TE1 pin via a wire to ground, best if thats the engine itself, even if it's only through a wire.
- Count number of flashes from CHECK ENGINE light.
  - If system is operating normally (with no detected faults), the CHECK ENGINE light will blink continuously and evenly about 2 times a second.
- Otherwise, the light will blink a number of times equal to the trouble code as follows:
  - The light blinks only (.5 second ON, .5 second OFF) when indicating a number.
  - The light will be OFF for 1.5 seconds between the first digit and the second digit of the code.
  - If more than one code is stored, the light will be OFF for 2.5 seconds before the next code is displayed.
  - Once all code(s) have been displayed, the light will be OFF for 4.5 seconds and then the whole sequence will repeat.
- The diagnostic code series will continue to repeat as long as the check connecter terminals TEl and El are connected.
- When finished, remove the jumper wire (or wire connection to TE1)
- After repairing the malfunction, clear the codes from the ECUs memory.

Clearing Trouble Codes

All trouble codes must be purged from the ECUs memory after repairing the faults. Otherwise, code(s) would remain in the ECUs memory indefinitely and would appear along with a new code in the event of a future problem.

- Remove the EFI fuse (15A) for 30 seconds with the ignition switch OFF to clear any codes. It may take longer than 30 seconds, depending on ambient temperature (the lower the temperature, the longer the fuse must be left out).
- Trouble codes can also be cleared by disconnecting the vehicle battery. However, other memory functions (clock, radio, etc.), will need to be reset.
- After the codes are cleared, road test the vehicle (as applicable for the fault) and recheck if any codes reset. If so, it indicates that the trouble area has not been resolved.

Note: anything that starts with a single digit is pretty much serious bar a few of them.

OBD1 Codes

The serious codes.

1 Normal Condition

(this single blink, which is not something you would normally see on a converted engine)

2 Air Flow Meter signal. (will not stop it running, ECU will default to base map)

3 Ignition signal.

4 Engine Coolant Temperature Sensor signal. (may rob power as engine will use base map)

5 Oxygen Sensor. (may rob power as engine will use base map)

6 RPM signal (Crank Angle Pulse). (critical: engine should not run)

7 Throttle Position Sensor signal. (critical: engine should not run)

8 Intake Air Temperature Sensor signal. (will not stop it running, may rob power as engine will use base map)

9 Vehicle Speed Sensor signal.

10 Starter signal.

11 Switch signal.

11 ECU/ECM.

12 Knock Control Sensor signal. (no effect to running, good to resolve)

12 RPM signal. (critical: engine should not run)

13 Knock Control CPU (ECM). (no effect to running, good to resolve)

13 RPM signal. (critical: engine should not run: 1uz-fe uses this signal to apply ignition and fuel tables, without it, the ecu has no idea where to begin.)

14 Turbocharger Pressure. (ignore for 1uz-fe)

14 Ignition signal.

The not so serious codes

21 Left Oxygen Sensor. (resolve it, but it will run without it in base map.)

22 Engine Coolant Temperature Sensor signal. (will not stop it running, will rob power, note: this is ECU temp sensor, not the dash one, there are two, this is the two wire one more central at the front.)

23 Intake Air Temperature Sensor signal. (will not stop it running, may rob power as engine will use base map)

24 Intake Air Temperature Sensor signal. (will not stop it running, may rob power as engine will use base map)

25 Air-Fuel Ratio Lean. (resolve this)

26 Air-Fuel Ratio Rich. (resolve this)

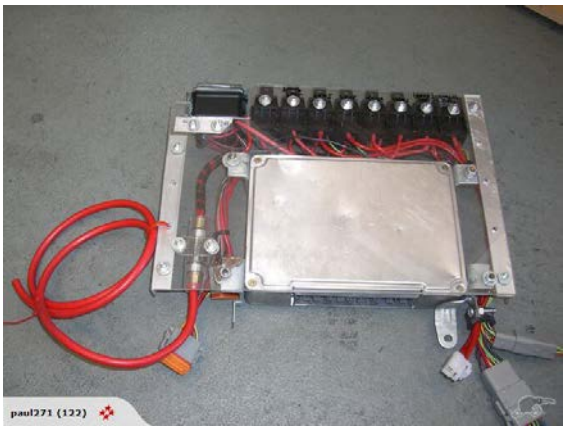
27 Right Oxygen Sensor signal.

28 Left Secondary (Sub) Oxygen Sensor signal.
(good to resolve: it's thought this might engage base map, see four o2 section for how to trick the ecu into thinking it has four when it only has two, and thus clearing this code.)
29 Right Secondary (Sub) Oxygen Sensor signal.
(good to resolve: it's thought this might engage base map, see four o2 section for how to trick the ecu into thinking it has four when it only has two, and thus clearing this code.)
31 Air Flow Meter signal (Vacuum Sensor signal). (will not stop it running, may rob power as engine will use base map)
32 Air Flow Meter signal. (will not stop it running, may rob power as engine will use base map)
34 Turbocharger Pressure signal. (ignore for 1uz-fe)
35 Turbocharger Pressure Sensor signal. (ignore for 1uz-fe)
35 HAC Sensor signal.
41 Throttle Position Sensor signal. (critical: resolve)
42 Vehicle Speed Sensor signal. (no effect to running)
47 If you have deleted the traction control and sub throttle sensor you may get code 47, What you need to do to clear the code is to earth IDL2 and bridge VC to VTA2. This should fix the code. WARNING: Other effects from this method are unknown.
43 Starter signal.
51 Switch signal.
52 Knock Sensor signal.
53 Knock Sensor signal.
54 Inter-cooler ECM signal.
56 Hydrostatic Fan not connected.
59 Automatic Transmission Temp voltage (high out or of range) ?
71 EGR System.
72 Fuel Cut Solenoid signal.
78 Fuel Pump Control signal.
81 TCM Communication. (will show up when no automatic trans is in place on crown majesta stand alone and other pre 95' ecus)
83 TCM Communication. (will show up when no automatic trans is in place on crown majesta stand alone and other pre 95' ecus)
84 TCM Communication. (will show up when no automatic trans is in place on crown majesta stand alone and other pre 95' ecus)
85 TCM Communication. (will show up when no automatic trans is in place on crown majesta stand alone and other pre 95' ecus)

15 Connection Board for older cars / race cars

Below, pictures of a basic ECU board, made for a customer, to house the ECU and fuses, relays required to run all the electrics in a race car, Uses high quality electrical parts that cost about $500 on their own, could be created for less for a road car using off the shelf parts from nation wide electrical supply chains. The ecu is meant to be on the below side, with the top side in below photo. The relays outward as are the fuses. could be done differently

The concept of putting the ecu and relays and fuses related to the engine (and not the entire system as is the case here) stands useful. In high vibration environments soldier will break. If your running 1500hp, in a drag car, or more, then boards like this are a NO GO, you need to crimp and screw in each connection, same goes for trails trucks running 44's and being driving on the tar-sealed roads from time to time.



The parts come from Hella.co.nz,

The DT plugs are the most expensive part. At $36 each. The board is just Perspex, 3mm, cut using a 1mmx110mm steel cutting disk, on grinder, with a steady hand and carefully measured. The alloy angle is 2mm. The alloy angles make it easy to mount the thing gives it strength too. There are holes every so often cable tie the loom.

The bolts used are too long to double up of nuts on the bottom side, with enough 'P clamp loom' if needed. The 'P clamps' hold the board loom in place and make for a tidy install. I had to re-make one or two ecu mounts or re-bend them to get ECU even.

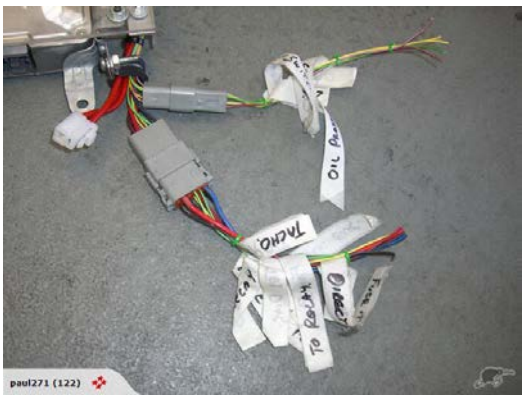
I used heat shrink wrap, for sealing the joins and a 25-40watt solder iron?, 1mm solder (tin kind). cable ties, different colours is helpful. The huge red cable is the power for the board, plugs in well to cable blocks, from jay car $15, fuse ($12?) 100amp is enough.

The board has a 'common earth rail' for all relays, to allow the coil in them to trip when power is applied to each one's switching side. There is also a separate Earth rail for ECU's two earth connection (E1 and E2) to prevent interference; for good measure. There is a tag, which holds the ecu's loom as it comes in from the engine, there to take strain off the plugs and wiring when in place.

Allow an inch between ECU and relays, cables get larger than expected once all in place. The fuse box is from Hella about $136+gst, and you can get cheaper ones from supercheap that are good, I doubt you need a 12x fuse box, may only need 8 row one from s/cheap. ($21??). I had to remove the inner plate in the hella fusebox and solider a wire to the pole on each side of each fuse, not sure why they only had two circuits in it.

However it only had two electrical channels in (I make also of use of relays) not enough for the electrical system. I used a 80amp replay for the starter (factory spec), you don't need that, 40amps is fine, but the extra is good. You don't really need so many relays, chances are, you probably only need 6 relays.

1. Fuel pump,
2. Fuel injectors, (have constant power on IGN key position, earth is at the ecu for injection trigger, duty cycle is an ecu function),
3. Ignition/spark (goes to the igniter's and coil),
4. Fan or not,
5. Engine main ACC (power all the little stuff),
6. Starter solenoid 80am/40amp.



Three Plug bundles,

- separate sensor outputs and basic power (style + quality + possible interference),
- one for car side (inputs and outputs, e.g ignition and start), as well as ,

- another for tacho, oil, water, idiot light (oil low), etc etc). As well as .. check engine/diag light,
- goes to engine loom, blends into the engine harness,
- the fourth bundle, which is not shown, is the actual loom which comes from the engine.

16 - Swapping Between Series One and Series Two (non VVTI) engine

The front plugs at right next to the Diagnostic plug are configured differently, they will plug in fine. But the engine will not run, or even start.

- The coil wires need to be swapped over.
- So do the wires for the Crank Angle sensor.
- Note: never make a change to your wiring without confirmed the accuracy of my information to your particular situation.

The information came about because someone (Nathan, on oldschool.co.nz) I know did this swap. His car previously had a Series Two 1uz-fe (1997) and he swapped it out for a (working) 1993 engine. The used the same ecu, (a 1997 one), which is fine, there's no issue with that. But when it came time to start the engine, the error code 'RPM signal' came up. Problem was (as I suggested at the time), the plug set near the diagnostic plug is slight different between the version (it was just a guess at the time), with no RPM signal the engine cannot determine its speed, so it can’t apply the ignition and fuel tables.

17 Diagrams & Reference Material

- Technical Articles - Toyota Series - Resource Kit.

Technical Articles - Toyota Series

01 Electrical Fundamentals with questions

02 Electrical Circuits with questions

03 Electrical Components with questions

04 Analog vs Digital Meters with questions

05 Wire, Terminal and Connector Repair with questions

06 Automotive Batteries with questions

07 Toyota Starting Systems with questions

08 Toyota Charging Systems with questions

09 Understanding Toyota Wiring Diagram

10 Electrical Diagnostic Tools

11 Diagnosing Body Electrical Problems

12 Semiconductors with questions

13 Transistors with questions

14 Computers / Logic Gates with questions

15 Overview of Sensors & Actuators

16 Electronic Transmission #1 - Operation

17 Electronic Transmission #2 - Diagnosis with questions

18 Shift Interlock System

Technical Articles - Toyota Series - Engine Performance OBD

20 EFI#1 EFI System Overview

21 EFI#2 Air Induction System

22 EFI#3 Fuel Delivery & Injection Controls

23 EFI#4 Ignition System

24 Engine Controls #1 - Input Sensors

25 Engine Controls #2 - ECU/Outputs

26 Engine Controls #3 - Idle Speed Control 352KB

27 Engine Controls #4 - Diagnosis

Technical Articles Toyota - Series - Engine Performance OBD-II

31 Sensors#1 - Mode Sensors and Switches

32 Sensors#2 - Thermistors with questions

33 Sensors#3 - Position Sensors with questions

34 Sensors#4 - Air Flow Sensors with questions
35 Sensors#5 - Pressure Sensors with questions
36 Sensors#6 - Speed Sensors with questions
37 Sensors#6 - Oxygen / Air Fuel Sensors with questions
38 Sensors#8 - Knock Sensors with questions
39 Ignition#1 - Ignition Overview w/questions
40 Ignition#2 - Electronic Spark Advance w/quest
41 Ignition#3 - Distributor / Distributorless w/qu
42 Fuel System#1 - Overview with questions
43 Fuel System#2 - Injection Duration w/ques
44 Fuel System#3 - Closed Loop /Fuel Trim w/qu
46 OBDII#1 - Overview of On-Board Diagnostics
47 OBDII#2 - Serial Data
48 OBDII#3 - Data Interpretation
55 Emission#1 - Chemistry of Combustion
56 Emission#2 - Emission Analysis
57 Emission#3 - Engine Sub Systems
58 Emission#4 - Closed Loop Feedback Systems
59 Emission#5 - Electronic Spark Advance
60 Emission#6 - Idle Speed Control Systems
61 Emission#7 - Exhaust Gas Recirculation
62 Emission#8 - Evaporative Emission Control
63 Emission#9 - Positive Crankcase Ventilation
64 Emission#10 - Catalytic Converter
65 Emission#11 - Secondary Air

Technical Articles - Toyota Series - Automatic Transmissions

AT01 Fundamentals of Automatic Transmissions
AT02 Torque Converter
AT03 Simpson Planetary Gear Unit.pdf
AT04 Gear Selection and Function
AT05 Power Flow.pdf
AT06 Automatic Transmission Fluid
AT07 Transmission Oil Pump
AT08 valve Body Circuits
AT09 A340H Transfer.pdf
AT10 Electrical Control

AT11 Transmission Check, Adjustments and Diagnosis

AT12 Shift Lock System.pdf

AT13 Appendix

Technical Articles - Automatic Transmissions

AT21 Automatic Transmission Basics

AT22 U-Series Transaxle

AT23 Valve Body Circuits

AT24 Electronic Control System

AT25 Diagnostic Procedures

AT26 Diagnostic Tester

AT27 Remanufactured Transmission

AT28 Appendix.pdf

Technical Articles - Electrical (623 Training Course)

Elec01 Essential Electrical Concepts

Elec02 Electrical Circuits

Elec03 The Battery

Elec04 The starting System.pdf

Elec05 The Charging System

Elec06 Introduction to Electrical Signals.pdf

Elec07 Appendix.pdf

Elec11 Electrical Circuit Theory.pdf

Elec12 Using the Electrical Wiring Diagram

Elec13 Electrical Diagnostic Tools

Elec14 Six-Step Troubleshooting Plan

Elec15 Diagnosing Body Electrical Problems.pdf

Elec16 General Development of Multiplexing

Elec17 Appendix

Technical Articles - Toyota Series - Brakes

Brake01 Fundamental Principles

Brake02 Master Cylinder

Brake03 Drum Brakes

Brake04 Disc Brakes.pdf

Brake05 Brake Booster

Brake06 Parking Brake

Brake07 Brake Diagnosis

Brake08 Hydraulic Control

Brake09 Anti-Lock Brakes.pdf

Brake10 ABS Diagnosis.pdf

Brake11 Other ABS Actuators

Brake12 Traction Control System (TRAC)

Brake13 Appendix

Technical Articles - online instruction modules from this site

Control Devices

Circuit Protection

Understanding Relays with questions

Battery Basics v1.1

Battery Service v1.1

18 1UZ-FE NON-VVTI - Diagrams

18.1 - 1993 1uzfe Diagram

18.2 - 1992 Celsior 1uzfe UCF11 Diagram

18.3 - UZS131 Diagram

18.4 - 95'96 Lexus LS 400 Diagram (also works for 95,95 Crown Majesta)

19 1UZ-FE VVTI - Diagrams

19.1 - VVTI Engine Wiring Diagram

19.2 - VVTI Engine Wiring Diagram - LF1ECS98

19.3 - VVTI Engine Wiring Diagram - LF1EA98

19.4 - VVTI Engine Wiring Diagram - 1998 Crown Majesta

20 2UZ-FE - Diagrams

- no diagrams available as yet

21 3UZ-FE - Diagrams

21.1 - 2000 - 2003 3UZ-FE Tundra Diagram

22 Links to Useful Sites

22.1 - Phil Bradshaw's Home Page

22.2 - Lextreme's Forum (Wiring Section)

22.3 - v-eight.com Forum (Wiring Section)