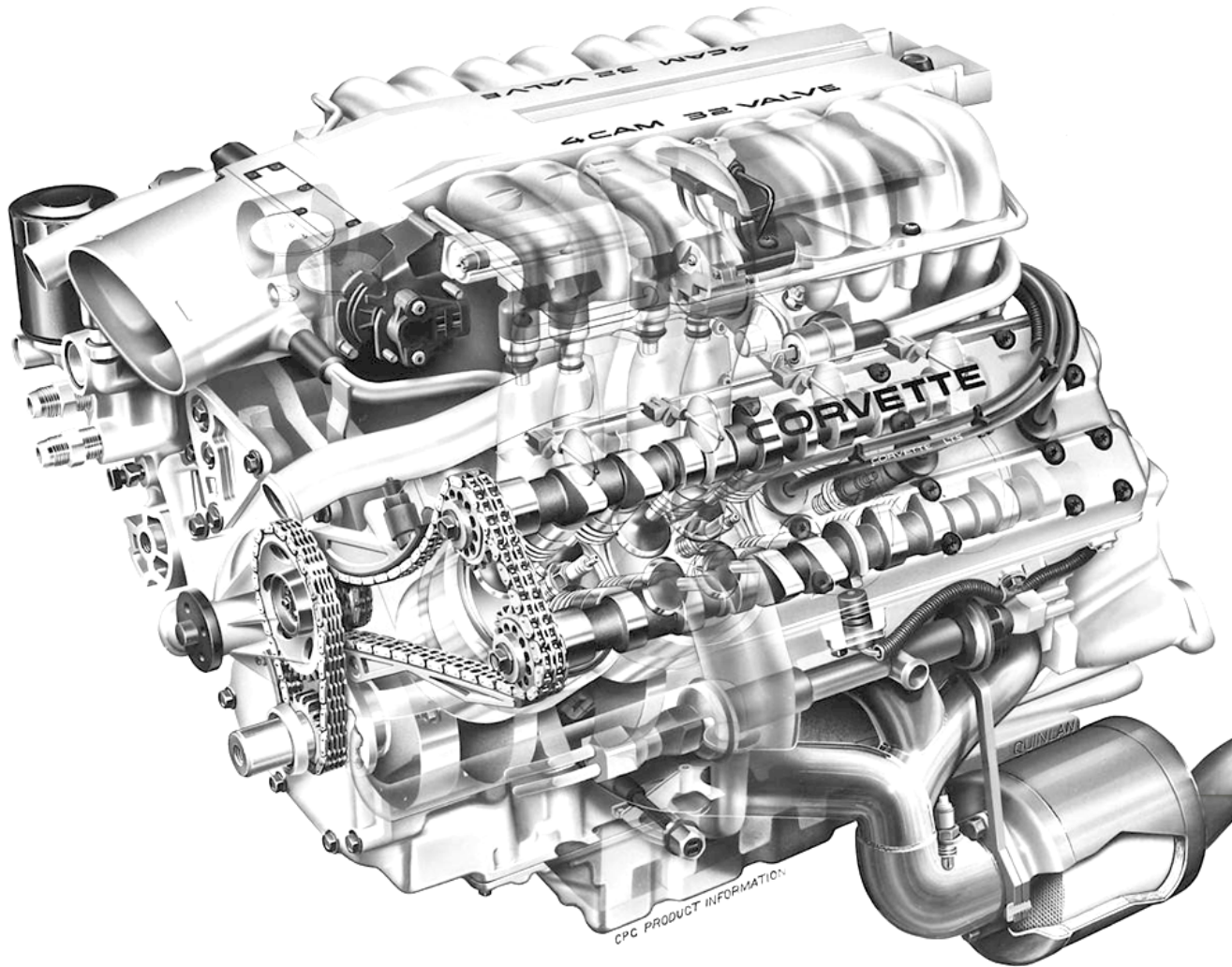


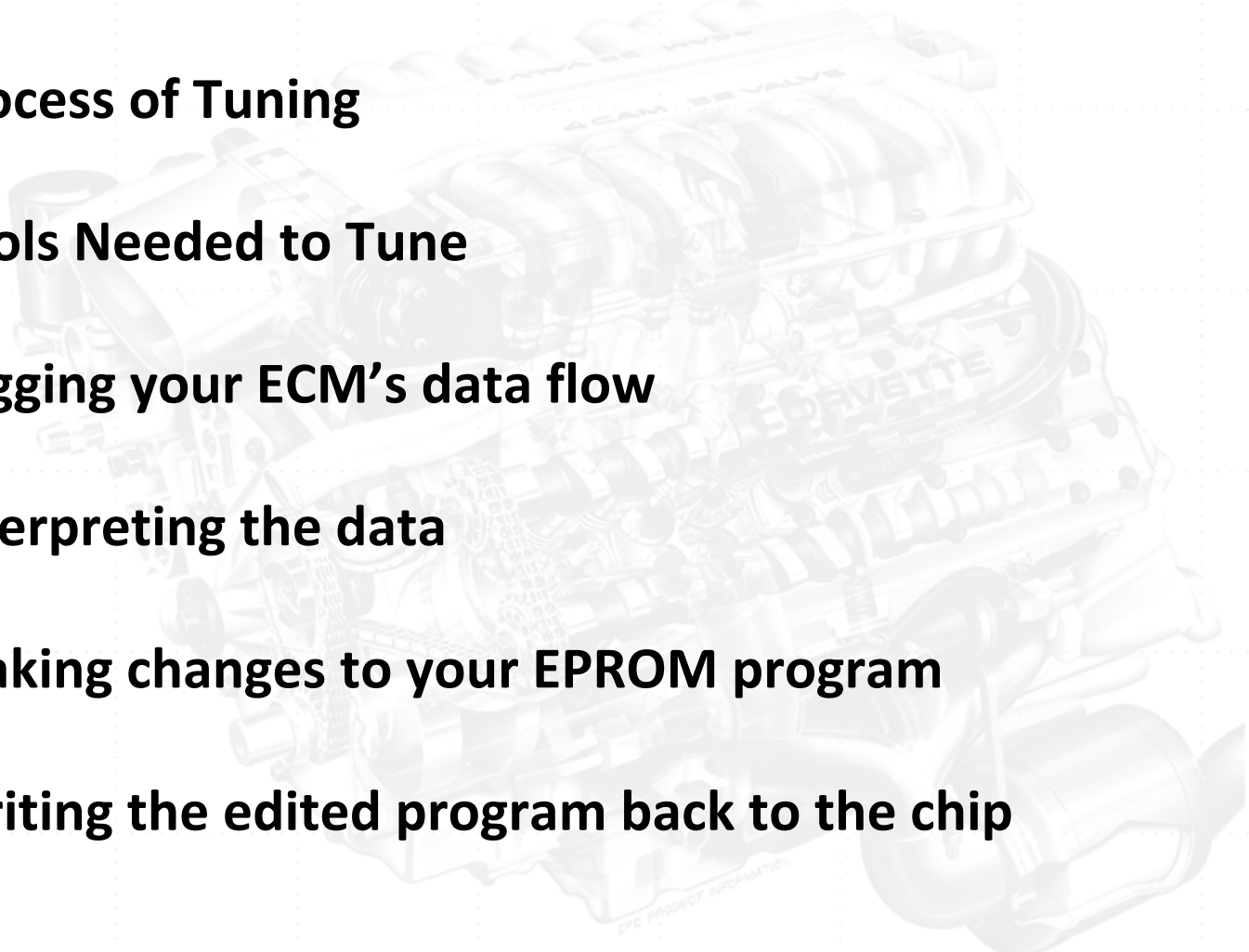
Introduction to Tuning the LT5



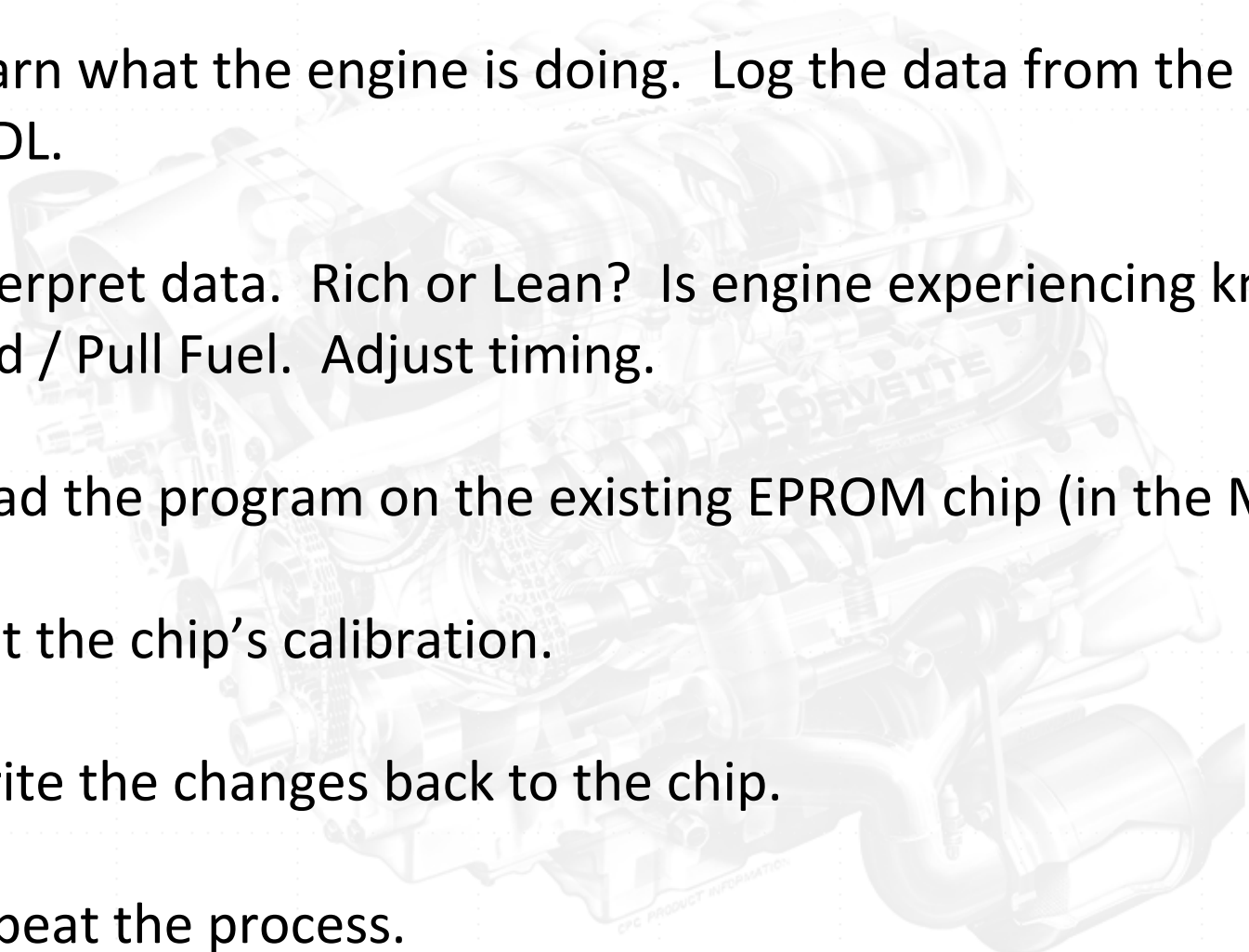
Haibeck Automotive Technology
The ZR-1 Specialist

ZR-1 **NET** Registry

Overview

- ✓ **Process of Tuning**
 - ✓ **Tools Needed to Tune**
 - ✓ **Logging your ECM's data flow**
 - ✓ **Interpreting the data**
 - ✓ **Making changes to your EPROM program**
 - ✓ **Writing the edited program back to the chip**
- 

The Process of Tuning

1. Learn what the engine is doing. Log the data from the ECM via ALDL.
 2. Interpret data. Rich or Lean? Is engine experiencing knock? Add / Pull Fuel. Adjust timing.
 3. Read the program on the existing EPROM chip (in the Memcal).
 4. Edit the chip's calibration.
 5. Write the changes back to the chip.
 6. Repeat the process.
- 

Hardware / Software Needed

Software

1. Log data stream from ECU (Scantool)
2. Make Changes to the Hexadecimal Data / Calibration on EPROM Chip (Bin Editor)
3. Write Changes to (E)EPROM Chip (Prom Burning Software)

Hardware

1. Laptop
2. Cable from Computer to ALDL
2. EPROM Chip Burner
3. EEPROM Chip (27SF512 or 27C256 or AT29C256)

Reference for obtaining equipment and software:

<http://www.moates.net/>

Logging Your LT5's Operation

Equipment Needed:

1. Laptop

2. Cable from ALDL to Laptop (Serial or USB)

<http://www.aldcable.com/> ~\$60

<http://www.moates.net> ~\$80

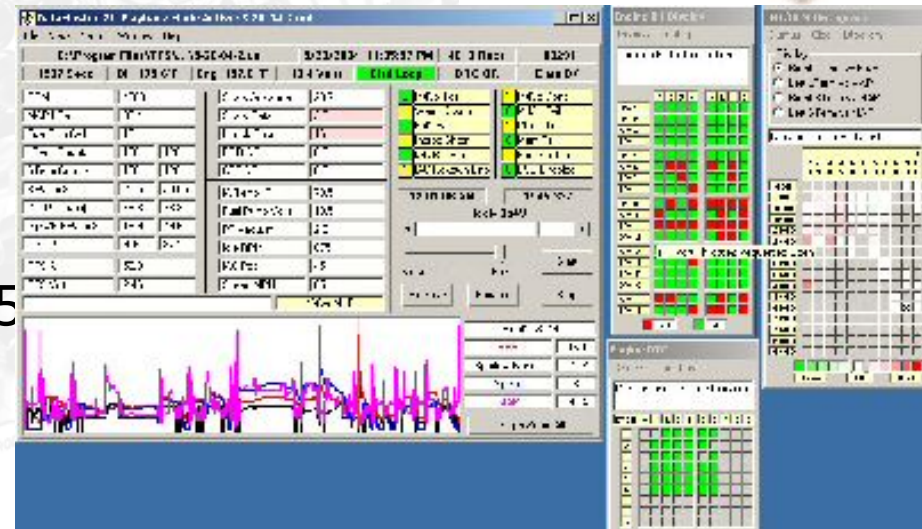
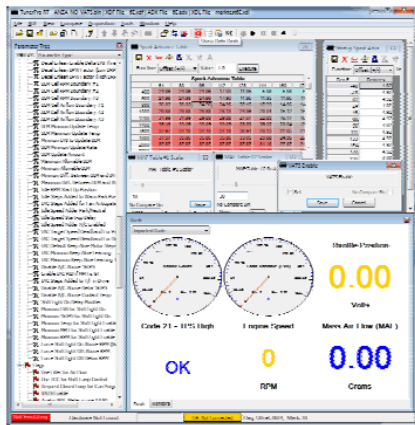


3. Diagnostic Software

[TunerPro RT](#) ~\$39

[TTS Datamaster](#)

[DataCat](#) \$65 / \$135



Logging Your LT5's Operation

Using the Correct Software / Map File (Mask)

TunerPro RT

- 1990 LT5 - 8E or 8EA Datastream File
 - 1991 LT5 - AF or AFA Datastream File
 - 1992 LT5 - D0 or D0A Datastream File
 - 1993-95 LT5 - F0A or F0 Datastream File
- (<http://www.gearhead-efi.com>)

DataCat

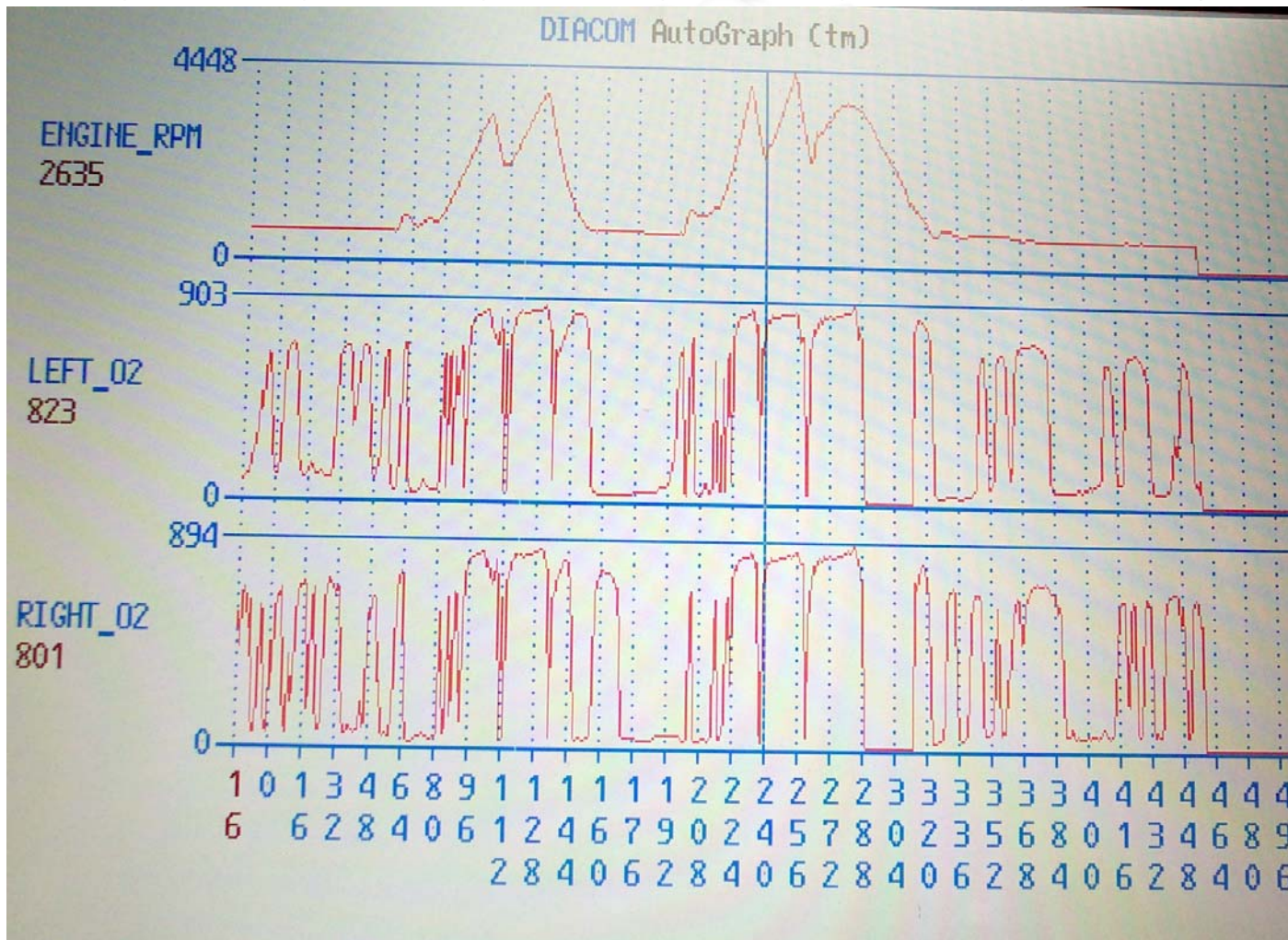
- Separate Software for 90-92 and 93-95 LT5s

TTS Datamaster

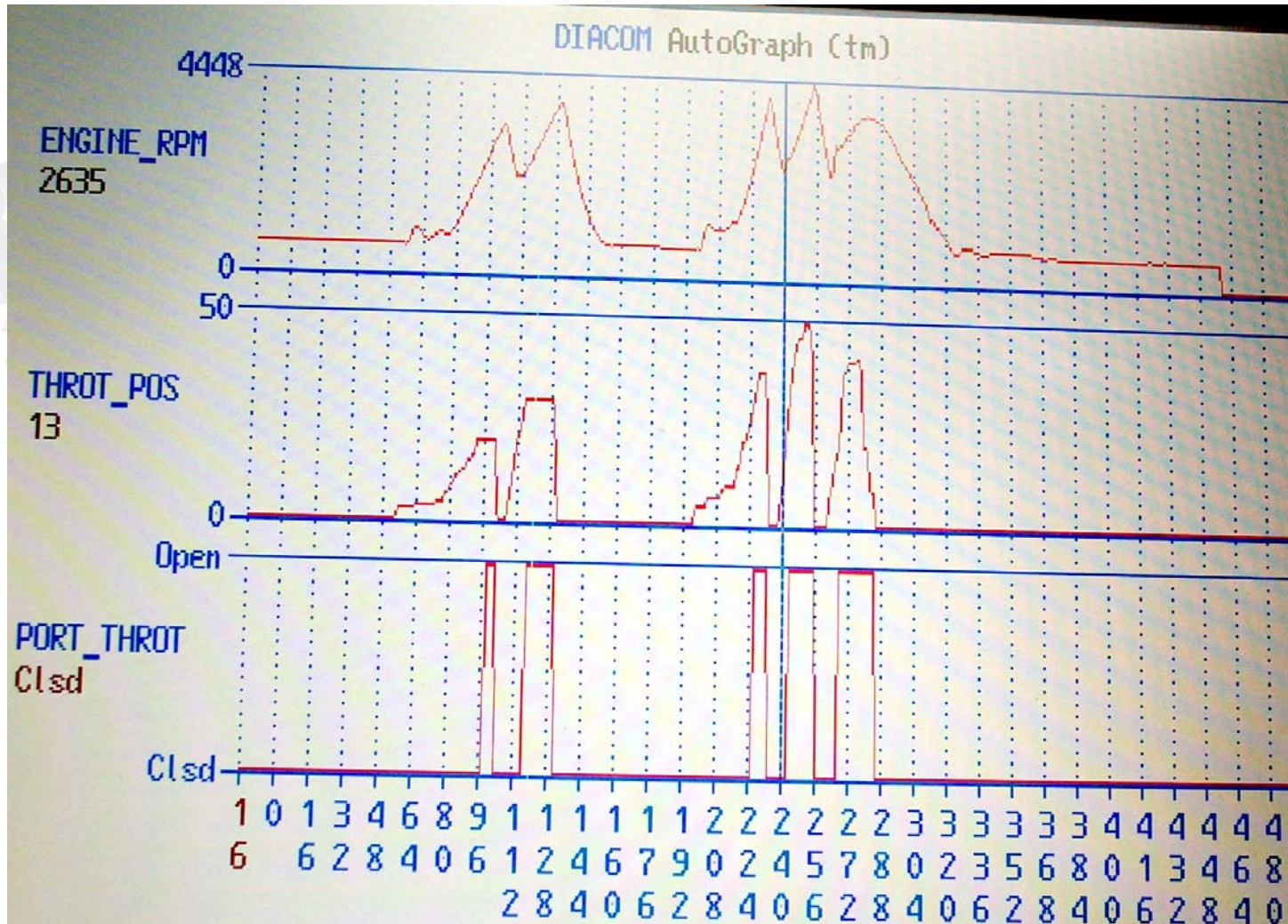
- Separate Software for 90-92 and 93-95 LT5s
- Z1 Version for 90 – 92 LT5
- Z2 Version for 93 – 95 LT5

http://web.archive.org/web/20011212092406/http://www.ttspowersystems.com/dm_dload.htm

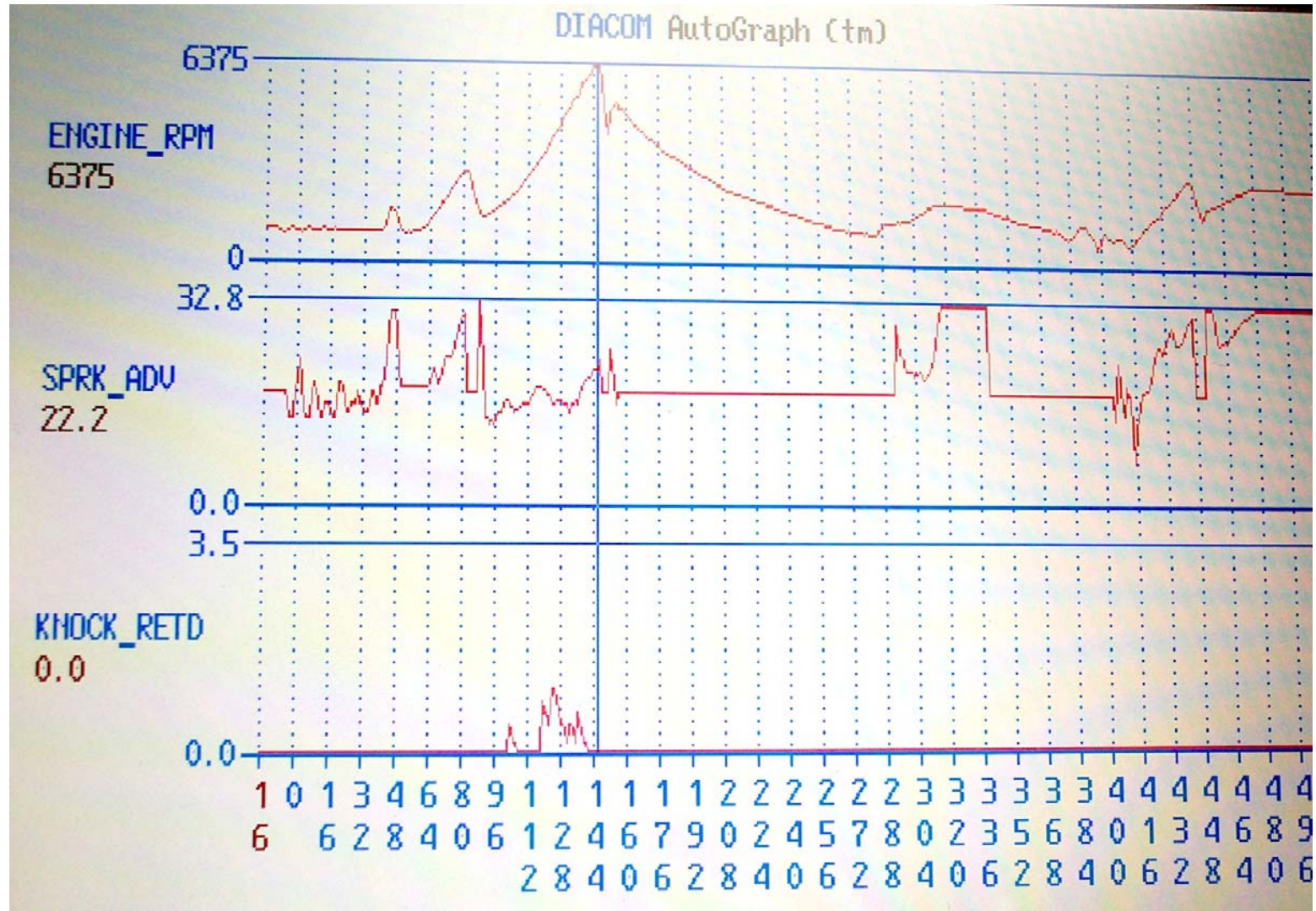
Normal Oxygen Sensor Data



Typical Secondary Port Throttle Data



Normal Spark Knock





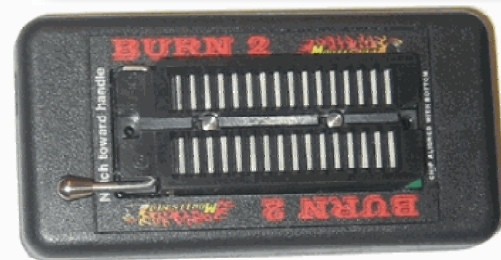
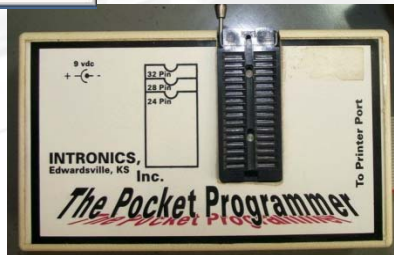
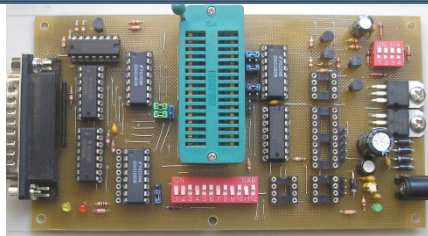
Is The Engine Ready For Tuning?

1. The engine must run smoothly. No misfire at idle or under load.
2. The fuel pressure must be 43 psi at idle and 51 psi at WOT. +/- 2 psi.
3. These engine data must be in the normal range before tuning.
 - A. Fuel blocks, 128. Fuel trims, 128. +/- 12 counts total.
 - B. The oxygen sensor voltages must be 200 to 800 millivolts. +100 – 50 mv. They need to be smooth sine waves and cycle about three times per second at idle.
 - C. There should be at least 1 IAC count when the engine is hot. Normal is 10 +/- 5 counts.
 - D. Make three runs from 30 to 90 mph at WOT. There should be less than four knocks greater than -4 degrees on the third run.

Reading the Chip

The image shows two software windows. The top window is titled "Reading Chip" and features a progress bar at 18%, two "twp peak" input fields, a "Sector" field with the value "1023", and a "Cancel" button. The bottom window is "Willem Eeprom Prog(0.97i+)", which includes a menu bar (File, Edit, Device, Action, Help), a toolbar, and a main interface for programming a 27C256 chip. It displays fields for "Size & Checksum", "Shift & Pattern adr", "WVP", "WVC", and "Vpp" levels. A "Programmer Settings" section includes checkboxes for "Skip Write 0xFF" and "Fast Programmin", along with fields for "Offset (Hex)", "Check Type", and "Printer Port". A "StatusBar" is visible at the bottom of the window.

The right window is "Moates.net Flash & Burn Interface". It lists "Supported Chips" including 29C256, 29F040, 275F512, 2732A (Read-Only), 27C128 (Read-Only), 27C256 (Read-Only), 27C512 (Read-Only), J3 Ford Adapter, J3 Ford EEC-IV Reader, and J3 Ford EEC-V Reader. It has sections for "Chip Addressing" and "Buffer Addressing", each with "Start Address in Hex" and "End Address in Hex" fields. Buttons include "Load File to Buffer...", "Save Buffer to File...", "Program Chip", "Read Chip", "Edit Buffer", "Erase Chip", "Blank Check", "Verify Chip w/ Buffer", "Cancel Operation", and "Close". A status area at the bottom shows "PromIO.dll Version: 1.00.0098.00" and "HW: No Hardware Found. Connect hardware and restart window."



View & Edit the Chip's Calibration

Equipment Needed:

1. Laptop
2. Tuning Software: TunerPro / C.A.T.S.
3. Chip Reader / Writer: Wilhelm board / Pocket Programmer / Burn 2
4. Memcal Adapter for ECM - Moates
5. Memcal Adapter for Reader/Writer - Moates
6. EEPROM Flash Chip - Moates

**Complete Kit: [C.A.T.S. OBDI Tuner PGM](#)

ECM Definition File
Software CD
Burn2 Programmer
G1 Memcal Adapter
HDR1 Memcal Adapter
SST27SF512 Flash Chip



View & Edit the Chip's Calibration

In addition to software, you will need the correct definition files:

- 1990 LT5 - \$8E or \$8EA Definition File
- 1991 LT5 - \$AF or \$AFA Definition File
- 1992 LT5 - \$D0 or \$D0A Definition File
- 1993-95 LT5 - \$F0A or \$F0 Definition File

Using C.A.T.S – Purchase at <http://tunercat.com/>

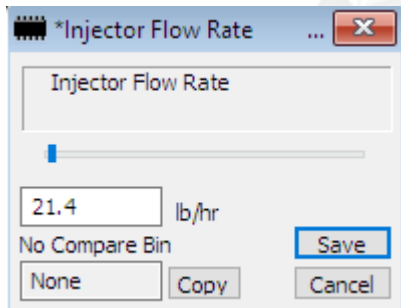
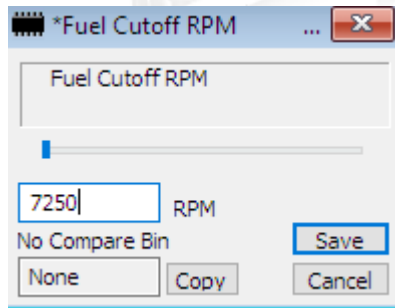
Using TunerPro – Find on a Definition Forum
(<http://www.gearhead-efi.com>)

Scalars, Flags, and Tables

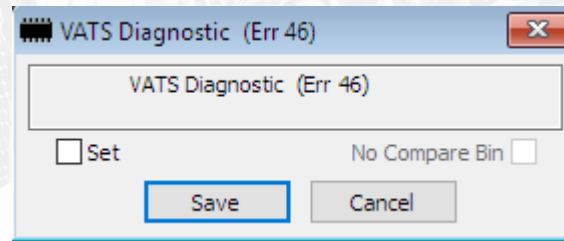
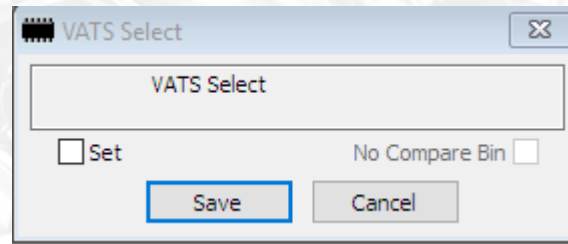
The image displays three screenshots of a software interface, each showing a 'Parameter Tree' window. The first window shows a list of parameters under the 'Scalars' category, including items like 'Cylinder Volume', 'Fuel Cutoff Speed', and 'RPM Threshold To Enable CARS'. The second window shows a list of parameters under the 'Flags' category, including 'VATS Select (X =Enabled)', 'Vehicle Speed Diagnostic (Error 24)', and 'Port Throttle Vacuum Diag. (Error 56)'. The third window shows a list of parameters under the 'Tables' category, including 'Spark Advance #1 (Port Throttles Closed)', '% Volumetric Efficiency #1 (Port Throttles Open)', and 'DFCO Enable TPS Threshold Vs. RPM'.

Scalars, Flags, and Tables

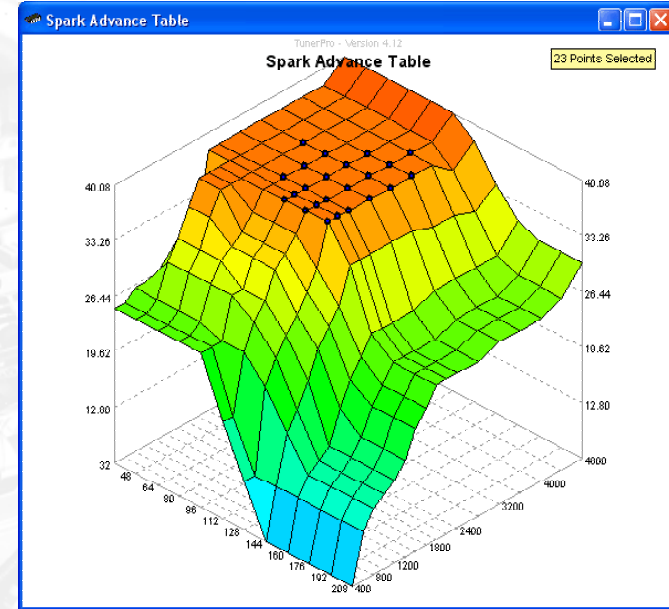
Scalar



Flags



Tables



RPM	25	30	35	40
400	25.3	25.3	25.3	25.3
600	28.1	28.1	28.1	28.1
800	35.2	35.2	35.2	30.2
1000	35.2	35.2	35.2	35.2
1200	35.2	35.2	35.2	35.2
1400	35.2	35.2	35.2	35.2
1600	35.2	35.2	35.2	35.2
1800	35.2	35.2	35.2	35.2
2000	35.2	35.2	35.2	35.2

The Spark Advance Table



RPM	MAP (Kpa)															
	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
400	25.3	25.3	25.3	25.3	23.2	20.0	18.3	15.5	14.1	12.3	10.2	8.1	6.0	5.3	3.9	3.9
600	28.1	28.1	28.1	28.1	27.1	25.3	22.1	20.0	17.2	14.1	12.3	10.2	8.1	6.0	5.3	5.3
800	35.2	35.2	35.2	30.2	30.2	28.1	24.3	22.1	19.0	16.2	14.1	12.3	9.1	7.0	6.0	6.0
1000	35.2	35.2	35.2	35.2	33.0	30.2	25.3	23.2	20.0	17.2	15.1	13.0	11.3	9.1	8.1	7.0
1200	35.2	35.2	35.2	35.2	33.0	30.2	26.4	24.3	21.1	18.3	16.2	14.1	12.3	11.3	10.2	9.1
1400	35.2	35.2	35.2	35.2	33.8	30.2	27.1	25.3	22.1	19.0	17.2	16.2	14.1	13.0	12.3	11.3
1600	35.2	35.2	35.2	35.2	33.8	30.2	27.1	25.3	22.1	20.0	18.3	17.2	16.2	14.1	13.0	12.3
1800	35.2	35.2	35.2	35.2	33.8	30.2	27.1	25.3	23.2	21.1	20.0	18.3	17.2	16.2	15.1	14.1
2000	35.2	35.2	35.2	35.2	33.8	30.2	28.1	25.3	23.2	21.1	20.0	19.0	18.3	17.2	16.2	16.2
2200	35.2	35.2	35.2	35.2	33.8	30.2	28.1	25.3	24.3	24.3	22.1	21.1	20.0	19.0	18.3	18.3
2400	35.2	35.2	35.2	35.2	33.8	30.2	28.1	26.4	25.3	25.3	24.3	24.3	22.1	21.1	20.0	20.0
2800	35.2	35.2	35.2	35.2	33.8	32.7	30.2	30.2	28.1	26.4	25.3	25.3	24.3	23.2	22.1	21.1
3200	35.2	35.2	35.2	35.2	34.1	34.1	32.0	30.2	28.1	26.4	25.3	25.3	24.3	23.2	23.2	23.2
3600	35.2	35.2	35.2	35.2	35.2	35.2	33.8	31.3	28.1	26.4	24.3	23.2	22.1	22.1	22.1	22.1
4000	35.2	35.2	35.2	35.2	35.2	35.2	33.8	31.3	27.1	25.3	23.2	22.1	21.1	21.1	20.0	19.0
4500	32.0	32.0	32.0	32.0	32.0	32.0	28.8	28.1	27.1	25.3	24.3	23.2	22.1	22.1	21.1	21.1
5000	28.1	28.1	28.1	28.1	28.1	28.1	27.1	26.4	25.3	25.3	24.3	24.3	24.3	24.3	23.2	23.2
5500	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3
6000	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3
6500	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3
7000	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3
7500	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3



Fueling and AFR

1. The oxygen sensors set the AFR to 14.7 up to about 50% throttle.
2. Measure the AFR with more than about 50% throttle with a wide band oxygen sensor.
 - A. Recommended AFR at WOT 2000 to 4500 rpm is 12.3.
 - B. Recommended AFR at WOT 5000 to 7000 rpm is 12.6.

The Fuel Table

% Volumetric Efficiency #2 (Port Throttles Open)

RPM	MAP (Kpa)														
	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
2000	60.9	61.3	61.3	63.7	65.2	67.2	68.8	70.7	72.7	73.8	74.6	75.4	75.8	76.2	77.3
2200	60.9	61.7	62.1	64.5	66.4	67.6	69.1	70.7	72.7	73.8	74.6	75.4	75.8	77.3	77.7
2400	61.7	62.1	61.7	64.8	66.8	68.0	69.5	71.5	73.0	73.4	74.6	75.0	76.2	77.3	78.1
2800	64.1	64.1	64.8	66.0	68.0	69.1	70.3	71.5	73.0	73.8	74.2	75.0	75.8	77.0	78.1
3200	65.6	65.6	66.8	67.6	68.8	69.5	70.7	72.3	73.0	74.2	75.4	77.0	77.3	78.1	78.9
3600	68.4	68.4	69.5	69.9	71.1	72.3	73.4	75.0	76.2	78.1	79.3	80.1	81.3	82.0	82.8
4000	72.3	73.0	73.8	74.2	76.2	77.3	78.5	80.1	81.3	82.0	84.0	84.4	86.3	87.9	88.7
4500	75.8	76.2	77.7	78.5	80.5	81.3	83.2	84.4	86.3	87.9	88.7	91.0	92.6	93.8	95.7
5000	78.1	79.7	80.9	81.6	83.2	85.5	87.1	87.9	90.2	91.8	93.8	94.9	96.1	97.7	98.8
5500	80.1	81.6	82.8	83.6	84.8	87.5	89.8	91.4	93.0	94.5	95.7	96.9	97.7	99.2	100.0
6000	83.6	83.6	84.4	84.8	85.9	89.1	91.0	93.0	94.1	96.1	96.5	98.0	98.4	99.6	100.4
6500	85.2	85.2	85.5	85.9	87.1	89.8	92.2	93.8	95.3	96.9	98.0	98.8	100.0	100.4	100.8
7000	86.3	86.3	86.7	86.7	87.5	90.2	93.4	95.3	96.9	98.0	98.8	99.6	101.6	102.0	102.3

% Volumetric Efficiency #2 (Port Throttles Open) (Cont.)

RPM	MAP (Kpa)	
	95	100
2000	78.1	79.3
2200	78.5	79.7
2400	78.9	79.7
2800	79.3	80.1
3200	80.5	81.6
3600	84.0	84.8
4000	90.2	91.0
4500	96.5	98.8
5000	99.2	101.6
5500	100.8	102.3
6000	101.6	102.7
6500	102.0	103.1
7000	103.5	104.7

Adjusting The Fueling

Think in terms of percentage.

$12.6:1 \text{ AFR} / 100 = 1\% \text{ WOT AFR or } .126 \text{ AFR.}$

If the AFR is 13.0. $13.0 - 12.6 = .4$

$.4 / .126 = 3.2\%$

Add 3.2% fuel.

Using the Power Enrichment % Table

How GM Formats the Table

PE % Change to Fuel/Air Ratio vs. RPM

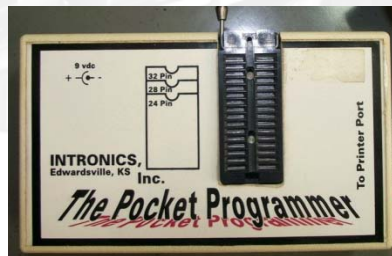
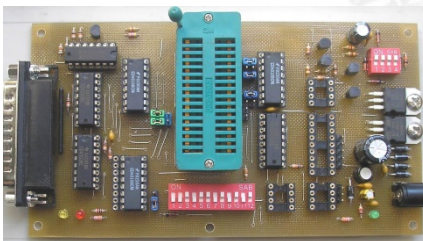
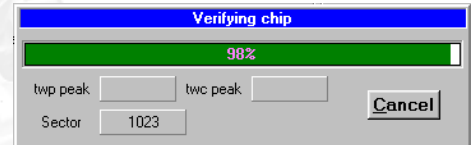
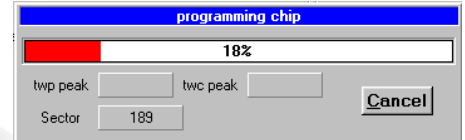
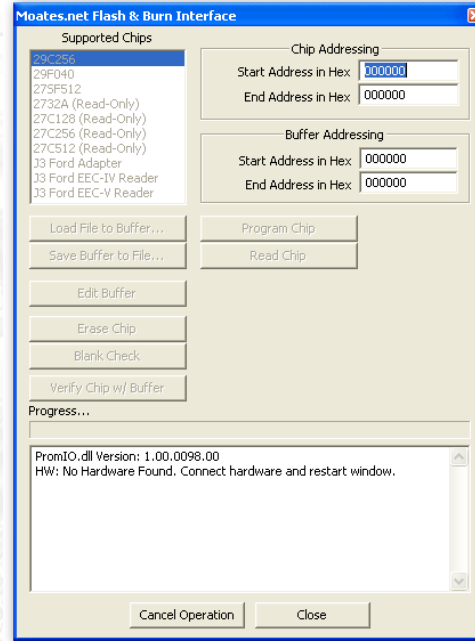
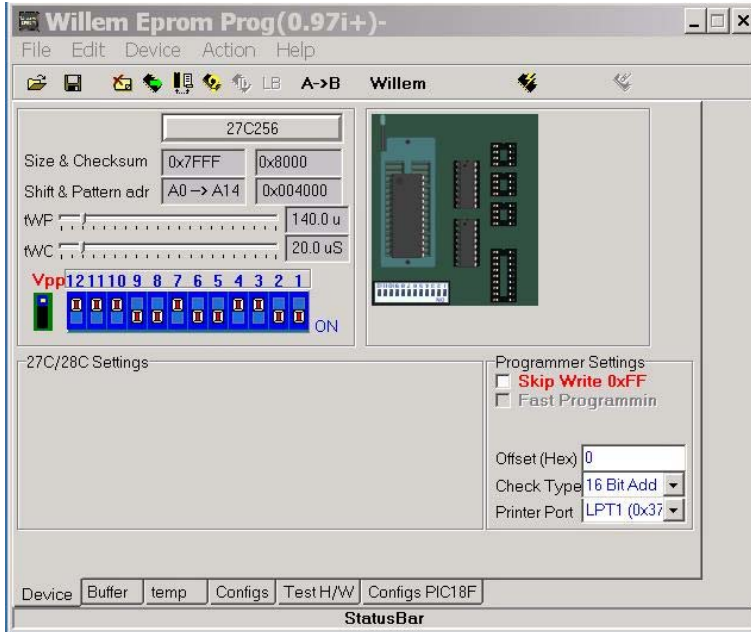
RPM	% Change
400	0.0
800	0.0
1200	0.0
1600	0.0
2000	0.0
2400	0.0
2800	0.0
3200	0.0
3600	0.0
4000	0.0
4500	0.0
5000	0.0
5500	0.0
6000	0.0
6500	0.0
7000	0.0
7500	0.0

A Table Setup for a 450hp Engine

PE % Change to Fuel/Air Ratio vs. RPM

RPM	% Change
400	0.0
800	0.0
1200	1.2
1600	1.2
2000	1.2
2400	1.2
2800	5.9
3200	5.9
3600	3.9
4000	5.1
4500	5.9
5000	5.9
5500	3.9
6000	2.0
6500	0.4
7000	1.2
7500	1.2

Burning the Chip



Takeaways

- Every LT5 will benefit from tuning to its specific operation
- Tuning requires an investment in both time and equipment
- There are a few easy changes to make
 - Set cooling fans to turn on at a lower temperature
 - Disable the CAGS 1 to 4 shift
 - Disable VATS
 - Set the power key default to Full Power on 91-95 ZR-1s
- Changes to fueling and spark advance must be thought through
- Improper editing can damage your engine
- Recommend never overwriting your original chip – Use a memory adapter
- Be careful what you read about on the forums – not all free advice is correct