Smithabusa's 4 Stage Gear Based Boost Controller

Greg Smith
SMITHABUSA
g.smith@linktestlab.com
313.743.4504

INDEX

I. Hardware Included:

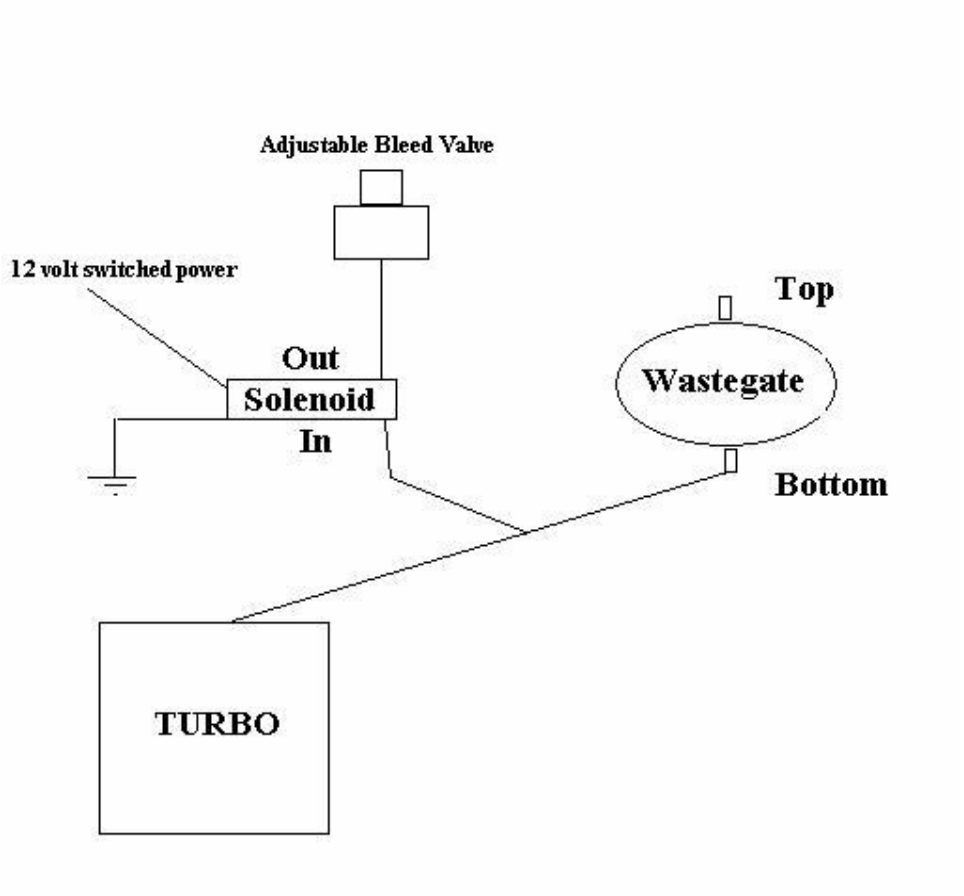
1	Modified GPS Sensor with 5th gear resistor soldered in
3	1/8 NPT 12 volt solenoids
2	1/8 NPT bleed valves
1	1/8 NPT Mini Adjustable Pressure Regulator
5	1/8 NPT 90 Degree Fittings
6	1/8 NPT Hose Barb Fittings
1	1/8 NPT Male to Male Adapter
2	8-32 Threaded Rod
4	8-32 Nuts and Washers
1	Male / Female 4 Pin Molex Connector
1	Flow Control Device
1	3/16” Plastic T Fitting
2	3/16” Plastic Y Fittings
1	3/16” to 1/4” Plastic Adapter
10	Feet of 3/16” Vacuum Line
6	Inches of 1/4” Vacuum Line
10	Small Zip Ties

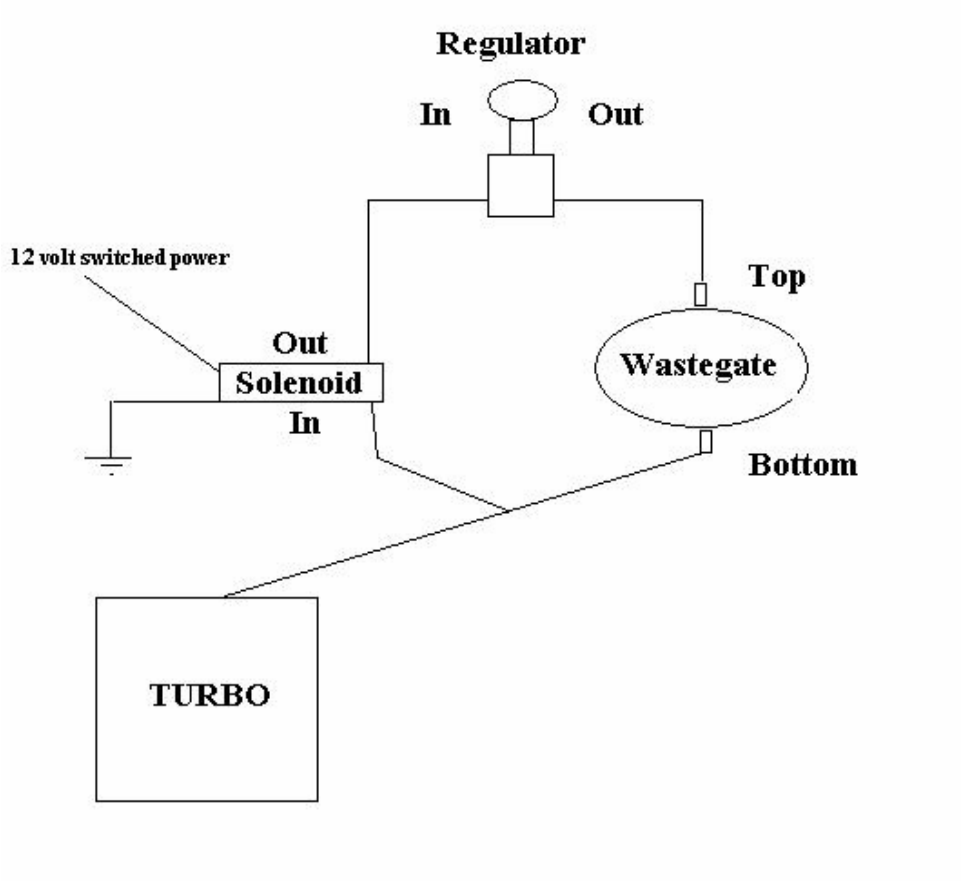
TOOLS / SUPPLIES NEEDED FOR INSTALATTION:

3/8” Open End Wrench
Small Flat Screwdriver
Wire Strippers
Soldering Gun
Solder
Shrink Tube
Also need all tools required to remove clutch cover and basket

II. Boost Control Basics:

There are 2 simple easy ways to increase boost above your current wastegate setting. On a dual port wastegate you can either bleed boost pressure off of the signal line which goes from your turbo/throttle bodies/plenum to the bottom of the wastegate. Any simple bleed device can allow more boost before the valve in the wastegate opens. The other way to increase boost is to add regulated air pressure to the top of the wastegate. This can be done with an adjustable pressure regulator, just like your air compressor may have. Air pressure added to the top of the wastegate in addition to the spring mounted in your external wastegate both act against the force exerted by the port on the bottom of the wastegate.





4 Stage Gear Based Boost Controller:

This boost controller uses both methods mentioned above to raise boost higher than the wastegate spring pressure. The standard 4 stage boost controller works as follows:

1st Gear: Wastegate spring pressure only
2nd Gear: Solenoid and bleed valve (the more you bleed off the more boost you will get)
3rd Gear: Solenoid and bleed valve (the more you bleed off the more boost you will get)
4th – 6th Gears: Solenoid and adjustable pressure regulator (the more air pressure you add to the top of the gate the more boost you will get)

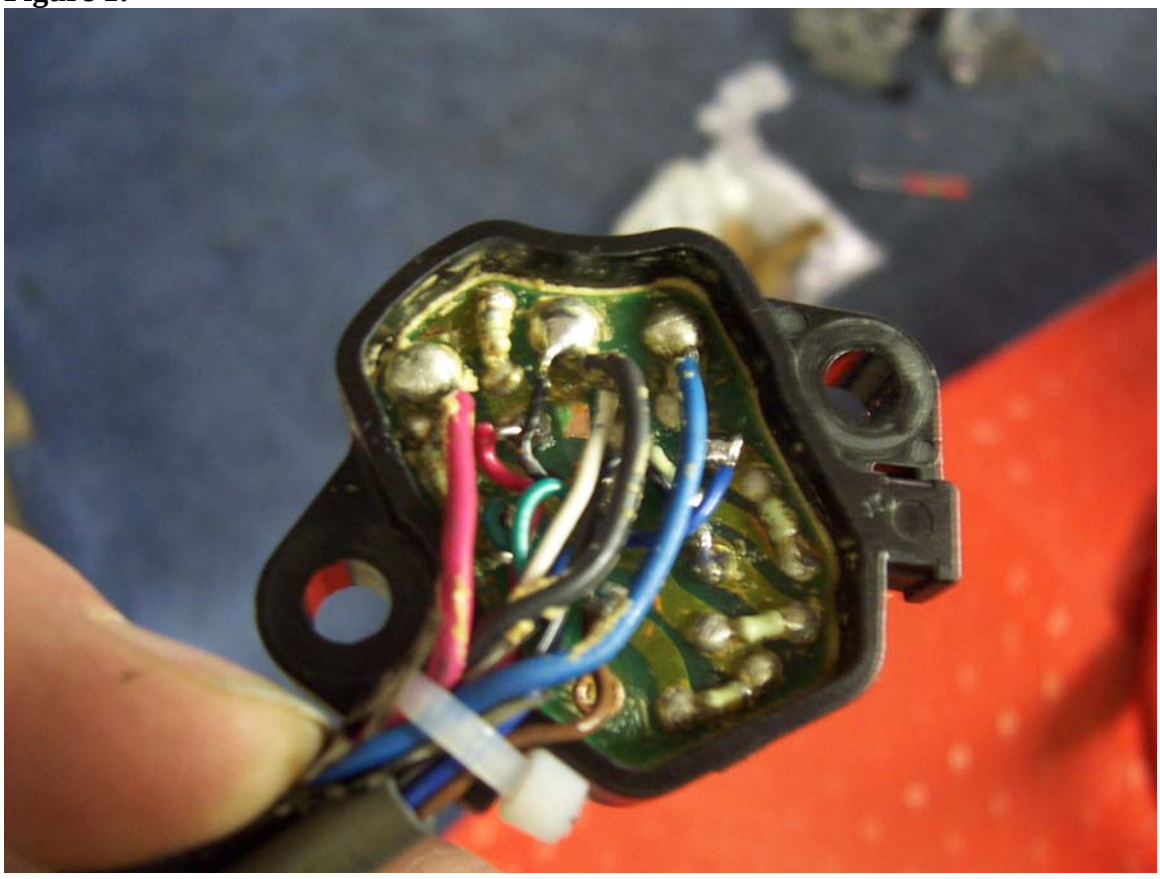
In order to arm the stages of boost I have modified a stock gear position sensor to provide grounds to the solenoid for each gear you have selected. With solenoids now connected to the gps signal, it is necessary to wire in a resistor just like a TRE to keep goofy GPS readings from throwing the ECM into default 6th gear map. On 99-00 bikes this doesn't matter, on 01-current bikes this will bring the rev limiter on early in every gear as the bike will default to 6th gear map. I am using the 5th gear resistor as a standard as there are so many out there with TRE's which use the same. I can wire in any non 6th gear resistor that you like if the 5th gear isn't adequate for your situation.

Figure 1 shows the wiring needed for the GPS to function with the boost controller. As a standard, I wire all GPS sensors as:

1st Gear: Red
2nd Gear: White
3rd Gear: Blue
4th Gear: Black
5th Gear: Green
6th Gear: Brown

High-Temp Black RTV is used to seal up the connection and keep oil out of the sensor.

Figure 1:



III. Installation:

I have included the few pages from the service manual that show how to remove the clutch basket as you will need to get at the stock GPS sensor and install the modified one. Be careful not to drop the small pins and springs that make contact with the sensor into the oil pan.

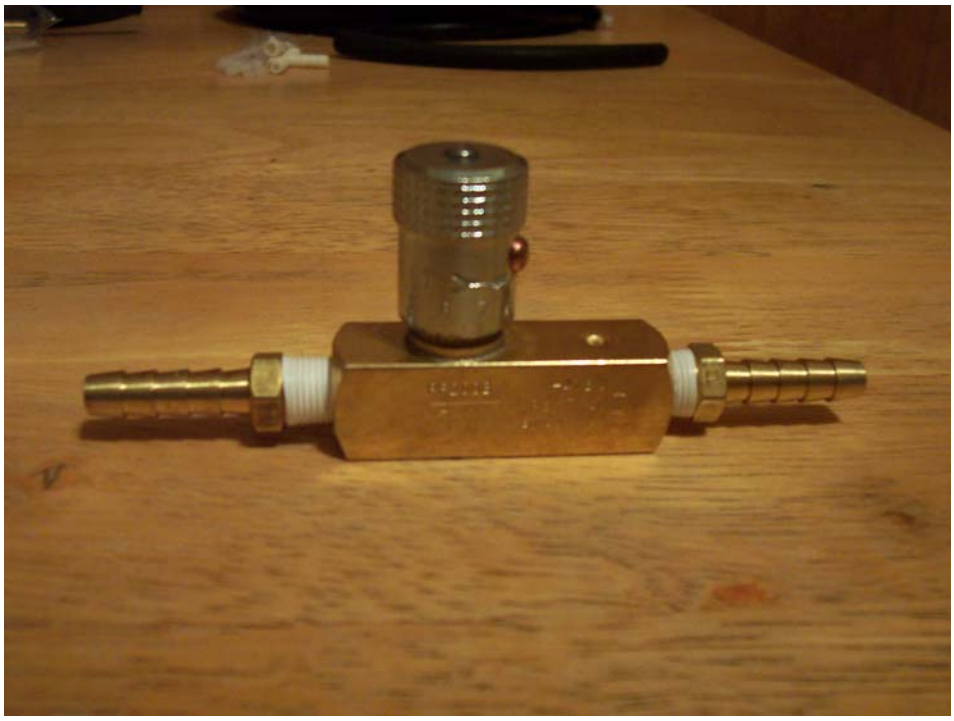
Remove the old sensor and install the new one. There are only 2 wires that will need to be wired up on the bike. The black wire is the sensor ground which is needed to supply ground as the ECM wire has had a resistor soldered in. The other wire needed is the red wire coming from the white connector; this is the 12 volt power supply for all of the solenoids. Run this to key on fused power at a minimum. If you wish to be able to completely shut boost control off then wire the power wire to a switch (make sure it's still key on power only). Now if you can't get good fuel, or are letting the wife ride the bike you can shut off boost control and keep the bike at spring pressure only.

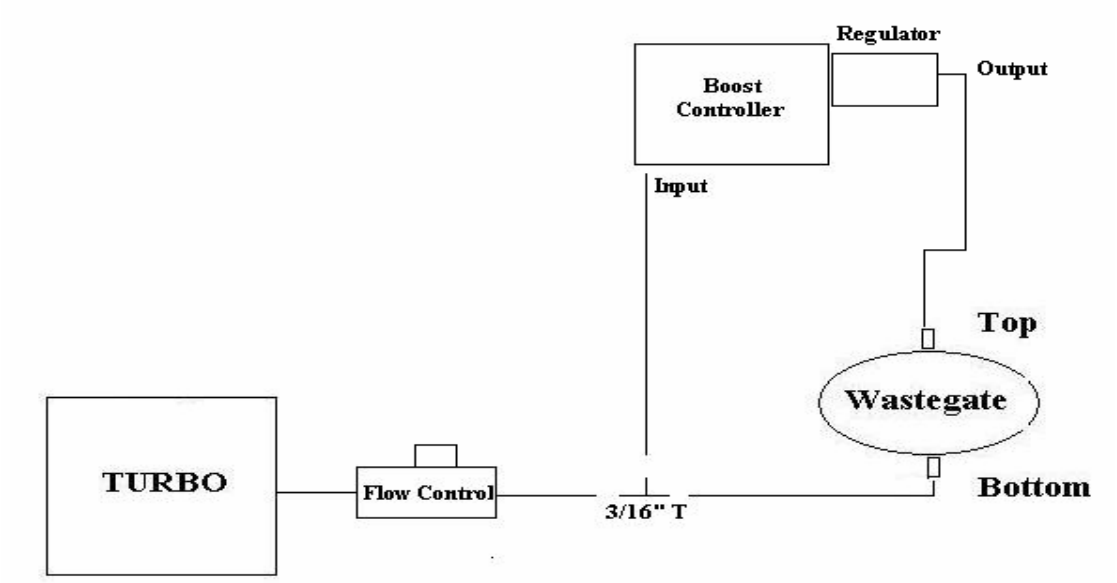
I would recommend mounting the boost controller in the tail section of the bike away from heat. It has been said before that solenoids can break down under extreme heat that occurs under the tank.

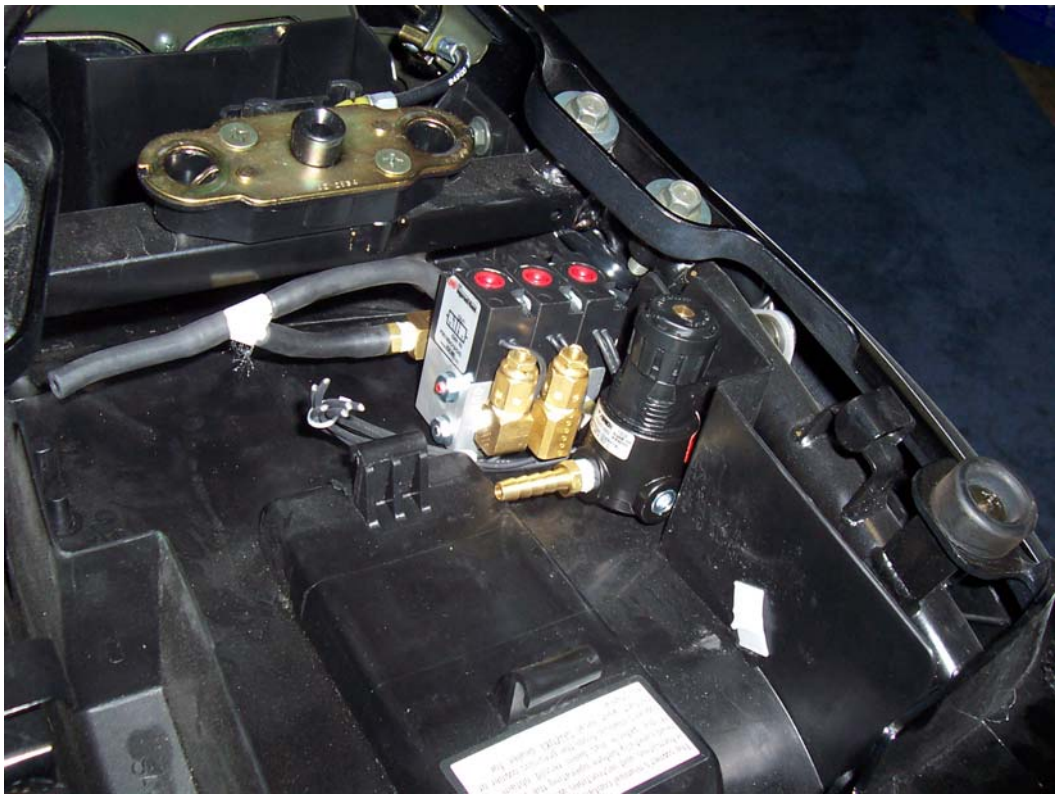
There are 2 vacuum lines you will need to connect on the boost controller. The vacuum line at the top of the boost controller photo needs to be T'd into the wastegate signal line (this is the line that goes from your turbo/throttle bodies/or plenum to the bottom port of the wastegate). The hose barb you see coming out of the regulator goes to the top side of the wastegate. I have also included a flow control valve which limits the volume of air going to the wastegate. The smaller volume or air you have going to the wastegate, the less you need to bleed off using the bleed valves to increase boost. You can make the bleed valves more or less sensitive by increasing or decreasing the air flow through the flow control valve. The flow control valve must come before you T into the signal line so that both the wastegate and the boost controller see the reduced volume of air. Use zip ties on all vacuum lines once pushed over the barb fittings.

Boost Controller

Flow Control

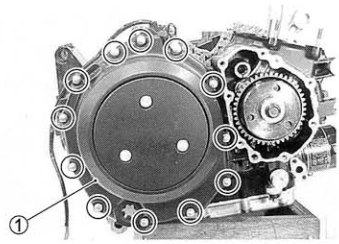



Regulator
Boost Controller
Output
Input
Top
Wastegate
TURBO
Flow Control
3/16" T
Bottom



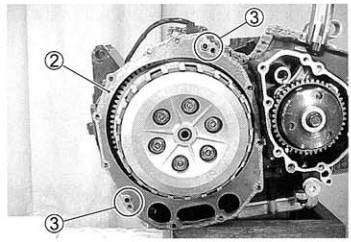
CLUTCH COVER

- Remove the clutch cover ①.



NOTE:
When removing the clutch outer cover, remove the three bolts.

- Remove the gasket ② and dowel pins ③.

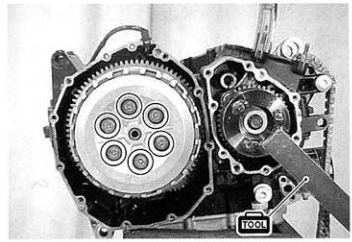


CLUTCH

- Hold the starter clutch with the special tool.

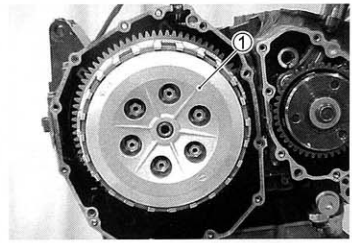
TOOL 09920-34830: Starter clutch holder

- Remove the clutch springs.

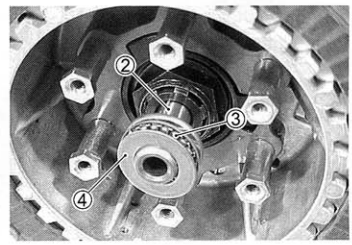


NOTE:
Loosen the clutch spring set bolts little by little and diagonally.

- Remove the pressure plate ①.



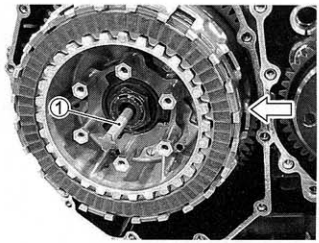
- Remove the clutch push piece ②, the bearing ③ and the thrust washer ④.



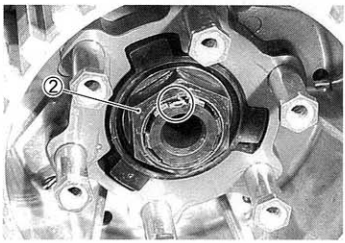
- Remove the clutch push rod ①.

NOTE:
If it is difficult to pull out the push rod ①, use a magnetic hand or a wire.

- Remove the clutch drive and driven plates.



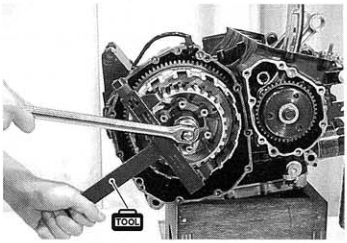
- Unlock the clutch sleeve hub nut ②.



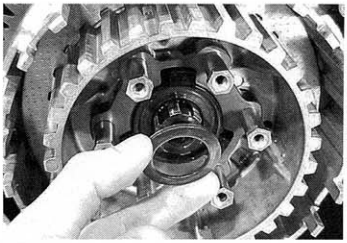
- Hold the clutch sleeve hub with the special tool.

TOOL 09920-53740: Clutch sleeve hub holder

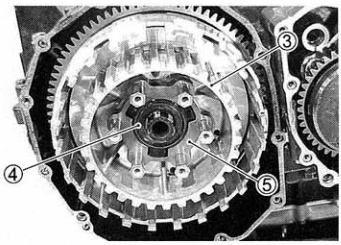
- Remove the clutch sleeve hub nut.



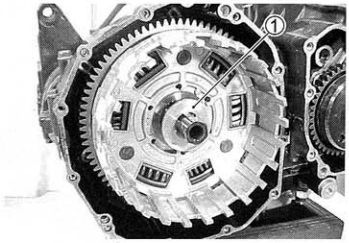
- Remove the washer.



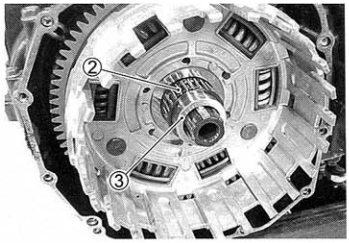
- Remove the clutch sleeve hub ③, the clutch drive cam ④ and the clutch driven cam ⑤.



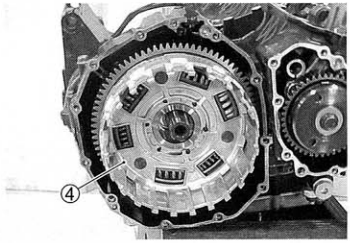
- Remove the thrust washer ①.



- Remove the bearing ② and the spacer ③.

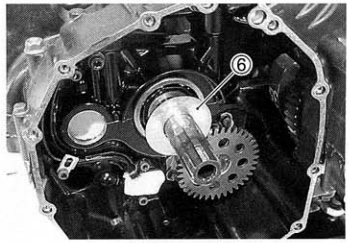


- Remove the primary driven gear assembly ④.



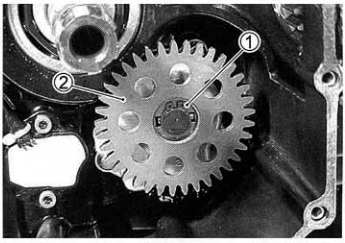
- Remove the oil pump drive gear ⑤ from the primary driven gear assembly ④.

- Remove the thrust washer ⑥.



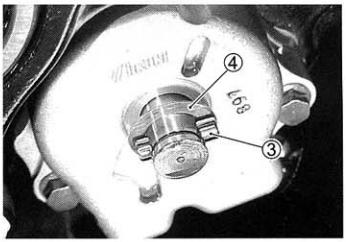
OIL PUMP

- Remove the circlip ①.
- Remove the oil pump driven gear ②.

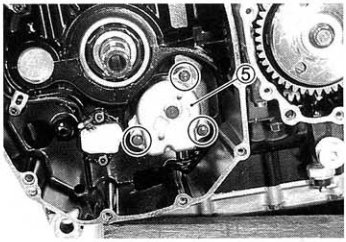


NOTE:
Do not drop the circlip ①, the pin ③ and the washer ④ into the crankcase.

- Remove the pin ③ and the washer ④.

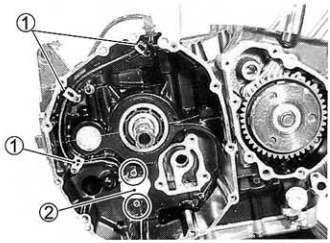


- Remove the oil pump ⑤.

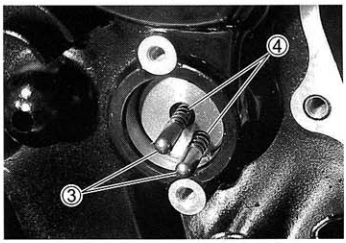


GEAR POSITION SWITCH

- Remove the gear position switch lead wire clamps ①.
- Remove the gear position switch ②.



- Remove the switch contacts ③ and the springs ④.



IV. Testing Boost Controller

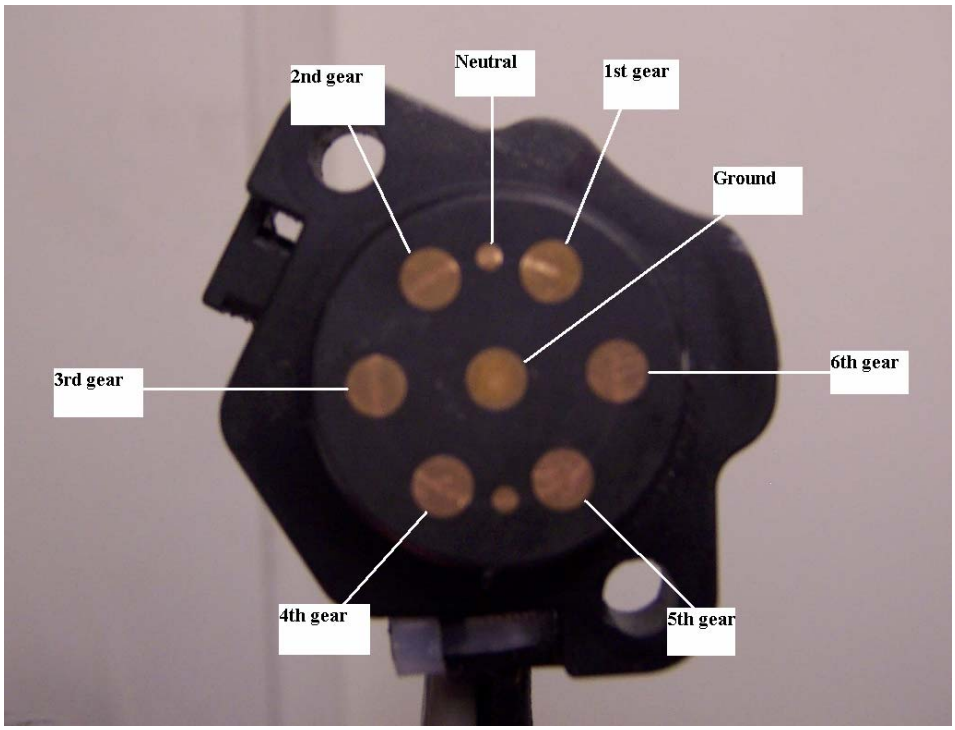
I have already tested everything on the bench, but it's always a good idea to test everything, it can give you a better understanding of how the device works. You can simply plug the GPS sensor in, wire up the power and ground, connect the GPS to the boost controller, and you can now verify proper operation without pulling the clutch basket. Once you have power going to the solenoids, and a good chassis or battery ground going to the sensor you can manually jumper the GPS sensor to each gear 1-6. Take a small piece of wire, touch one end to the center ground pin, and touch the other end to each corresponding gear you would like to test.

With the basic 4 stage boost controller the following should happen:

1st gear	No activity
2nd gear	The first solenoid with a bleed valve should click
3rd gear	The second solenoid with a bleed valve should click
4th – 6th gear	The last solenoid with a regulator should click.

To verify the valve is really opening you can use compressed air on the inlet side of the controller and repeat and should be able to hear air vent out of each stage assuming you have the bleeders or regulator open. I am sending them with everything closed.

Once this has checked out you can try the same thing but with the sensor mounted in the bike, using a rear stand is the easiest way to get into the upper gears with the bike sitting still, keep rotating the wheel and verify proper solenoid operation with each gear change.

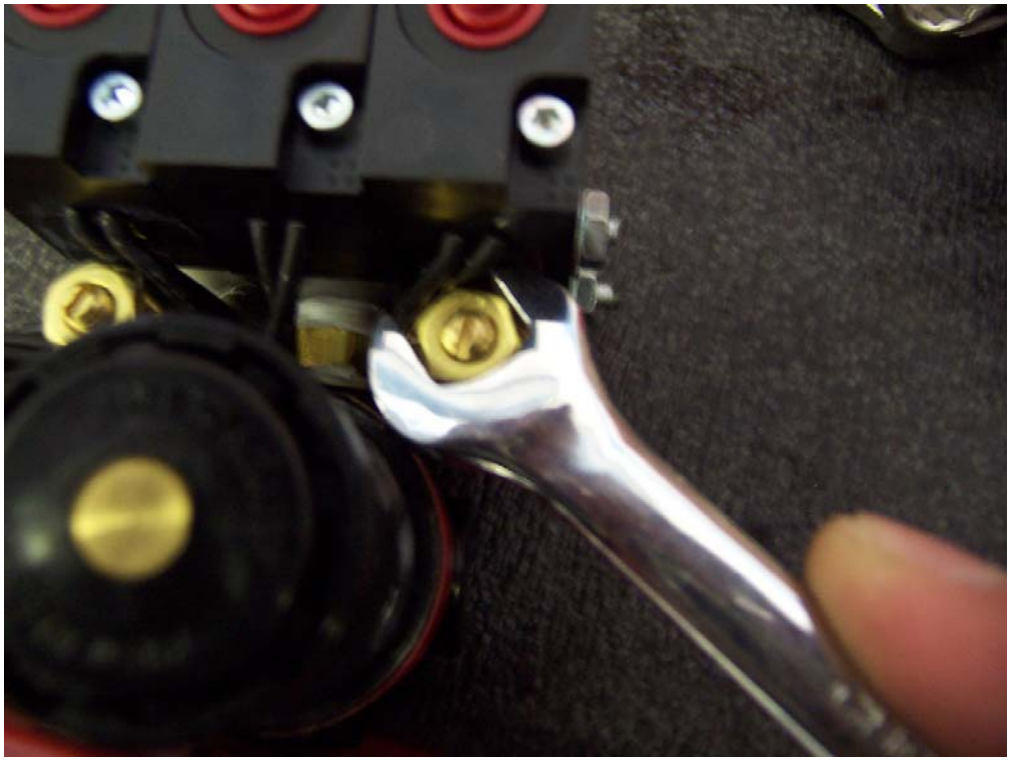


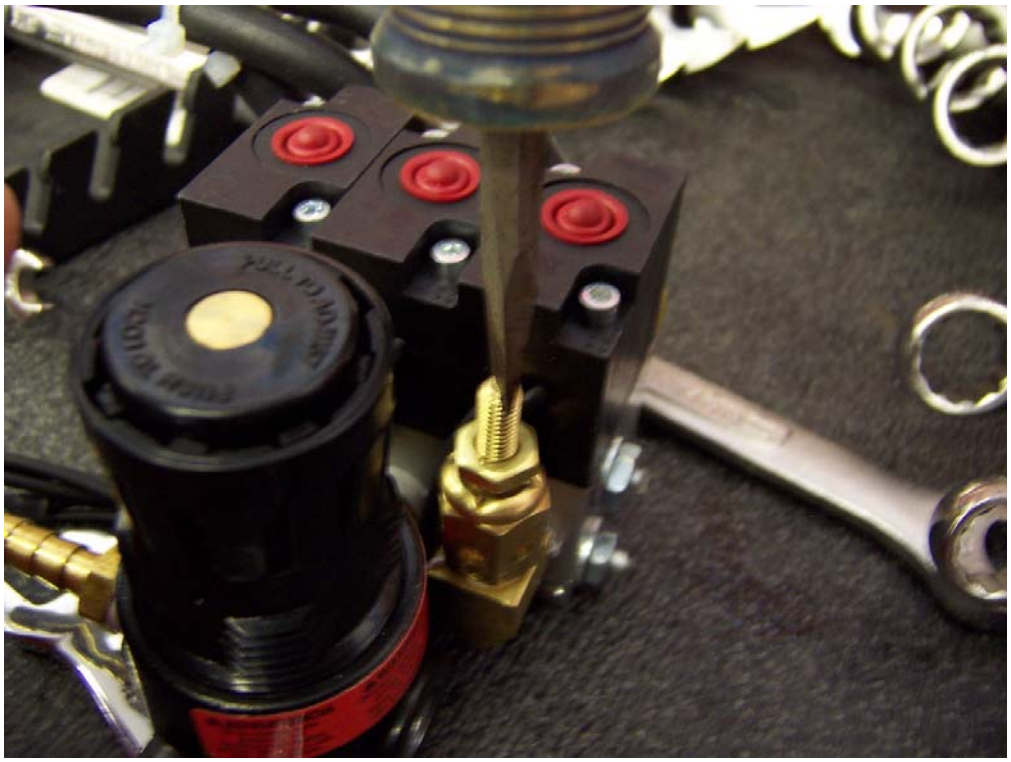
V. Setting Boost Pressure

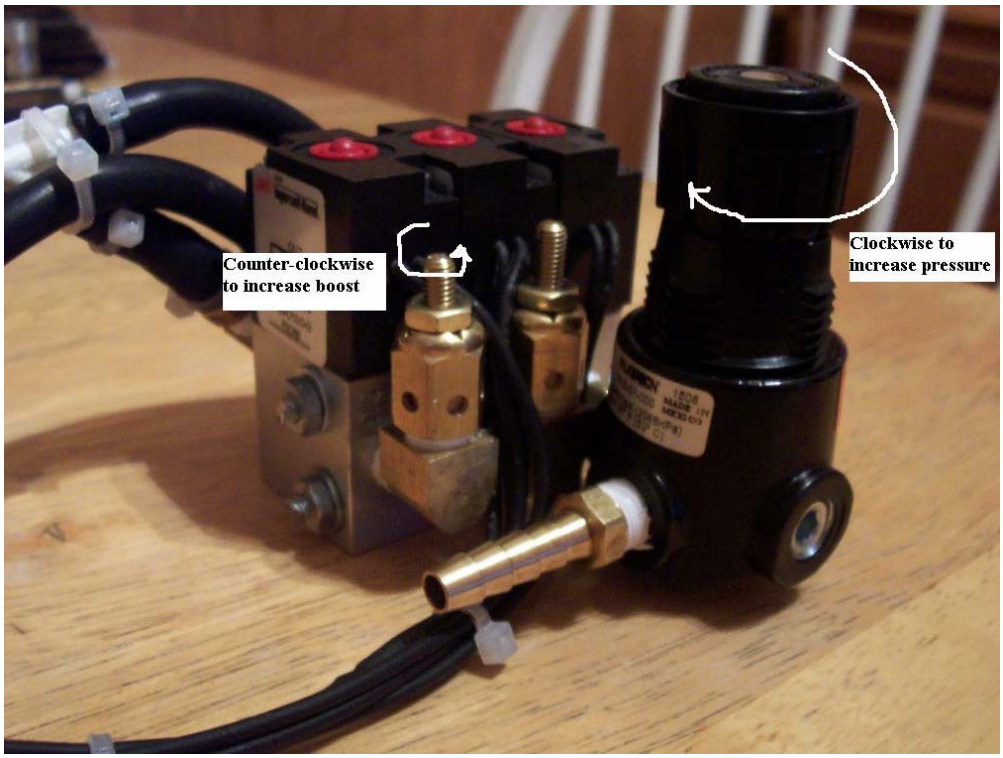
I would suggest riding the bike with everything hooked up and bleed valves and regulator closed to make sure you have no leaks and that your boost pressure is the same as before you installed the controller.

Setting the boost level is quite simple assuming you understand how each system (bleeds and regulators) work. To set boost with a bleed valve simply take a 3/8 open end wrench to loosen the jam nut, then use a small straight screw driver to open the valve. You can arm the solenoid and blow through the valve to get an idea of how much air is coming out. This method is trial and error. Take small steps, depending on how much air is coming through the flow control valve determines how sensitive your bleed valves will be. If you have a lot of air volume through the flow control valve your bleed valves will become less effective and require more turns to increase boost. Depending on target boost levels this may be a good thing. When the boost level is set, make sure to tighten the jam nut down. If this were to work itself loose, you could over boost the engine.

Setting the boost level with your regulator can be a little easier than the bleed valves. If you hook compressed air to the inlet of the controller, manually arm the solenoid, and put a boost gauge on the regulator output you can watch how much pressure the regulator will let through. The regulator is sensitive, be very careful not to see the boost level too high. They vary, but on average, the regulator takes approx. 1-2 full turns before any pressure is allowed through, after that each ¼ turn (90 degrees) will give in the ballpark of 4-5 psi of pressure. Don't forget, this isn't actual boost pressure, just the amount of air you are putting on the top of the wastegate in addition to spring pressure. As an estimate in the lower pressure ranges, just add regulator pressure to spring pressure for your estimated boost level. When you start getting into a lot of backpressure with upper boost levels it often requires more pressure on the top of the gate to get the boost desired. When the boost level has been set make sure and lock the knob by pushing down.






Counter-clockwise to increase boost
Clockwise to increase pressure

VI. Troubleshooting

If for some reason the boost controller isn't functioning there are a few things that can be checked.

- Check that both ground and 12 volt wiring is good.
- Check that connector on controller and harness is in tact.
- Check that GPS sensor is plugged in.
- Make sure that all vacuum connections are tight and not pinched.
- Make sure that all jam nuts on bleeds are tight
- Make sure locking ring on regulator is tight

If the signal vacuum line has a hole, or comes off of turbo/flow control/T, boost controller this can be very bad. Now you have a large vent going to the bottom of the wastegate and could produce excess boost.

If the signal vacuum line becomes pinched, this can result in no added boost from controller if it doesn't have an air source.

If the vacuum line going from the regulator to the top of the wastegate comes off, no boost pressure will be added, this will result in spring pressure only. If the line gets a hole in it, the boost pressure would be reduced.

Feel free to give me a call with any problems.

Greg Smith
g.smith@linktestlab.com
313.743.4504