Megasquirt® and the '02

A great fit for the BMW 2002 and it's easier than you think

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(JohnC)   (Grover)

Megasquirt® and the '02

- The objective of this tech session is to
  - Give you <u>basic</u> information about Megasquirt® and its application to the BMW 2002 M10
  - Encourage you to take the plunge if you've been thinking about it
  - Describe some options for implementation, and answer your questions
 - Tell you what you need and where you can get it

Agenda

- What is Megasquirt®?
- Why Megasquirt®?
- How it Works
- Getting Started
- What you need
- Where to get what you need
- Configuring
- Tuning
- Q&A

But first...

- Who are Tom and John, and what are their qualifications?
  - Tom and John are regular guys who like cars, and like to work on them
  - We have no previous automotive expertise
  - We don't have particular knowledge that would have been helpful prior to tackling our projects
  - **If we can do it so can you!**

Our Cars…
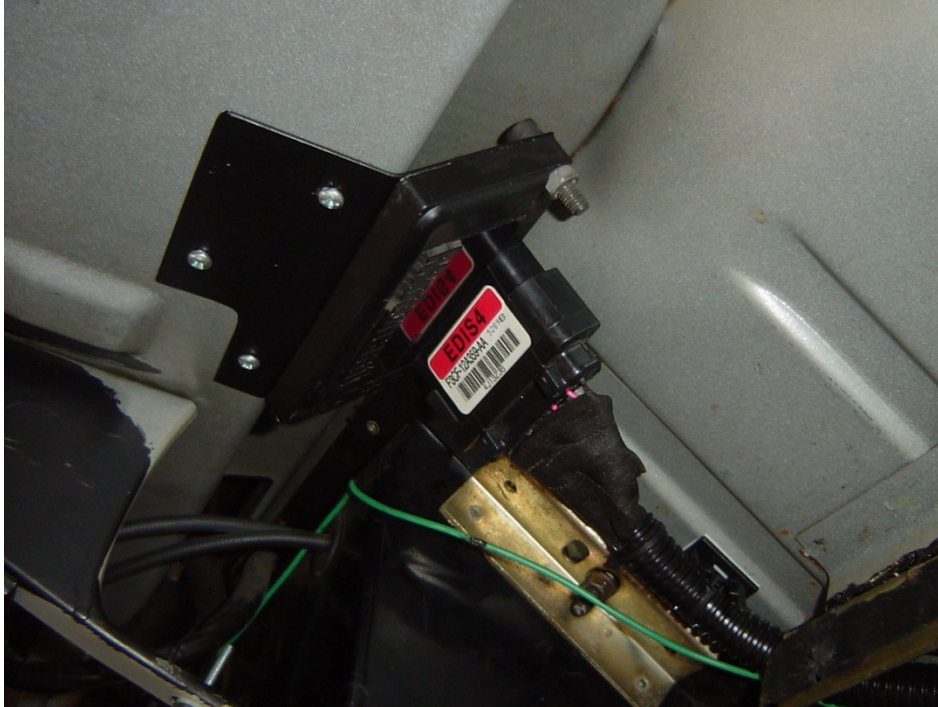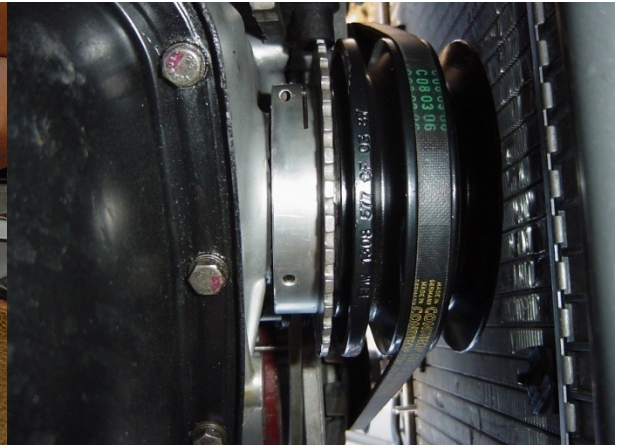
What is Megasquirt®

- MegaSquirt® is a Do-It-Yourself universal programmable electronic fuel injection controller for internal combustion engines.

- Megasquirt® is easily configured to control fuel delivery and spark timing for the BMW 2002 M10 engine

Warning: Megasquirt® is not for sale or use on pollution controlled vehicles. Check the laws in your jurisdiction to determine if using a Megasquirt® EFI controller is legal for your application

Why Megasquirt®?

- Get the best of both worlds
  - High Performance
  - Excellent Fuel Economy
- Easy to tune and optimize to your particular configuration
- Inexpensive compared to proprietary fuel injection systems
- Well suited to the hobbyist – A real DIY system, with a large support community

Why Not Megasquirt®?

- Megasquirt® may not be for you. Do you see yourself here?
  - I'm a traditionalist. BMW reached its pinnacle in 1973 and has been going downhill ever since
  - I love tuning carburetors. I especially enjoy purchasing, collecting and swapping jets, and adjusting mechanical chokes
  - My only use for a computer is to read and post on the 2002 FAQ
  - Reading technical manuals puts me to sleep within 5 minutes
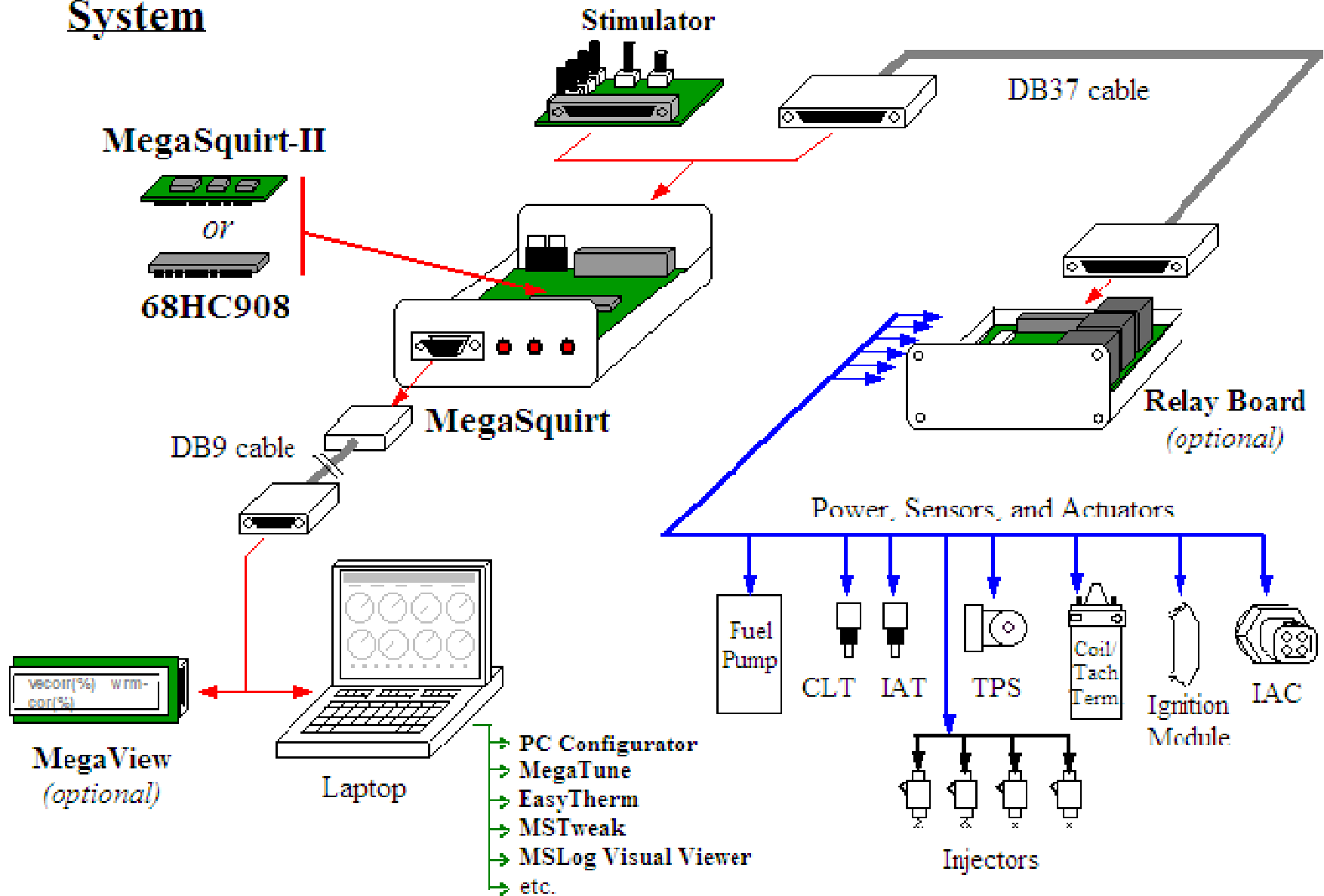- If this is NOT you, Megasquirt® and your '02 may be a good match!

How Megasquirt® Works

- The basic concept is that the ECU gathers information about how much oxygen is available for a given cylinder charge, then it injects the appropriate amount of fuel to achieve the desired Air to Fuel Ratio (AFR).
  - Volumetric efficiency (VE)
    - Your engine is an air pump. VE is a measure of how efficient the engine is with regard to filling the combustion chamber with a charge of fuel and air
  - Intake Air Temperature (IAT)
    - Air density goes down as temperature rises. IAT is one factor used by the ECU to calculate how much fuel to deliver
  - Manifold Absolute Pressure (MAP)
    - Air density increases as pressure rises. High pressure (atmospheric) indicates a Wide Open Throttle (WOT) condition
  - RPM
    - The faster the engine is turning, the more fuel it needs

How Megasquirt® Works

- Megasquirt® can also control your spark advance in a way that is superior to a distributor
  - A distributor advances spark only as a function of RPM, with an adjustment for MAP (if you have a vacuum advance or retard)
  - Megasquirt® can advance or retard your spark as a function of RPM *and* MAP, and is tunable in a 12X12 grid
  - With Megasquirt®, you can tune your ignition timing on the fly. No re-curving. You optimize to every condition (Wide Open Throttle, freeway cruising, etc.)

MegaSquirt System

Stimulator

MegaSquirt-II

or

68HC908

DB37 cable

DB9 cable

MegaSquirt

Relay Board
(optional)

Power, Sensors, and Actuators

vecoir(%)   wrm-
eoir(%)

MegaView
(optional)

Laptop

→ PC Configurator
→ MegaTune
→ EasyTherm
→ MSTweak
→ MSLog Visual Viewer
→ etc.

Fuel
Pump

CLT   IAT

TPS

Coil/
Tach
Term

Ignition
Module

IAC

Injectors

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Other Useful Capabilities

- Idle Air Control
  - Your '02 can start quickly with a stable idle regardless of the temperature
- Rev Limiter
  - Extremely useful! Especially during break-in
- X-Tau
  - A modern algorithm to enrich at throttle tip-in (more efficient than Accel Enrichment)
- Electric Fan Control
  - You set the on-off temperature parameters to exactly what you want
- Fuel cut-off
  - The system will turn off the fuel pump after three seconds if the engine isn't turning

Getting Started

Preparing your car

- Battery relocation
  - In general, it's a good idea to move your battery to the trunk or under the back seat to make more room for air intake
- Electric Fuel Pump
  - The in-tank fuel pump from a E-30 318is is ideal
- Return Fuel Line (early cars)
  - The early cars don't have a return fuel line. The common practice is to add a stainless steel line for the main feed and use the original line for the return
  - Tricky to bend and install! Take your time, buy extra material
  - You most likely will need to weld a fitting to the gas tank
- O2 Sensor
  - You'll need to weld a bung onto your header or downpipe

Getting Started

- Decide where you're going to install your ECU Relay Board, Wideband O2 controller, EDIS controller and coil pack

- Other:
  - Now is a good time to consider whether you're going to install an electric fan, upgrade your headlights, install that amp and subwoofer and all that stuff
  - This will make your wiring much easier, which will lead to a cleaner install, and fewer opportunities for mistakes. Ask me how I know…

- Auxiliary Fuse box
  - Not usually necessary if you're using a relay board, but consider future electrical needs

Fabrication

- Toothed Wheel
  - If you are going to use EDIS, you need to mount a toothed wheel on your crank pulley.
- VR Sensor Mount
  - needed for EDIS
- Throttle Position Sensor Adapter
  - There is no Variable TPS that will fit directly on to the 318i or 325i throttle body, so you'll need to fabricate or purchase an adapter
- Throttle Linkage
  - Various ways to approach this

Fortunately, if you're not inclined to make these parts, you can source them from Tom at 02Again

The Basic Parts

E30 parts:

- 318i manifold
- Fuel rail
- Fuel pressure regulator
- Water neck (for the extra sensor bung)
- Coolant bypass tube
- Throttle body and boot (58mm from an M20 is better!)
- Fuel pump (the one from the later M42 318is is best)
- While you are at it, you might want to get a battery cable and terminal, and the 80A alternator and brackets

The Basic Parts

- Megasquirt® ECU (MS II 3.57 recommended but not essential)
- Relay board (recommended but not essential)
- "Stimulator" (to test your MS II – recommended by the experts)
- Wiring kit (or you can make your own)
- O2 sensor (Wideband such as Innovate LC1 is HIGHLY recommended)
- Air Temperature sensor (GM sensor requires no calibration)
- Fuel Injectors (sizing discussed later)
- Variable Throttle Position Sensor and adapter
- EDIS-4 kit (optional)
  - VR sensor
  - Toothed wheel
  - Coil pack
- Fuel Pump Block Off and Distributor Block-off
- Optional:
  - Idle Air Control body and stepper motor or Bosch Fast Idle solenoid valve

Other Stuff

- You also need a laptop and a tuning cable, and if you have a newer laptop, a USB to serial adapter

- Miscellaneous stuff:
  - Wire Strippers
  - Heatshrink tubing
  - Crimpers
  - Connectors
  - Soldering Iron
  - Extra wire
  - etc. etc.

Recommended Sources

- 02Again
  - Tom Rafalski is assembling a Megasquirt® One-Stop Shop for the BMW 2002. Block off plates, adapters, toothed wheel mounted on a pulley, IAC body etc. etc. Tom can also provide the ECU, Relay board etc.
- DIYAutotune
  - A great source for the ECU, Relay Board, Wide-Band O2 sensor and controller, wiring and other bits and pieces. Outstanding technical support
- Five-0-Motorsport
  - Fuel injectors
- Boost Engineering
  - EDIS -4 Kits
- Pick-a-Part
  - E30 Parts
  - Fuel Injectors
  - EDIS-4

Wiring

MegaSquirt V3.0 Main Board External Wiring Diagram
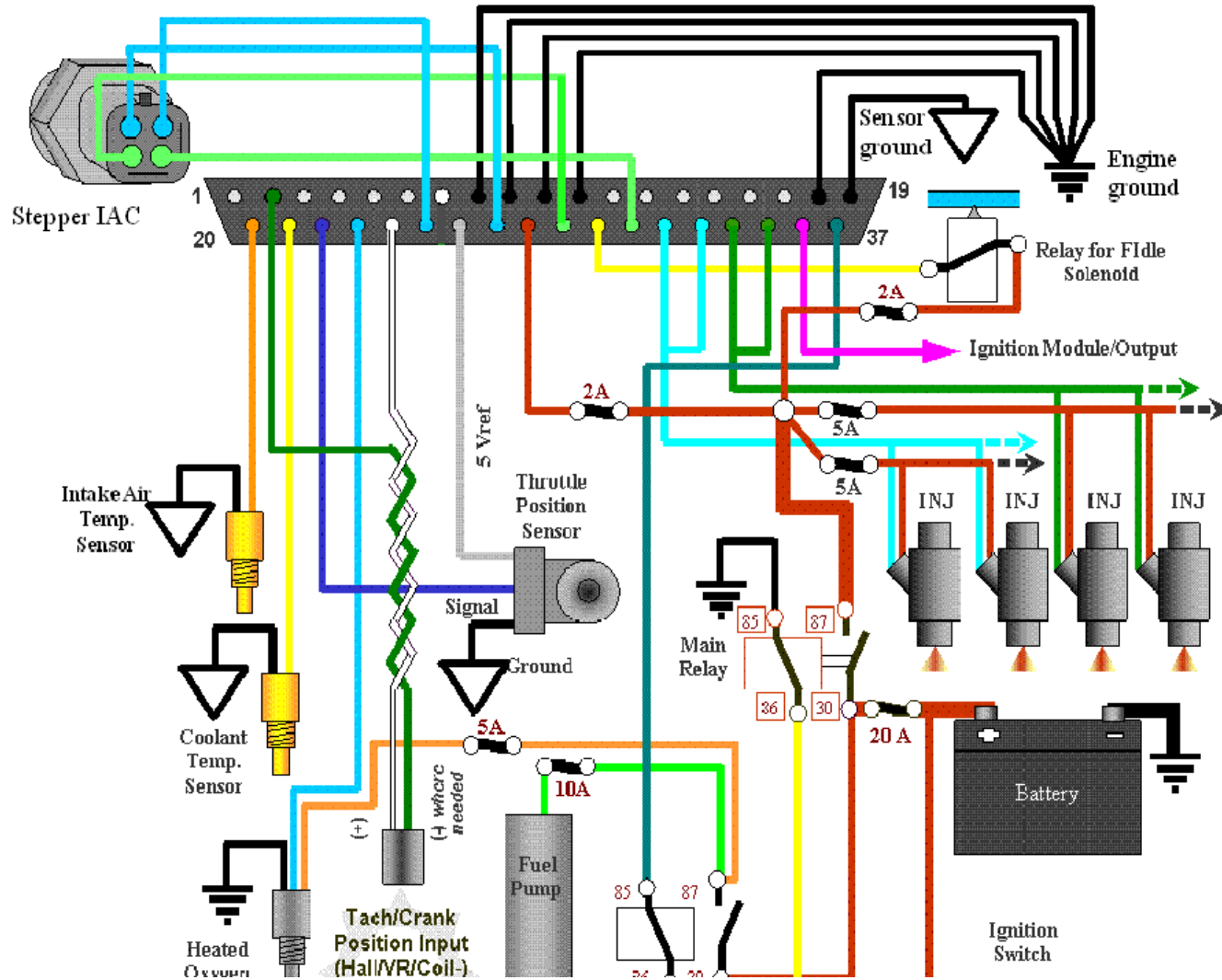
Relay Board
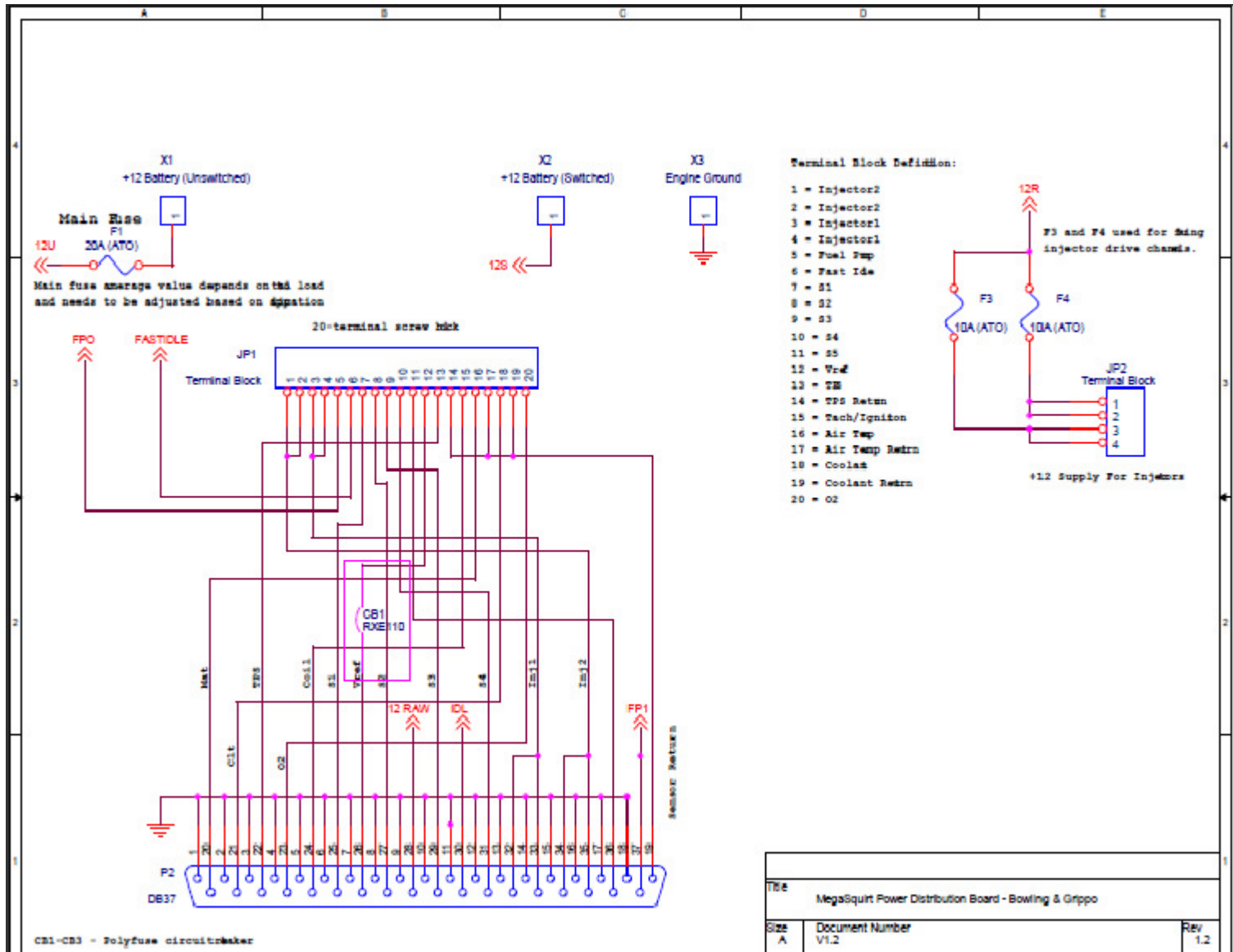
EDIS-4 Wiring

Connector shown looking into wiring harness

Shield

1 → PIP: to DB37 pin 24

2

3 → SAW: to DB37 pin 36

4

VR Sensor

Shield

5

6

7

Switched 12V (main relay) 15A → 8

9

10 → 1

11 → 2

12 → 3

Shield

To Tach

100k ohm

25µF

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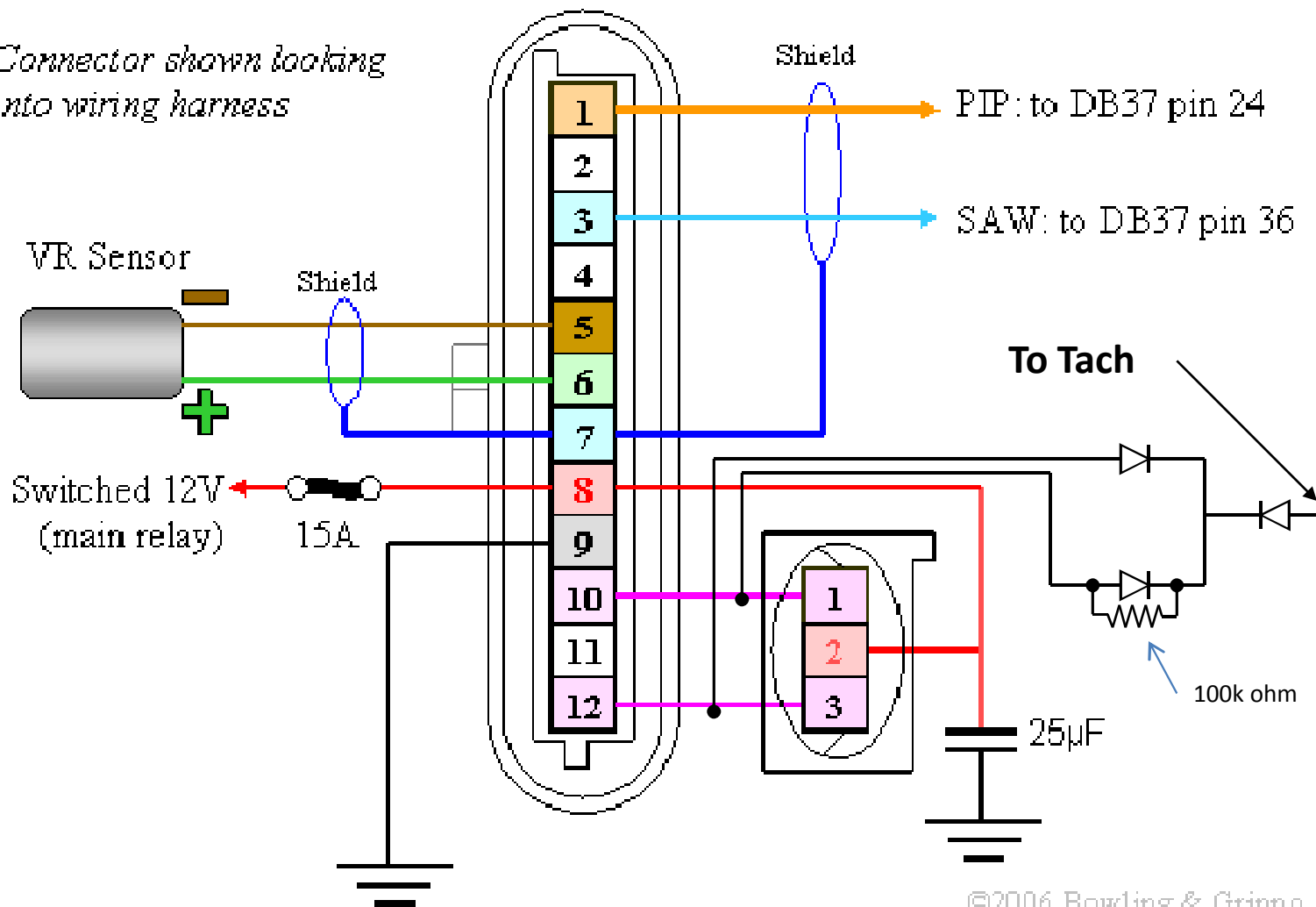
Configuration

- Injector Sizing
  - Use the Megamanual

Horsepower	# Injectors	Flowrate(lbs/hr)
150	4 ∨	22

[Compute Flowrate]   [Reset]

- High Impedence Injectors is recommended for simplicity
  - Don't have to mess with PWM, resistors or fly-back board

Configuration

- Start with the Megamanual
  - "MegaTune for MS-II v2.8"
    - This section will walk you through the configuration step by step using MegaTune software
    - MegaTune is the software that runs on your laptop that will assist you to build and tune your configuration
    - You can also start with another user's .msq file
      - You still need to walk through step by step to ensure that the file is appropriate for your unique configuration
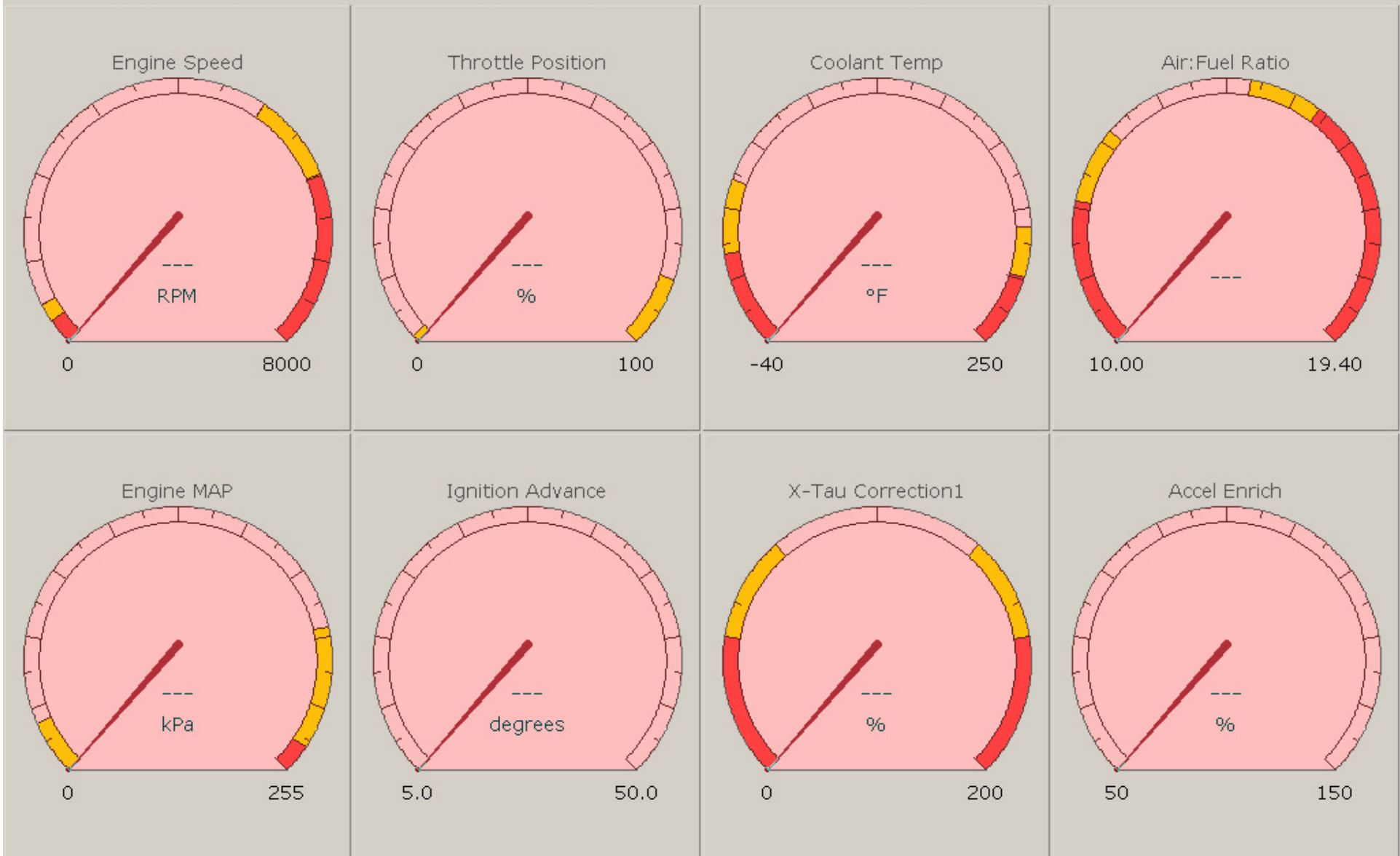
Basic Tables

- The basic tables are
  - VE (Volumetric Efficiency)
  - AFR (Air/Fuel Ratio)
  - Spark Advance
- Other Tables
  - Temperature Values (used for afterstart enrichment, IAC, Priming Pulse, Cranking Pulsewidth etc.)
  - Priming Pulse
  - Cranking Pulsewidth
  - Afterstart percentage and taper

Sample VE Table

VE Table 1 (MAP)

File   Edit Bins   Tools

kPa	%											
100.0	67	70	74	80	89	92	92	92	91	90	89	87
90.0	63	66	70	76	84	90	91	91	91	91	91	91
80.0	59	63	67	73	80	86	89	89	90	91	90	90
70.0	53	59	65	71	77	81	84	85	86	87	87	88
65.0	49	57	63	69	74	78	81	82	83	84	85	86
60.0	46	54	59	67	71	75	78	79	80	81	83	85
55.0	42	50	56	65	68	72	75	76	77	79	80	82
50.0	39	47	53	62	65	68	71	72	73	75	77	78
45.0	37	41	49	57	61	64	67	68	69	71	73	74
40.0	36	37	43	52	54	58	63	64	65	67	69	70
30.0	32	33	34	40	42	45	53	56	58	59	61	64
20.0	30	31	30	26	23	24	35	44	49	54	58	56

RPM												
	900	1200	1500	2000	2800	3600	4300	4800	5200	5600	6000	6500

Sample AFR Table

AFR Table 1

File   Tools

kPa	AFR											
100.0	12.9	12.9	12.9	12.9	12.8	12.8	12.7	12.6	12.5	12.4	12.3	12.2
90.0	12.9	12.9	13.1	13.2	13.2	13.2	13.1	12.9	12.8	12.6	12.5	12.4
80.0	13.2	13.2	13.4	13.9	14.1	14.1	13.9	13.5	13.2	12.9	12.7	12.5
70.0	13.3	13.4	13.8	14.6	14.9	14.9	14.6	14.3	14.0	13.3	13.0	12.7
65.0	13.5	13.5	14.0	14.9	15.6	15.7	15.3	14.8	14.3	13.6	13.1	12.9
60.0	13.5	13.5	14.1	15.2	15.9	16.3	15.8	15.2	14.6	13.9	13.4	13.0
55.0	13.5	13.5	14.2	15.4	16.3	16.5	16.1	15.4	14.8	14.2	13.6	13.2
50.0	13.5	13.5	14.3	15.6	16.6	16.9	16.3	15.6	15.0	14.4	13.9	13.4
45.0	13.5	13.5	14.4	15.7	16.9	17.0	16.4	15.7	15.2	14.7	14.1	13.6
40.0	13.5	13.5	14.5	15.8	17.1	17.2	16.6	16.1	15.4	14.8	14.2	13.8
30.0	13.5	13.5	14.8	16.2	17.4	17.4	16.9	16.5	15.9	15.2	14.6	14.1
20.0	13.5	13.5	14.9	16.4	17.8	17.9	17.7	17.2	16.5	15.8	15.1	14.4

RPM												
900	1200	1500	2000	2800	3600	4300	4800	5200	5600	6000	6500

Sample Spark Advance Table

Spark Advance Table

File   Edit Bins   Tools

kPa	deg											
100.0	11.0	18.0	19.0	20.0	21.0	22.5	24.0	26.0	28.0	28.0	28.0	28.0
90.0	11.0	20.0	22.0	23.3	24.8	26.2	28.0	30.1	32.4	33.0	33.0	33.0
80.0	11.0	22.0	24.0	26.0	28.0	30.6	32.3	34.4	35.6	35.7	36.0	36.0
70.0	11.0	24.0	26.0	28.7	30.8	33.6	36.2	37.9	39.4	40.0	40.0	40.0
65.0	11.0	26.0	28.0	30.0	32.0	35.0	38.0	39.3	41.0	41.5	41.5	41.5
60.0	11.0	28.0	28.0	30.0	32.0	35.0	38.0	40.1	42.0	42.0	42.0	42.0
55.0	11.0	28.0	28.0	30.0	32.0	35.0	38.0	40.5	42.0	42.0	42.0	42.0
50.0	11.0	28.0	28.0	30.0	32.0	35.0	38.0	40.7	42.0	42.0	42.0	42.0
45.0	11.0	28.0	28.0	30.0	32.0	35.0	38.0	40.6	42.0	42.0	42.0	42.0
40.0	11.0	28.0	28.0	30.0	32.0	35.0	38.0	40.4	42.0	42.0	42.0	42.0
35.0	11.0	28.0	28.0	30.0	32.0	35.1	38.0	40.0	40.0	40.0	40.0	40.0
30.0	11.0	18.0	24.0	26.0	27.9	30.0	33.0	35.0	35.0	35.0	35.0	35.0

RPM

400	500	1200	1350	1500	1750	2000	2500	3000	3500	4500	6000

Start-Up and Tuning

- Verify timing
  - Check VR sensor signal polarity - the VR sensor output falls from a positive to a negative polarity

  Default EDIS Advance (no SAW commanded advance)
  Missing Tooth

  Fire - 10 Degrees Advance
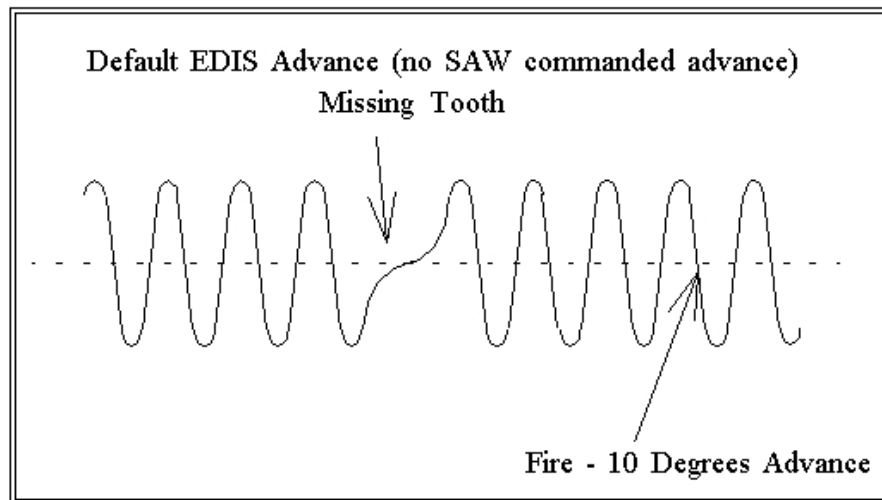
  - You can do this by lining up a tooth on the sensor, then rotating the engine while monitoring the voltage with a voltmeter

Start-Up and Tuning

- Calibrate Coolant and Air Intake sensor if not using GM sensor
- Calibrate TPS
- Configure O2 Sensor Controller
- Get the car to start and idle
- Go easy while calibrating your VE table
  - Use the Megalog Viewer program to calibrate your VE table
  - Once you have your VE table somewhat refined, you can start tweaking things
  - Try X-Tau before messing around too much with Accel Enrichment
- READ THE MEGAMANUAL
- ASK QUESTIONS

General Settings

ECU Type (1=MS-II, 2=MicroSquirt)	1

MUST set ECU Type before editting other values.

Engine displacement (cu.in.)	121.0
Injection Timing Delay (%)	0
Dual Table Use	Single Table
Barometric Correction	Initial MAP Reading
X-Tau Usage	Warm-up + Accel/D
Prime, ASE, WUE Baro Tables	Table

Input Smoothing Factors

MAP/MAF Averaging Lag Factor	70
RPM Averaging Lag Factor	50
TPS Averaging Lag Factor	75
Lambda Averaging Lag Factor	60
CLT/IAT/Battery Lag Factor	50
Knock Averaging Lag Factor	80

Sampling Rates

TPS Sample Rate (msec)	25
MAP Sample Rate (msec)	25

F1 | Fetch From ECU | Burn To ECU | Close

Injector Characteristics

Injector Open Time (msec)	1.0
Battery Voltage Correction (ms/v)	0.20
PWM Current Limit (%)	75
PWM Time Threshold (msec)	25.5
Injector PWM Period (µsec)	66

Red settings require an MS-II reboot!

F1 | Fetch From ECU | Burn To ECU | Close

Idle Control

Algorithm	15-Minute IAC
Fast Idle Temperature (°F)	140.0
Time Step Size (msec)	2.5
Acceleration Step Size (msec)	0.0
Minimum # steps to move (steps)	2
PWM Frequency (Hz)	80
Start Value (retract)	280
Cranking Position (extend) (steps)	70
Crank-to-Run Taper Time (sec)	8
Hysteresis (°F)	5.0

Time-Based After Start (extended warm-up)

Cold Temperature (°F)	0.0
Cold Position (steps)	20
Cold Taper Time (sec)	300

F1 | Fetch From ECU | Burn To ECU | Close

Generic Port Settings

Port: PM2 - FIdle   ☑ Enabled

Variable		Threshold	Hysteresis
coolant	>	170.0	5.0
And			
rpm	>	450	10

Power-on value: 0

Triggered value: 1

Fetch From ECU | Burn To ECU | Close

Injection Control - Page 1

Calculate Required Fuel

Required Fuel...	14.0
	7.00

Injector Control

Control Algorithm	Speed Dens
Injections Per Engine Cycle	2
Injector Staging	Simultaneou
Engine Stroke	Four-stroke
Number of Cylinders	4
Injector Port Type	Port Injectio
Injectors	4
Engine Type	

Fetch From ECU | Burn To ECU | Close

Required Fuel Calculator

Engine Displacement	123	◉ CID ○ CC
Number of Cylinders	4	
Injector Flow	23	◉ lb/hr ○ cc/min
Air-Fuel Ratio	14.7	

OK | Cancel

Rev Limiter

Algorithm	Fuel Cut
Maximum Retard (deg)	12.0
Lower Rev Limit (RPM)	6300
Upper Rev Limit (RPM)	6400

F1 | Fetch From ECU | Burn To ECU | Close

EGO Control

EGO Sensor Type	Single Wide Band
NB AFR Target (AFR)	0.0
Ignition Events per Step	16
Controller Step Size (%)	1
Controller Authority ± (%)	0
Active Above Coolant Temp (°F)	158.0
Active Above RPM (RPM)	1200
Active Below TPS (%)	75.0
Active Below MAP (kPa)	85.00

WB Controller Settings

Algorithm	Simple
PID Proportional Gain (%)	100
Transport Delay 1 (msec)	10
Transport Delay 2 (revs)	4000
PID Integral (%)	20
PID Derivative (%)	0

F1 | Fetch From ECU | Burn To ECU | Close

Base Ignition Settings

General Ignition

Trigger Offset (deg)	-5.00
Skip Pulses	3

Prediction Settings

Predictor Algorithm	Alpha-Beta-Gamma
Alpha (%)	90
Beta (%)	80
Gamma (%)	10

Tach Signal Masking

Time Mask (msec)	0.0
Percentage Mask (%)	50

Next-Pulse Tolerance

Cranking (%)	50
After-start (%)	70
Normal Running (%)	25
Check Tach Sync Options	Check Always
Ignition Input Capture	Rising Edge
Cranking Trigger	Calculated
Coil Charging Scheme	EDIS
Spark Output	Going High (Inverted)

F1 | Fetch From ECU | Burn To ECU | Close

Other Fuel Settings

Engine Start Up

Max. Cranking Speed (RPM)	300

VE Table Adjustments

(May have to save MSQ and reload to get to stick)

Use MAP/baro for tables	Use MAP only

- Must also set/unset MAPbaro in settings.ini -

AFR Table Fuel Calc Usage	Separate VE & AFR
AFR Stioch. Ratio (Volts)	1.470
AFR Stioch. Ratio (AFR)	14.7

Two-Point Prime

Prime Pulse Cold PW (msec)	12.0
Prime Pulse Hot PW (msec)	4.0
Prime Delay (sec)	0

Additional Fuel (switched by E0 low or cyclic)

Fuel Added to Base PW (msec)	0.0

Additional Fuel (cyclic only)

Time Between Added Fuel (sec)	0
Number of Cycles	0

F1 | Fetch From ECU | Burn To ECU | Close

Cranking Pulsewidth

Coolant (°F)	Cranking PW (msec)
-20.0	16.0
0.0	15.1
20.0	14.2
40.0	12.9
65.0	11.1
90.0	9.0
110.0	7.2
125.0	5.8
145.0	3.8
153.0	3.0

Coolant Temp

-40 °F

-40   250
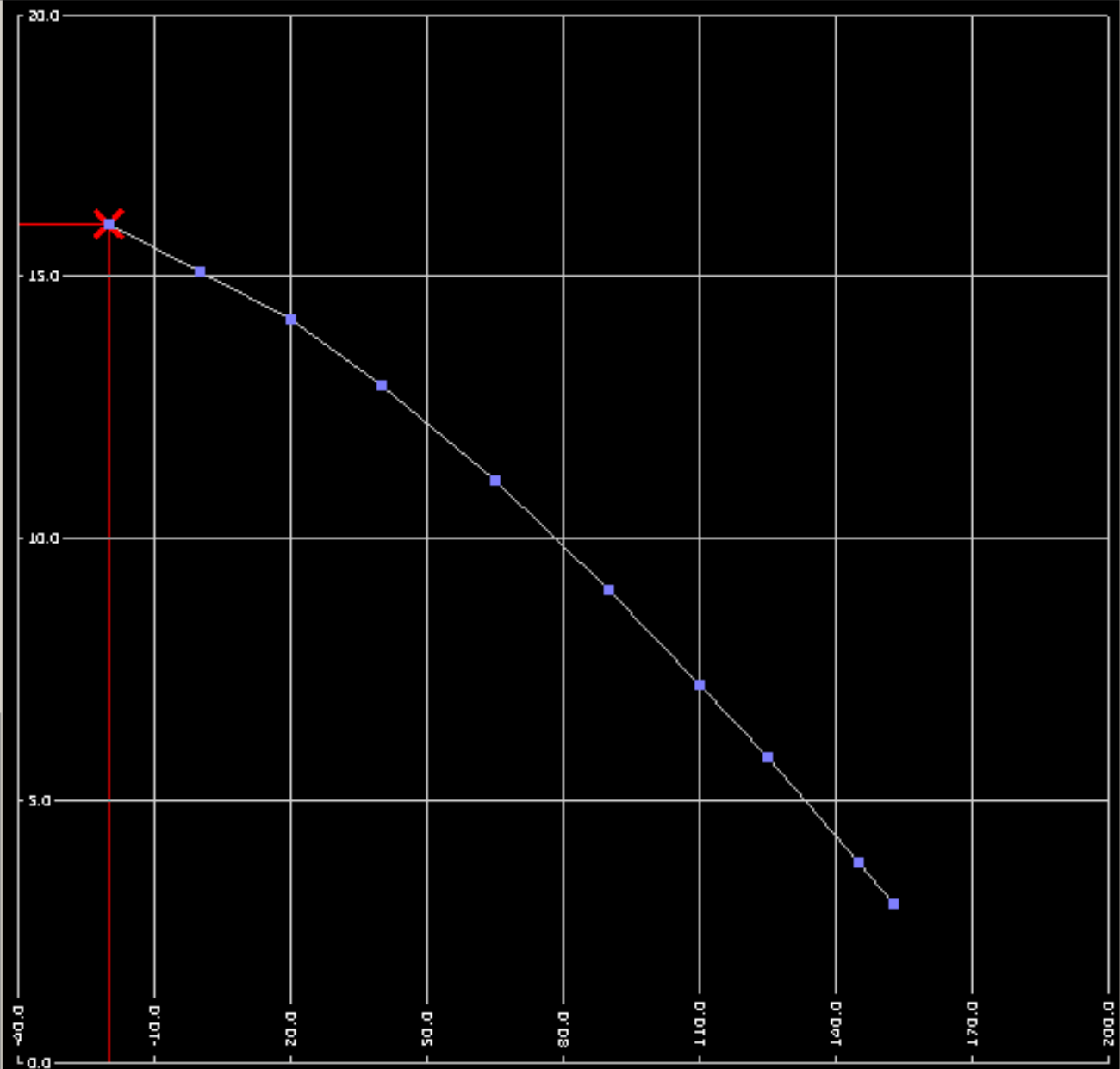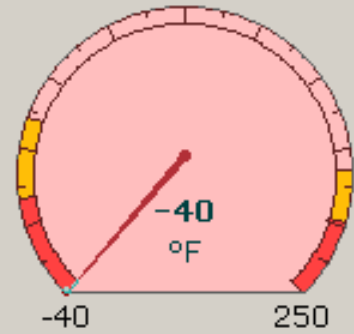
File   Tools

Coolant (°F)	Afterstart (%)
-20.0	55
0.0	51
20.0	47
40.0	43
65.0	38
90.0	33
110.0	29
125.0	26
145.0	22
153.0	20

Coolant Temp

-40
°F

-40   250
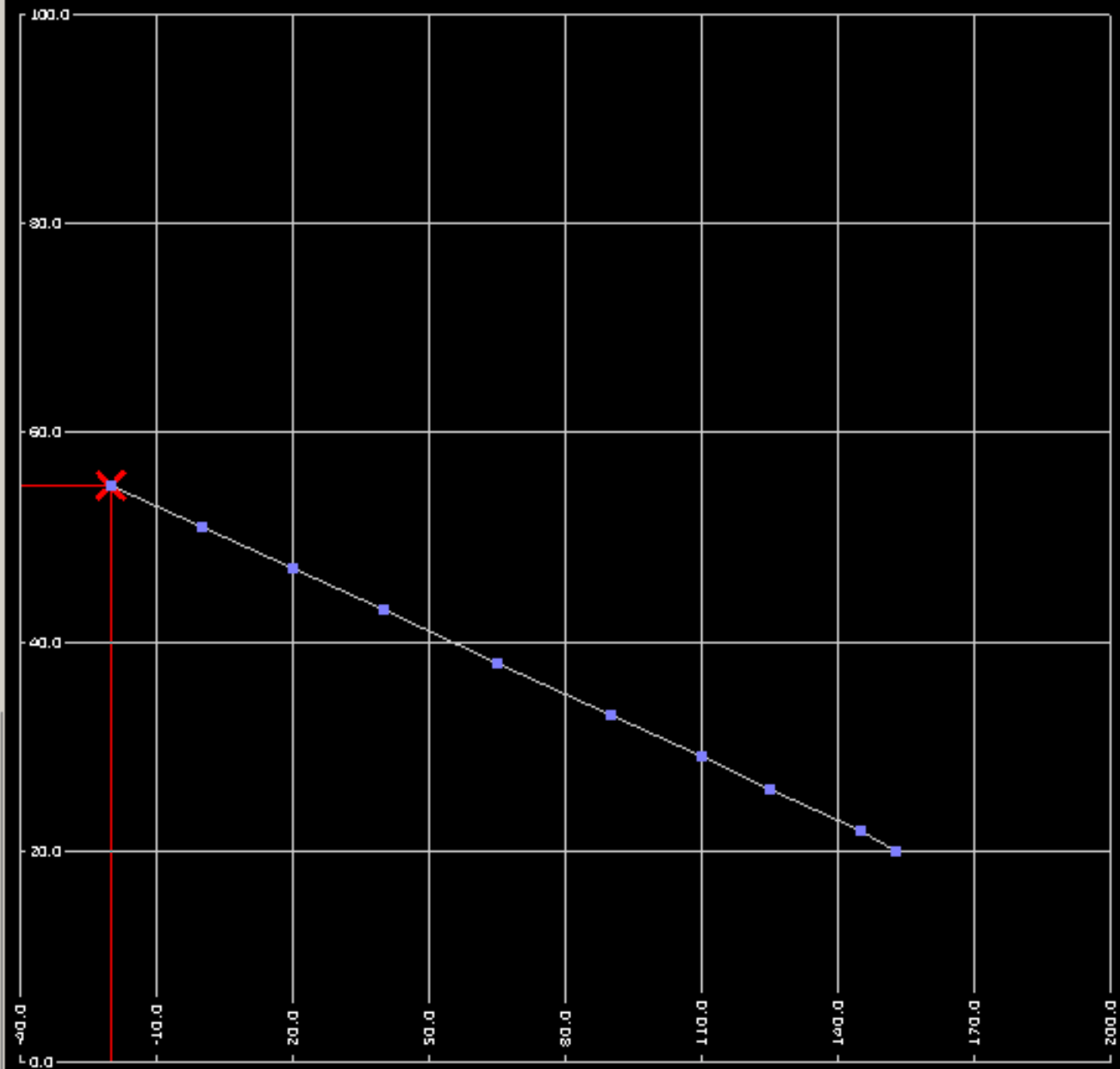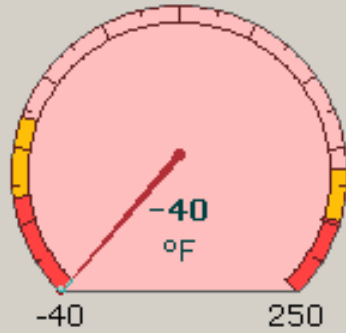
IAC Steps

File   Tools

Coolant (°F)	IAC Steps (steps)
-20.0	76
0.0	78
20.0	80
40.0	82
65.0	87
90.0	93
110.0	101
125.0	108
145.0	123
153.0	132

Coolant Temp

-40 °F

-40   250
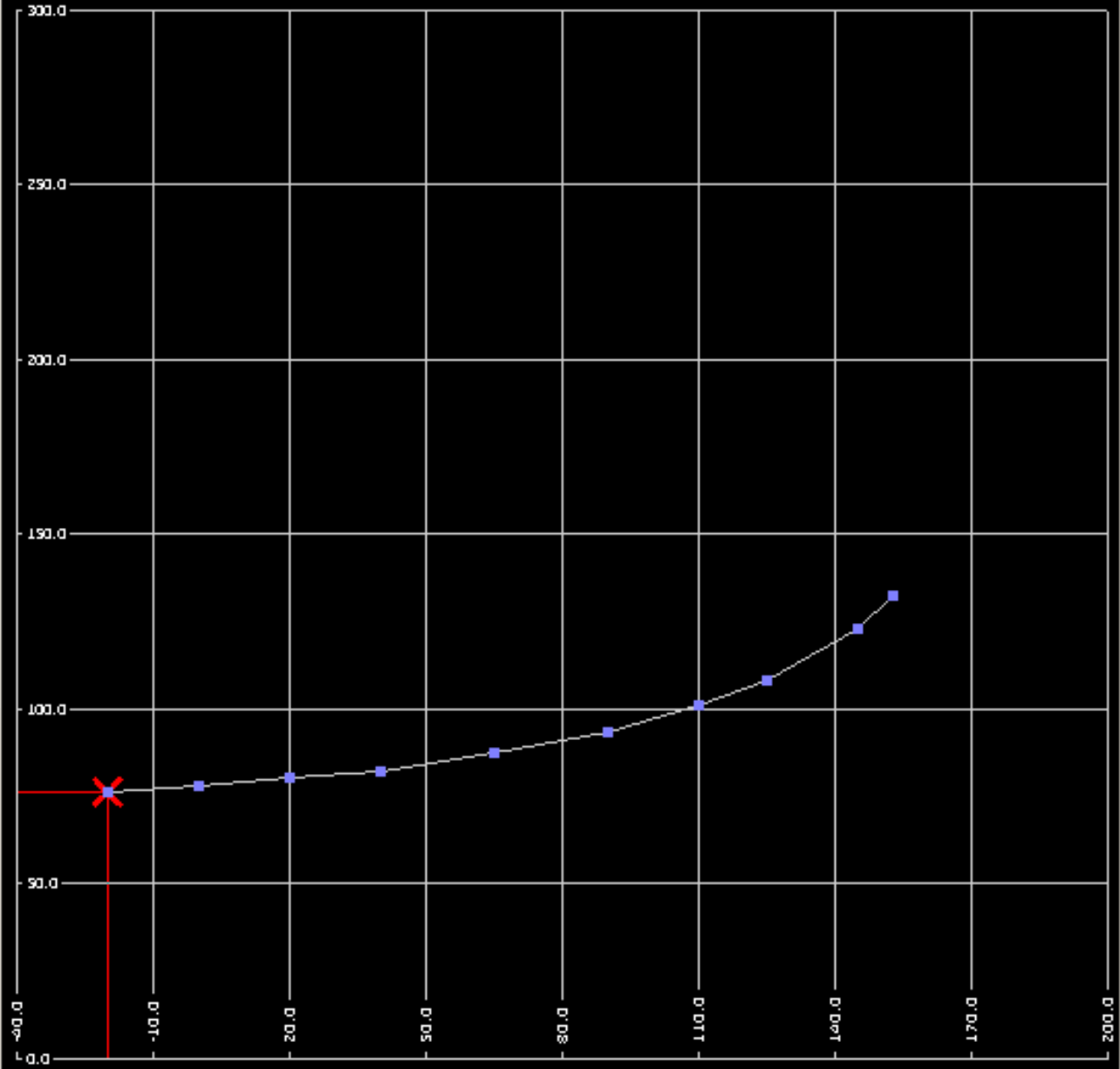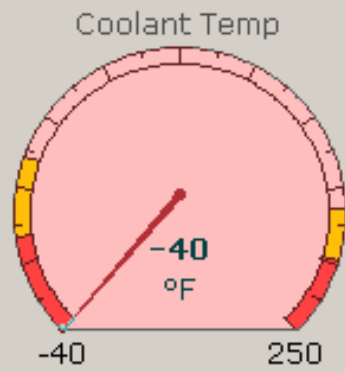
Acceleration Wizard - Page 1

MAP-Based
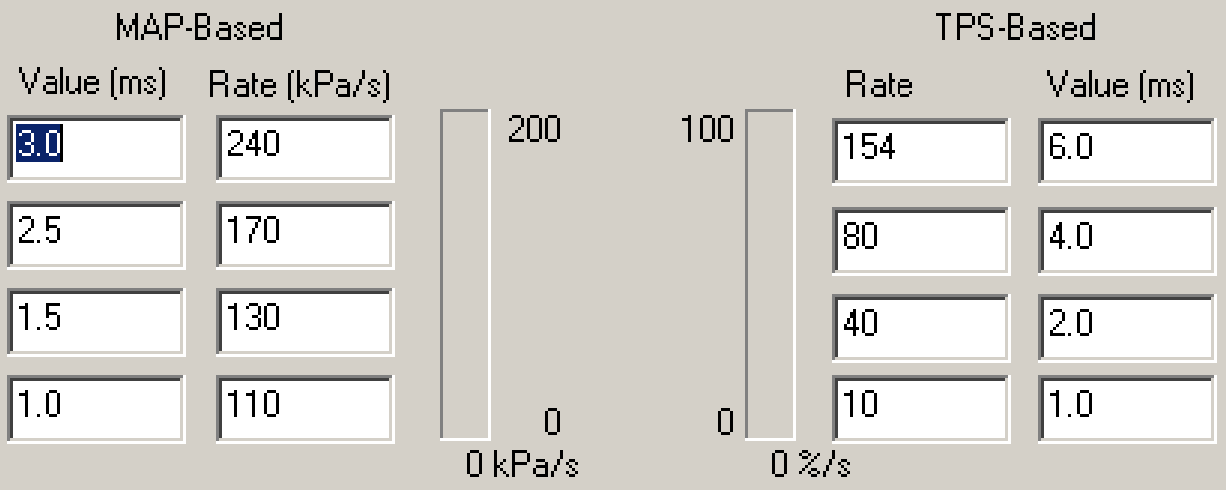
Value (ms)	Rate (kPa/s)
3.0	240
2.5	170
1.5	130
1.0	110

200

0

0 kPa/s

TPS-Based

100

0

0 %/s

Rate	Value (ms)
154	6.0
80	4.0
40	2.0
10	1.0

MAP vs TPS (33%)
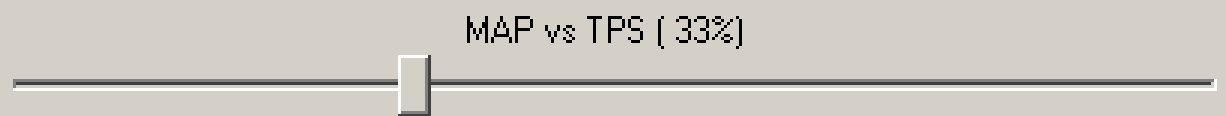
MAPdot Threshold (kPa/s)	100	TPSdot Threshold	30
Accel Time (s)	0.2	Decel Fuel Amount (%)	90
Accel Taper Time (s)	0.1	Cold Accel Enrichment (ms)	3.0
End Pulsewidth (ms)	2.0	Cold Accel Mult (%)	130

[Fetch From ECU] [Burn To ECU] [Close]

MegaLogViewer - datalog200811221634.xls

File   View   Options   Calculated Fields   Help

Quick Views

Graph 1
RPM
MAP

Graph 2
DutyCycle1
AFR
PW

Graph 3
TP

Graph 4

Max = 6246.0
Max = 102.8
RPM
MAP

Min = 12.4
Min = 0.0
101.0
5622

Max = 80.4
Max = 21.9
Max = 20.745
DutyCycle1
AFR
PW

Min = 1.0
Min = 7.4
Min = 0.0
8.219
13.20
77.0

Max = 100.0
TP

Min = 0.0
100
508702.459s.
508735.013s8s.
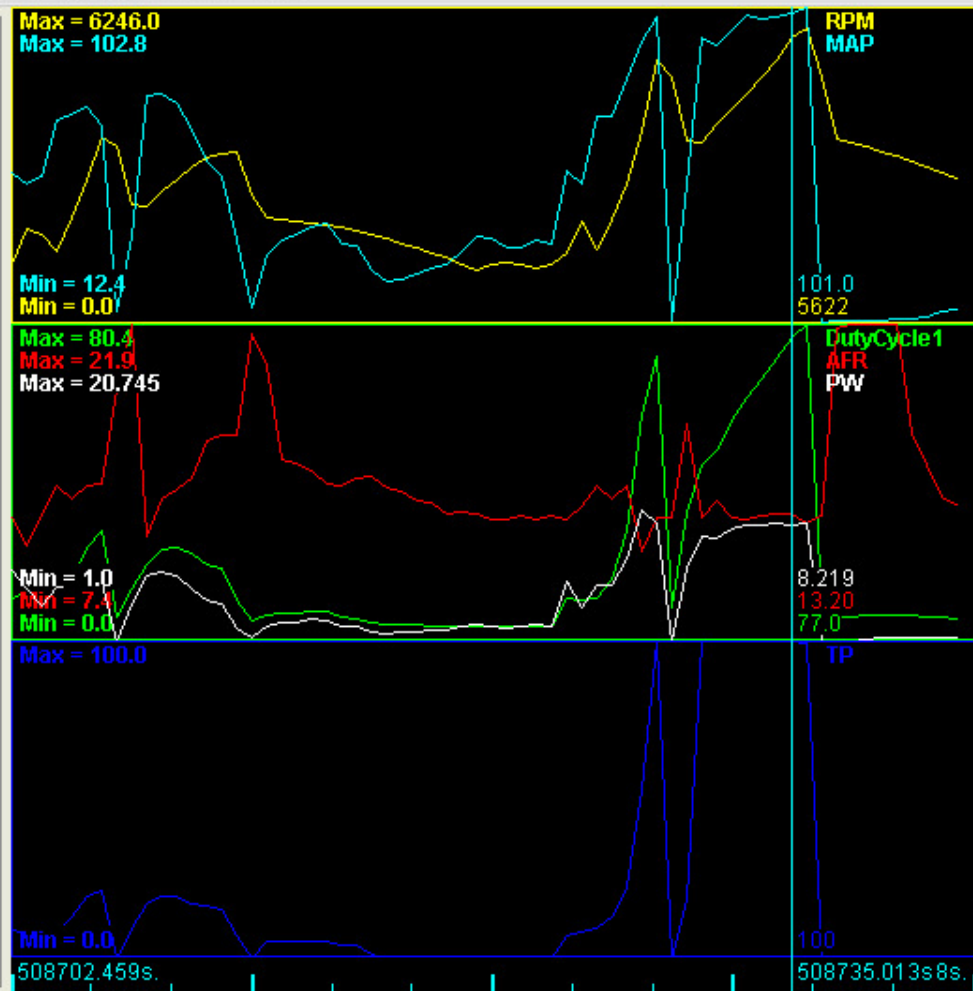
veTable1

100	67	70	74	80	89	92	92	92	91	90	89	87
90	63	66	70	76	84	90	91	91	91	91	91	91
80	59	63	67	73	80	86	89	89	90	91	90	90
70	53	59	65	71	77	81	84	85	86	87	87	88
65	49	57	63	69	74	78	81	82	83	84	85	86
60	46	54	59	67	71	75	78	79	80	81	83	85
55	42	50	56	65	68	72	75	76	77	79	80	82
50	39	47	53	62	65	68	71	72	73	75	77	78
45	37	41	49	57	61	64	67	68	69	71	73	74
40	36	37	43	52	54	58	63	64	65	67	69	70
30	32	33	34	40	42	45	53	56	58	59	61	64
20	30	31	30	26	23	24	35	44	49	54	58	56
	900	1200	1500	2000	2800	3600	4300	4800	5200	5600	6000	6500

| Open MSQ | Save MSQ | veTable1 |
| VE Analyzer | Save MSQ As | afrTable1 |

afrTable1

100	12.9	12.9	12.9	12.9	12.8	12.8	12.7	12.8	12.5	12.4	12.3	12.2
90	12.9	12.9	13.1	13.2	13.2	13.2	13.1	12.9	12.8	12.6	12.5	12.4
80	13.2	13.2	13.4	13.9	14.1	14.1	13.9	13.5	13.2	12.9	12.7	12.5
70	13.3	13.4	13.8	14.6	14.9	14.9	14.6	14.3	14.0	13.3	13.0	12.7
65	13.5	13.5	14.0	14.9	15.6	15.7	15.3	14.8	14.3	13.6	13.1	12.9
60	13.5	13.5	14.1	15.2	15.9	16.3	15.8	15.2	14.6	13.9	13.4	13.0
55	13.5	13.5	14.2	15.4	16.3	16.5	16.1	15.4	14.8	14.2	13.6	13.2
50	13.5	13.5	14.3	15.6	16.6	16.9	16.3	15.6	15.0	14.4	13.9	13.4
45	13.5	13.5	14.4	15.7	16.9	17.0	16.4	15.7	15.2	14.7	14.1	13.6
40	13.5	13.5	14.5	15.8	17.1	17.2	16.6	16.1	15.4	14.8	14.2	13.8
30	13.5	13.5	14.8	16.2	17.4	17.4	16.9	16.5	15.9	15.2	14.6	14.1
20	13.5	13.5	14.9	16.4	17.8	17.9	17.7	17.2	16.5	15.8	15.1	14.4
	900	1200	1500	2000	2800	3600	4300	4800	5200	5600	6000	6500

C:\Program .... 2.886\increase prime and cranking pulse 2.msq

Record 5382 of 6136 - Zoom: 8x - Play speed: 100.0%

Crank:N   ASE:N   Warm:N   Run:Y   Accel:N   Decel:N   bit 7:N   bit 8:N

Time:508735.013	SecL:303	RPM:5622	MAP:101.0	MAP/baro:102.4	MAF:0	TP:100
vBatt:13.20	AFR:13.20	IAT:84.6	CLT:168.4	Engine:1	Gego:100	Gair:97
Gwarm:100	Gbaro:100	Gammae:97	AccelEnrich:100	Gve:89	PW:8.219	DutyCycle1:77.0
Gve2:89	PW2:8.219	DutyCycle2:77.0	SparkAdv:27.0	knockRet:0.0	ColdAdv:0.0	Dwell:0.70
tpsDOT:7	mapDOT:34	IAC:132	deltaT:5320	Trigger±:0	tachCount:20361	XTau1:99
XTau2:99	E85fuelCorr:100	Ethanol%:0	AFRtrgt1:12.30			

Start   MegaTu...   My Docu...   untitled - ...   Microsoft...   Gmail - pr...   MegaLo...   8:36 AM

Acknowledgements

- The Megasquirt community
  - http://www.msefi.com/index.php
  - http://www.megamanual.com/mtabcon.htm
- Finkbuilt
  - http://www.finkbuilt.com/blog/category/automotive/megasquirt-efi/
- Zenon
  - http://www.zeebuck.com/bimmers/bmvseite/
- Tim S.
  - http://www.hbci.com/~tskwiot/2002.html
- Johnhup
  - http://www.bmw2002faq.com/content/view/79/32/
- Curtis Ingraham
- Cris Padagas

Questions???