



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

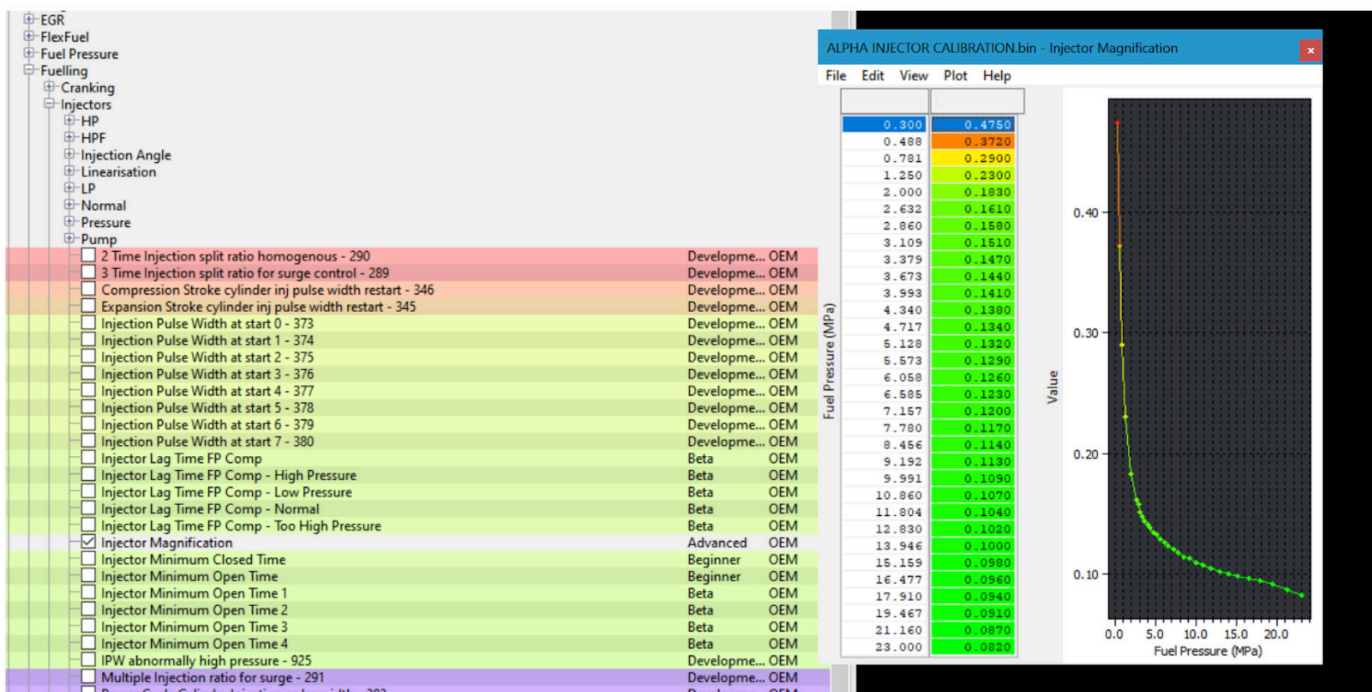
This tuning guide was made using EcuTek software. Other software may not use the same naming conventions for their tables.

## 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.**



## 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:

	High Pressure Fail	High Pressure	Normal	Low Pressure
<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.

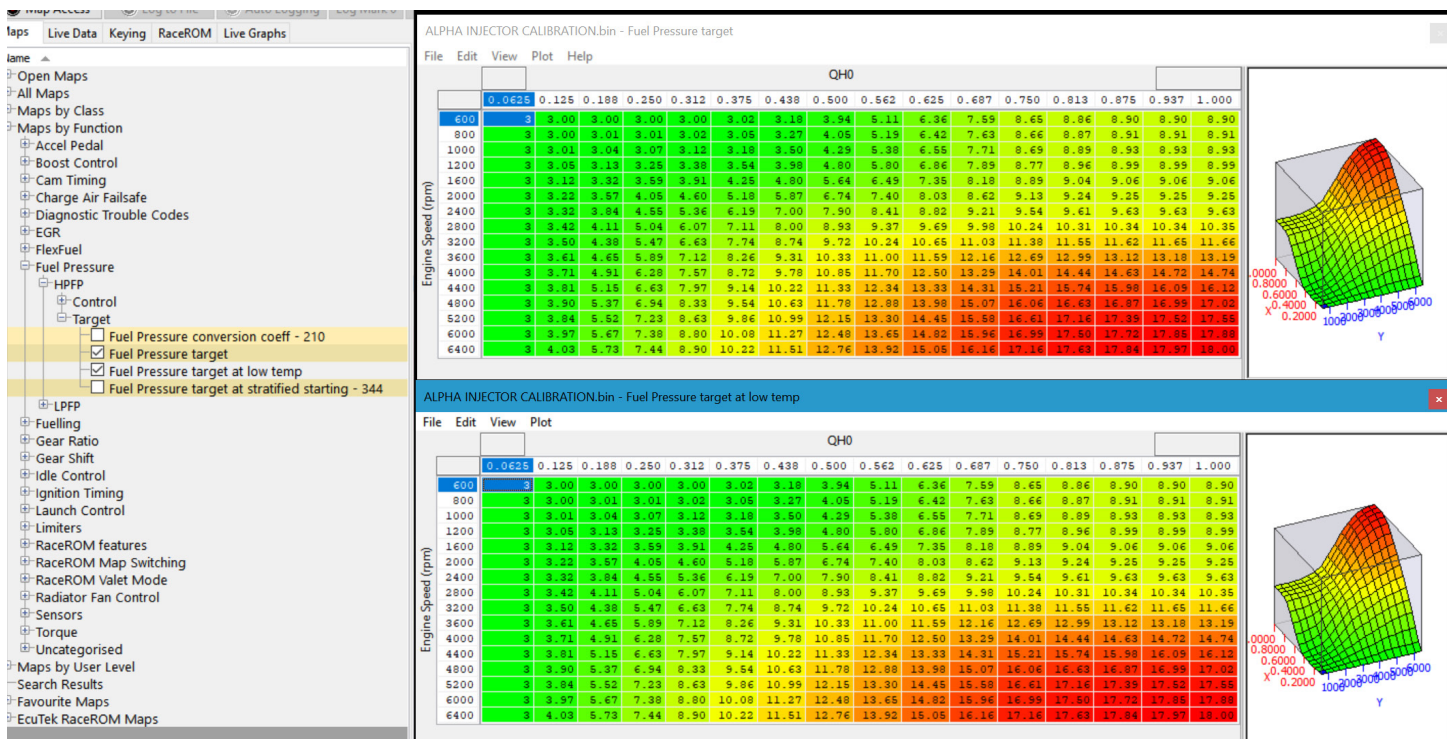
The screenshot displays the ALPHA/Nostrum KDI injector calibration software interface. On the left, a tree view shows the calibration structure, including Fuel Pressure (HP, HPP, LP, Normal, Pressure) and Pump. The right pane shows a grid of calibration tables for Peak Current (A) and Hold Current (A) at various pressure levels. The 'Pressure' section shows a 'Fuel Pressure - Peak Injector Current' table with a value of 20.00 MPa.

Category	Parameter	Value	
Fuel Pressure - HP	Injector Current Switch Pulse Width - HP	Beta OEM	
	Injector Delay Time Initial - High Pressure	Beta OEM	
	Injector Hold 1 Current Initial - High Pressure	Beta OEM	
	Injector Hold 2 Current Initial - High Pressure	Beta OEM	
	Injector Hold Time Initial - High Pressure	Beta OEM	
	Injector Hysteresis Initial - High Pressure	Beta OEM	
	Injector Peak Current Initial - High Pressure	Beta OEM	
	Injector T2 Delay Time Initial - High Pressure	Beta OEM	
	Fuel Pressure - HPP	Injector Current Switch Pulse Width - HPP	Beta OEM
		Injector Delay Time Initial - High Pressure Fail	Beta OEM
		Injector Hold 1 Current Initial - High Pressure Fail	Beta OEM
		Injector Hold 2 Current Initial - High Pressure Fail	Beta OEM
Injector Hold Time Initial - High Pressure Fail		Beta OEM	
Injector Hysteresis Initial - High Pressure Fail		Beta OEM	
Injector Peak Current Initial - High Pressure Fail		Beta OEM	
Injector T2 Delay Time Initial - High Pressure Fail		Beta OEM	
Fuel Pressure - LP		Injector Current Switch Pulse Width - LP	Beta OEM
		Injector Delay Time Initial - Low Pressure	Beta OEM
		Injector Hold 1 Current Initial - Low Pressure	Beta OEM
		Injector Hold 2 Current Initial - Low Pressure	Beta OEM
	Injector Hold Time Initial - Low Pressure	Beta OEM	
	Injector Hysteresis Initial - Low Pressure	Beta OEM	
	Injector Peak Current Initial - Low Pressure	Beta OEM	
	Injector T2 Delay Time Initial - Low Pressure	Beta OEM	
	Normal	Injector Current Switch Pulse Width - Normal	Beta OEM
		Injector Delay Time Initial - Normal	Beta OEM
		Injector Hold 1 Current Initial - Normal	Beta OEM
		Injector Hold 2 Current Initial - Normal	Beta OEM
Injector Hold Time Initial - Normal		Beta OEM	
Injector Hysteresis Initial - Normal		Beta OEM	
Injector Peak Current Initial - Normal		Beta OEM	
Injector T2 Delay Time Initial - Normal		Beta OEM	
Pressure		Fuel Pressure - Peak Injector Current	Beta OEM
		Variable Injector Current Fuel Pressure Threshold	Beta OEM
		Variable Injector Current Fuel Pressure Threshold Hys	Beta OEM
		Variable Injector Current Fuel Pressure Threshold Hys	Beta OEM
Pump	2 Time Injection split ratio homogenous - 290	Developme... OEM	
	3 Time Injection split ratio for surge control - 299	Developme... OEM	



## 3. Fuel Pressure Target

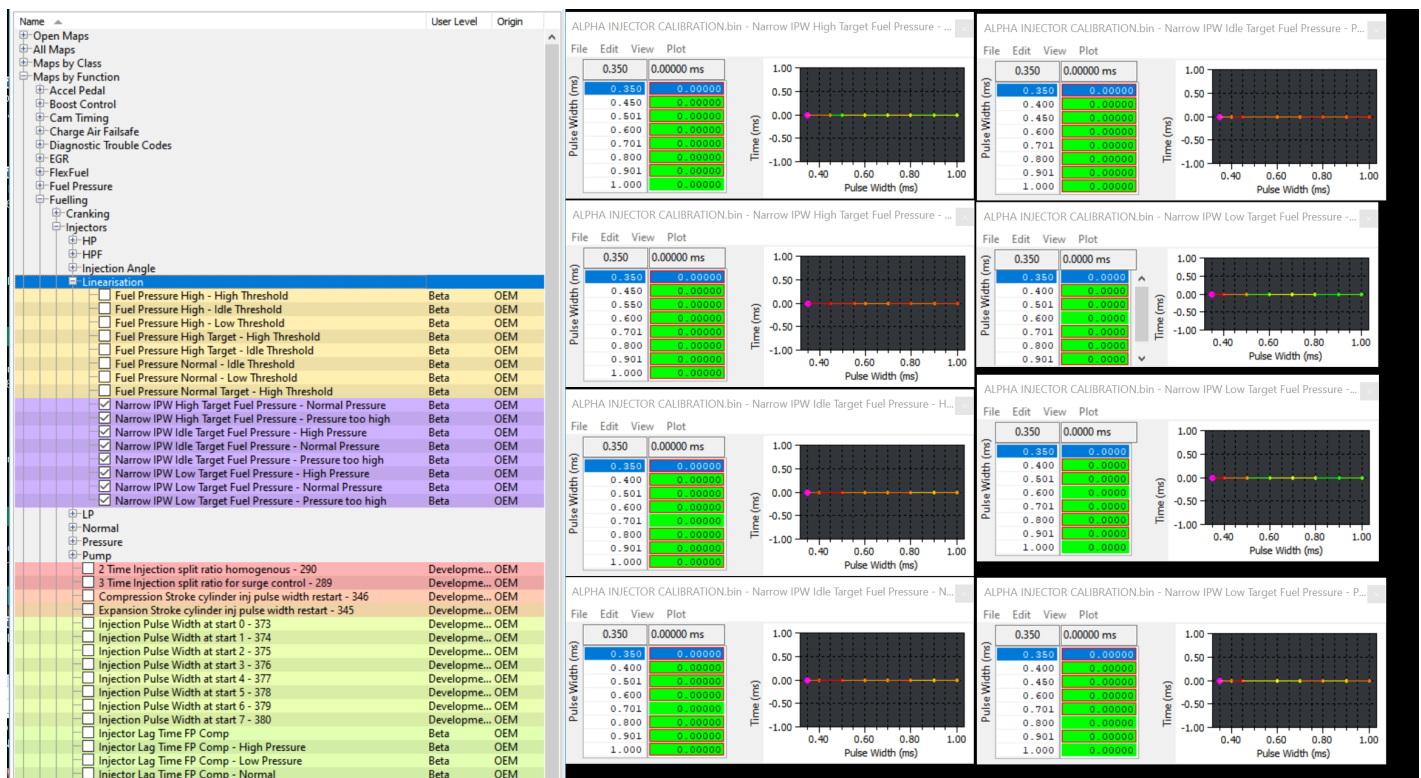
- Calibration of the ALPHA/Nostrum KDI injectors require modification of the calibration data responsible for fuel rail pressure targets.
  - Adjustment of the fuel pressure target tables is required as the nominal operating pressure of the ALPHA/Nostrum KDI is lower than that of the factory injectors. This is due to design characteristics that affect all GDI Injectors.
- 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.**
  - 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.
- This will ensure a more consistent injection quantity at low load and low injector pulse-width to prevent any AFR oscillations.**



SC#3

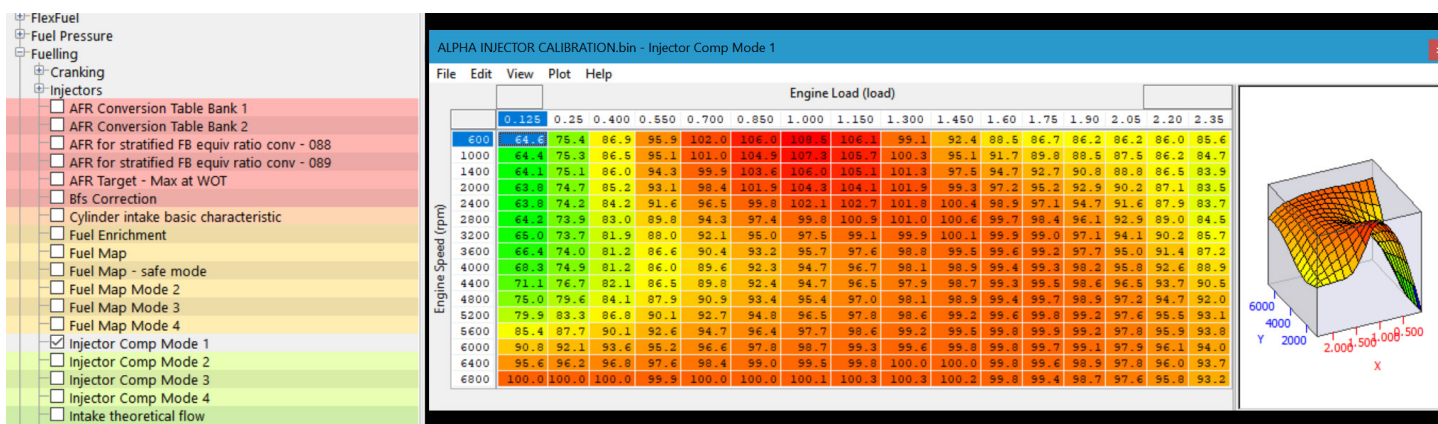
## 4. Narrow Injector Pulse Width

- 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 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.



## 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.
- 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

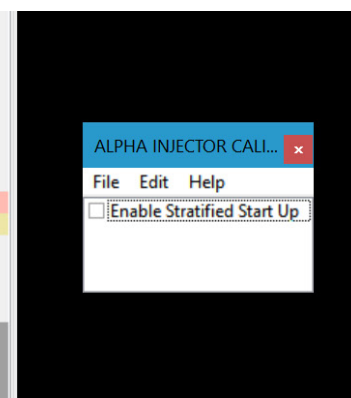


## 6. Stratified Startup

- 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.

Limiters			
RaceROM features			
RaceROM Map Switching			
RaceROM Valet Mode			
Radiator Fan Control			
Sensors			
Torque			
Uncategorised			
<input type="checkbox"/> AT(off)/MT(on) Switch	Beta	OEM	
<input type="checkbox"/> Enable Stratified Start Up	Beta	OEM	
Maps by User Level			
Search Results			
Favourite Maps			
EcuTek RaceROM Maps			



## 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 therefor the split injection modes may need to be turned off if you are experiencing issues.

ROM - ALPHA INJECTOR CALIBRATION.bin (...

File View Colouring Logging

Map Access Log to File Auto Logging Log Mark 0

Maps Live Data Keying RaceROM Live Graphs

Name

Diagnostic Trouble Codes

EGR

FlexFuel

Fuel Pressure

Fuelling

Cranking

Injectors

HP

HPF

Injection Angle

Linearisation

LP

Normal

Pressure

Pump

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

ALPHA INJECTOR CALIBRATION.bin - 2 Time Injection split ratio homogenous - 290

File Edit View Plot

Value

0.00600 0.00760 0.00920 0.0108 0.0124 0.0140 0.0156 0.0172

Engine Speed (rpm)

600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800

SC#7

ALPHA INJECTOR CALIBRATION.bin - 3 Time Injection split ratio for surge control - 289

File Edit View Plot

Value

0.0176 0.0192 0.0208 0.0224 0.0240 0.0256 0.0272 0.0288

Engine Speed (rpm)

600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800

ALPHA INJECTOR CALIBRATION.bin - Multiple Injection ratio for surge - 291

File Edit View Plot

Value

0.00600 0.00760 0.00920 0.0108 0.0124 0.0140 0.0156 0.0172

Engine Speed (rpm)

600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800

ALPHA INJECTOR CALIBRATION.bin - Twice Injection Split Ratio - 671

File Edit View Plot

Value

0.00200 1

Engine Speed (rpm)

400 800 1200 1600 2000 2400 2800 3200

Value

2.00 1.50 1.00 0.50 0.00

Engine Speed (rpm)

1000 2000 3000

ALPHA INJECTOR CALIBRATION.bin - Twice Injection Split Ratio - 672

File Edit View Plot

Value

0.00200 1

Value

0.00400 0.00600 0.00800 0.01000 0.01200 0.01400 0.01600

Value

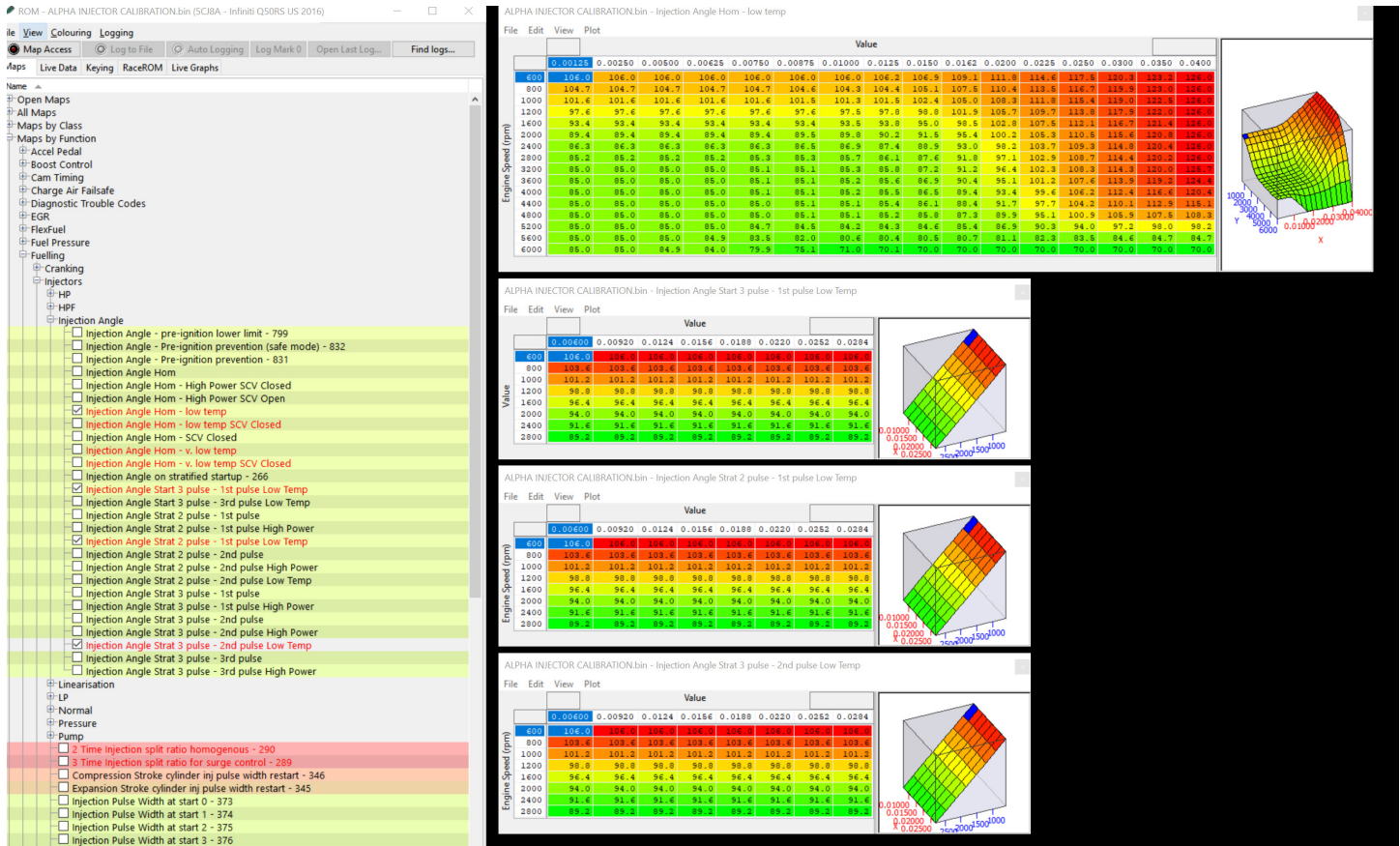
2.00 1.50 1.00 0.50 0.00

Value

0.0050 0.0100 0.0150

## 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.



## 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.
- You will want to calibrate this table so that the average of the fuel trims at each fuel pressure is within +/- 10%.
  - 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.
- Adjustments to this table should have smooth transitions for good drivability.
  - 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) = - 3**

**Multiplier (MPa/V) = 6.12**

### **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!