Steven Rosser's MegaSquirt Conversion Notes

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Foreword (by Simon Holywell)

Steven Rosser wrote this guide to aid people who wish to complete a conversion from the standard L-Jetronic fuel injection management to MegaSquirt on an Alfa Romeo V6. Whilst his conversion was a GTV6 with a 75 3.0 engine the principals are the same for all L-Jet V6s.

I have edited this guide to make it suitable for publishing on the web but all information remains intact and is the sole work of Steven Rosser. As are the tuning files that are included in this document.

Also included in this guide are two schematics, which were created by Peter Florance for a BMW 521i but are a perfect match for the L-Jet on Alfa V6s. The schematics are for L-Jet to MegaSquirt pin outs and a fuel pump circuit modification.

An alternative way (perhaps cheaper) to buy the MegaSquirt components is to get into a group buy in your area or country. There are often group buys listed on the http://www.msefi.com forums. If you live in Australia, as I do, then the best way to get the components is to checkout the Australian section of the aforementioned forums as there is usually a group buy on the go. It is considerably cheaper and you get to know other helpful MegaSquirters at the same time.

Personally, I would not attempt to build this controller without first building the stimulator as it gives you practice and is an invaluable diagnostic tool. Unless you are an expert electrical kit constructor, your going to need to iron out some bugs and the stimulator makes that so much easier and given their minimal cost they should be in

every MegaSquirters toolbox. For those in Australia there is an AussieStim designed by Stewart, which is a lot cheaper as it is made from local parts and can be bought through the group buys.

As always, if you are stuck during your build make sure that you have followed the MegaSquirt manual and this guide closely. If you still cannot troubleshoot the problem then search the forums at http://www.msefi.com for a previously posted answer. If you still do not find what you are looking for then post a new topic and someone will be along to help you shortly.

Simon Holywell compiled this version of the guide into PDF for http://www.fulloctane.com. This guide is displayed in 12pt Verdana with 1.5 line spacing, which according to current font analysis is the easiest font to read on screen and paper.

You can click on the titles in the table of contents and table of figures to be taken to the relevant section.

Introduction

Thought I would compile a complete A-Z detailing exactly what I did to convert a GTV6 from its stock L-jet injection system to the “Megasquirt” (MS) programmable fuel injection system. Overall, it is relatively straightforward but there are a few essential modifications from the standard MS build that need to be done to ensure that it works correctly and reliably. I have referenced the MS build manual and simply highlighted the areas where deviations are needed away from the standard build. Apologies in advance for the poor photo quality, they were taken with a mobile phone!

Figure 1: Completed MegaSquirt

Note of Caution & Disclaimer

I am not an expert in mechanics, engineering, tuning, electronics or software. I am a DIY mechanic who is pretty hands on regarding various cars over a number of years. I've owned this GTV6 for over 12years and therefore because it's mine and feel I know it well enough to do whatever I like, I built an MS fuel ECU.

I am simply giving you my opinion and a description of what worked for me. This is not an endorsement for anything you choose to do. Like any home modifications you do this at your own risk, your quality of workmanship and implantation is your personal choice. For instance, although the benefits of this system are that it allows you to tune the best from your car it also gives you complete control over fuelling so that you could screw your car up. Melted pistons would not be cheap to fix!

If you damage your car, yourself or indeed anything in any way, shape or form; remember you did it yourself!

Now back to the interesting bit…

Background

The recipient car is a 1983 Euro GTV6 fitted with a 3.0 from a 75. The motor is stock Alfa except for Colombo Bariani AR6104/294s cams, 7000rpm limiter in rotor arm, CSC exhaust manifolds with O2 sensor, no centre box, Ansa rear box, BMW735i AFM on modified stock air box, more cold air inlets into air box, which in turn holds a K&N filter.

The above modifications make the car breathe sufficiently better that it ran either very dangerously lean at high load or extremely rich at low load if the top end was fuelled OK. To workaround this on L-jet I cut into the water temperature sensor circuit and wired two loops of cable, one loop going to a dash mounted 0-10k rotary potentiometer, the other loop going to a magnetic “reed” switch near the throttle linkage, which in turn had a small magnet placed on it. The set up was such that at less that approx 1/3 throttle the reed switch was closed therefore the ECU saw the real engine temperature, however as the throttle was opened more the reed switch opened so the ECU saw the resistance set on the in car pot. I simply set the in car pot so that fuel was rich at high load & rpm using the O2 sensor output to a voltmeter on the road.

This “bodge” actually works surprisingly well especially considering it cost £2, but I really wanted better fuelling control, hence the move to a programmable system.

When choosing a replacement ECU I had some key criteria that the system must fulfil:

Firstly, it must be very low cost, thereby counting out most of the well-known contenders at the first hurdle.

Secondly, I wanted to easily retrofit the standard L-jet ECU in case I get any trouble with the new system. L-jet is not perfect by any means, but the ECU has proven 20 year plus reliability.

Thirdly, it should be home tuneable by me, therefore needed simple to follow GUI software for me to play with.

Fourth, as stated earlier I am neither a mechanic or software expert nor electronics expert; I am a nonprofessional in all three disciplines, but pretty hands on re car DIY & tuning. Therefore, the system installation and tuning needed to be within my limited capabilities and resources to complete.

I choose Megasquirt as it met all of these criteria. It is certainly the cheapest, posts on
GTV6.org from Peter Webb proved it is achievable as an L-jet ECU swap, the tuning software for MS is very intuitive and it looked like I knew enough to complete the project.

On the downside, it only controls fuelling not ignition, unlike some of the other full house systems like EMS, Autronic, Motec etc. Megasquirt *CAN* be made to supply spark control too and many users have. However, as it requires a lot of custom work I have not touched that side yet, maybe a future project if I get bored!

My car now runs on MS. Driveability is improved, especially in the areas where it's off cam, the car comes on cam 400 rpm earlier (3800 versus 4200rpm), fuel consumption is reduced when cruising and as a bonus the car sounds even better too – better because it's

smoother. The very first time I returned from a drive on MS even my wife noticed the car sounded better & smoother, such was the difference. Once the AFM is completely ditched, a dyno session will be on the cards soon to make sure the full power high rpm areas are dialled in OK, although at the moment plug readings, O2 sensor and the “seat of the pants dyno” all say it runs well!

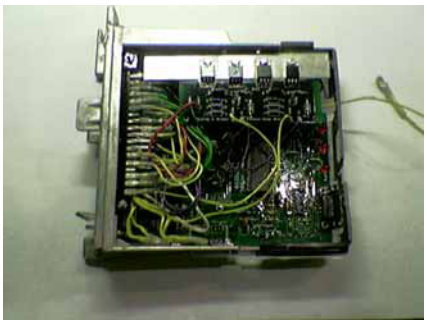


Figure 2: Inside the case

Required Components

Megasquirt Parts you will need:-

1. MS main board kit from B&G
2. MS component kit Bill Of Materials (BOM), from Digikey
3. MS “FlyBack board” kit from B&G
4. MS “FlyBack board” component BOM kit from Digikey

Additionally I would recommend you also buy the “stimulator kit” and components from B&G & Digikey too as this simplifies testing & fault finding.

Additional parts you will need:-

1. One spare L-jet ECU to gut and house your MS (DO NOT use you are only working ECU!)
2. Vacuum hose (approx 1.5m), make sure the surface is not electrically conductive, and a “T” that fits it to connect to the vacuum port for your Fuel Pressure Regulator (NOT your distributor vacuum feed!)
3. Fine bore metal tube that your vacuum hose will be a snug airtight fit over. (Try a DIY store, I used B&Q 4mm Aluminium tube) This will take the vacuum hose through the bullhead.
4. DB9 serial cable
5. The following electronic components from your local supplier, which are needed for the modifications, I bought them from Maplins in the UK. Alternatively, you could get them from Digikey at the same time as your original kit (I did not realise I needed these until after I had started building!):
    - Resistors: One each of 1.6k ohm ½ watt, 1k ohm ½ watt.

- Transistors: Two of NPN type ZTX751 or equivalent (1amp is plenty) & Four of IRFIZ34G type (same as Q2 & Q7 in the standard MS build).
- Capacitors: Two of 0.01uf, one of 0.1uf and one of 0.22uf, all rated at least 250v
- Diode: One of IN4004 (400v)
- Two magnetic chokes for your radiator fan leads, as the fans are electrically noisy.

6. "L" section aluminium bracket from a DIY shop, you only need about 10-15cm long by about 2cm on each side of the "L", 2mm thick would be ideal. This will become the mounting for the "FlyBack" board; see diagrams in the MS manual. B&Q in the UK sell something appropriate.
7. Access to basic DIY tools such as drills, files, cable connectors, ties, cable shrink-wrap etc
8. Soldering iron, solder, solder remover tool, heat-sink compound.
9. PCB board cleaner & old toothbrush
10. PCB board sealer (one you can solder through)
11. Laptop computer (any old one will do if it has serial port)
12. Selection of coloured wires (mostly smallish gauges)

Preparation

1. Go to these sites and browse around, first the main page for info and links to ordering: http://www.bgsoflex.com/megasquirt.html . Second the main forum page: http://www.msefi.com, you will note many other MS users are very helpful & knowledgeable; chances are any issues you find will have been encountered by someone else who can help you resolve.

2. Read the Manual http://www.megasquirt.info/index.html (Please RTFM!). It is very, very comprehensive covering everything from basics of fuel injection, step-by-step build, troubleshooting and pointers to the majority of installation foibles, right through to tuning and other add-ons. The reason I have suggested you ordered additional components at the outset is to build the problematic areas from day 1 using up rated and/or improved circuitry. You can get a PDF version of the manual at the bottom of the page http://www.megasquirt.info/index.html, beware the whole thing is 190 pages.

3. Print out ***Appendix I***, which precisely shows how to wire from MS output pins to L-jet pins. The title says it is for a BMW 528i, do not worry as the system on the GTV6 is the same.

4. Print out ***Appendix II***, which shows a modified fuel pump circuit allowing you to keep the stock Alfa combo-relay intact.

5. Download the latest “Megatune” software from the Yahoo groups or from www.msefi.com . Current version is 2.20 as of writing this guide.

6. Download the best.msq file, it is my current version of MS code that runs very nicely in my car, you should be able to use this to get your car running as a basis for your tuning. Source: http://www.fulloctane.com/rosser/best.msq

7. If you have not soldered ever or for a long time go and buy a simple electronics kit to practise on. Building the MS really is not difficult at all, but I would suggest it is a bit daunting as your first soldering project!

8. Procure all of the items I listed earlier.

9. Print and keep the BOM lists for both the main MS board and the FlyBack Board to ensure you have all the correct parts.

Modifications Needed

With regard to the modifications away from the stock build, I made the following changes:

- "FlyBack" board added as the 6 low impedance injectors in the Alfa overloaded the basic circuitry. This damages components U7, Q2 & Q7.

- Altered the components in the circuitry that reads engine rpm as the basic build was too susceptible to electrical noise from the car.

- Changed embedded CPU code to be compatible with the factory Alfa Throttle Position Switch (TPS).

- All other modifications are physical allowing the MS to become easily interchangeable with the L-jet ECU.

All of these are detailed in this guide.

Building

Give yourself plenty of time and space in a well-lit area. Lay out the components in whatever logical order suits you, I left the components bagged (and therefore correctly labelled) & grouped all the resistors together, all the capacitors together etc so they were easy to find at each step.

Firstly, take your old L-jet ECU and dismantle it, remove the two screws at the bottom to slide the black casing off downwards revealing the twin circuit boards within. You need to keep the black outer casing, the Aluminium “skeleton” that the boards are attached to, the harness connector and the small nuts and bolts that attach the two big round Phillips transistors to the skeleton.

Mark the orientation of the harness connector to the ally skeleton (paint dot or score it) then carefully drill out the rivets holding the harness connector to the skeleton. Then you will find dismantling the rest is pretty intuitive, it is a little awkward to get the connector pins off the board, and I cut them off near the board end. The Bosch harness connector is of excellent quality, it is robust, fits perfectly, all the pins are numbered for your convenience and once trimmed and filed the cut off pins are a good size to fit small spade connectors for your MS to L-jet wiring, or you can solder directly to them.

Now follow the Megasquirt Mega Manual to the letter except for the following CRUCIAL differences:

Step 1: You are using the L-jet case so forget the part about making sure the board fits in the recommended MS case, it fits in the L-jet skeleton with room to spare.

Step 2: Install the DB9 connector but DO NOT permanently install the DB37 header to the MS board (remember you are using the Bosch connector), I originally did install mine but found it's a bitch to get off again and there isn't room to fit it in the casing with the DB37 in place. The problem is if you do not have the DB37 header you will not be able to follow the test areas in the build manual. As a matter of interest, I found every single test area was successful first time round. The instructions are sufficiently "baby steps" that you really should not go wrong.

If you're not comfortable with your ability to get it right first time then do fit the DB37, but make sure any solder your use is easy to remove. Might be best to just bend the DB37 pins such that they all make contact without solder & just snap fit the item (wish I'd done that) it'll be loose but so long as it all makes contact and you are careful it shouldn't matter. Then build and use the Stimulator as suggested in the manual.

Follow all steps 3- 46 inclusive exactly as stated in the manual.
Take particular care to orient dips, diodes or polarity sensitive capacitors correctly, the manual clearly states where you need to pay attention to polarity / orientation, if the manual does not suggest an orientation you do not need to worry which way round the component goes.

Step 47: Resistor R10, do not use the standard build MS 390 ohm resistor, which is not strong enough for our application, substitute your extra1600 ohm ½ watt resistor instead. (In fact values up to 200k ohm or even higher will still work)

Follow step 47, as detailed in the manual.

Step 48: Install the IN4004 diode you purchased instead of the IN4001 recommended. The IN4004 is rated to 400v whereas the IN4001 is only rated to 50v; this change is purely for enhanced reliability as the voltage spikes within the rpm input circuit can be over 100v.

Follow step 49 exactly as detailed in the manual, complete with "bypass jumper".

Step 50: Install part U4, the Opto-isolator. Note, this component can be damaged by excess heat sink when soldering if you are heavy handed (go on, guess how I know this!) I suggest you solder it one leg at a time letting it cool completely before doing the next leg.

Step 51: Capacitor C12 the "Ed capacitor", do not use the recommended 0.001uf capacitor, instead substituting for the bigger 0.01uf. This component change will give you a more stable rpm reading in the MS otherwise rpm appears erratic and "jumpy" by +- 100 when the engine runs. The manual says you can increase up to 0.1uf, but I tried this and could not rev the engine beyond 1800rpm! Stick with 0.01uf as a compromise.

Step 52: follow carefully making sure you mount the MAP sensor the correct way round with the notch where the manual says so.

Step 53: Resistors R4 and R7, do not install the standard 2.49k ohm resistors, instead use 2.2k ohm resistors instead. These changes allow MS to read your stock Bosch sensors accurately enough. In the Digikey BOM of equipment you will have been sent a pack 10x 2.2k ohm resistors whereas you only needed 8x for the

rest of the MS board, therefore you have 2 spares for this step – very convenient.

Step 54: Do not add the jumper as the manual suggests. Instead, jumper a 10-12cm wire into hole marked XG1, which will later be grounded directly to the L-Jet case. This gives a “stronger” earth and therefore a clearer signal from this component.

Follow Step 55 – 58 inclusive as per the manual.

Step 59: Install Diodes D9 and D20, but do not install Diodes D7, D22 and D23 – you do not need them.

Now for some New Steps: -

Take the diagram you printed from ***Appendix II*** for the fuel pump drive circuit modification.

A. Take one of the four spare IN4001 diodes you have from not installing D5, D7, D22 or D23 and install it on the bottom of the board between hole 19 of the MS DB37 connector and the furthest hole for transistor Q3 (there is nothing installed in this hole as yet)

B. Take one of your ZTX751 transistors or equivalent and stand it upside down on your bench with the “flat” side facing left, bend the top and bottom legs right round 180 degrees so that you can solder it to the board upside down. Bend the third leg, from the flat side out at a right angle so it will be horizontal to the plane of the board when installed.

C. Solder the 1k-ohm resistor you bought to the horizontal leg of step “B” so it sticks out horizontally.

D. Slip some heat shrink over the 1k resistor leads so it does not short anything.

E. Take the standard MS build transistor Q3 and bend the legs slightly as the manual suggests such that it would drop into its three holes in the board. Then bend the emitter leg out at right angles so that it can be soldered to the other end of the 1k ohm resistor you already soldered in step C/. The Emitter leg is the one furthest from the DB37. The leg you bend is the centre leg on the right hand side if it is fitted in the board with the DB37 end towards you.

F. Bend the leads as required to make it all fit in the correct holes.

G. Place the two vertical legs of Q3 and solder them into the MS board

H. Place the vertical legs of the upside down transistor and solder then into the vacant holes labelled D7 on the board

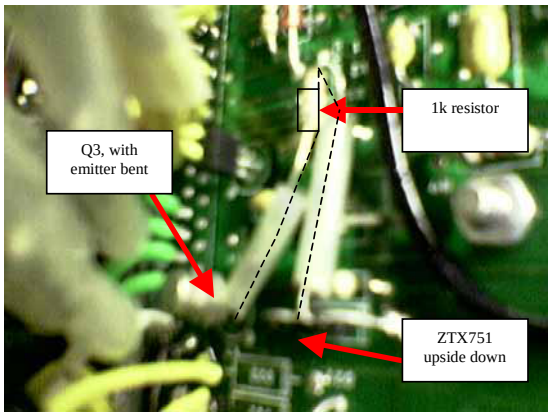


Figure 3: Fuel pump circuit layout

I agree it looks like a bit of a lash up and apologies that camera phones do not focus well from 2 inches. When you are finished the 1k resistor will be suspended in mid air between one leg of Q3 and 1 leg of the upside down transistor.

I. Put a large blob of non-conducting "goo" on this area when you finish the entire MS build and have a running car, as it would otherwise this mod would be prone to vibration and failure.

Back to the manual and complete steps 60 and 61 as described.

Step 62: Remember you have already installed Q3 in the extra steps.

Steps 63 to 68 inclusive follow the instructions as per the manual.

Skip step 69, this area is bespoke later on in these instructions.

Step 70: Put the LEDs in as stated in the manual. I will probably move mine off the board to somewhere more visible in the car, simply running fine cables out to wherever simply keeping the orientation correct. I will probably use some spare CAT 5 or similar, but as I have not done it yet I cannot really give instruction.

Now build your “FlyBack board” following the instructions in that part of the manual to the letter except you only need one “L” bracket, not two as shown in the instructions. You are building this additional item because the GTV6 &75 use 6x 2.4ohm injectors, grouping these three injectors per MS output circuit will overload the basic “flyback” circuit within the MS. The flyback board piggybacks up rated circuitry into the system that is comfortably up to the higher loads our injectors will impose. Without this board I experienced problems, as have others, fit it now and you will not need to worry about this area.

Final Assembly

You have pretty much finished the main build; just needing some more bespoke bits to make it all come together.

This is what you will end up with:-

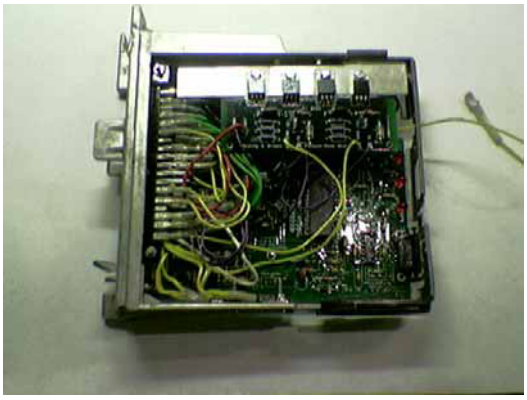


Figure 4: View from the top. The flyback board can be seen on the far side of the case.

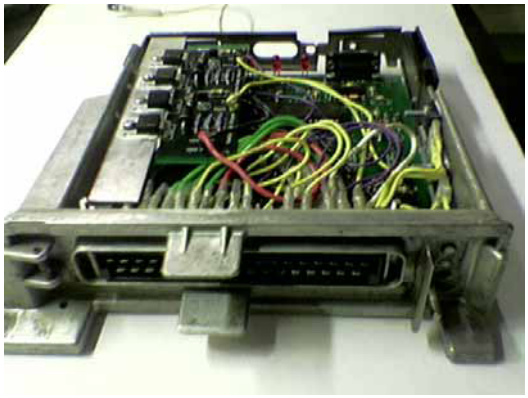


Figure 5: L-Jet connector rigged up to the board.

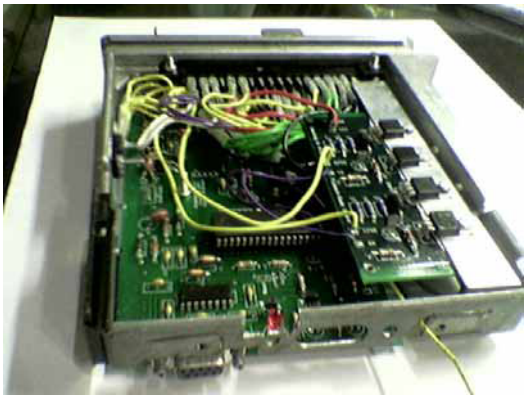


Figure 6: The serial port and diagnostic LEDs

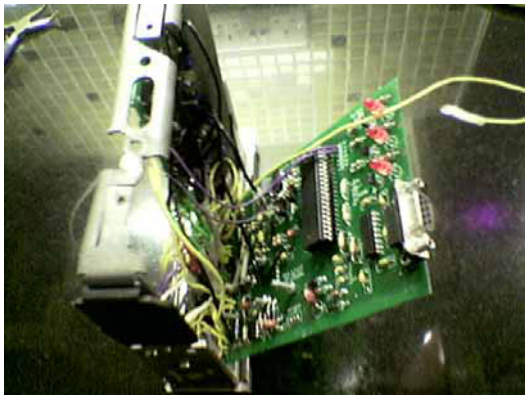


Figure 7: Mounting circuit board

The MS board lines up inside the skeleton such that the DB37 end is at the L-jet harness connector end on the box. There is a groove cast into the skeleton under the Bosch connector that the end of the MS board can slot loosely into. To assemble:-

1. Remove the DB37 if you installed it and using the L-jet to MS pin out diagram as reference, wire up jumpers 10-15cm long or so to all the MS pins numbered in that diagram. Use your own logic for colour coding, I used things like Red for +12v input, Black for all grounds, purple for sensor feeds etc, it is your installation, your choice! Your MS board will now have a lot of multi coloured leads where it should have a DB37 connector, do not connect the “free” ends to anything just yet.

2. Remember that MS holes 7-11 inclusive also need to be grounded, so wire jumpers to these too.

3. Group all the leads that are grounds together and crimp them to ring connectors; these will later bolt to the L-jet’s ally skeleton to provide a good ground for everything.

4. Solder 6 x 6cm wires to the MS board holes labelled Q2 & Q7. Because the L-jet case is different you will mount them heat-sinked to the inside of the ally skeleton, you will note some perfectly convenient holes to bolt them too! Solder the other end of the wires to your Q2 & Q7 FETs. Take care to get the pin orientation correct i.e. as if they were mounted direct to the board. Do not bolt them up to the skeleton just yet.

5. Solder 12-15cm leads from the vacant holes of Diodes D22 and D23; solder to the end nearest the DB37 holes. These leads will be linked to your FlyBack board.

6. Take your L-jet skeleton and align it so the end with the connector faces away from you. Take your FlyBack board and line it up on the right hand side nearer the bottom of the case, mark where the mounting holes will need to be. I used two of the four existing holes in the skeleton that held the big round Phillips transistors; I simply used two of those bolts to hold my FlyBack board perfectly, these also provided mounting points for all the grounds.

7. Line up your MS board in the slot at the connector end of the skeleton; you will see where you need to cut metal from the skeleton to clear the serial port connection. Cut it now and make another hole sufficient for you MAP vacuum tube.

8. Cut matching holes in the L-jet black outer casing for the serial port and the MAP hose. Do not put the case on yet!

9. Wire your MS board leads to the Bosch harness connector. I used small spade connectors on the ends of the leads to connect to the L-jet harness, or you could solder them. I only used spades so I could easily change anything if I got the pin out wrong at all. Follow the pin out diagram precisely (I missed a couple of grounds first time)

10. Wire the FlyBack board and MS board together as stated in the Manual for the FlyBack board. With the exceptions that I suggest running the FlyBack ground lead to the same ground as all the other ground leads on the casing and share

the +12v feed with the same spade connector from the L-jet feed pin. This makes it more robust than jumpering off the main board, which the manual suggests. Do not forget to slip all your ground leads in with the bolts that hold the FlyBack board to the skeleton.

11. Follow the MS to L-jet pin out wiring diagram to the letter; the only problem I found is my car did not have an O2 sensor as standard, so that lead was absent. However, because my CSC manifolds had an O2 port I had already installed a three wire sensor for rough tuning purposes (and to plug the hole of course!). On the photo's above you will notice a long straggling yellow lead on it's own ending in a spade connector, this plugs into my O2 sensor feed separate from the main wiring harness.

12. Bolt the FETs Q2 & Q7 to the skeleton in two convenient holes, use heat-sink compound whenever the manual suggests.

13. Fit it all together carefully; you will need small bolts or pop rivets to reconnect the harness connector to the skeleton. I used non-conducting clear rubber solution to "glue" the MS board into the slot at the harness end of the skeleton, this is flexible so I can lever the board out if necessary. Remember to the ground leads to the same bolts that hold the FlyBack board in place.

14. Slice several 8mm deep rings off the vacuum tube – check it is non-conducting! Glue these to the bottom of the MS board, again with something non-conducting and do not cover any components or soldering. These will just be

"spacers" to ensure your board cannot ground against the L-jet casing. This is a bit of a lash up I agree and I will make this more permanent at some stage, but have not yet. "Potting" the whole board is probably a good idea at some point in the future, however do not do any such thing yet until you are happy it all works reliably.

15. Under the bonnet, find an existing rubber grommet on the bulkhead that you can feed the vacuum hose through. Place a screw in end of the metal tube so it doesn't get blocked with bits of grommet, make a pilot hole with a screwdriver or similar and push your tube through the grommet. Remove the screw and connect the vacuum tube to either side.

16. Now pull off the hose for the fuel pressure regulator on your plenum and connect your MS vacuum hose with your "T".

Figure 8: T-connection for MAP sensor

You are basically teeing into this plenum chamber source to feed the MAP sensor on your MS system. Make sure you T into the plenum and not the vacuum source for the distributor

as this vacuum source originates right at the throttle butterfly and instantly transits between ambient pressure and vacuum.

17. Disconnect the electrical connector from the cold start injector; you do not need this cold start anymore.

18. Clip your magnetic inductors around the leads for the radiator fans up close to the motors; this helps suppress electrical noise from these components.

Embedded Code Change

Your MS would now work, however before trying it in the car you need to make a change to account for the GTV6 throttle position switch being of a different type to the standard MS recommendation. The MS build default expects a 0-5v 255 position rotary throttle position switch which it uses in conjunction with "TPSdot" code to calculate whether and how much acceleration enrichment is needed ("TPSdot" means Throttle Position Switch Delta Over Time or more simply rate of change).

Whereas the GTV6 has an on/off idle and ¾ full throttle type switch. You can either change the throttle assembly for one from another Alfa, apparently, various 155's can provide donor parts, or change the MS embedded code. I figured changing the throttle assembly involved unacceptable additional "real work" and would be very awkward to change back if ECU problems ensue, whereas the code change takes about a minute, has zero cost and allows ECUs to be swapped without further ado. I changed the code from "TPSdot" to "MAPdot" (Manifold Absolute Pressure rate of change).

There are theoretical arguments supporting both "TPSdot" and "MAPdot" being the "best". However, in practice both work and in any case our cars have the "wrong" type of TPS fitted as factory equipment – which I felt rather simplified the decision making process. Interestingly theory implies that the greater the ratio of throttle valve area to engine capacity the more appropriate "MAPdot" becomes to the sensitivity of the vehicle application. The GTV6 2.5 (and 3.0 too) has a comparatively large throttle valve for the engine capacity meaning you actually get sudden MAP changes for comparatively small throttle position changes. In practise the

MAPdot code works superbly on my car, throttle transitions are handled with better driveability that the stock L-jet.

To change the code:

1. Go to the MSefi.com, Download Files/Embedded code and download the file titled “V2.98MAPdot .S19 file”. Save this locally on your PC/Laptop.
   (Source: http://www.msefi.com/dload.php?action=file&file_id=69)
2. Holding your board CPU side up, serial port connection to left you will see a small rectangle on the board to the left of the CPU labelled “BOOT”, the rectangle contains two holes. Jumper these holes together temporarily, a cut off leg from a diode or resistor bent into a “U” works fine.
3. Connect your serial cable between the MS & the PC/Laptop
4. Run a HyperTerminal session on your PC/Laptop, set up so you can talk to the MS, as described in the manual.
5. Power up the MS with a 9v battery.
6. You will get the “Boot>” prompt on the HyperTerminal screen.
7. Type “W” to wipe the existing program.
8. Then type “U” to upgrade.
9. From the File menu select “send text file” and browse to wherever you saved the MAPdot .s19 file from the MSefi.com downloads page. It will take a minute or so for anything else to happen, so do not worry when nothing whatsoever appears to be happening, it will display “completed” when done.
10. Power down the MS, remove the temporary BOOT jumper.

You are now running a code version, which calculates acceleration enrichments based on rate of change of MAP sensor reading rather than rate of change of TPS.

Disconnect your temporary power supply and off you go to the car with your laptop and MS hybrid. Do not put the casing on the ECU yet, until you are sure it all works OK.

Final Set Up

Unplug your L-jet ECU.
Take your naked MS/L-jet hybrid ECU into the car; connect your serial cable, MAP hose and L-jet loom harness. Connect the other end of you serial cable to the laptop.

Now turn the ignition key to “run” (but not start) so your dash warning lights are on, open the Megatune (MT) software on the laptop and you should see roughly correct figures for air and coolant temperatures and near 100 for MAP, all other gauges will read zero. On the “real-time display” page you will note the CPU counter is running from 1 to 255 and back to 1 continuously in 1 second increments, the battery reading should also be correct fro your non running car, i.e. in the region of 12v.

From the menu bar in MT select “open” and find the “best.msq” file (source: http://www.fulloctane.com/rosser/best.msq) I’ve supplied from my car, it will ask you to burn the values to the controller, select yes. You have now loaded my current working version of the Megasquirt code for my Alfa. My car runs nicely, yours will need tuning to get the ideal mixtures for your car.

For instance if your car is completely stock 2.5 my set up will be around 25% too rich, if yours is a stock 3.0 then my file will probably be a little lean for you at low rpm where I’m off cam, but too rich up top. If your car is a mildly modified 3.0 then it should be reasonably close.

There are two ways to change the fuelling, if yours is a 2.5 simply change the required fuel figure in the “constants” menu inputting 2490cc rather than 2959cc in the helpful prompt script. If yours is

a 3.0 then keep the figures I use and tweak the VE figures in the VE table page once it is running.

Especially make sure you have the correct number of cylinders shown and that PWM is set to 25% and 1.0ms. Remember you have installed the FlyBack board and must use these start settings for PWM rather than the default values suggested in the manual.

If you change anything here then use the “save as” option and save your new configuration to the laptop. I suggest you use a simple name and date convention like “250804a”, “250804b” etc for each “save” to keep track of changes. That way you can easily find and revert to a known working file if you screw up tuning later on.

The moment of truth

Turn the ignition off, now turn it on again & make sure Megatune is running and shows what you expect, you should hear your fuel pump run.

Start your car, it should need no throttle to fire but might need some to keep it running if the fuel map is wrong for your car.

If this is not successful follow the manual instructions and play with required fuel figures etc as necessary.

When it starts, you will be sooooo pleased with yourself!

Now remove the ECU once more & clean it thoroughly with PCB board cleaner & let it dry. Now spray it with board sealer to keep moisture out, let it dry thoroughly for many hours.

Troubleshooting

If it does not work, check the following:

1. Double check you have followed precisely the diagram for L-jet to MS pin out.

2. Check the grounds to the board and that the hybrid ECU skeleton is grounded to your cars chassis.

3. Check the wiring for your remote mounted Q2 and Q7 injector driver FETs

4. Check the wiring connecting the FlyBack board.

5. Go back to the manual and look at the various troubleshooting comments.

Generally problems are simple and user based, for instance on different occasions I missed a couple of grounds and reversed the wiring for transistor Q2, simple mistakes and easily rectified.

Tuning

This is where you do your own thing, tune the car so that you are happy with it, if your not sure get it on a dyno and dial it in properly. If it's roughly OK and doesn't go lean a full throttle according to your O2 sensor you should be able to tune it pretty good all by yourself using your own common sense and the various free software available in the Megasquirt community. Make a point of reading the tuning area of the manual if you have not done so already.

However, you do need to understand the basics of tuning i.e. do not go lean at full throttle. Remember this system gives you the capability to make your car run better, but it also gives you the capability to screw it up mightily, it's your system & your decision and your responsibility how you use it !

I suggest you take the lid off the AFM, mark the notch on the "W" spring for future reference then undo it and reset the wiper so the AFM flap is wide open.

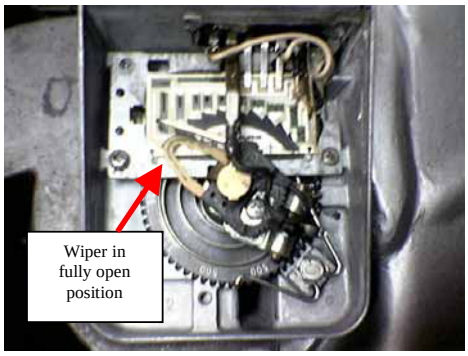


Figure 9: Air flow meter

Otherwise, this air flow restriction will spoil your tuning. The standard AFM aperture is 5cmx4.6cm =23cm2, yet the throttle

valve is about 8cm diameter = approx 50cm2. Therefore, you can see the AFM is the main restriction, although this will be less apparent on a 2.5 than a 3.0. For reference my AFM is from a BMW 735i and its narrowest area is 6.6cmx4.6cm = 30cm2, so although it is 30% bigger than the stock Alfa version it is still way undersized for the throttle valve size.

After starting for the first time let it warm to full operating temperature then assess whether too rich / lean etc. Alter the VE figures a little at a time to dial it in before adjusting acceleration enrichments or cold start enrichments. Get the base VE's for warm tick-over correct first before touching these subsidiary areas.

Play with the MS tuning tools, they are generally straightforward, but remember if you screw the tuning up irretrievably, just open and re-burn the last known working .msq file version you have saved and start again.

You will note my VE table has zero fuelling on full overrun from 2000 rpm upwards, this improves economy but gives a slight "crackle & pop" to the exhaust on the overrun around 2000 rpm, I quite like this sound, but you may not! I chose to waste a line of MAP settings for this, you might choose not to.

For information, at warm tick-over my car shows a MAP value of around 34Kpa, full throttle goes to 98Kpa or so. Cruising gives Kpa's between 30 and 50 depending on speed etc, a gradient sees the Kpa figure climb if holding constant speed and full overrun pulls down to12 Kpa. Note my maximum programmed KPA and rpm points are only 94 and 6700 respectively, even though actual MAP and rpm can go above these figures. MS extrapolates beyond the edge of the table and simply uses whatever the last value was;

having these values overflowing allows me to have a more granular map in the middle where it is more useful. Simply my choice.

When you are happy with the way it runs take the AFM off completely, you will need to salvage an air temperature sensor from a scrap AFM (open element are best), put it in your new inlet pipe assembly and connect the wiring. You need to bespoke this yourself, I haven't finalised my own yet so can't really offer full instructions, although it will involve 4" pipe and a modified air-box lid so I can keep the factory air-box & my K&N panel filter. Although the air inlet pipe for sale by Greg Gordon looks pretty good as a start point & comes with a nice air filter too. Tune the high MAP areas again as you'll now have a lot more airflow even on a stock motor and a higher full throttle MAP value.

For piece of mind keep the original ECU, air-box lid plus AFM & hose in the boot and swap back in about 10 minutes if you ever have to.

Spares

You will have a number of spare parts left over, most are because of the Digikey minimum ordered amounts for some components, however some are because I deliberately suggested you order them, these are:

Four spare FETs just like Q2 & Q7. You only have these because they are handy spares for an area of the board that can suffer problems if the installation is not perfect. You will thank me for having these spares should they play up at any stage.

One spare ZTX751 or similar, again it is purely a spare; just in case you screwed up it is odd upside down mounting.

Three capacitors, one 0.22uf, one 0.1uf and one 0.01uf. These are in case you experience a symptom called “tach spikes”, whereby rpm momentarily reads incorrectly, usually massively too high. This has the effect of sending an overly long injector pulse width and therefore a momentary rich stumble.

This is caused by noise in the rpm input and beware that the GTV6 has a noisy electrical system anyway. A change highlighted earlier in the build on step 51 and the inductors on the fans solved the problem on my car. However, if you still get issues try something called the “Dave cap” (appropriately named after a person called Dave who thought of it), which provides additional buffering to the input circuitry.

Take the smallest capacitor (0.01uf) and solder it to MS board bridging between the “banded” end of Diode D5 and XG1. It is easier to do this on the back of the board, but be very careful to

ensure you solder to the correct places. If that does not cure the problem, try the next size capacitor and so on.

Other than that, refer to the www.msefi.com forum for help and tips.

Most Important Factor of All

Enjoy!

Appendix I: MS to L-Jet connection diagram

TITLE

1981 BMW 528I L-JETRONIC DIAGRAM
Megasquirt Conversion

DRAWN BY	DATE	REVISED
PETER FLORANCE	3/11/2003	03/18/2003

REV.	DESCRIPTION	DATE	BY
1	corrected coolant temp sensor pin	03/18/03	PF

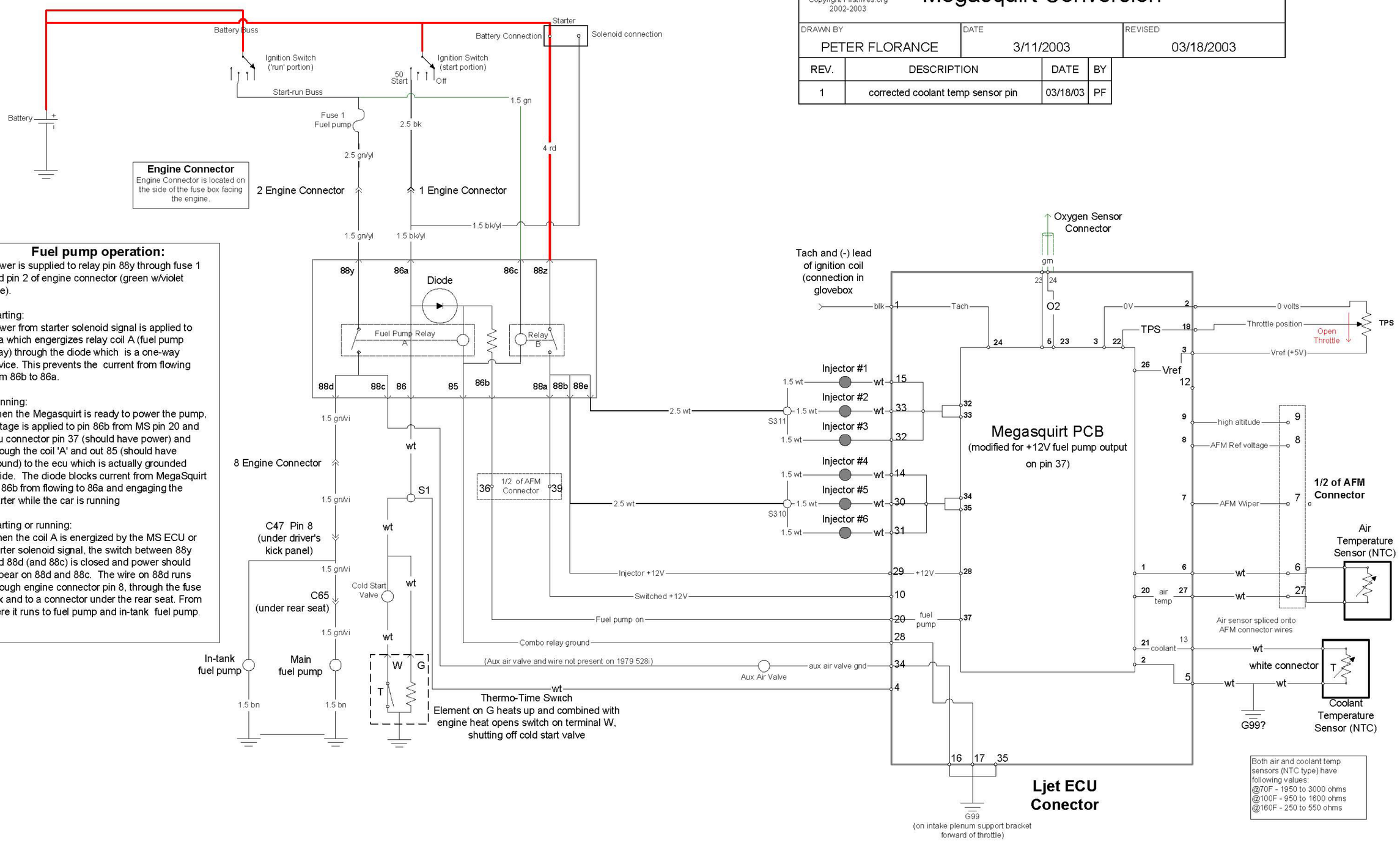
Fuel pump operation:

Power is supplied to relay pin 88y through fuse 1 and pin 2 of engine connector (green w/violet wire).

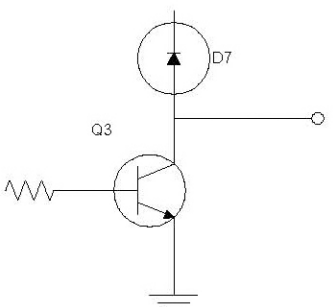
Starting:
Power from starter solenoid signal is applied to 86a which engergizes relay coil A (fuel pump relay) through the diode which is a one-way device. This prevents the current from flowing from 86b to 86a.

Running:
When the Megasquirt is ready to power the pump, voltage is applied to pin 86b from MS pin 20 and ecu connector pin 37 (should have power) and through the coil 'A' and out 85 (should have ground) to the ecu which is actually grounded inside. The diode blocks current from MegaSquirt on 86b from flowing to 86a and engaging the starter while the car is running

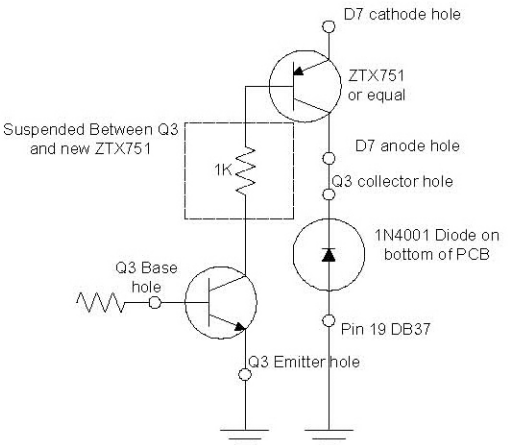
Starting or running:
When the coil A is energized by the MS ECU or starter solenoid signal, the switch between 88y and 88d (and 88c) is closed and power should appear on 88d and 88c. The wire on 88d runs through engine connector pin 8, through the fuse box and to a connector under the rear seat. From there it runs to fuel pump and in-tank fuel pump.



Appendix II: MS Fuel Pump drive circuit



Megasquirt
Fuel Pump Drive



Megasquirt
Fuel Pump Drive for Ljet Combo
Relay