



Q50 Q60 RED ALPHA INJECTORS

# TUNING GUIDE

# Introduction

The goal of AMS Performance is to provide the highest quality, best performing products available. By utilizing research and development, and rigorous testing programs AMS Performance will never compromise the quality or performance of our products. In addition, AMS Performance will only provide the finest customer service offering only parts and advice that are in the best interests of the customer. AMS Performance was built on a foundation of integrity. This is who we are; this is what you can count on.

A vehicle modified by the use of performance parts may not meet the legal requirements for use on public roads. Federal and state laws prohibit the removal, modification, or rendering inoperative of any part or element of design affecting emissions or safety on motor vehicles used for transporting persons or property on public streets or highways. Use or installation of performance parts may adversely affect the drivability and reliability of your vehicle, and may also affect or eliminate your insurance coverage, factory warranty, and/or new OEM part warranty. Performance parts are sold as-is without any warranty of any type. There is no warranty stated or implied due to the stresses placed on your vehicle by performance parts and our inability to monitor their use, tuning, or modification.

These instructions are provided as a guide only as there are many variables that cannot be accounted for concerning your particular vehicle, including but not limited to model year differences, model differences, the presence of non-OEM parts, and modifications that may already be or were previously installed. A basic knowledge of automotive parts and systems is helpful but a better understanding of the parts and systems on your particular vehicle may be required.

If you have any questions or issues at any time during the installation of your AMS Performance product(s) please call us for technical assistance. The AMS Performance tech line can be reached during business hours at 847-709-0530 for AMS Performance products only.

# Table of Contents

**02** Introduction

**04** Injector Sizing

**06** Fuel Pressure Target

**09** Stratified Startup

**13** Base File Request

This tuning guide was made using EcuTek software. Other software may not use the same naming conventions for their tables.

## ALPHA / Nostrum Injector Calibration Steps

**Note:** If any of these required MAPs are not available in your ROM, they may need to be requested from ECUtek. Please ensure these MAPs are present before beginning the tuning process.

### 1. Injector Sizing

- Calibration of the ALPHA/Nostrum KDI injectors requires modification of the calibration data in the injector data table “Injector Magnification.”
  - This calibration table works very similarly to a standard injector scale table for a port injected vehicle. Coarse global fueling adjustments can be made here in respect to injector flow rate changes.
  - This Calibration Table is in the Folder as shown in the screen capture below.
  - Please note, the ALPHA/Nostrum KDI injectors flow approximately ~40% more fuel than the stock injectors and a coarse “Injector Magnification” adjustment could be made to accommodate this, however we
  - recommend the starting point for this calibration table be directly transposed from the data that is provided with your injector purchase.
1. **Injector calibration from one matched set of 6 injectors may differ slightly than another matched set of 6. Please keep this in mind when calibrating.**

Fuel Pressure (MPa)	Value
0.300	0.4750
0.488	0.3720
0.781	0.2900
1.250	0.2300
2.000	0.1830
2.632	0.1610
2.860	0.1580
3.109	0.1510
3.379	0.1470
3.673	0.1440
3.993	0.1410
4.340	0.1390
4.717	0.1340
5.128	0.1320
5.573	0.1290
6.058	0.1260
6.585	0.1230
7.157	0.1200
7.780	0.1170
8.456	0.1140
9.192	0.1130
9.991	0.1090
10.860	0.1070
11.804	0.1040
12.830	0.1020
13.946	0.1000
15.159	0.0980
16.477	0.0960
17.910	0.0940
19.467	0.0910
21.160	0.0870
23.000	0.0820

## 2. Injector Drive Current

- Calibration of the ALPHA/Nostrum KDI injectors require modification of the calibration data in the injector data tables responsible for injector drive current.
- The ALPHA/Nostrum KDI Injectors for the VR30DDTT engine require a higher drive current than stock to open fully. The recommended drive currents are listed below:

	<i>High Pressure Fail</i>	<i>High Pressure</i>	<i>Normal</i>	<i>Low Pressure</i>
<i>Peak Current</i>	16.4	15.4	14	12
<i>Hold 1</i>	7	6.6	5.4	5.4
<i>Hold 2</i>	3.6	3.6	3	3

- The ALPHA/Nostrum KDI Injectors for the VR30DDTT engine also require the highest drive current to be utilized at a lower injection pressure.

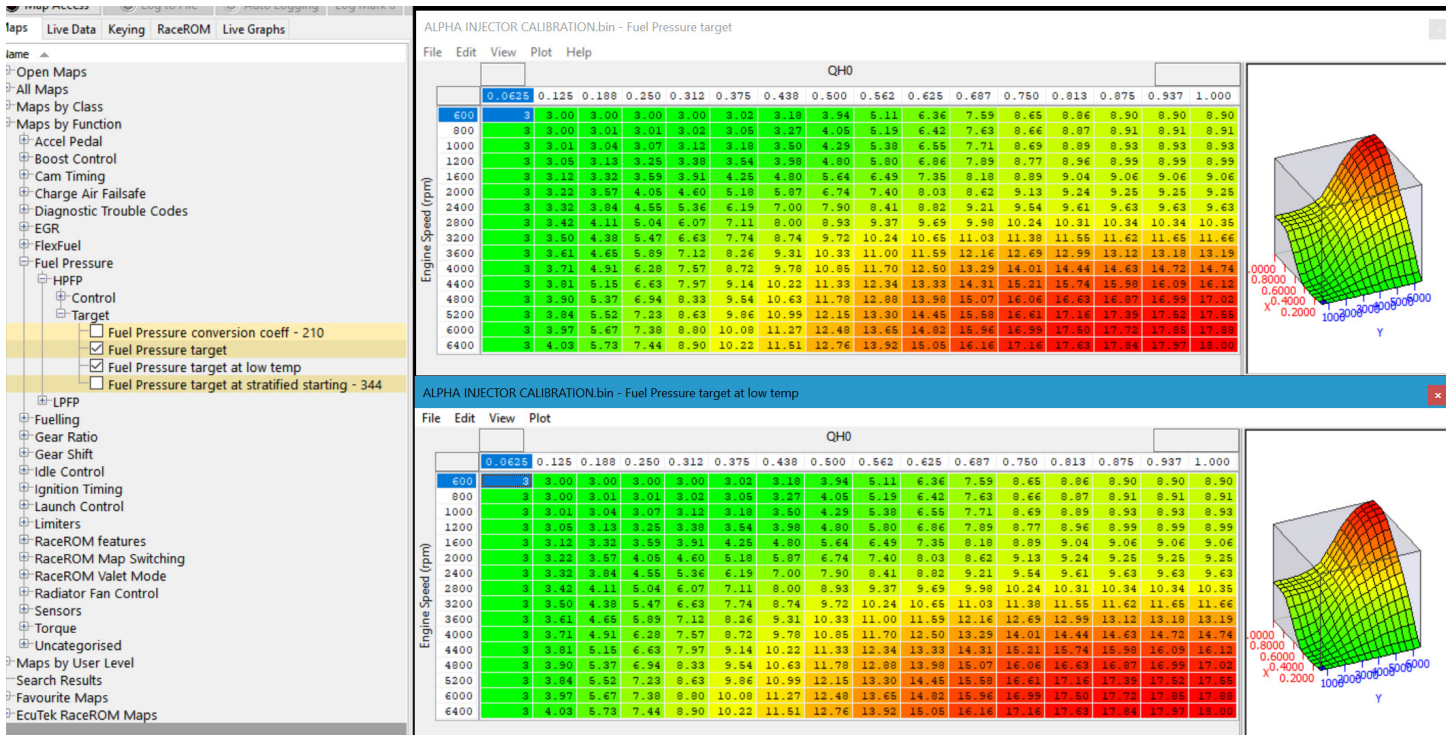
### 1. The recommended value for this pressure threshold is 20MPa.

- These Calibration Tables are in the following folders as shown in the screen capture below.

The screenshot displays a software calibration interface. On the left is a tree view of calibration parameters, and on the right is a grid of calibration tables. The tree view includes folders for Fuel Pressure, Fuelling, Cranking, Injectors, HP, HPF, LP, Normal, and Pressure. The grid shows tables for Peak Current (A) and Hold Current (A) at various pressure levels (High Pressure, High Pressure Fail, Low Pressure, Low Pressure Fail, Normal) for both HP and LP injectors. The values in the grid correspond to the data in the table above.

### 3. Fuel Pressure Target

- Calibration of the ALPHA/Nostrum KDI injectors require modification of the calibration data responsible for fuel rail pressure targets.
  - Adjustment of the fuel pressure target tables is required as the nominal operating pressure of the ALPHA/Nostrum KDI is lower than that of the factory injectors. This is due to design characteristics that affect all GDI Injectors.
1. **GDI injectors have a max pressure at which the force of the fuel can prevent the injector from opening, and we need to be sure that this pressure is not reached.**
  2. **Pressures above approximately 24 MPa may prevent the injector opening thus it is important to have adequate fuel pressure control to limit pressure oscillations.**
- AMS and Nostrum recommend targeting a maximum fuel pressure of 18 MPa on all three fuel pressure tables as shown in the screen capture below.
  - AMS and Nostrum also recommends that the fuel pressure target near idle and low rpm, low load cruising be lowered to 3MPa and that the fuel pressure target does not rise or fall during idle operation.
1. **This will ensure a more consistent injection quantity at low load and low injector pulse-width to prevent any AFR oscillations.**



### 4. Narrow Injector Pulse Width

- Calibration of the ALPHA/Nostrum KDI injectors require modification of the Injector calibration data responsible for narrow fuel injection pulse width compensation.
- The “Narrow IDW” tables correct for the non-linear injector flow target characteristics at low injector pulse widths.
- These tables are specific to the OEM injectors and for this reason they should be zeroed out when changing injectors.
- These Calibration Tables are in the folder as shown in the screen capture below.

The screenshot displays a software interface for injector calibration. On the left is a tree view of parameters, and on the right are eight graphs showing Pulse Width (ms) vs Time (ms) for different conditions.

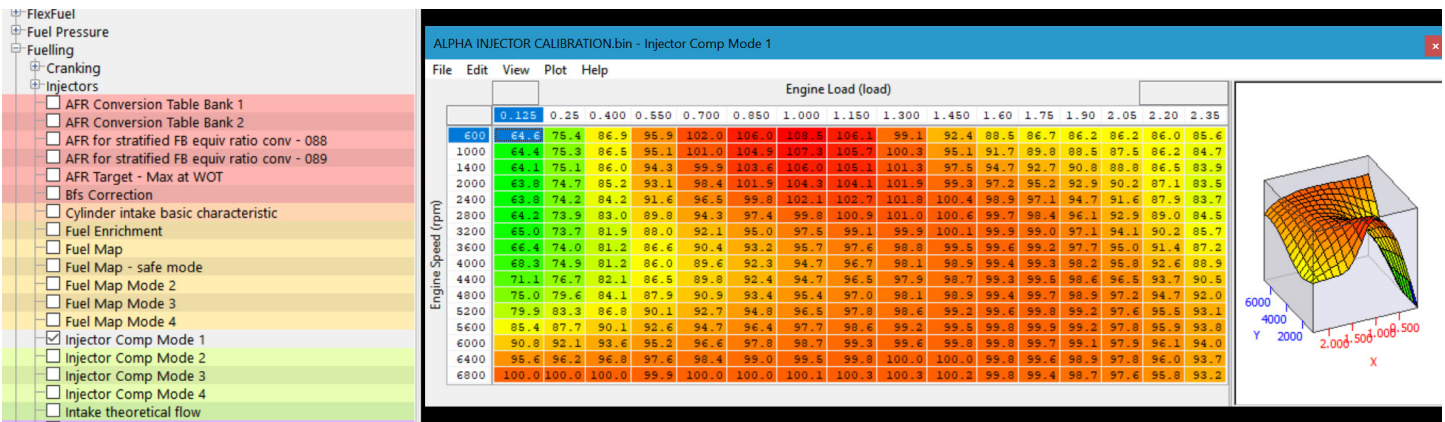
Name	User Level	Origin
Linearisation		
<input type="checkbox"/> Fuel Pressure High - High Threshold	Beta	OEM
<input type="checkbox"/> Fuel Pressure High - Idle Threshold	Beta	OEM
<input type="checkbox"/> Fuel Pressure High - Low Threshold	Beta	OEM
<input type="checkbox"/> Fuel Pressure High Target - High Threshold	Beta	OEM
<input type="checkbox"/> Fuel Pressure High Target - Idle Threshold	Beta	OEM
<input type="checkbox"/> Fuel Pressure Normal - Idle Threshold	Beta	OEM
<input type="checkbox"/> Fuel Pressure Normal - Low Threshold	Beta	OEM
<input type="checkbox"/> Fuel Pressure Normal Target - High Threshold	Beta	OEM
<input checked="" type="checkbox"/> Narrow IPW High Target Fuel Pressure - Normal Pressure	Beta	OEM
<input checked="" type="checkbox"/> Narrow IPW High Target Fuel Pressure - Pressure too high	Beta	OEM
<input checked="" type="checkbox"/> Narrow IPW Idle Target Fuel Pressure - High Pressure	Beta	OEM
<input checked="" type="checkbox"/> Narrow IPW Idle Target Fuel Pressure - Normal Pressure	Beta	OEM
<input checked="" type="checkbox"/> Narrow IPW Idle Target Fuel Pressure - Pressure too high	Beta	OEM
<input checked="" type="checkbox"/> Narrow IPW Low Target Fuel Pressure - High Pressure	Beta	OEM
<input checked="" type="checkbox"/> Narrow IPW Low Target Fuel Pressure - Normal Pressure	Beta	OEM
<input checked="" type="checkbox"/> Narrow IPW Low Target Fuel Pressure - Pressure too high	Beta	OEM
LP		
<input type="checkbox"/> Normal		
<input type="checkbox"/> Pressure		
<input type="checkbox"/> Pump		
<input type="checkbox"/> 2 Time Injection split ratio homogenous - 290	Developm...	OEM
<input type="checkbox"/> 3 Time Injection split ratio for surge control - 289	Developm...	OEM
<input type="checkbox"/> Compression Stroke cylinder in pulse width restart - 346	Developm...	OEM
<input type="checkbox"/> Expansion Stroke cylinder in pulse width restart - 345	Developm...	OEM
<input type="checkbox"/> Injection Pulse Width at start 0 - 373	Developm...	OEM
<input type="checkbox"/> Injection Pulse Width at start 1 - 374	Developm...	OEM
<input type="checkbox"/> Injection Pulse Width at start 2 - 375	Developm...	OEM
<input type="checkbox"/> Injection Pulse Width at start 3 - 376	Developm...	OEM
<input type="checkbox"/> Injection Pulse Width at start 4 - 377	Developm...	OEM
<input type="checkbox"/> Injection Pulse Width at start 5 - 378	Developm...	OEM
<input type="checkbox"/> Injection Pulse Width at start 6 - 379	Developm...	OEM
<input type="checkbox"/> Injection Pulse Width at start 7 - 380	Developm...	OEM
<input type="checkbox"/> Injector Lag Time FP Comp	Beta	OEM
<input type="checkbox"/> Injector Lag Time FP Comp - High Pressure	Beta	OEM
<input type="checkbox"/> Injector Lag Time FP Comp - Low Pressure	Beta	OEM
<input type="checkbox"/> Injector Lag Time FP Comp - Normal	Beta	OEM

The graphs on the right show Pulse Width (ms) vs Time (ms) for various conditions. Each graph has a table of data points:

Pulse Width (ms)	0.350	0.00000 ms
0.350	0.00000	0.00000
0.450	0.00000	0.00000
0.501	0.00000	0.00000
0.600	0.00000	0.00000
0.701	0.00000	0.00000
0.800	0.00000	0.00000
0.901	0.00000	0.00000
1.000	0.00000	0.00000

## 5. Base Fueling Compensations

- Calibration of the ALPHA/Nostrum KDI injectors require careful consideration of the calibration tables responsible for fine tuning fueling.
  - These tables are labeled “Injector Comp Mode 1,2,3,4) and as shown in screen capture.
  - It is worth noting that if you have previously applied fueling compensations utilizing these calibration tables due to the modifications on the car or oxygenated fuel, this may be a good place to start for fine tuning your new set of injectors.
1. If you are unsure of your current “Injector Comp” calibration, please “zero” the table out where all cells are equal to 100 as this will apply no fueling corrections and work well as a starting point.



SC#5



## 6. Stratified Startup

- Calibration of the ALPHA/Nostrum KDI injectors require the toggle “Enabled Stratified Startup) to be disabled. (not checked)
- Leaving this table “checked”, will cause poor cold and warm startup conditions.

This is due to the very narrow pulse width of the factory startup, split injection, and injection angle of the startup. Under these conditions, the Alpha injectors would be commanded to inject such a small amount of fuel per injection stage that there can be a discrepancy between the amount of fuel being commanded for injection, and the amount of fuel actually injected.

The screenshot displays the ALPHA software interface. On the left, a tree view shows the 'Uncategorised' section expanded, with two items highlighted: 'AT(off)/MT(on) Switch' (pink background) and 'Enable Stratified Start Up' (yellow background). To the right, a table shows the following data:

<input type="checkbox"/> AT(off)/MT(on) Switch	Beta	OEM
<input type="checkbox"/> Enable Stratified Start Up	Beta	OEM

On the right side of the screenshot, a dialog box titled 'ALPHA INJECTOR CALL...' is open, showing a menu with 'File', 'Edit', and 'Help' options. The 'Enable Stratified Start Up' option is checked in the dialog box.

## 7. Turn Off Split Injection (Optional)

1. If you are experiencing some stumbling or misfires at lower rpm and higher load or when transitioning from lower to higher load, you may be experiencing missed injections due to very low pulse widths introduced by the ECU splitting the main injection pulse into either two or three injections during a single combustion cycle.
  - If you log the "Injection Pulse Width 1,2 and 3", you will see when the ECU is changing modes, and you will also see some very small pulse widths.
  - As known with larger injectors on other platforms, its generally understood that larger injectors are not as precise when injection pulse widths are very small. This is also true with the Alpha KDI injectors for the VR30, and therefore the split injection modes may need to be turned off if you are experiencing issues.

The screenshot displays the Alpha Injector Calibration software interface. On the left is a tree view of calibration parameters. The main area shows several calibration screens for different injection modes, each with a data table and a 3D surface plot.

**Parameter List (Left Panel):**

- 2 Time Injection split ratio homogenous - 290
- 3 Time Injection split ratio for surge control - 289
- Compression Stroke cylinder inj pulse width rest...
- Expansion Stroke cylinder inj pulse width restart ...
- Injection Pulse Width at start 0 - 373
- Injection Pulse Width at start 1 - 374
- Injection Pulse Width at start 2 - 375
- Injection Pulse Width at start 3 - 376
- Injection Pulse Width at start 4 - 377
- Injection Pulse Width at start 5 - 378
- Injection Pulse Width at start 6 - 379
- Injection Pulse Width at start 7 - 380
- Injector Lag Time FP Comp
- Injector Lag Time FP Comp - High Pressure
- Injector Lag Time FP Comp - Low Pressure
- Injector Lag Time FP Comp - Normal
- Injector Lag Time FP Comp - Too High Pressure
- Injector Magnification
- Injector Minimum Closed Time
- Injector Minimum Open Time
- Injector Minimum Open Time 1
- Injector Minimum Open Time 2
- Injector Minimum Open Time 3
- Injector Minimum Open Time 4
- IPW abnormally high pressure - 925
- Multiple Injection ratio for surge - 291
- Power Cycle Cylinder Injection pulse width - 393
- Temperature Compensation - 383
- Twice Injection Split Ratio - 671
- Twice Injection Split Ratio - 672
- AFR Conversion Table Bank 1
- AFR Conversion Table Bank 2
- AFR for stratified FB equiv ratio conv - 088
- AFR for stratified FB equiv ratio conv - 089
- AFR Target - Max at WOT
- Bfs Correction
- Cylinder intake basic characteristic
- Fuel Enrichment
- Fuel Map
- Fuel Map - safe mode
- Fuel Map Mode 2
- Fuel Map Mode 3
- Fuel Map Mode 4
- Injector Comp Mode 1
- Injector Comp Mode 2
- Injector Comp Mode 3

**Calibration Screens (Right Panel):**

- SC#7: ALPHA INJECTOR CALIBRATION.bin - 2 Time Injection split ratio homogenous - 290**  
 Table: Value vs Engine Speed (rpm). Values range from 0.00600 to 0.0172. Plot shows a 3D surface.
- ALPHA INJECTOR CALIBRATION.bin - 3 Time Injection split ratio for surge control - 289**  
 Table: Value vs Engine Speed (rpm). Values range from 0.0176 to 0.0298. Plot shows a 3D surface.
- ALPHA INJECTOR CALIBRATION.bin - Multiple Injection ratio for surge - 291**  
 Table: Value vs Engine Speed (rpm). Values range from 0.00600 to 0.0172. Plot shows a 3D surface.
- ALPHA INJECTOR CALIBRATION.bin - Twice Injection Split Ratio - 671**  
 Table: Value vs Engine Speed (rpm). Values range from 0.00200 to 0.01600. Plot shows a 2D line graph with a constant value of 1.00.
- ALPHA INJECTOR CALIBRATION.bin - Twice Injection Split Ratio - 672**  
 Table: Value vs Value. Values range from 0.00200 to 0.01600. Plot shows a 2D line graph with a constant value of 1.00.

## 8. Injection Angle (Optional)

If you are experiencing some stumbling or rough running when the engine is cold, you may want to adjust the injection angle tables during low temp operation. I have found adjusting the tables to be similar to what is shown below seems to work pretty well.

The screenshot displays the 'ALPHA INJECTOR CALIBRATION' software interface. On the left, a tree view shows the 'Injection Angle' settings menu with various options like 'Injection Angle - pre-ignition lower limit', 'Injection Angle - Pre-ignition prevention (safe mode)', and 'Injection Angle Strat 3 pulse - 1st pulse Low Temp'. On the right, three 3D surface plots are shown, each representing a different injection angle table. The top plot is for 'Injection Angle Hom - low temp', the middle for 'Injection Angle Strat 3 pulse - 1st pulse Low Temp', and the bottom for 'Injection Angle Strat 3 pulse - 2nd pulse Low Temp'. Each plot shows a grid of values across engine speed (rpm) and throttle position, with a color-coded surface representing the injection angle.

## 9. Fine Tuning

SC#8

- After you have completed all the previous steps it's time to start the engine and start tuning.
  - Dialing in your new injectors to maintain a target AFR with minimal fuel trim corrections will be an iterative process of driving at various engine speeds and engine loads and reviewing your datalogs.
  - The first task you should work on is fine-tuning the injector magnification table.
1. You will want to calibrate this table so that the average of the fuel trims at each fuel pressure is within +/- 10%.
  2. This injector magnification curve should remain quite smooth
- If your collected data suggests otherwise you can make up for it in the next step using the injector compensation table.
  - Secondary fuel adjustments after adjusting the "Injector Magnification" table will be taken care of in the previously mentioned "Injector Comp" tables.
1. Adjustments to this table should have smooth transitions for good drivability.
  2. Please reference SC#5 for the location of this table, and for the smoothness of the data.

## **10. AMS Fuel Sensor Upgrade Offset & Multiplier Values**

The “Offset” and “Multiplier” values are only for customers that have replaced their OEM fuel sensor with the AMS Red Alpha High Pressure Fuel Sensor (ALP.28.07.0010-1) on the direct injection rail.

**Offset (MPa) = - 4.3**

**Multiplier (MPa/V) = 6.30**

### **Codes That May Appear During Installation:**

Turning off these codes ensures that the ECU will not falsely throw a DTC when running the Alpha FPS. The reasoning for turning off these codes, is that during normal operation the voltage from the sensor will differ from that of the factory sensor. The ECU compares these new sensor voltage readings to a known value range for diagnostics, and since the voltage differs from the predetermined diagnostic thresholds, error reporting function is then determining an error and reporting the DTC. Ideally, the better route for calibration other than turning off the codes would be to calibrate the diagnostic thresholds for the fuel pressure sensor, but these tables are currently unavailable in the current software revision.

- P0193 - Fuel rail pressure sensor “A” circuit high
- P119C - FUEL PRESSURE SENSOR (Fuel pressure sensor)

## **11. Base File Request**

- If you are not comfortable with adjusting the tables or do not have access to some of the tables outlined in this document, please let us know by emailing your AMS sales representative.
- Please provide your current calibration ID and the injector magnification calibration that was provided with the injectors.
- We are more than willing to help assist with any injector calibration needs.

Any questions or concerns that are not outlined in this tuning guide should be forwarded to your AMS sales representative.

Thank you and enjoy!