

## Tech

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# Apex'i Super AVC-R Boost Controller Installation

Typically, the first step in increasing boost to gain more HP on TTs is getting a Jim Wolf ECU and 'boost jets'. Boost jets are good for about 12.5-15 psi. However, to run higher boost levels (or to run more steady low boost levels) requires and electronic boost control. If you expect to run more than 12 PSI an upgraded ECU is a must! The remapped ECU is critical to keep proper air/fuel ratios at higher boost levels the stock ECU can't handle. Also larger injectors are needed (555 cc or bigger) to run over 15 PSI of boost safely. The stock 370 cc's won't be able to handle the larger fuel load required.

Wastegates control the amount of boost turbos create. When they are closed, the turbo is the only pathway for air to follow. When the wastegates open, they allow an alternate path for air to move through, allowing boost to drop. The wastegates are controlled by a pair of actuators that move depending on the amount of vacuum pressure applied to them. In stock form, the amount of vacuum is a function of the entire system. With boost jets, the amount of vacuum is restricted slightly, keeping the wastegates closed longer, but vacuum is still a function of the system. As a side note, the stock design has a set of boost cut solenoids in the vacuum pathway to vent any vacuum from getting to the wastegate actuators. The stock wastegate springs, set at 6 psi, are the only things controlling the boost as a fail safe. This is known as 'safety boost'. Generally when an EVC is installed, these solenoids are removed from the pathway. This is good and bad: Good because there's no more safety boost. Bad because safety boost exists for a reason, to protect the engine's functions. Operation of an EVC (Electronic Valve Controller) or boost controller is pretty straight

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forward. It regulates the amount vacuum applied to the wastegates to control the total amount of boost produced. The wastegates are now controlled indirectly by the electronics, still utilizing vacuum provided by the system to the actuators, but in a more controlled fashion. It uses a solenoid to maintain a specific vacuum. In the case of the AVC-R this is accomplished by controlling the solenoid **duty cycle** which determines how long the solenoid stays closed vs. open in a 40 msec cycle, and can be based on RPM, Gear, and Injector Utilization. Another nice feature of the Apex'i AVC-R is that will allow monitoring of a series of functions such as boost pressure, duty cycle, injector utilization, RPM, etc., and can provide a peak hold or a linear map of the results.

For more information on the AVC-R, take a look at <http://www.apexi-usa.com/superavcr2.htm>

The following procedure is compiled from three installations on '90-'93TTs

### Special Tools:

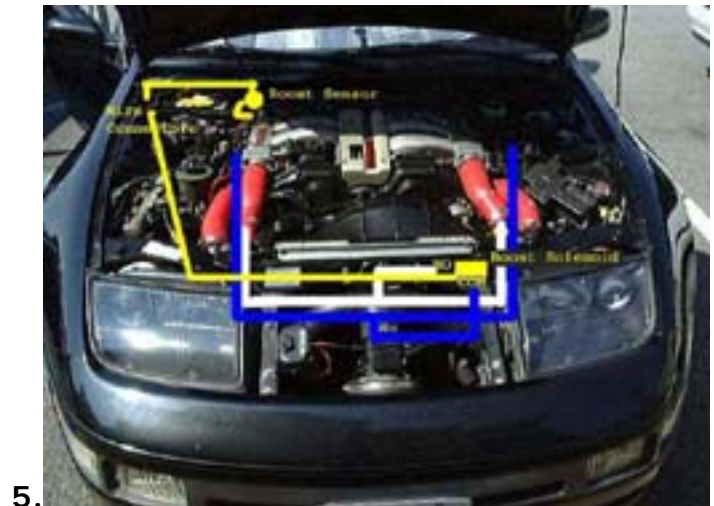
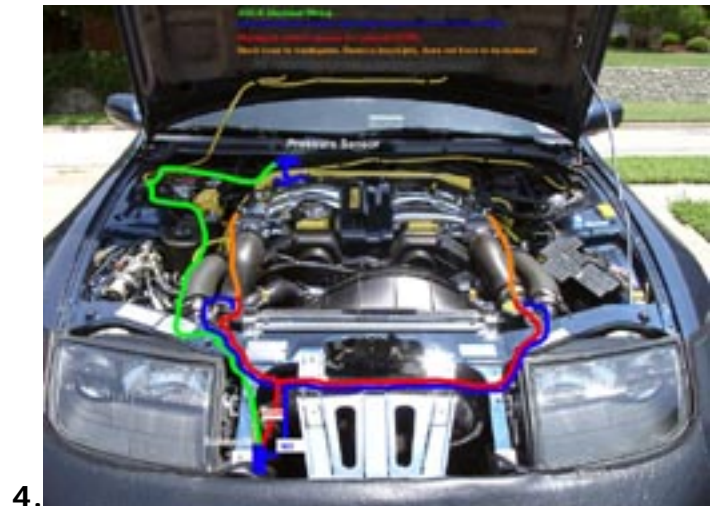
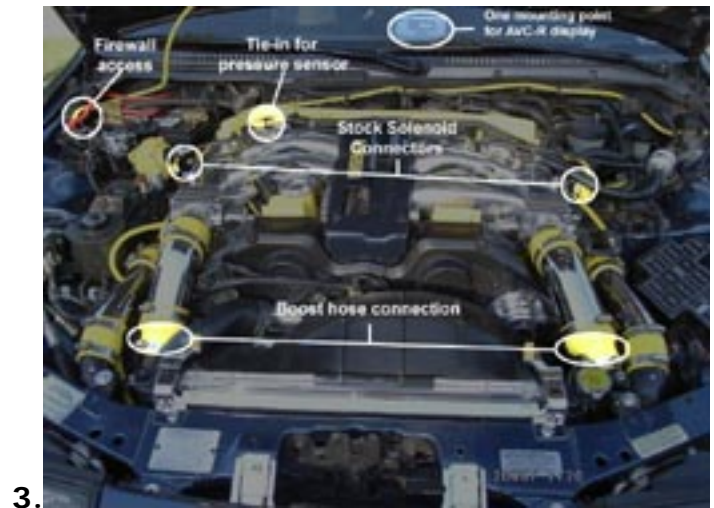
Drill and drill bits *Carbide bits if mounting the solenoid on the front bumper.*  
Soldering iron  
Solder

### Other Items:

Electrical Tape  
10' to 20' of ¼" vacuum hose  
*Although hose comes with the kit, it wouldn't hurt to get some extra, and it's cheap. Re-using the stock boost hoses (the orange lines in 4.) requires 10' of hose. To replace everything requires 20'. The differences are explained later.*  
2 - ¼" Barrel connectors  
Zip Ties *Both short and long. The ones provided won't be enough.*  
¾" #12 nuts, butts, and locking washer or self tapping screws *For the solenoid mount*  
½" #10 self tapping metal screws  
A pair of self tapping metal screws  
2 - ¼" Hose clamps  
Wire coat hanger

### Preparation:

1. Read these instructions entirely and make sure to have all the items and tools necessary. This



includes an inventory check to make the AVC-R kit is complete. Make sure to get everything now as not to be missing something then suddenly having to go out and get it, only to find the store is now closed.

2. Use picture **3.** to locate the following items on the car:

ECU location (passenger floorboard, not shown in **3.**)

Boost solenoid electrical connector (one on each side of engine)

Vacuum hose on passenger side of balance tube (pressure sensor tie in)

Fender opening beside the battery and firewall access inside the passenger fender well

stock vacuum hose that goes to stock solenoids (boost hose connection in **3.**)

### Procedure:

There are 5 distinct components to the installation:

- I. Run wiring harness and splice into ECU
- II. Install the pressure sensor
- III. Install the solenoid and all vacuum hoses
- IV. Install and connect the display unit
- V. Set up the AVC-R parameters

#### **I. Run the Wiring Harness and Splice Into the ECU**

1. Disconnect the battery ground. Turn the steering wheel all the way to the right, exposing the rear of the passenger fender well.

2. Remove the windshield trim overhanging the battery. There are typically two plastic phillips type connectors. If careful (and they're not too brittle), unscrew the center 'screw' then pop them out and reuse them later. Loosen the terminals of the battery and remove them. Remove the battery bracket and then pull the battery and take care not to sit it directly on the ground which will cause it to drain and be ruined. It's best to sit it on a table or a piece of wood. Locate the hole in the fender wall at the base of the battery compartment. It may have a black plastic shield covering it which can be removed. (**6.**)

3. Next remove the screws on the passenger fender liner (**7.**) to gain access through the firewall

6.



7.



8.

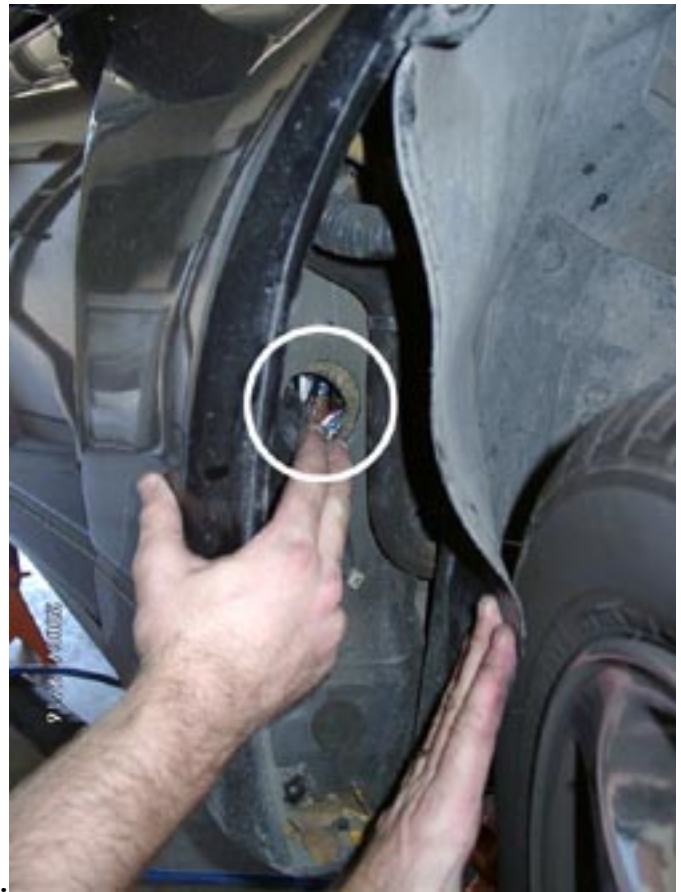


into the passenger floorboard area where the ECU is located. If there is a mud guard installed, remove it to get full access.

4. Expose the ECU by pulling up the passenger floorboard carpeting. Use a 10 mm socket to remove the 4 bolts holding the wooden panel in place (8. - **White circles**). Remove the running board trim (8. - **Yellow circles**). Remove the passenger side kick panel. There is a sunken phillips head screw that holds it in place (8. - **Green arrow**).

5. Feed the AVC-R wiring harness through the hole by the battery (6.). Use a straightened coat hanger and electrical tape one end of it to the AVC-R wiring harness where the bundle of colored wires is hanging out. This will help feed the wiring harness through the firewall. Look inside the fender well and pull loose the big rubber boot that protects the main wiring harness. (9.) This exposes a hole through the firewall. Feed the coat hanger through the firewall and it will poke out in the ECU compartment. Get inside the car, grab the hanger, and gently pull the AVC-R wiring harness through. Also have pull the display unit connector of the wiring harness through. Make sure to pull enough cable through to connect to the display unit in desired mounting location. More on this later. Remove the coat hanger from the harness. I use an Xacto knife and cut a notch in the rubber firewall boot so it can be put back in place and allow the AVC-R harness to rest in that notch.

6. Remove the ECU from the floorboard (3 x 10 mm screws) (10.) Then remove the ECU harness cable by unscrewing the plastic holder (1x 10 mm) (11.). Now the tricky part. The AVC-R wiring harness needs to be spliced into the ECU harness. If using snap-on 'piggyback' connectors, this will go fast. All three of the installs contributing to this page use a solder splice for a more secure connection. Refer to picture 12. for splice points. **Note that the circles show the relative location of the connection. They are not necessarily circled around the proper wire color.** The following table shows the relationships of the AVC-R harness wires to the ECU wires.



9.



10.



11.

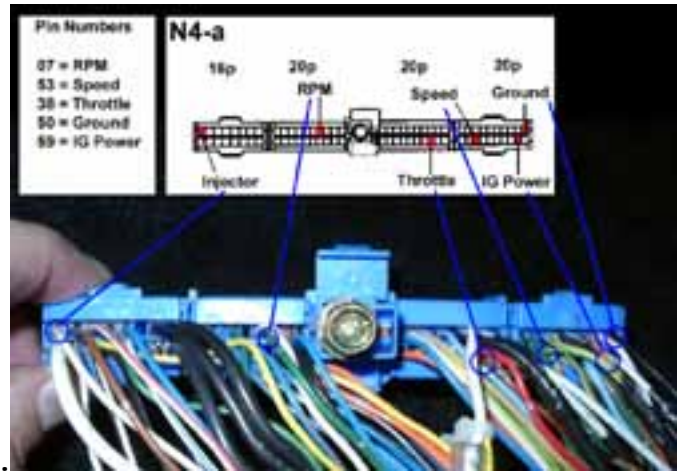
Function	AVC-R Color	ECU color	Pin #
IG Power	Red	White	59
RPM *	Purple	Yellow/Red	07
Ground	Green	Black	50
Ground	Black	Black	50
Throttle	Gray	White	38
Speed	White	Yellow/ Green	53
Scramble	Orange	N/A	N/A

\*The purple wire from the AVC-R is either connected to the RPM signal (as shown in the chart) or to the injector wire. All three installations for this page have connected it using the RPM signal on the ECU.

**NOTE:** For the ground wires, splice both the green and black wires to a single ground wire on the ECU. Splice the GREEN wire closest to the ECU connector and splice the black wire 1/2" further away. Sounds odd, but is rather critical.

My preferred method of splicing is the military splice. It takes a bit more time but guarantees a solid connection. Take the target ECU wire and strip away a piece of the insulation. Using a small screwdriver or other pointed tool, poke a hole through the bundle of exposed wire strands. Next, strip the end from the appropriate AVC-R wire, feed it through that hole and wrap it securely around the ECU wiring. Then, use a soldering iron and heat up the wire until the solder will melt on the wire (not the iron), this prevents a 'cold' solder from happening (breaks apart easily). Use electrical tape to wrap up the splice and make sure that it can't touch any other bare wire. A small zip tie over the electrical tape ensures it doesn't go anywhere. The best method for insulating is using heat shrink tubing and a heat gun.

7. Re-connect the ECU harness to the ECU and reinstall the ECU by reversing the removal procedure. Make **CERTAIN** that you tighten the screw on the ECU harness all the way down. Then push in both ends of the connector to ensure a good seat in the ECU.



12.



13.



14.

## II. Install the Pressure Sensor

8. This entire procedure references picture **13**. The best mounting place for the pressure sender is on the firewall behind the balance tube. Use two self tapping screws to mount the sensor.

9. Use the supplied 1/8" hose and secure it to the bottom of the sensor. I prefer to use zip ties to secure all vacuum connections, but the provided brass clamps work too.

10. Determine where to tap into the vacuum system. On Carlos' install, the stock boost gauge hose was used (**Inset 1, 13.**). On Greg (Dallas)' and nixit (Da][as)' installs, the sensor was tapped into the vacuum hose running between the balance tube and the fuel dampener (**Inset 2, 13.**). Carlos' method is probably easier as the hose for the fuel dampener is very short which makes it harder to deal with. Cut the selected system vacuum hose and insert one of the small T's. Then attach the other end of the pressure sensor hose to the T. Secure all connections with zip ties or hose clamps.

11. Find a point on the new hose and cut it to insert the AVC-R supplied air filter, which is the clear top/UFO looking thing. (**Circled in 13.**). Again secure the connections with zip ties or hose clamps. These tend to fail over time, if problems arise later, this is the first item to check for leaks.

12. Connect the sensor into the wiring harness. From the hole in the fender wall by the battery (**6.**), run the sensor connector around the back of the battery compartment along the firewall and secure it in various places with zip ties. Be **SURE** to not let the harness hang close to the plenum or other part of the rear of the engine that will get very hot. Disconnect the stock boost solenoid electrical connectors. There is one on each side of the engine. The easiest way to spot them is they are rectangular black connectors... everything else is grey. (**14.**) (**15.**)

## III. Install the Solenoid and All Vacuum Hoses

13. Remove the throttle body hoses. These are the big black hoses in the front of the engine. I recommend marking them if the factory colored



15.



16.



17.

paint dots are worn off or keep track of them to know which side is up and what hose belongs where. A good idea is mark the hoses from left to right as 1,2,3 and 4. This will only save headache later if done now. Once the hoses are removed stuff the opening with some shop towels to avoid anything falling inside. This is a good time to do a [throttle body cleaning](#).

14. Remove the center panel (4 x 10 mm). On '90 models there may only be 2 bolts. Depending on where the solenoid will be mounted (see next item) the intake might need to be removed. This entire procedure assumes a cone intake is installed. To remove it, first release the mass airflow sensor connection which is the black box just above the cone part of the intake. Unscrew the filter from the shield, if it's connected. This is located on the end of the filter. Loosen the two hose clamps on each end of the larger rubber T using a flathead screwdriver or 8 mm socket and pull the entire intake assembly out. Stuff rags in the remaining openings to make sure nothing falls into the intake tract.

15. There are several different mounting places for the solenoid. Pick a favorite. On Greg's Z it is mounted directly against the front bumper. On Carlos' Z it's mounted on the driver's side behind the POP charger. On Nixit's Z (displayed in the images) it is mounted on the passenger side headlight wall near the bumper. Things to consider for placement: Make sure the vacuum hoses can't be interfered with by the auxiliary fan. If planning to install a dual POP charger later, put the solenoid where it won't have to move again.

16. If mounting the solenoid directly on the back of the bumper, the carbide drill bits are needed to drill through the steel. Otherwise, normal drill bits can be used. Get the rectangular black rubber 'cushion' out of the AVC-R bag of parts and use it as a template to drill your holes. There are four screws but two should be plenty. Drill the holes, then secure the solenoid in place with the screws. **Make sure to put the rubber 'cushion' between the solenoid and the mounting point.** Nixit's installation is shown in (16.).

17. Thread the electrical harness for the solenoid from the battery compartment forward to the center panel area. There are several points along



18.



19.



20.

the way to zip tie it down to make the installation neat. Poke it through an opening by the radiator on the passenger side. **(17.)** Connect the harness to the solenoid.

18. Disconnect the stock boost hose underneath the **INTAKE** pipe on each side of the engine. This is the pipe connecting up directly to the throttle bodies. **(passenger side 18.)** The yellow lines indicate where the hose actually connects underneath the hard pipe. **(driver side 19.)** points out the correct hose.

**NOTE: On the passenger side, make SURE to remove the correct hose. The stock recirculation valve hose connects to the other hard pipe on the passenger side. The line in question is closest to the radiator.**

If boost jets were installed, they will be in the ends of these two hoses. If they're close to the end, use a pair of needle nose pliers to squeeze the hose behind the jet and work it forward and out of the hose. or cut the hose behind the boost jet.

19. The **easiest** way to install the AVC-R is to simply connect new hose to the ends of these boost hoses which go down to the wastegate actuators. By disconnecting the stock solenoids earlier, it effectively kills the stock boost control system. However, contrary to what many people believe, there **ARE** stock boost jets installed at the other end of these hoses (near the stock actuators). By leaving this hose in place the car will run slightly higher 'natural' boost, i.e. when the AVC-R is totally off, it will still be able to run about 9 PSI. With these hoses completely removed and replaced by new hose, it will run the correct 'natural' boost of 7 PSI with the controller turned off.

20. Greg's installation completely replaced the hose all the way to the wastegate. The main reason this was done is because he was already down in the engine replacing the valve covers and plenum. Both Carlos and nixit used the existing hose because it's a **lot** less work. If choosing to replace the entire hose, remove the hard pipes running alongside the engine to get to the other end of the hose. There is a T down there connecting the hose to the wastegate actuator and the stock boost cut solenoid. Connect new hose in



21.



22.

at this point and cap off the stock solenoid with a vacuum cap. Sorry, no pics of this procedure as Greg didn't have the digital camera when he did the work on his car.

21. Connect the ¼" hose to the output where the stock boost was connected on the hard pipe up front and use the clamps provided with the AVC-R kit or zip tie them down. Run through the headlights around past the center panel and back onto the other side. Yes, this is a loop!

**NOTE:** Since the hose has to loop back on itself to go to the front of the car, take care that you don't get a tight crimp in it. Also, be careful on the passenger side not to end up with an excess of hose in that area near the alternator pulley.

22. Now connect a ¼" barrel connector to the stock boost hose for both the driver and passenger side and clamp or zip tie them down as well. Run another piece of new ¼" hose from one barrel, through the headlight, center panel area, headlight and connect it to the other barrel connector on the other stock hose. Loop #2. Clamp or zip tie everything down.

23. Tie the solenoid into these two loops. Split each loop in the middle to make an equal length on each side. Insert a ¼" T connector. Cut an appropriate length of hose and run from the solenoid to the T. Connect the COM side of the solenoid to the loop that goes to the wastegates. Connect the NO side to the loop that is connected to the front hard pipes (intake side). Clamp or zip tie all connections. Finally, secure the hose to various parts of the car (frame walls, auxiliary fan, etc.) with zip ties to keep the hoses secure. Take care, if necessary, that the hoses cannot come in contact with the opening in the auxiliary fan. Pictures **20.** & **21.** show different approaches for the hose connections and solenoid placement.

**NOTE:** Picture (**21.**) was taken before the install was finished. Do not leave loops in your vacuum hose as is shown in the picture. After the picture was taken we pulled the rest of the hose through and got rid of the loops. Also, the T's in Nixit's install are closer to the passenger side so they wouldn't lay over the cone intake. However, the length of hose is still the same to the passenger and driver's side. We just allowed more hose on

the passenger side that is not seen.

24. Remove the rags from the intake tract.  
Reinstall the intake if it had to be removed.  
Reinstall the throttle body hoses.

#### **IV. Install and Connect the Display Unit**

25. This part is very subjective and just depends on personal preference. Greg (Dallas) installed it using the supplied bracket on the dashboard above the center console. Carlos installed it in the second DIN slot of the center console and nixit's is installed in the glove box. Picture (22.) shows a couple of options.

#### **V. Set up the AVC-R parameters**

26. Reinstall the battery and connect the terminals. Reinstall the trim piece above it.

27. Start the engine. Go to the engine bay and listen for leaks, locate any and clamp them down tighter.

28. Enter the monitor section of the AVC-R and see if it reports a good throttle position (surge the engine to check), a good boost pressure (should be about 1 Bar), speed should be zero as the car is not moving, and RPM should be very close to what the dash reads.

29. There's been quite a bit of debate about how this thing actually works. Basically, the FIRST thing to do is go to Car Settings and do the following:

Cyl: 6

Speed: 2

Throttle: rising arrow from left to right

Decide how much boost to run. If there is not an upgraded ECU installed, set the boost no higher than .8 bar (roughly 12 psi) to be safe. If there is an upgraded ECU, and stock injectors, set it to 1 to 1.05 bar (14 - 15 PSI). If there are 555 cc injectors, set it to around 1.15 - 1.2 bar (17 - 17.5 PSI).

**NOTE: These are just GENERAL guidelines.**

**Remember, too much boost will kill the engine fast, so if deciding to run extreme amounts of boost, don't come cry to us when the motor explodes on the freeway. Basically, this means take some responsibility for your actions, because we won't.**

30. The AVC-R has three setting modes, A, B, and OFF so there are two different boost settings. Choose one of them and set the base boost level as desired. What actually controls the amount of boost is the duty cycle, not the boost setting. For 1 bar, try starting around 58%. Higher percentages = higher boost.

31. It is a good idea to find out what the 'natural' boost is with the system off. Set the AVC-R to OFF (hit the left arrow in the selection mode). Then go to the boost monitor screen. Find a stretch of deserted road and make a wide open run in 3rd or 4th gear (4th goes to ~126 MPH). The boost monitor screen should tell what peak boost was. It should be around 0.5 - 0.65 bar (7 - 9 psi). This will show what the car will boost with no boost controller at all (Good to know). Put the AVC-R in the desired boost mode (A or B), get into 3rd or 4th gear again, and go full throttle again. If it boosts over your target amount, reduce the duty cycle and try again. If it boosts under, raise the duty cycle.

32. Once it boosts correctly, make 2 more runs in succession (this means wide open throttle). My understanding from LRD VDR and others is this triggers the AVC-R into self learning mode which is supposedly a 'good thing'. Go back to the boost setting screen and if the duty cycle displays '\*\*\*' then it is in self learning mode and you're good to go.

[Greg \(Dallas\)](#)

[Carlos Ramirez](#)

#### **Other Credits:**

*Greg:*

Thanks to Kyle @ SGP who sold me my AVC-R and gave me the first introduction to it when I installed it on my car.

Thanks to LRD VDR who has helped me understand it a bit more than I did before.

Thanks to nixit (Da][as) who was a willing guinea pig for my second install :-)

*Carlos:*

I like to give credit to Sam from <http://www.jspec.com/> who sold me the AVC-R,

to Gyro from DSP Racing who helped me with

some of AVC-R settings,  
to Orion (John) from TT.NET who helped me with  
various questions, and  
to Tom Bullinger who's web site I used as  
reference in the installation process ([http://www.  
frontiernet.net/~tomb/BoostController.html](http://www.frontiernet.net/~tomb/BoostController.html))

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