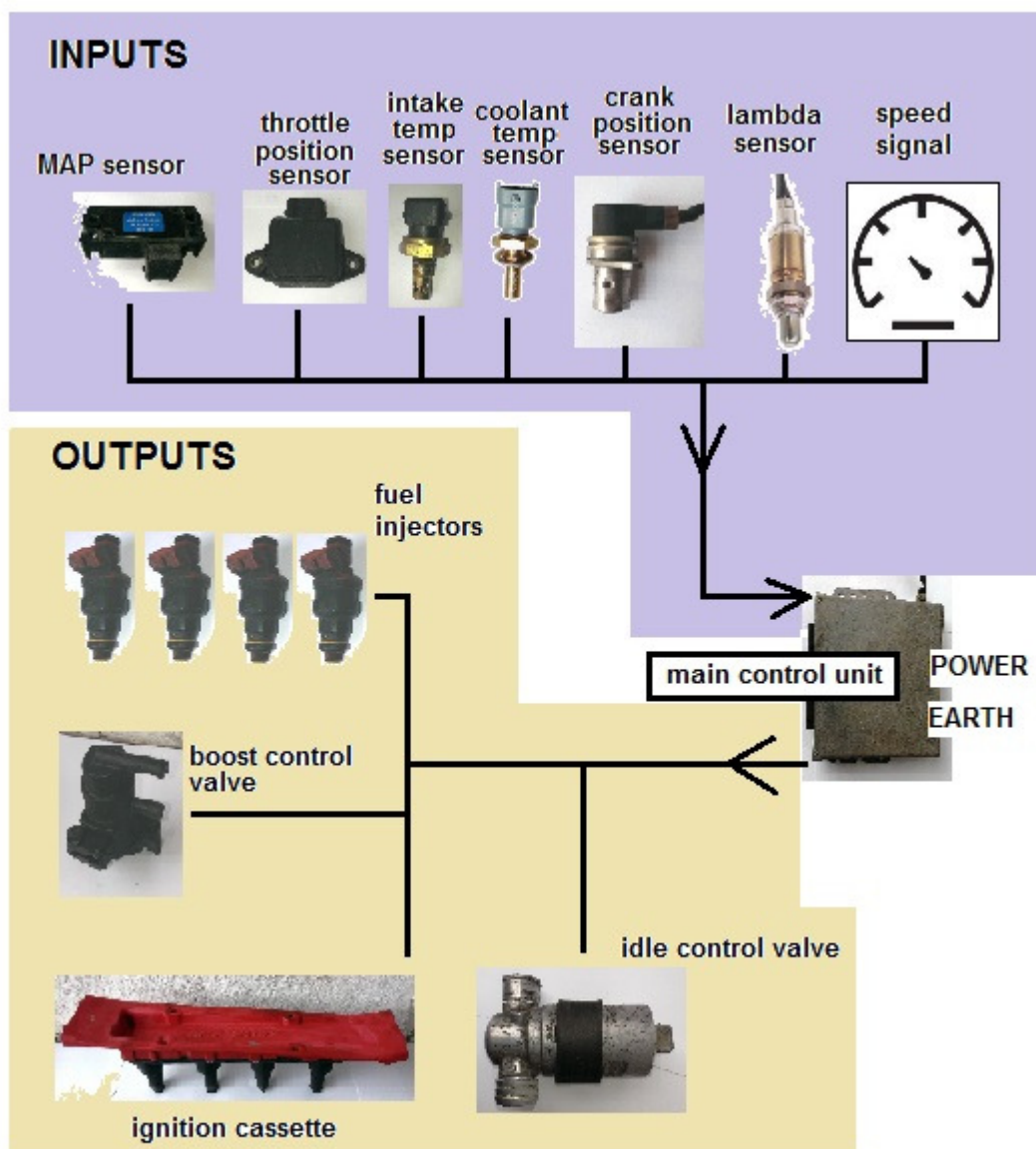


# Installing Trionic 5.5 to a Saab 900

Guide by Emmett Jenner via Saabforums.com

Trionic 5.5 is the ultimate Saab engine management system. It's complex enough to be able to manage the 3 elements of control of a turbocharged engine from one central control unit whilst also providing driveability, reliability, fuel economy but at the same time it is still simple enough to be retrofitted to earlier cars and tuned by the owner (for free) by applying anything from pre-configured stage 1, stage 2, stage 3 maps and tweaks right through to full manipulation of any part of any of the hundreds of maps within the control unit.



## Trionic 5.5 Component Map

To learn more about Trionic 5.5 have a look at the documentation here:

<http://www.saabsforum.com/viewtopic.php?f=17&t=42>

And here: <http://www.saabsforum.com/viewtopic.php?f=17&t=177>

It's good to understand what you're working with before you jump straight into carrying out a conversion. My guide here is meant to help you but you should try to understand what you're doing and where I'm offering this guide it is up to you to decide if you want to follow it and I can't accept any responsibility for any mistakes by you or by me in this guide. There are model variations which means pin numbers and wiring colours do vary so again, it is important that you know what you're doing. Incorrectly or badly wired vehicle electronics can cause fires which can occur unexpectedly. Parts of this conversion also involve work to the fuel system which can also cause fires. So if you aren't good at working with vehicle electronics or mechanical components please don't use this guide as an excuse to get involved with something you don't understand. This is a big job and will take more than a couple of lazy hours on a Sunday afternoon.

The old Saab 900 control systems are separate for boost control via the standalone APC controller, distributor controlled ignition timing with a vac capsule and a basic batch-firing fuel ECU. The original systems do work if in good shape but they ARE limited. To really unlock the sparkle of the super-tough high-compression Saab twin-cam turbocharged motor there is nothing which does it better than Trionic 5.5

To convert a Saab 900 to use this more advanced Saab ECU we have on Saabsforum.com this simple guide to cover the basics. It does not include any information on tuning because that information is available elsewhere and not essential for getting the car running.

Read the whole guide through once to decide if you can do the job and if you want to do anything else at the same time.

## Basic outline of works

1. Collect necessary tools and new parts
2. Strip parts from donor vehicle
3. Remove old systems from your 900
4. Replicate the donor vehicle systems on your 900
5. Write new code to the trionic 5.5 ECU

## 1. Collect necessary tools and new parts

A donor vehicle: By far and away the best way to get the parts required for the conversion is to either find a donor in a scrap yard or to buy one. It is better to buy one as you know the car runs and you'll have all the parts on hand and available. Any Saab 9000 made in 1994 or after is a potential donor car. Even a non-turbo has trionic 5.5 although does not come with a boost control valve and possibly the wrong MAP sensor. Look at the front of the cylinder block to see if you can see the crank sensor mounted on the block.

### Crank sensor mounted to cylinder block in a GM 900.



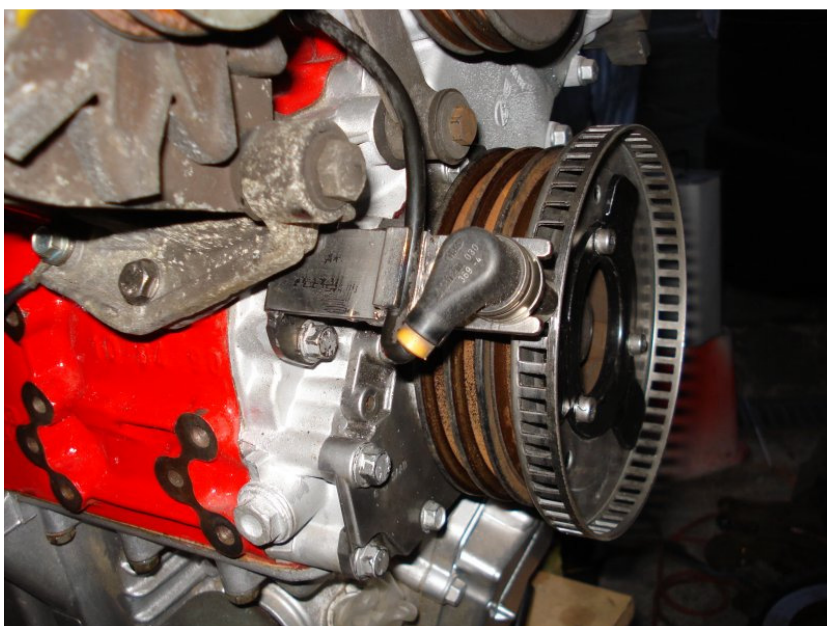
If it does not have this then it is more likely the earlier trionic 5.2. and not as good but still usable with the earlier oil pump mounted crank sensor. Don't use the trionic 5.2 unless you have no choice. Other suitable donor cars are the GM900 and the early 9-3. The GM900 must be a turbo as non-turbo was Bosch motronic. If you are looking at a 9-3 you can identify a suitable donor by the presence of a red ignition cartridge, a black ignition cartridge indicates Trionic 7 which isn't as good as trionic 5. Transmission type and engine size aren't important as it would be very difficult to find the perfect donor vehicle so you may as well consider re-flashing of the ECU to be part of the process. If you could find a 2.0 turbo with a manual gearbox and no VSS security immobiliser the ECU would work without a re-flash but that would be a very difficult car to find. Alternatively, if you know a good supplier of used Saab parts they may be able to provide you with ALL the parts required and properly remove them from the vehicle at a reasonable cost.

**A flywheel with a pattern cut into it for the crank sensor:**



There are a few different ways to create a toothed wheel for the crankshaft sensor to read. The best way for a car with a manual gearbox is to cut a pattern into the back of the flywheel which replicates the position of the teeth on the original crank sensor wheel on the donor vehicle. If you have an automatic Saab 900 then you'll have to use one of the other solutions mounted at the pulley end of the engine. A few people sell these crank trigger kits online if you search around for them. You can also mount a genuine Saab trigger wheel to the crank pulley and create a bracket for the sensor. The trigger wheel is attached to the crankshaft inside the cylinder block so not easy to get but it was available from Saab as a new part at very little cost.

**An original Saab trigger wheel mounted to the crankshaft pulley with a sensor bracket.**



At the time of writing there are two places you can obtain the better CNC machined flywheel:

1. In the UK you can use Cranford Engineering, <http://www.cranford-engineering.co.uk>.
2. In the US you can buy from <http://www.eeuroparts.com> -  
<http://www.eeuroparts.com/Parts/52160/Trionic-5-T5-Conversion-Flywheel-Trigger-Kit-101K10038>

It is a good idea to have the holes in the flywheel welded up at the bottom so they don't interfere with the signal to the crankshaft sensor. Bear in mind you will still want to attach the clutch pressure plate to the front of the flywheel so as much as possible of the original threaded hole should remain. Cranford Engineering can include this as part of their work. I've not personally seen the part from [eeuroparts.com](http://www.eeuroparts.com) so I don't know whether they include welding up the holes. It is also possible to have the clutch pressure plate holes for the larger 240mm clutch from the 91-93 2.3 9000t drilled while the other work is being done. Then you can use the much larger 240mm clutch from the 9000.

**A new set of spark plugs** are essential. The correct spark plugs are NGK BCPR7ES – don't use anything else. Trionic 5.5 uses the spark plugs like sensors to tell the ECU certain things about the combustion process, engine position and presence of knock. The original spark plugs from your 900 are different and the new ones are very cheap.

**A multimeter** is a good tool to have for checking pin positions. I wouldn't be confident attempting the job without a multimeter to hand. Slight variations do occur through the models and years so sometimes the diagrams and pin-out lists don't match the wiring loom you have.

**Insulating tape** is essential for covering up wires after the conversion is complete. Saab used insulating tape originally although in most cases 21st century engine bays have very little tape visible preferring more advanced methods for insulating cables. If you're a dab hand at military spec wiring (google that) then you can miss out the insulating tape entirely. A step up from insulating tape is heatshrink. You put it over the wire before joining it and then use a heatgun or hair drier to make it shrink around a solder joint or crimp connector. If you decide to use heatshrink you'll want to get all sizes available from single wire size up to 20 or 30mm for insulating cable trunks and connectors. It depends on the quality of the work you want to do. You could just leave all the wires exposed, it would still work but would look awful and might not last that long.

**Plastic insulating conduit** from donor the vehicle. If you can get some nice long bits of the original plastic insulating conduit from the donor car and some from your original wiring loom you should have enough to insulate the cable trunks and make the job look OEM spec with the same sort of resilience as a factory installation.

**A BDM module for interfacing with the T5.5 ECU.** You'll require this for writing code to the ECU. Search for Saab BDM Trionic Module on google and you should find a place to buy one. At the moment you can buy them from here: <http://www.epartsland.com/products/bdm-interface-saab-900-9-3-9000-9-5-trionic-t5-t7-tuning>

**A pin strip** for use with a printed circuit board (PCB pinstrip) <http://www.maplin.co.uk/p/254mm-pin-strip-jw59p>

Some means of connecting individual wires to the pins on the main trionic 5 connector. This is to provide power when you have the ECU on the bench to programme it. Some small **crocodile clips** or **spade connectors** will do the job. Alternatively you can chop a **spare socket off another t5 wiring loom**, that's the safest way as there's no danger of a disconnection during programming. You'll want a plug in power supply capable of providing enough voltage and current to the ECU during programming. **An old laptop power supply** is ideal for this.

**A soldering iron and solder.**

**A hole saw** which is the same size as the crankshaft sensor and a drill. The metal you're drilling through is aluminium so nothing fancy required. Just a basic holesaw will do the job. You'll also require a drill-bit for drilling the hole for the bolt which holds the crankshaft sensor in place. If you already have a set of drills you should have the right size in there already.

**Wire strippers.** Some assorted wire joiners, ring terminals, spare wire (automotive quality)

**Plastic or metal tubing** to fit in where air mass meter is removed. Varies depending on the 900 you have so cannot give exact size. Measure your existing air mass meter and pipes and find something that will fit. Can just leave the air mass meter in place with the electrical socket disconnected but that would be very poor workmanship.

**Bypass tube to replace the Air Mass Meter**



A few meters of **replacement VAC hose** if your existing hoses require renewal. The configuration will change slightly so there will be some disconnecting / reconnecting and changing of hose lengths. Good idea to have a few meters to hand just in case.

## 2. Strip parts from donor vehicle:

Don't break anything. Don't cut the engine wiring loom from the donor car. You must remove every connector and any mechanical components obstructing the removal of the loom so the loom can be removed cleanly from the engine bay without cutting ANY wires. Remove all the components from the donor vehicle as per above list. Additionally remove some good quality automotive grade wire in the longest lengths you can get. Take out plastic wiring insulating conduits for reuse on your 900. Clean all the parts thoroughly and even refurbish or paint things if you want.

**Essential Parts List**, take all these from the same donor vehicle if possible, then you know they match and they are all working:

### Trionic 5.5 engine control unit (ECU)



### 2. MAP sensor with the mounting clip



3. **Throttle Position sensor** (if the donor car is a Saab 9000 take the whole throttle body)



4. **Air intake temperature sensor**



5. **Coolant temperature sensor**



6. **Crankshaft position sensor**





**7. Lambda sensor**



**8. Direct Ignition cassette**



**9. Idle control valve – including the rubber sling for mounting it**



**10. Boost control valve**



**11. Fuel injectors**



**12. Engine wiring loom from donor car (do not cut any wires)**

**13. Body interface connector from donor car (cut the connector off the body wiring loom leaving a few inches of cable)**

**14. Boost Control Valve wiring connector. Remove with as much of the original wires as possible**



**15. Plastic frames which hold fuel injectors**



16. Bracket to mount boost control valve
17. Boost control valve x3 rubber connecting tubes
18. Plug to seal up hole after removing distributor



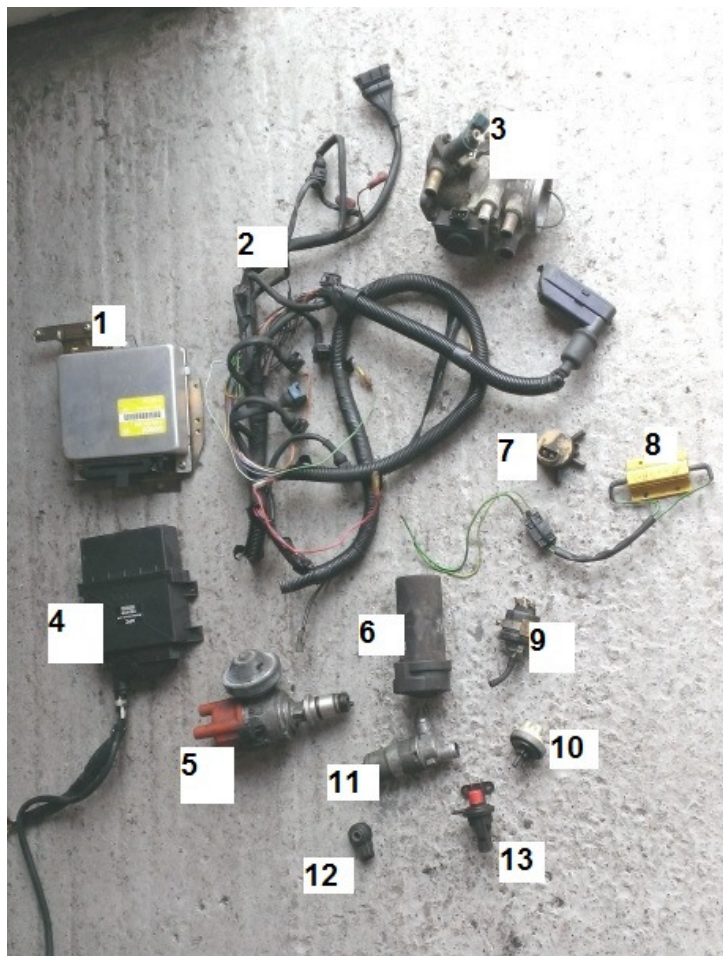
19. Ideally a cast elbow from turbo to exhaust with a hole for a lambda sensor or a weld-on boss to attach the lambda sensor to your exhaust



### 3. Remove old systems from your 900:

Take off the following parts from your 900.

1. Original ECU from behind the carpet in the front right footwell
2. Engine wiring loom (this does not include headlight or ABS wiring)
3. Take off and set aside throttle body unless you have a replacement from a 9000
4. APC boost controller unit and wiring loom. Don't cut the knock sensor wire. You might want the APC controller later for another project.
5. Distributor, unbolt and remove – plug the hole with the plug from the donor vehicle
6. Ignition coil mounted above the radiator – you can cut off the bracket as well
7. APC boost control solenoid
8. If you had a Lucas ECU you can remove the ballast resistor
9. Pressure transducer from under dashboard, plug VAC hose
10. Fuel pump cut off switch. Join wires together and plug VAC hoses
11. Idle control valve
12. Knock sensor
13. Cruise control APC pressure cut off switch



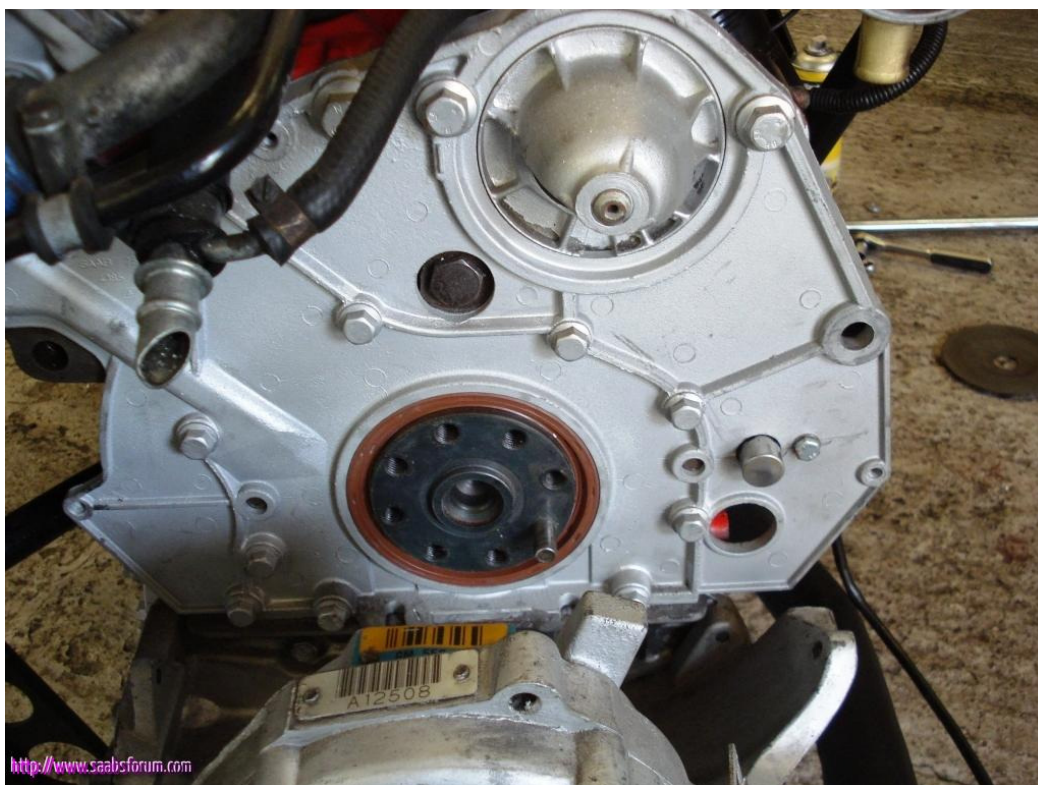
**Not pictured:**

14. Fuel injectors
15. Spark plugs
16. Ignition control module (next to APC control unit)
17. Heat plate from on top of the turbo, it is there to protect the distributor
18. Air Mass Meter – replace with straight pipe
19. Existing lambda sensor if you have one – unless it is the same as the T5 one you have

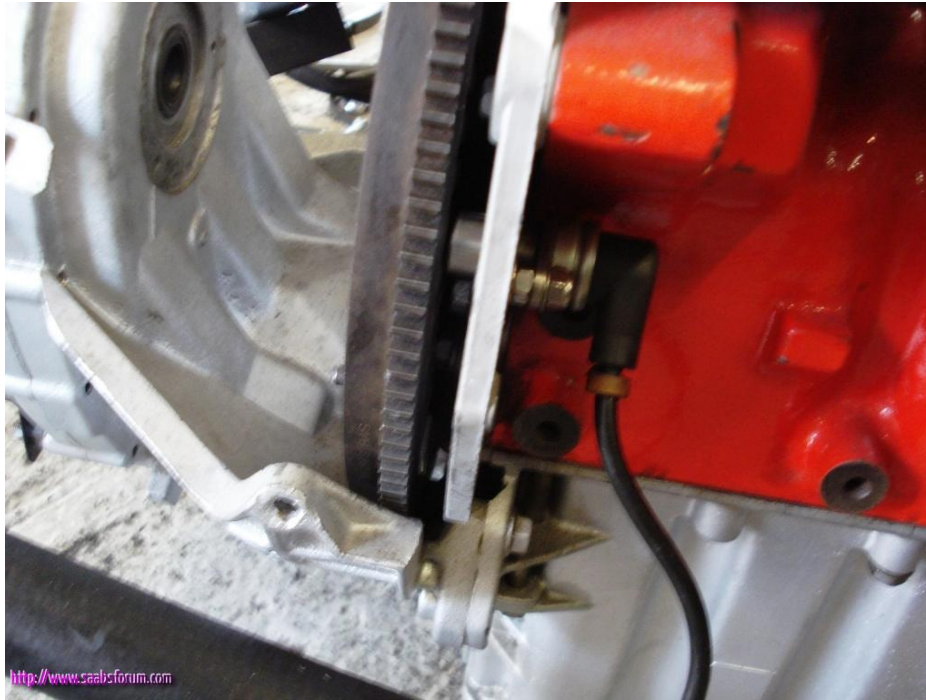
## 4. Replicate the donor vehicle systems on your 900:

Start with the big one. Replicate the crank position sensor. Take out the clutch and remove the flywheel. Drill a hole in engine block end-plate for the crank sensor to stick through so it can read the back of the flywheel. Drill a hole next to it at the correct spacing to put the bolt through for securing the crank sensor in position. Eeuroparts.com customers have the option to purchase a bracket to mount the crank sensor, follow their instructions for this part of the job. Eeuroparts.com also have their own instructions for positioning the sensor but if you're doing it without their instructions then there is a line 90-degrees from the peg in the block-end-plate to the edge, you can see it in the photo. Drill your holes along that horizontal. Make sure you get the positing right. You only get one shot at this, if you mess it up you'll have to change the block end plate.

### Crank Sensor mounted in block end plate



Test fit and get it all bolted up using washers to space the crankshaft sensor correctly with the teeth on the back of the flywheel. Somewhere around 2mm is about right. Use a locking nut on the bolt for the sensor or at least some form of thread locking compound, if the sensor comes off while you're driving the engine will stop. As the engine vibrates when running non-locking bolts are likely to work loose. Once all nicely mounted up you can refit the flywheel and clutch and anything else you removed for this part of the job.



**Next mount the remaining components.**

### **Trionic ECU**

If you have an engine wiring loom from a 9000 donor car you can mount the trionic ECU in the same place as the original APC control unit. Take the brackets off the APC box and use them to mount the trionic ECU. It has to sit a little further back because you'll want room to disconnect and reconnect the wiring harness. Get all your measurements right before drilling any holes. The PCB inside the trionic ECU is reversible. So if you find the mounting flanges on the ECU case aren't the right way around you can remove the PCB and flip it over inside the ECU case. By mounting it where the original APC was located you don't have to extend the engine wiring loom as the ECU is in effectively the same place that it was on the 9000.

Trionic 5.5 ECU mounted using original 900 APC brackets in the original 900 APC location



## MAP sensor

The perfect place for this is between the engine coolant bottle and the engine air intake snorkel. You can clip it onto the edge of the engine bay. You have to make room for it by shortening the bottom of the intake snorkel to move it closer to the front of the engine bay. Remount the intake snorkel, drill a couple of new screw holes if you have to, often I find there are existing holes I can use. Fit the shortest VAC hose you can which will fit without kinking. Ideally you will connect to a point on the manifold where the MAP sensor is the only device attached. Find a single take-off tube or modify a twin take-off so one of the holes is blocked. Ideally you don't want other devices sharing the manifold pressure the MAP sensor is reading – example, brake vacuum booster would really screw with the readings if it were on the same take-off as the MAP sensor, if unavoidable then make sure the device sharing with the MAP sensor isn't going to effect the reading. A short hose which cannot vibrate or pulse (at higher boost pressures) is what you want to achieve to get the most stable MAP signal.



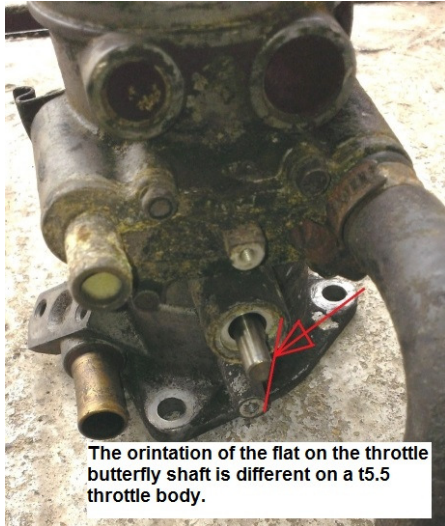


You can see here where I've shortened the bottom of the intake snorkel to move it forward. You can also see the plastic insulating conduit for the wiring loom going to the engine.



### Throttle Position Sensor:

The 9000 throttle body is the ideal part, just replace it complete with the correct throttle sensor already attached. If you can't get the whole throttle body because your donor parts came from a GM900 or a 9-3 then you'll have to modify the 900 throttle. A sensor and throttle and or throttle body from a 2.1 900 also fits but check it is the right throttle position sensor for your setup. However you manage to achieve it, you must get the correct throttle sensor mounted to your throttle body. Different specifications of sensor provide different signals and have different wiring connectors. Ideally use the throttle sensor from the donor car.



### Air Intake Temperature Sensor:

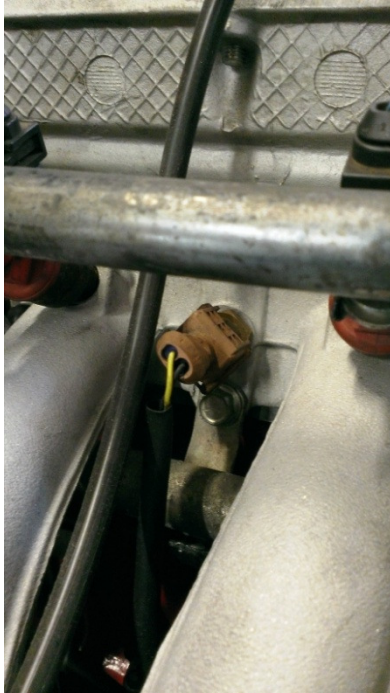
Mount it somewhere on the air intake tubing a few inches before the throttle butterfly. As this is the pressurised side of the turbo compressor you'll want to make sure you mount this sensor properly. If it is loose or if there is any possibility of air leaking out around it then that will happen when the engine is on boost. A weld-on mounting boss would be great if you could get it tig welded to an aluminium intake tube as per original design.



### **Coolant Temperature Sensor:**

Mount it in the same place as the existing one, between runners 2 and 3 on the intake manifold. No requirement to drain the coolant unless you want to. Have the replacement in your hand as you remove the old one. Switch them over quickly and no coolant will spill.

### **Coolant temperature sensor mounted between intake runners**



### **Lambda Sensor:**

If you already have a Lambda sensor on the car that's good news. Just unscrew the old one and screw in the trionic one. Lambda sensors come in only a few basic types and it may be the case that the one you have fitted will be the same as the trionic one and you don't have to replace it. Look at the wiring plugs to see if they're different. Important thing is the number of pins. There is a heating pin for heating up the lambda sensor. The heating pin is connected to a relay (fuel relay) and a signal pin which goes to the ECU. There are various configurations of this but the concept is basically the same. You'll get an engine warning light on the dashboard if you do this wrong but can always be fixed afterwards. It's not essential for running the engine. There is an original cast elbow available for the exhaust with a lambda sensor hole already there to mount the sensor. If you don't have the hole you can drill one and tap it out to screw in the sensor. You could also weld a lambda sensor boss onto the downpipe a bit further down and fit the sensor there instead.

### **Lambda sensor screwed into an original 900 cast turbo exhaust elbow**



### **Direct Ignition Cassette.**

Fit your new NGK resistor type spark plugs (specified above) and slot in the DI cassette. No real specific instructions for this except that the screws can vibrate lose if not well tightened to the valve cover. Over tightening will strip the threads so take care not to end up in that situation. You could check the specified torque setting in the workshop manual if you want.

### **Idle Control Valve:**

On the 9000 the idle control valve hangs off the bottom of the inlet manifold. You can replicate this setup on the 900 by removing the manifold stay and fitting the idle control valve under the throttle body. If you remove the bottom throttle body mounting stud from the inlet manifold you can replace that with a much longer bolt, cut the head off that bolt and smooth off the end. Screw a nut onto the bolt, add a washer, mount the bolt in the hole on the inlet manifold and then undo the nut. That has the effect of securing the lower part of the throttle body to the inlet manifold and now you have a prong to hang the idle control valve from. Connect up the rubber hoses for the idle control valve. If you don't have a 9000 throttle body just mount the idle control valve in the standard location and hook up the hoses as normal.

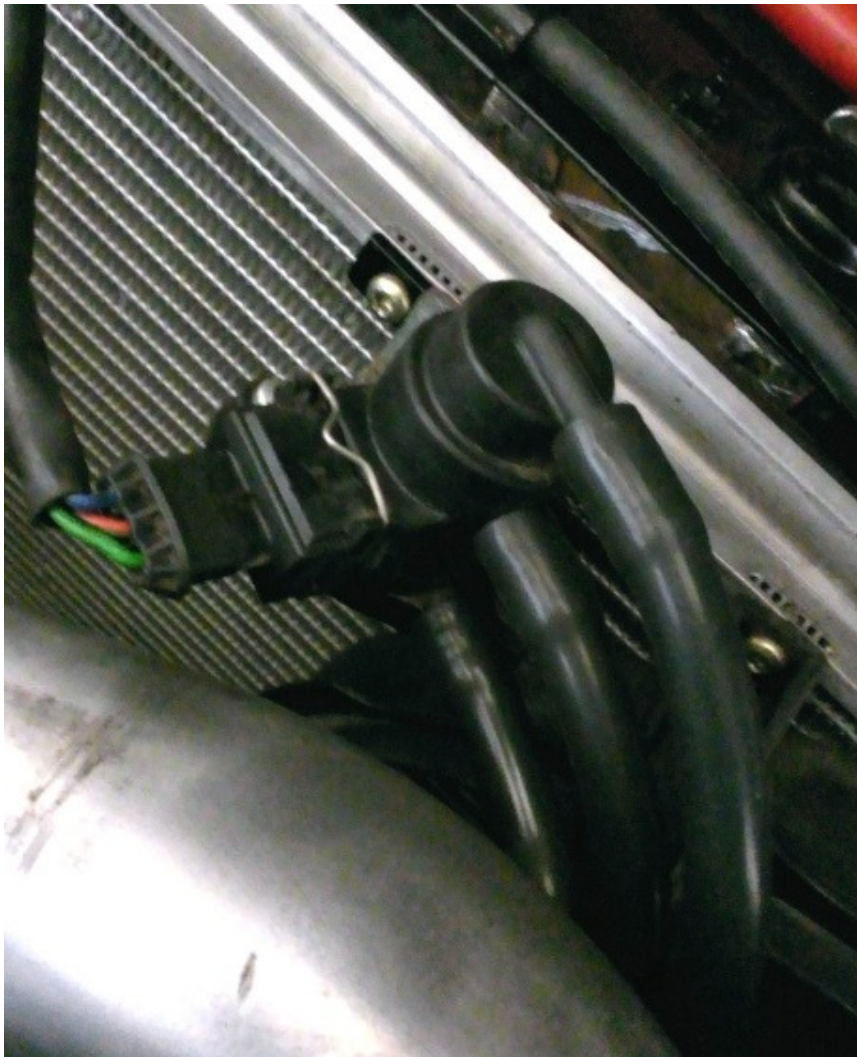
### **Idle control valve mounted under the throttle on a long bolt**



### **Boost control valve:**

Ideally you will have the mounting bracket from the donor car and it will be in reasonable condition. The quick way to do this is to mount it with a cable tie and just forget about it. If you want to do it properly make a little bracket and screw it to the top of the radiator or the slam panel. Make sure the rubber hoses can still reach and that the bonnet can shut. Also bear in mind the engine moves when driving so it shouldn't be too close to the engine pipework either. It must be mounted on an anti-vibration mount as per original Saab setup. Connect the rubber hoses. The take-offs from the valve have markings on them to show you which port connects to which hose. At this point it is worth mentioning the wastegate actuator should be the OEM part and set at the default arm length and default opening pressure. Trionic engine management does not like to be fooled by an incorrectly tensioned or configured wastegate. It wants to fully control boost pressure using the boost control valve. By all means feel free to fit an upgraded part but the spring pressure and arm length should still be set conservatively so T5 can dump all the boost if it wants to. There are various articles available via Google explaining how to set your base boost.

### **Trionic 5 Boost Control Valve mounted to top of the radiator on a 900**



### **Fuel Injectors:**

The 9000 fuel injectors are the same shape as the 900 ones so can fit straight in to the original location. Make sure the rubber seals aren't kinked as you don't want a fuel leak. These injector seals are available as a replacement part, it does not hurt to renew them while you're in there although not essential. It also isn't a bad thing to have the injectors sent away for sonic cleaning and testing. Again, not essential. You could also buy x4 new fuel injectors. They're about £50.00 each. The standard trionic fuel injectors have a particular spray pattern which is designed to spray the fuel in a particular direction. The black plastic frames which hold the injectors by their electrical connector keep the injectors properly aligned and point the fuel in the right direction for best delivery. It's a good idea to fit the plastic frames. Check the fuel pressure regulator rating on the donor car and make sure you have the same rating on your 900. Likely 3.0 bar but check to make sure.

### **Plastic frames holding injectors in ideal position**



### **Wiring Loom:**

Essentially this is plug'n'play. Ready to go. Connect up all the connectors to the sensor sockets. Route all the cables nicely but don't insulate until the engine is running. If there are problems later you'll want to be able to trace wires and probe terminals. On the 9000 (and probably the GM900 as well) the cables for the injectors, coolant temp sensor, throttle sensor and idle control valve run under the inlet manifold. This is a much tidier configuration compared with how they are normally routed on a 900. Try to replicate this to make your engine bay look tidy. Make sure none of the cables are rubbing against any sharp edges or hot parts like the cylinder block. Connect the earth wires to the cylinder head. You should end up with a body interface connector and a socket for the ECU. These should be routed to the front left corner of the engine bay and you can hook things up

to the cars electrical systems down there. In theory you should be able to lift this complete loom back off the car and replace it with another one from the same kind of donor vehicle.

The boost control valve and lambda sensor have separate sockets for their connections. Ready those by stripping out unnecessary pins and removing insulation so you can connect the bare wires to the right terminals when the time comes. These wires may require extending to reach the right pins.

This image shows the body connector and the boost control valve connector with the minimal number of pins required to complete the installation. You can use a sharp pointed tool to push back the tab inside the connector terminal and pull the wire out of the socket to remove unnecessary wires.



At this point you basically have the whole engine bay sorted and now you've just got to work on the electrical connections to connect the T5 control system to your 900 internal wiring – i.e. so when you turn the key in the ignition switch it magically works just like it is meant to.

### **Connecting trionic wiring loom to the car:**

This is the bit where people usually mess up really bad. It takes a basic understanding of how vehicle electronics, relays and wiring diagrams work to be able to get this next bit right. If you're reading this and thinking about doing the conversion yourself but not sure, it's probably best to take it to a specialist if you have one nearby.

## **Fused Supply:**

On the 900 the supply to various components is originally un-fused. This includes the relays and the ECU. On other models of car, like the 9000 and GM900 a fuse was included so it is up to you whether you choose to fuse these supply wires or not. The obvious difference is that if you have a shorting out wire it will quickly blow a fuse and the circuit will be isolated. Without a fuse in the supply wire to the ECU and relays you risk shorted wires starting fires. Under normal circumstances it shouldn't be possible for the wires to short-circuit but if you were to have an accident and the car became damaged then anything is possible.

If going with the original un-fused setup then make sure your insulation is good quality including thick plastic conduit and the cables aren't tightly rubbing off metal components. Things like alternator and starter motor wires are also un-fused on the 900 but fused on later designs on other cars.

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Because of wiring differences from different vehicles it is not possible to be 100% clear on which pin numbers you're supposed to be working on. The best I can do here is to describe the process for working it out.

Get the body connector which came from the donor car. Sometimes it is a round plug, sometimes it is a long grey connector of a similar design to the ECU socket depending on which sort of car the parts came from.

Using the pin-out diagram which is mostly correct for most harnesses you have to work out which pins you can eliminate and which pins are required for your installation. I've included a list below of pins which aren't required for running T5.5 on a 900. You can take all of them out of your body connector. Don't modify the engine harness. Leave that complete. Just remove the pins from the body connector or cut them short and insulate the ends if you're not sure. You can remove them later when you're satisfied that everything is working.



## Pins required to retrofit Trionic 5.5 to a 900

Pin #	Wire Colour	Function	Required or not?
1	Red	+30 (power supply) +12 Volt	YES
2	Blue	Boost pressure control valve	YES
3	Grey	Injector 1	YES
4	Blue	Injector 2	YES
5	Yellow	Injector 3	YES
6	White	Injector 4	YES
8		Knock detect (knock indicator) Switches to GND	YES
9	Brown/white	Trigger 1	YES
10	Green	Trigger 2	YES
11	Blue	Trigger 3	YES
12	Grey	Trigger 4	YES
13	White	Engine torque limitation	NO
14	Orange	Drive	NO
15	White	Brake light switch	NO
17	Yellow	Combustion cylinder 1+2	YES
18	Brown	Combustion cylinder 3+4	YES
20	PK	MAP (Manifold Absolute Pressure) signal +5 Volt	YES
21	BU	M96: EVAP canister purge valve diagnosis	NO
		M96.5: Fuel tank pressure sensor 0-5 Volt	NO
22	Grey	MAP sensor input signal P_Manifold 0 – 5 Volt	YES
23	Green	Oxygen sensor 1 (front lambda sonde) AD_sond	YES
24	Black/white	Main ground	YES
25	Black/white	Main ground	YES
26	Green	Boost pressure control valve	YES
27	Yellow/red	EVAP canister purge valve	NO
28	GN	EVAP canister close valve	NO
29		Heat plate activation relay	NO
31	Yellow/white	Main relay	YES
32	White	Check engine	YES
33	Blue/white	Diagnosis (data link under seat, TECHII)	NO
35	YE/BK	Engine load signal out	NO
36	BU/WH	Cruise control	NO
38	YE	Low fuel signal light	NO
39	Green	Speed signal Bil_hast	YES
41	Yellow	Crankshaft position sensor	YES
42	WH/BK	Throttle position sensor	YES
43	Blue/white	Pressure sensor	YES
44	Orange	Knock signal AD_knock	YES
45	GN/BN	Throttle position sensor AD_trot	YES
46	Black	Intake air temperature sensor AD_lufttemp	YES

47	Black	Oxygen sensor, reference ground	YES
48	Red	+30 (power supply) +12 Volt	YES
49	BU/VT	Idle air control valve (IAC)	YES
50	Black	Oxygen sensor 1, preheating	YES
51	BK/WH	Oxygen sensor 2 (rear), preheating	NO
52	YE/WH	Vacuum pump, brake system	NO
54	RD/WH	A/C out	NO
55	Brown	Shift up light (to instrument cluster) Switches to GND	NO
56	Violet	Fuel pump relay	YES
57	Yellow	Throttle position signal	YES
58	Blue	Engine speed signal (RPM) Rpm	YES
59	Green/white	A/C in	NO
60	Green/white	+15 (switched power supply, ignition contact)	YES
62	Grey	CANH (CAN bus high signal)	NO
63	Red	CANL (CAN bus low signal)	NO
65	Red/white	Programming voltage +16 Volt	NO
66	Black	Reference ground for engine coolant temp. Sensor 0 Volt	YES
67	Black/white	Sensor ground 0 Volt	YES
68	Yellow	Engine coolant temperature sensor AD_kylv	YES
69		Exhaust gas temperature (not mounted) AD_EGR 0-5 volt	NO
70		Oxygen sensor 2 (rear lambda sonde) AD_cat	NO

**Pins from the list above which you will have to connect to your 900 are as follows:**

1. Main power, connect using a ring terminal to the power distribution point next to the right hand spring housing. Combine with some of the other power wires for other bits covered below. It's better to join them all up and mount them as one thick supply wire for the whole loom. Pins 1 and 48 are connected to the same permanent live. You can see the terminal at the top of the picture, the two power wires feeding the main relay and the fuel relay.



2. The boost pressure control valve is sometimes separate from the main engine loom so if your wiring loom does not include a connector for the boost valve then it is wired via the body connector. There are two wires from the ECU and one power wire which you can get from a wire which is live with ignition or the main relay. Pin 2 and pin 26.

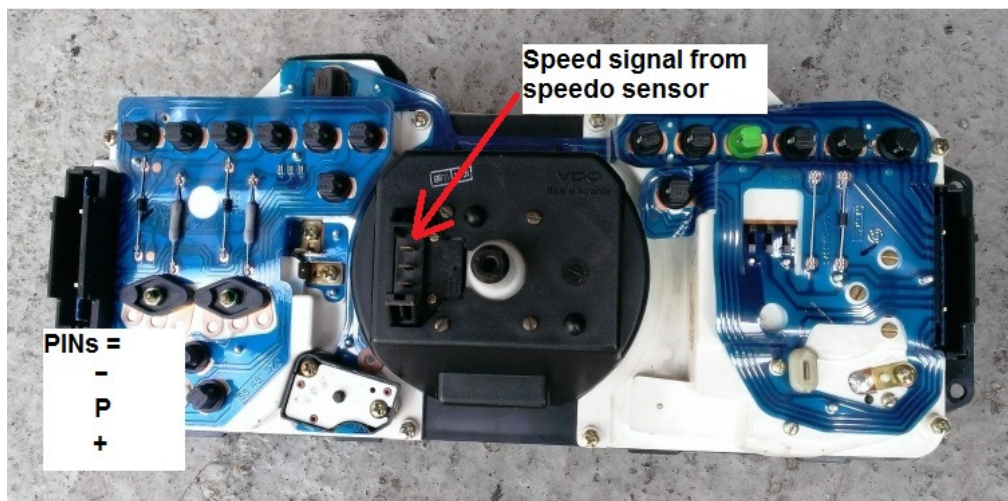
23. Oxygen sensor is the same as the boost pressure control valve. i.e. it often goes through the body connector and doesn't have its own plug on the engine wiring loom. Pins 23, 47, 50

24. All the ground wires should be grounded. That's fairly obvious. There are ground wires coming out of the engine wiring loom which are terminated with ring terminals and you attach those to the cylinder head, commonly to the front lifting eye which is mounted to the front intake runner. The ground wires are 24, 25, 66 and 67.

31. Main relay, this is the wire from the ECU which activates the main relay. The ECU uses this wire to turn on and turn off the fuel injection components. The main relay also turns on the fuel relay on the original set up but you've got to break that link so cut the wire running between pin 87 on the main relay and pin 86 on the fuel relay. We'll give control of the fuel relay to the t5 ECU instead. I'll cover full set up of the relays separately. Pin 31 from the trionic ECU connects to pin 85 on the main relay.

32. Check Engine light. Technically this isn't required for the engine to run but you want to know if the ECU has picked up a fault so make the check engine light work because you can use it to read the onboard diagnostics from the ECU by counting the number of flashes of the check engine light. There is a 2 pin connector under the dashboard next to where the original ECU was installed. The Yellow White wire is for the check engine light. The blue wire is for the rev counter.

39. Speed Signal. You get the speed signal from the back of the speedometer. Up to 1988 the signal won't work. After 1988 the signal will work. This means if you have an older speedometer you'll have to swap it for a later one. There other ways to provide the ECU with a speed signal but this is the preferred method. Try other things if you want to. Without a speed signal the ECU will be stuck on base boost and it won't try to increase boost pressure. Connect pin 39 to the P terminal on the back of the speedometer. The middle pin. Don't disrupt the wire for this as the wire also feeds the signal to the cruise control. If you want the cruise control to continue to work you'll have to keep the wire running to the cruise module.



56. Fuel Pump Relay. Connects to Pin 85 on the fuel pump relay.

58. REV counter signal. This connects to the blue wire in the 2-pin connector under the dashboard. The same connector as the Check Engine light. Pin 58 from the ECU goes to the blue wire in the 2-pin connector under the dash.

60. Switched Live. This isn't a power wire. It's a signal to the ECU that the ignition switch is in the RUN position so the ECU is to power up the relays and the fuel injection components. It also signals to the ECU when the engine has been turned off. The ECU will then run the Direct Ignition burn-off cycle. You can connect this pin to any wire which goes live as you turn the ignition switch to the RUN position. Two ideas for where to get this are at the old ignition module just behind the left headlight in the inner-wing area, the wire to the old ignition coil or up near the duct for the heating system inside the plastic grey 6-pole connector. The standard colour is green/white for this ignition wire. Probably the easiest place to get this wire is from the old 7-pin ignition module connector. Just cut the connector off and use the green/white wire out of there.

62 & 63 are the CAN wires. You won't require these for getting the car running but they are used later for live mapping and tuning with the ECU connected to the car, also good for logging. It's important to keep these available even if you don't plan to tune the car immediately. They serve an important function so don't cut them off or remove them.

The list above should be all the connections required between the car and the engine wiring loom via the body connector.



## Power Distribution terminal on a 900



'Always live' power from the power distribution terminal on top of the right side spring housing in the engine bay goes to Pin 86 & Pin 30 on both relays. This should come in as two thick (high current) wires to Pin 30 and then a thin wire can loop off to Pin 86. Look at the original configuration of the relays as they may not be far off this configuration anyway. Just pin 86 on the fuel relay will be incorrect. You can see two high current wires leading away from the top terminal to the cabin where the relays are mounted

Pin 85 on the main relay goes to Pin 31 on the ECU.

Pin 85 on the fuel relay goes to Pin 56 on the ECU.

Pins 87 & 87b on the relays are voltage output pins. You want to power some components from the main relay and some from the fuel relay so neither relay is overloaded and so the right components power up at the right time. You can use the main relay to power the Direct Ignition cassette and the boost control valve. The fuel relay should power the fuel pump, injectors and lambda sensor. The fuel pump should already be connected to the correct Pin on the correct relay so just leave the original configuration as was. Same goes for the lambda sensor if your 900 already has one.

With all of the above completed you should be able to start the car for the first time. And fingers crossed you got everything right and it does start first time. It's a rewarding feeling. The only thing which could prevent the engine starting is the VSS security on the ECU if your parts came from a car with VSS immobiliser and security. You can turn this off by re-flashing the ECU. If VSS is enabled and stopping the car from starting you may see that the engine will start, run for a couple of revolutions and then shut down. That would be typical behaviour of VSS not disabled.

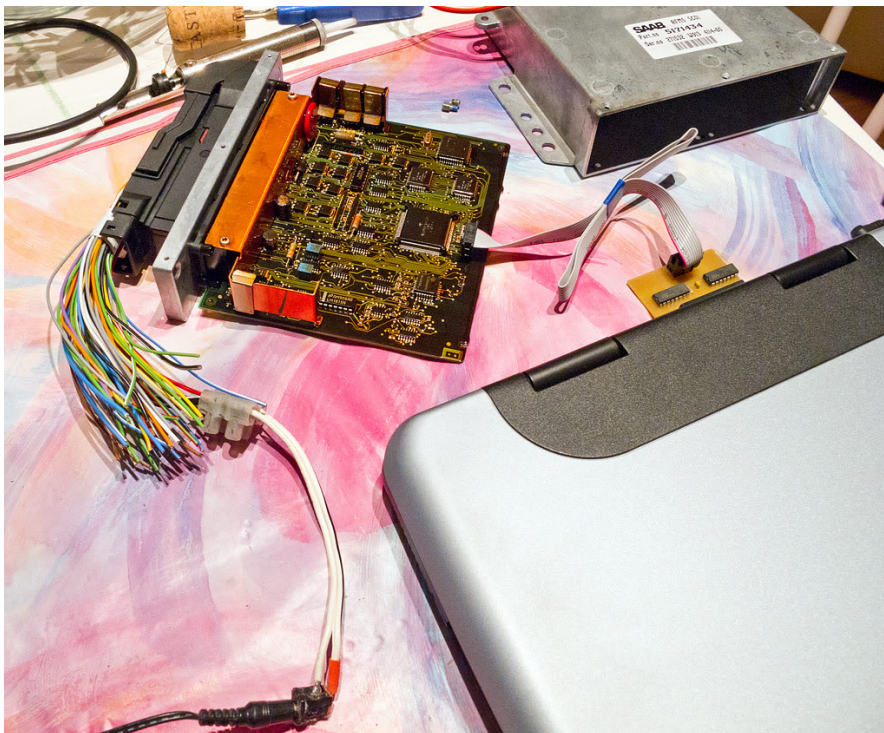
## Re-flashing the ECU:

9 times out of 10 it will be necessary to re-flash the ECU with a modified binary file. This is to turn off support for control of the fuel vapour evaporation valve as most 900s don't have that. You are also likely going to have to turn off the VSS security if it is enabled. You can also turn off the automatic gearbox as you won't require that if fitting to a manual car. Apart from that it's a good idea to find a binary file (.bin) from a website which will work on a 2.0 turbo. <http://www.ecuproject.com> is a good place to find a standard .bin file. You can leave the maps in the file as standard maps or you can apply a stage wizard to the file which will manipulate various maps within the file to give the car a bit more go. If you have only standard hardware it wouldn't be very clever to apply much more than a stage 2 wizard.

### To flash the ECU you require the following.

1. BDM module with ribbon cable
2. PCB (printed circuit board pins) to solder into the ECU board
3. T5\_suite software including the scripts for working with the BDM
4. A stable power supply to run the ECU off the car, a laptop power supply is good for this
5. An old computer running Windows XP
6. The T5\_suite manual so you can follow the instructions

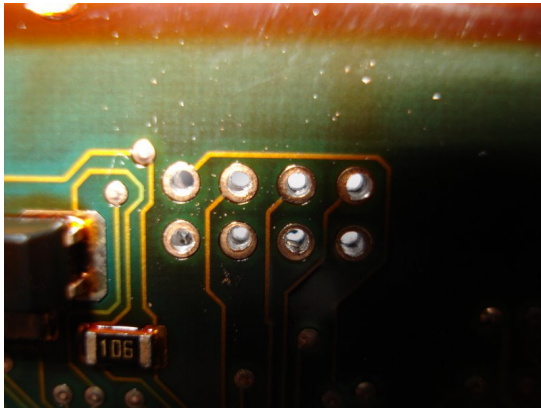
### A typical BDM setup for flashing a trionic ECU.



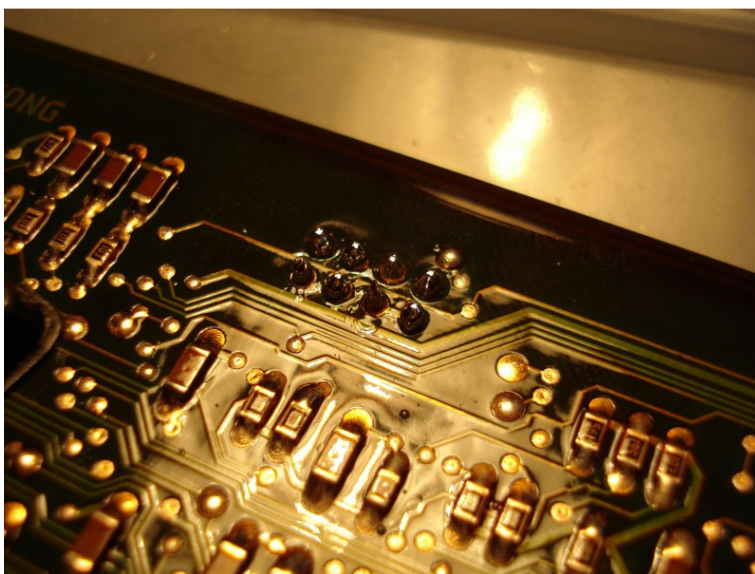
I'm not going to rewrite the instructions for using T5 suite or the BDM module as that was already done by the software author.

Fitting the pins to the ECU circuit board is fairly simple. You'll require a small tip for your soldering iron. You can either heat the pins and the holes on the board and force them through which is a bit messy or you can drill some small holes in the board using a micro-drill. These tools and parts are all available from Maplin if you are in the UK or RadioShack or similar in the US. With the holes drilled in the board it does not require as much force to push the pins through and the job is neater as a result. Both ways of doing this works as long as you do the job neatly. Add solder to the back of the pins so they are joined to the tracks and will talk to the ECU.

**Shows holes drilled in the circuit board using a micro-drill, you can see the original solder still exists around each hole so the pins will still work. If your micro-drill is too big it will obliterate the solder**

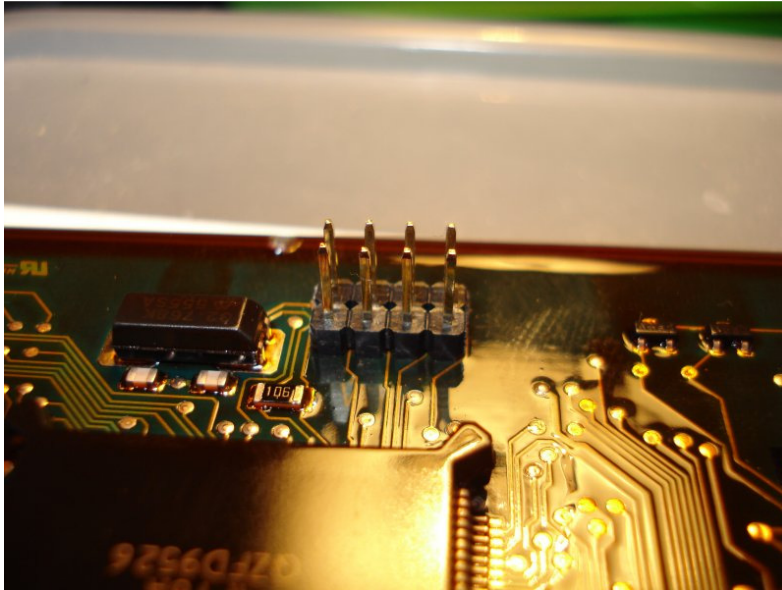


**Shows the solder added to the bottom of the ECU circuit board. Make sure pins aren't joined together or solder crossing tracks on the PCB.**





**Neatly installed pins. Easy to connect the ribbon cable. Bent pins are harder to connect to and not as nice to look at.**



Once you've written your starter binary file to the ECU and the engine has started and you've started to use the car you can continue to use the BDM method for uploading binary files to the ECU offline or you can switch to use the Lawicel CAN USB adapter and work live with the ECU using a laptop. Live mapping can't be committed to long term ECU memory so you'll have to take the ECU off the car and hook it up to the BDM kit to permanently write live-mapped files to the permanent memory on the ECU. You will be saving these files to the laptop as you go but once the ECU has been disconnected from the battery it will revert to the default .bin you originally loaded up at the beginning. There is another option I've been made aware of which allows you to write an image to the ECU using the Lawicel through the CAN adapter. You have to supply programming voltage to the ECU. In theory you could avoid using the BDM interface completely although a Lawicel CAN to USB adapter is much more expensive than a BDM module so it depends on how much you plan to tune the ECU.

If you check through various Saab forums you can find people who are prepared to flash trionic ECUs in exchange for folding beer tokens.

**This is pretty much the end of the installation guide. From here on, so long as you did everything right all that's left to do is tune it.**

# TROUBLESHOOTING

Troubleshooting a non-starting trionic 5.5 car has already been documented but here is a copy of the information. You use the Check Engine light and some straight forward diagnosis to locate the fault.

## **Trionic ECU Flash codes:**

2 Flashes - MAP sensor  
3 flashes - Intake air temperature sensor  
4 flashes - Coolant temperature sensor  
5 flashes - Throttle position sensor  
6 flashes - Oxygen sensor (lambda probe)  
7 flashes - Fuel / air mixture  
8 flashes - EVAP valve  
9 flashes - faulty ecu

## **Troubleshooting Step-by-step:**

Engine fails to start – BUT it does turn over

Step 1 - Check fuses:

Fuse 23 – ECUsupply, +30 circuit (always powered)

Fuse 13 – ECU supply, +15 circuit (only when key ON)

Fuse 14 – fuel pump relay supply to fuel pump.

Replace any blown fuses and go to step 2

(Note – 30 and 15 don't mean 30 and 15 volts – that is just the SAE accepted name for unswitched and switched power – it should be around battery voltage when on).

Step 2 -Check the CHECK ENGINE light.

Ignition ON.

Check the fuel level

Does the CHECK ENGINE light illuminate and stay ON?

YES – Control module is activated

NO – check the +15 supply to the control module

NO – the CHECK ENGINE light shines weakly or flickers. Check the +30 supply or ground connection. May also hear a buzzing sound from main and fuel pump relays, and tach needle moves.

Step 3 –Check the main relay-

Ignition OFF

Pop connector off DI cassette – connect a test lamp between pins 10 and 6 of the cable side of the connector.

Remove fuse 23 for 5 seconds (or more), then re-insert.

Ignition ON – the test lamp should light up for about 6 seconds and then go out.

Does it light up?

YES – Main relay is OK.

NO – Go to TEST 4(not Step 4) -Main relay check

Step 4 – Crankshaft Position Sensor test.

From Step 3, Turn the key to START (from ON) to run the starter motor after the test lamp has gone out. It should light up again.

Does it light up?

YES – Crankshaft position sensor is OK.

NO – A problem with the Crankshaft sensor or connection to the control module.

Step 5 – Check the fuel pump relay.

Ignition OFF

Remove fuse 23 for 5 seconds, then re-insert.

Ignition ON –listen for the fuel pump to run. It should run for about 2 seconds then stop.

Does the fuel pump run?

YES – fuel pump and relay are OK (Pump may have low pressure, but at least it's trying)

NO – Go to Tests 1 and 2 - Fuel Pump/Relay check

Step 6 – Injector wiring check

Ignition OFF

Pop a connector off a fuel injector.

Connect a test lamp between pin 1 of the connector and ground

Remove fuse 23 for 5 seconds, then re-insert.

Ignition ON – the test lamp should light up for about 6 seconds and then go out.

Did the light come on?

YES – Main relay is still OK, and wiring to injectors is OK.

NO – check the wiring from the control module to the injectors.

Step 7 – DI check

Ignition OFF

Remove the DI, leave the cable connected.

Put 4 spark plugs into the boots, and connect up a ground to each one. IMPORTANT – there MUST be a spark plug in each position, and each one MUST be grounded. Otherwise, the DI may be damaged.

Remove fuse 23 for 5 seconds, then re-insert.

Ignition ON – the plugs should spark

Do they spark?

YES – DI is OK

NO – DI is probably bad.

Test 1 -Fuel Pump testing-

Jumper fuse 14 to fuse 22.

Does the fuel pump run?

No – check the wiring at the fuel pump, but chances are the fuel pump is bad.

YES – fuel pump is OK – Go to Test 2.

Test 2 -Fuel Pump relay Part 1

Ignition OFF

Connect a voltmeter between ground and fuse 14.

Remove fuse 23 for 5 seconds, then re-insert.

Ignition ON –The voltage should jump up for a couple of seconds, then drop back down.

What voltage did you see?

0 volts – Fuel pump relay may be dead. Go to Test 3

12 volts – There's a problem with the fuel pump

Less than 10 volts, but more than 0 – dirty fuel pump relay contacts.

Test 3 – Fuel Pump relay/Anti-Theft

Note – this is for US anti-theft systems.

Ignition OFF

Remove the fuel pump relay. Connect a voltmeter from pin 86 to ground.

Ignition ON.

What voltage did you see?

12 volts – Anti-theft is OK, relay is bad

0 volts – Anti-theft module is keeping the fuel pump off.

Go to Anti-theft box on the right hand side of the passenger compartment, by the knee bolster. Make sure the contacts are OK.

Jumper pins 9 to 21. Repeat Test 4 – if the fuel pump runs, the problem is the anti-theft module.

Test 4 -Main Relay Check-

Remove main relay.

Jumper from pins 30 to 87 on socket.

Does the Idle Air control valve click?

YES – main relay is bad. Replace or try cleaning contacts.

NO – Check wiring from pin 30 to battery +, and from 87 on out.