Disclaimer

I am not intending this to be authoritative or even remotely suggest that this is the only or best way to install any of this stuff. I am just an enthusiast sharing my experience.

My only hope is that someone finds this useful and can save themselves a little time by seeing an example and learning from all the dumb things I tried.

Objective

Water injection is a long proven method to reduce detonation under high load conditions which allows for running more aggressive timing and/or more boost with less risk of engine damage. It has the added benefits of breaking down carbon deposits, effectively steam cleaning valves, and also decreasing the intake charge temperature. In the case of positive displacement supercharging, it also helps to reduce rotor temperatures and the liquid improves the effective tolerances allowing a little more boost to be made.

Water/Methanol injection is the introduction of a mixture of water and methanol into the intake system, usually in mixtures of up to 50% Methanol. Higher concentrations can be used but become increasingly flammable so require additional care in mixing, storage and pumping. The main advantage of adding Methanol is that it introduces additional fuel rather than just water, which does not burn.

What is described here is the installation of one particular water/methanol injection system along with a boost gauge and controls and indications to easily turn the system on and off from inside the cabin. I did this in a 2003 XKR but the installation would be similar for other model years and even non supercharged cars.

Parts List

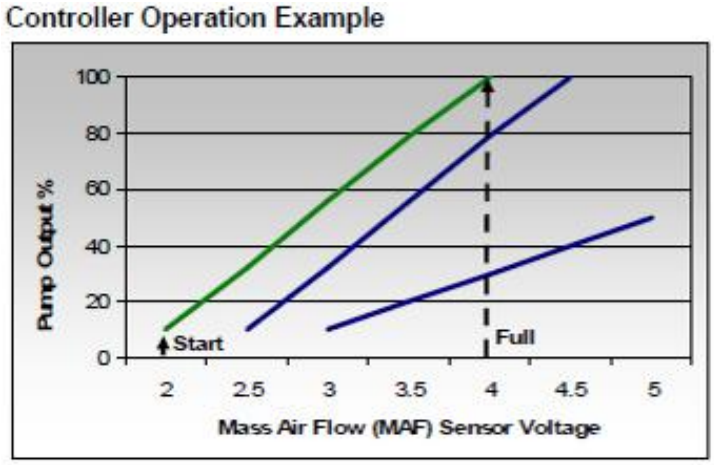
Snow Performance Stage II MAF Boost Cooler
Snow Performance plastic mounting adapter
Podi Electronic Stepper Motor Boost Gauge (English units, white needle)
Various crimp electrical connectors (spade, ring, union)
Various Posi-Lock electrical connectors (http://www.posi-lock.com/)
Various lengths and colors of wire
12V, 30A relay
Generic gauge pod from Autozone or similar
Single 680ohm resistor

Choice of Parts

Many systems are commercially available with different feature sets and it is even possible to entirely build one from scratch, for those that are inclined. The most simplistic systems are either on or off but more complex ones can run off of a signal from either a boost pressure or the mass air flow (MAF) sensor.

Superchargers are fairly non-linear in their boost characteristics but airflow is a reflection of engine load so I chose the MAF style for the better control over the injection timing. In principle at least, using an air flow signal *should* be easier to tune.

Another advantage of the Snow Performance system is that is has a proportional pump control that lets you set an "on" and "full spray" point in the MAF signal. The plot below is taken from the Snow Performance instruction manual and shows some examples of the functionality. To configure the system you choose a starting point of when the pump will come on 10% duty cycle and a final point where it will be on 100%. In between those two points is a linear extrapolation of duty cycle.



I tried to find a boost gauge that would fit in reasonably with the other gauges white text and white needle layout and ended up with a Podi brand. Podi is a Canadian company that normally caters to the VW and Audi crowd but the markings and text matched pretty well with the rest of the instrument cluster.

The Podi gauge actually has a configurable display and needle color, either red or white, in any combination you like. The colors and also brightness are configured by way of a remote control and, once set, the configuration is stored and is not lost even when disconnected from battery power.

The other advantage that this gauge has is that it is an electronic stepper motor type, meaning there is a self contained pressure sensor and only the wiring needs to be routed into the cabin and to the gauge display. The electronics also have some filtering applied to the signal to reduce needle jitter as is common in analog pressure gauges.

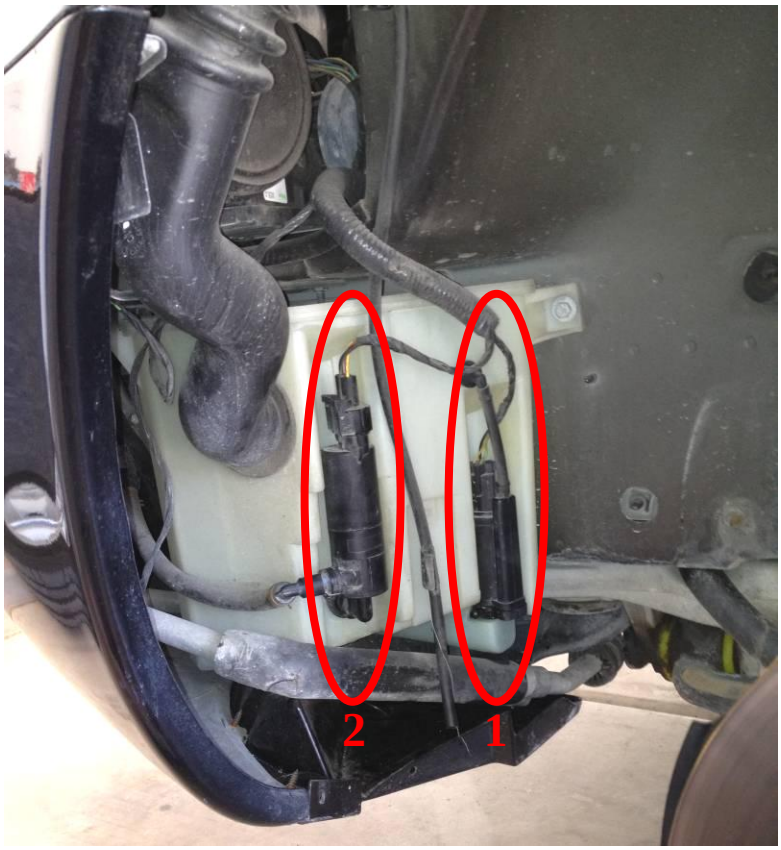
Reservoir

The Snow kit comes with a dedicated reservoir but the XK series has a very large (7 liter) washer fluid reservoir already, which provides an ample source from which to draw. The washer reservoir also has a built in low level sensor, which is a handy indication of when it's time to refill. What's more, there is precious little room under the bonnet of these cars so finding a place to mount the Snow reservoir would have been difficult without going to the boot.

The first step in the installation is to raise the front of the car and remove the left front wheel.

Never support a car with only a hydraulic jack, always use jack stands set at the appropriate jack points to support the weight of the vehicle when doing work.

Remove the wheel liner and also the front undertray (the plastic cover that fits over the front cross member and connects to the bumper corners). The picture below doesn't show the undertray removed, but I ended up taking it off. You should see something similar to this:



This particular car is equipped with the headlight washer option, so has two washer motors mounted. The primary washer motor for the windshield is labeled as #1. The low level sensor is build into this motor assembly.

The headlight washer motor is labeled #2 in the picture. I happen to live in a desert so the washers, in general, are relatively under utilized and the headlight washers are used 6 times less (because they only come on every 6th application), so I was willing to give up the headlight washers entirely in the interest of the water injection.

I removed the washer reservoir from the car to clean it and mount the water injection fitting. It may not strictly be necessary to clean the reservoir but given that there may have been soapy washer fluid used in the past I thought it best to rinse the reservoir out before using it to inject things into the engine.

First step in removing the reservoir is to remove the wash motors. Unlatch the wiring harness from the top of each motor and tuck the wires out of the way then pull the fill neck free. All of the fittings just push into rubber grommets and none of them are glued or otherwise secured so it should not be very difficult to remove any of them.

Get a bucket. Seriously. 7 liters is a considerable amount and unless your reservoir is already empty or you enjoy a pond in your garage, a bucket is required for this part. There really isn't an elegant way

to drain the reservoir, at least that I could think of, so I just pulled the windshield washer motor up from its mount and let the fluid drain out into the bucket below. This takes some time but eventually the geyser will subside.

Pull the windshield and headlight washer motor out of the reservoir. The washer motor will get put back, so it can be left connected and tucked out of the way but the headlight motor can be removed entirely at this point. The connection to the plumbing is a sliding clip type that hooks behind a barb on the motor housing to hold it in place. Push the "U" shaped clip up to release and the hose should pull off. It may take some wiggling but it will eventually let go.

Hang the headlight washer tube down into the bucket as it will drip for a while as it drains. Try to get it as low as possible so that all of the washer fluid works its way out.

Lastly, unbolt the reservoir and remove it. There are 3 bolts securing it in place.

Bolts #1 and 2 aren't too bad to get to but #3 is somewhat hidden away as it mounts upward into a bulkhead and is a little difficult to get to. Once you locate it, it isn't too bad to remove with a socket.

Wash the reservoir out thoroughly with water and let it dry. I pulled out all of the rubber parts, cleaned them and put them back excepting the bung for the headlight washer motor.

What is provided with the Snow kit is an NPT style threaded fitting that has a ¼" slip style compression fitting for the tube output. The Snow kit also includes a tube of industrial contact

adhesive that is safe for use with methanol, which they recommend for using to mount all of the fittings.

Test fit the NPT fitting into the headlight washer bung and you should find that it's a reasonably snug fit. I applied a good helping of the adhesive to the threaded part of the NPT fitting and then slid it into the headlight washer motor rubber bung. Give it a twist to distribute the adhesive evenly and at this point you should see a small bead of the adhesive around the outside of the fitting. Push the bung and fitting into the opening in the reservoir until it's seated and then leave for at least several hours to dry.

Once the reservoir is mounted back in the car, replace the windshield washer motor and adjust all of the tubing so that there isn't any undue stress on it.

Electrical tape the electrical connector for the headlight washer motor to prevent any water or dirt from entering (red circle). The controlling electronics don't check for the headlight washer so there will be no errors or messages about it being disconnected. Cable tie the loose end to the windshield washer harness to keep it from rattling around.

Once it's done dripping, also tape up the end of the headlight washer tubing and also tie it out of the way.

Pump

The pump was the most challenging part of the installation both in the sense of finding a place that it would fit and also physically doing it (4 arms and a lift would have made it a lot easier). The pump for these injection systems are not exactly small, nor particularly light weight.

With that giant washer reservoir on the left side there is essentially no room for mounting the pump in that corner of the car. After much pondering, head scratching and a bit of swearing I decided to attach it to the bottom of the front bumper reinforcement on the left hand side. There is also room on the right side front inside the bumper (opposite where the reservoir is mounted on the left side) but this is quite a long run of tubing for the intake side of the pump loop and I was a little concerned about siphoning fluid that far. The high pressure output side has less a concern about long runs, so there is more flexibility about length.

In hindsight, it probably wouldn't have mattered much, the pump seems pretty capable of pulling the fluid and, as long as the pump is mounted at or below the height of the reservoir, it wouldn't need to work very hard.

The bumper reinforcement isn't quite wide enough to pick up all 4 of the mounting screws so I made a bracket from a piece of steel stock. Nothing fancy, just a flat plate with pre-drilled holes. The two holes in the middle (green) are for securing the bracket in place and are oversize so that the screws thread into the bumper support.

The rearward holes (red) are also oversize because the mounting screws for the motor will also thread into the bumper support.

The forward holes (blue) are slightly smaller as these are the ones where the screws will thread only into the bracket.

When done, I sprayed it with some Rustoleum black paint to keep the rust off.

The supplied screws are self tapping but the bumper reinforcement is a pretty heave piece of steel so I pre-drilled the holes for easier installation. Safety glasses are recommended as you are likely to get a face full of metal chips when drilling the holes and also when installing the screws.

Be careful to drill the holes vertically or even angled slightly outward. There is not much clearance between the pump body and the screw and if they go in strait up it's not a problem but if they start to thread while tilted toward the center of the bracket, they will be very difficult to get installed. Don't ask me how I know this.

The motor is mounted on rubber bushings to damp vibration so you will want the screws snug but not overly tight.

The picture shows the motor from directly below. The side with the tubing fittings is toward the left of the car where the reservoir is and the motor side with electrical connections is facing toward the right. You can see the bottom of the bumper and also the bottom part of the mesh grille.

Right

Rear

Front

Left

The supplied tubing is just enough to install the system as it's described here. There may be ways to do the installation so that it takes a little less, and there are definitely ways to install it such that it will take more. If you decide to install a reservoir and pump in the rear of the car then you will most likely need more tubing than is provided with the kit.

From near the pump location feed one end of the tubing around the corner of the bumper to the area where the reservoir fitting is installed. Connect the tubing, making sure that there are no sharp bend or kinks. I secured it using cabled ties to keep the tube from flopping around too much.

Go back to the pump and measure off enough tubing to connect it to the input side of the pump, again ensuring that there aren't any sharp bends or kinks. Cut the tubing with scissors or side cutters at the location you marked.

Remove the plug from the input side of the pump. You will need to push in on the plastic fitting that the plug slides into to release the teeth that hold it in place. With the plug removed, make sure that the cut on the tube is strait and clean, with no burrs, and then insert it into the pump. It should slide in easily and you will feel it hit the bottom of the fitting. At that point it should be snug and you shouldn't be able to pull it back out.

Connect the end of the remainder of the tubing to the output side of the pump.

The wiring attached to the pump is rather short so you will need to add to its length. I used 16ga stranded wire to extend the length and connected the ends together with crimp style unions before taping them up for protection from the elements. The plan was to route the pump wires up to the engine management bay on the right hand side of the engine compartment near the firewall, so I left a good length of wire to work with. Wire is cheap and it's a lot easier to make them shorter when finishing up than it is to make them longer. Finally, I laid the pair of wires inside a flexible wire conduit for extra protection.

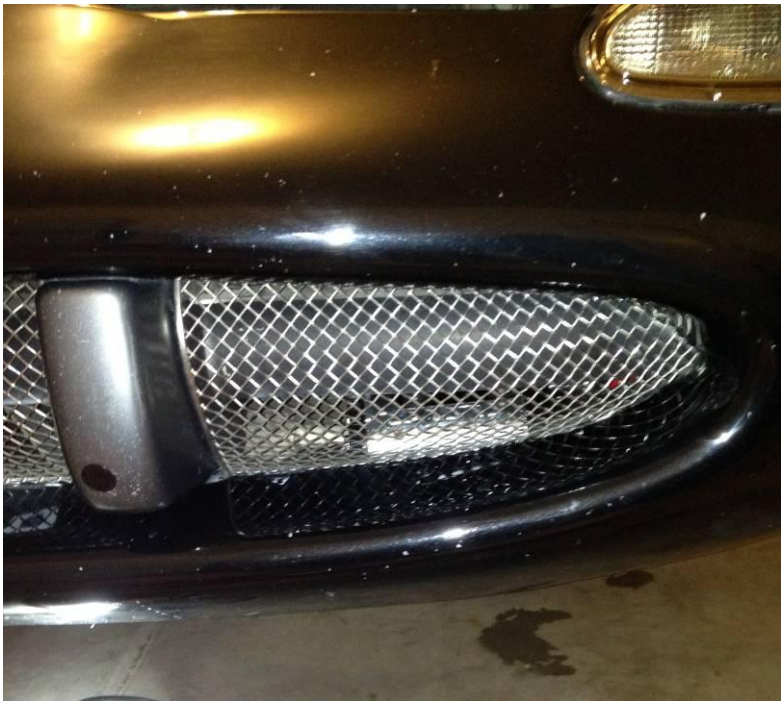
Now to route the wires and tubing across the front of the car to the right hand side. I attached them to the mounting tabs of the mesh grille as this allows a relatively strait run across the front, it isn't near any particular heat source and it's relatively protected from physical damage.

The tabs are a sort of "U" shape (red circle) and it's pretty easy to thread a cable tie through them and tighten it up to hold the wires and tube.

Leave enough tubing near the pump to make the bend without kinking, then tie up the tube near the pump to act as a strain relief. The wire and tube can then be laid together for routing.

Looking up from the below the front bumper there is a path to route the wire and tubing on the outside of the radiator and into the engine compartment just in front of the airbox. Once into the engine compartment I routed the tube and wire under the intake snorkel to keep it out of the way.

Once mounted, the pump is visible from the front of the car and it does overlap slightly with the radiator, but only just. I don't think it will be much of an impediment to cooling.



Intake Tube

Next is to install the spray nozzle bung in the intake tube. There are a number of options available depending on the type of tubing the bung is being installed into but for the stock intake tube I choose the plastic model that Snow Performance offers. Note: This is a separate component from the Boost Cooler and must be explicitly ordered.

There are more than a few schools of thought about what is "best" location to mount the nozzle, and couple of considerations for the jaguar intake in particular.

This installation is being done on a 4.2L and the first consideration is the sheer number of noise dampers in the intake tube. I hadn't really noticed all of them poking out the bottom side before removing the tube from the car. Earlier cars don't have as many to contend with so this is less a problem but my thinking was that it might be a bad idea to spray right over or directly into one of the silencers since it might result in water pooling in the recessed area.

The other, less obvious consideration (at least until you try to mount the bung) is access. The intake tube has a reasonably sized cross section, but is an odd shape inside so getting your hand into the tube for the purpose of mounting the bung can be difficult. The bung mounts from the inside out and I can just barely reach the location shown in the picture.

When you drill the hole for mounting, make sure to clean any loose plastic bits, as you don't want the engine ingesting something like that. After drilling, I filed the opening a little to smooth all of the edges and then cleaned the tube to remove any left over chips or dust.

I put some of the contact adhesive on the bung and inserted it into the hole. While holding it in place from the inside (this is that hard to reach part) I then put more of the adhesive around the base of the bung before threading the nut on. Snug the nut with a wrench and let the adhesive cure.

After the giving the glue some time to cure, choose your nozzle and thread it into the nozzle adapter and tighten per the instructions. I used one of the plugs from the pump to keep dirt out of the fitting while working on the rest of the installation.

The correct nozzle size to use is also a subject of some debate. Per the recommendation from Snow Performance, an XKR in stock form should use the 375ml/min nozzle. There are web sites with various calculators based on displacement and boost that recommend larger nozzles, sometimes a lot larger. The only real consensus seems to be that if you really want to know which one is right for the car, then you have to tune it on a dyno.

For what it's worth, I have tried both the 375 and 625ml/min options and can't tell a big difference in performance when using the butt dyno.

Controller

When doing electrical work is always a good idea to disconnect the battery, especially when working with unfused circuits like those described below.

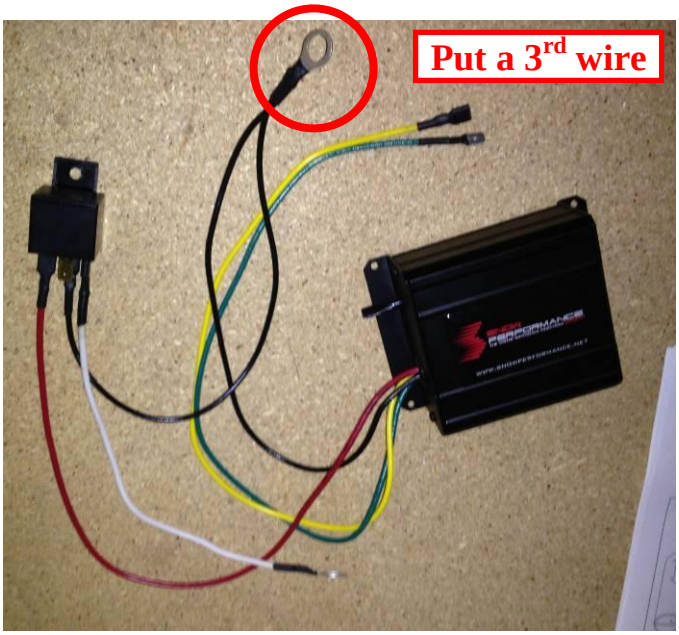
The injection system controller is designed to be mounted in the engine bay, but should be reasonably protected from water and extreme heat. The installation manual recommends against mounting it directly to the engine block, although, if I'm honest, it never occurred to me that someone might think that a viable location. There is some extra space in the passenger side bay, where the ECU lives, which also gives convenient access to a fuse box and a ground, both of which are needed need.

The system needs a circuit with about 15A of usable capacity. There are a lot of circuits in these cars but most are fused for less than 15A and reading through the ones that are rated for more than that, I wasn't getting the impression that any of them had and EXTRA 15A available. Fortunately the controller has a built in circuit breaker, so it's safe to wire it using an un-fused circuit, and there is easy access to a direct battery connection in the ECU bay.

To start remove the plastic bay cover and locate the power and ground. Next to the fuse box cover is a rubber boot, which covers the battery supply for the fuse box (circled in red), and there is a ground bolt at the front of the bay (circled in green)

I wanted to have a switch inside the car to allow turning the system on and off and while you could directly wire the controller through the switch, it would need to be a capable of handling the full current draw of the pump. It would also mean routing large wires through the firewall and to the switch.

The alternative is to use a relay, which let me use smaller wires and a smaller switch. The relay type isn't too important so long as it can handle at least the 15A that the pump requires and I found a 30A model at Radio Shack that worked well which had a screw mount that I could use to attach it.



There are two empty spaces on the relay brackets in the bay, so if you had an extra Jaguar socket, you could use the stock hardware to do this. Not having a socket I ended up modifying the bracket slightly in order to attach the relay with the screw mount, but I think it looked ok in the end.

I won't spend too much time on the attaching of connectors other than to say how they needed to be. Most of the connections I used are spade connectors, except for the battery and ground which are loop type to mount over the bolts.

The relay has four terminals: power in, power out, switch in and ground and the Snow controller also has four: power, ground, pump output and MAF signal input.

Make up a wire for main power to the relay (shown white) with a spade terminal on one end and a loop on the other to go over the battery terminal bolt.

Put spade connectors on the power (red), pump (green) and MAF signal (yellow) wires of the Snow controller. I trimmed their length a bit since all of the connections were nearby where I was mounting the controller. The red wire from the controller runs to the output terminal of the relay.

I tied all of the grounds into a single connecter for convenience. Make up a wire for the relay ground with a spade on one end. Make up another wire with a spade on one end for the pump ground. This isn't shown in the picture because I forgot about the pump the first time around and had to remake it. You could also hard wire the pump ground (one of the wires brought up into the engine bay earlier) but I wanted to have connections for the pump wiring in the bay should I ever need to make changes, so did it with a pigtail.

Take the wire for the relay, the pigtail for the pump ground and the black wire from the Snow controller and crimp all three of them into the loop connection for mounting to the ground bolt.

The relay I picked up had a screw mount, but not being too eager to start poking holes in things I pondered a bit and decided I could use the bracket that the rest of the relays are mounted to.

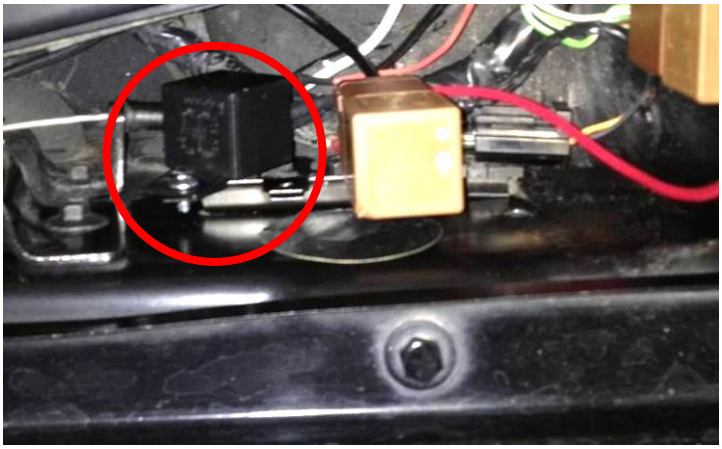
This is the one from the side of the car that has only one relay attached to it and is held on by the 10mm plastic nuts. In the picture the table is the side where it mounts to the car and the relay will mount on the side facing up. You can use a short metal screw to hold the relay on but be sure to drill the third tab (far right) because putting a screw through the middle tab will interfere with the mounting of the plastic dust cover. This is another are where I did it wrong the first time and needed a mulligan.

With the screw in place you will have to notch the back side of the dust cover to make it fit. I used side cutters to nibble away at the plastic and make a notch.

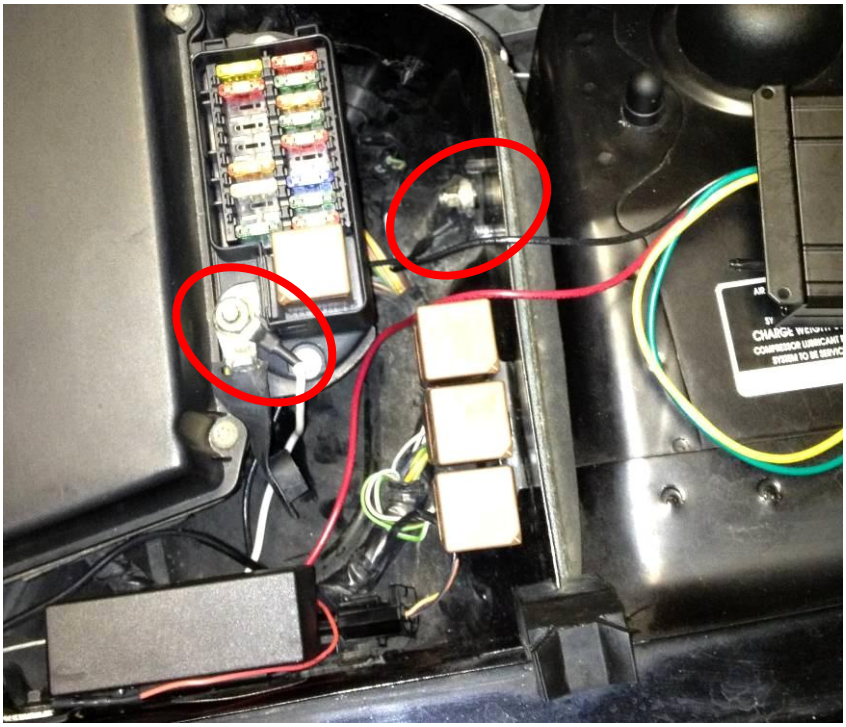
Be careful with the length of the screw. The self tapping metal screw shown here is actually too long and will dig into the fender when the bracket is installed, but it was useful the first time around to get the threads started. Once I had a usable threaded hole I replaced the screw with a non-tapping sheet metal screw that was shorter.

The screw mount relay sits a little lower than the stock ones and you may need to tilt it slightly to get clearance for the wires on the bottom. This picture also shows the final screw I used.

I found it easiest to put the relay onto the bracket out of the car, attach the wires, rotate the relay to horizontal and then mount the bracket in the car. Once the plastic nuts are installed it's easy to rotate the relay back toward vertical and clip the original relay onto the front most tab.

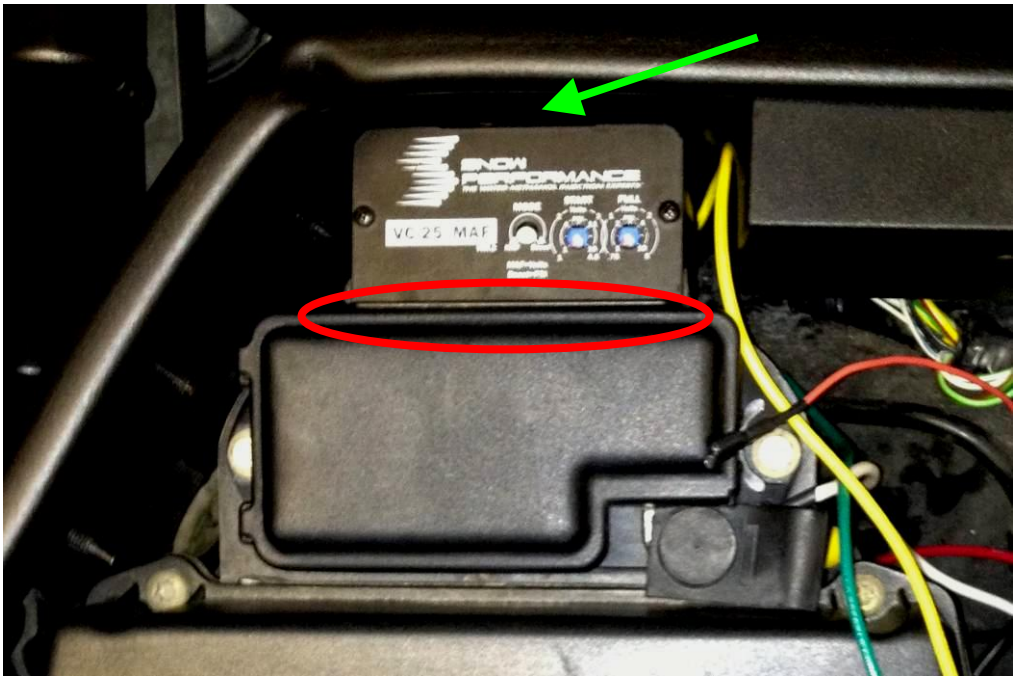


With the battery disconnected I removed the nuts for the power and ground and attached the white and black loop connectors.



The control box fit snuggly in between the fuse box and the outside of the bay. There is a rubberized label on the top of the controller that will prevent metal to metal contact and rattles (green arrow). I attached 3M double sided molding tape to the bottom of the controller and, with the fuse box lid

removed, attached it to the side of the fuse box (red circle). Once the lid is reinstalled you can barely see the tape and there is easy access to the adjustment screws on the controller.



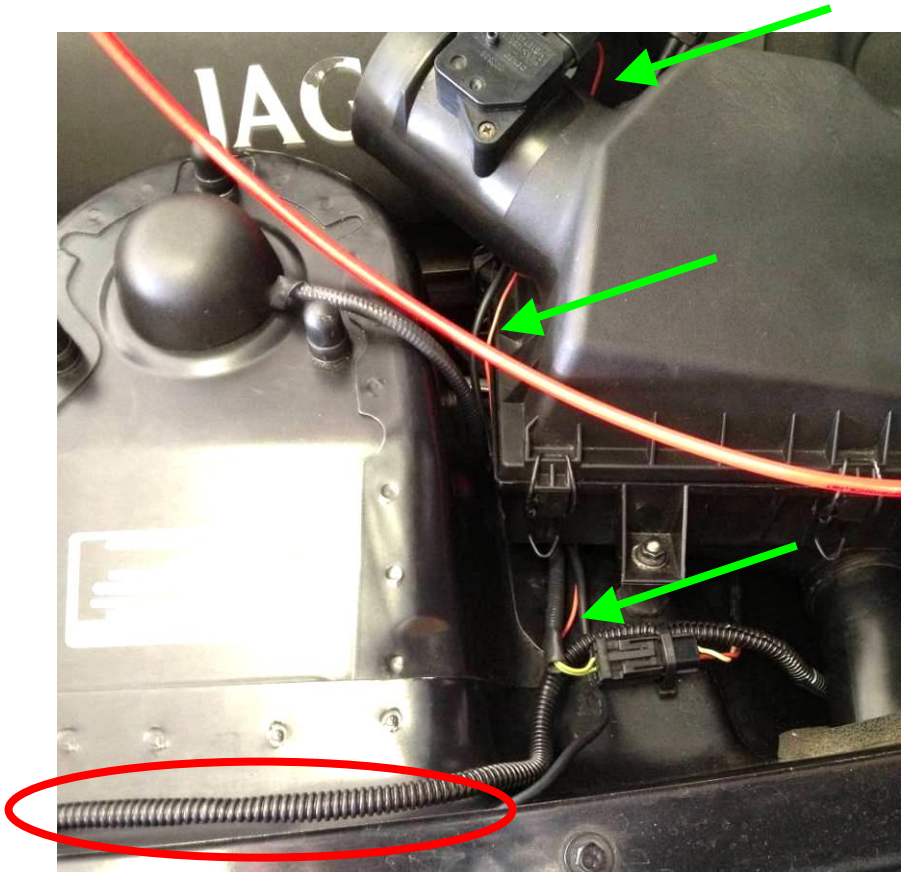
The controller runs off of the MAF signal so I needed to tap that wire. It wasn't obvious where in the harness that's near the ECU the MAF signal wire was to be found so I tapped it right at the MAF sensor where I knew for sure which wires were which. I attached the tap to the Green & white wire (middle, pin #3).

There is only the one clip holding the MAF connector on (red circle) and removing it isn't too difficult, but it does have internal seals so can be pretty tight. If it doesn't pull off easily then I found that inserting a large flat head screwdriver between the connector and MAF sensor body then turning it gently can be helpful to get a little leverage and push the connector off. Work back and forth between the left and right side trying not to get too much an angle on the connector.

It shouldn't be too hard to remove but the clip is pretty stiff so if it doesn't want to budge it could be that it just isn't completely unlatched.

I used a Posi-Tap and attached it to the center wire of the MAF connector. Once I had tested the system I came back and put a little silicone on the Posi-Tap where the wire attaches just to keep any water and dirt out. Posi-lock also makes a self sealing version of their connectors but I didn't have any handy and the silicone works well enough.

With the wire attached I routed it under the intake tube, around the bottom of the airbox (green arrows) and then fed it into the harness with the pump wires (red circle).



To tidy up I added a couple more cable ties to hold the pump harness to an existing connector and tie the tubing to one of the intake resonators (green arrows).