MegaSquirt and getting started

By Peter Florance – PF Tuning
and
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Some recent PF Tuning projects
Birken Lotus 7 clone
MS1 Extra Alpha-N
Volvo 240 ITB – MS1 Extra Speed Density
BMW 325is (D Street-Prepared) MS2Extra 2.1.0 Speed Density

Photo by Chris Przepiora.
1993 SM2 Turbo Miata w/ MiataPNP - MS2Extra

Photo by Mike Powers.
Decision Time

• Think about what problem you are solving by building this system. The answer to above will help you decide everything else below.

• Fuel, ignition or both
  – Fuel-only easier for newbies.

• Injection Method
  – Single point injection (throttle body).
  – Multi port (individual injectors).
Trigger Decisions

• Trigger Method
  – Distributor, Generic Toothed Wheel, OEM Wheel or CAS

• Trigger Sensor type
  – Points, hall, optical
  – VR
Code Decisions

• Choose a code and or platform
  – MS1- B&G
    • Runs on MS1 chip. Fuel only
  – MS1 Extra
    • Runs on MS1 chip. Spark, fuel and extras
  – MS2
    • Runs on MS2 Daughterboard and and soon Microsquirt.
  – MS2 extra –
    • Runs on MS2 Daughterboard (and Microsquirt?)
  – MS3
Packaging

- V2.2
- V3.0
- V3.57
- Microsquirt
- MiataPNP
- Spectre EMSPro
Sensor Decisions

• O2 Sensors
  – Wideband
    • Accurate at wide range of AFR’s
    • More expensive than narrow-band and can be finicky
    • A must for forced induction; desirable performance applications
  – Narrow-band
    • Cheap, probably came with your car
    • Only accurate at 14.7:1 otherwise only reads richer and leaner
Sensor Decisions, continued

• Coolant Temp Sensor
  – OEM with pull-up resistor
  – OEM with Easytherm
  – GM (works with all codes)*

• Manifold Air Temp Sensor
  – OEM with Easytherm
  – GM (works with all codes)*

* GM sensors are Best for newbies; MS2 has thermistor tables so any known thermistor should be useable.
More sensors

• Throttle Position Sensor
  – Careful, many throttle switches look like sensors

• Map Sensors
  – 250kpa – standard on V3.0 V2.2
  – 300kpa and 400kpa - optional
What to get

• Purchase a stim.
  – The only way to learn the code and the tuning – your car is not a stim!

• Timing Light
  – A must for ignition setup; old non adjustable type works best with wasted spark

• Fuel Pressure Gauge (consider extending with hose to be viewable from passenger compartment during test.

• Voltmeter with audible continuity check
  – 12V test light also useful

• Laptop with serial port
  – Careful with USB adapters; check sticky list on MSEFI
Wiring tools and bits

- Wire, harness or plug and play solution
- Strippers
  - Get proper type for stranded wire
- Heatshrink tubing
- No electrical tape or wire nuts
- Consider gasketed connectors like Weatherpak or similar
More wiring bits

• Zip Ties
  – Cut with flush cuts

• Crimp Terminals and tooling
  – Brand names are best: 3M, AMP, Molex T&B
  – Insulation color is for sizing; not a fashion statement
    • Red 18-22 gauge; Blue 14-16 gauge; Yellow 10-12 gauge
    • Radio Shack has cool little yellow butt splices for smaller wires (smaller OD)
  – Non-insulated terminals – even smaller OD, great strength and works well with heatshrink tubing
  – Open barrel (Faston etc)
  – Get good tooling (crimper's) and learn how to use them
Howard Electronics
Soldering Station Deal

• Xytronic 379 Temperature Controlled Soldering Station. $49.95 currently. www.Howardelectronics.com

• Get additional tips XYB04 XYB05

• Use 'Megasquirt discount code' for additional 5% discount
Tools continued

• Liquid rosin flux or alcohol based flux helps a beginner solder like a pro. No acid flux!
  – 63/37 solder (or lead-free if you are required but higher temp required) with rosin core flux.
  – Use the largest tip that will fit the job.

• Seam-ripper for slitting jacketed cable

• Wire markers
Research and prep

- Get dyno curves or data from similar setup if possible
  - Use for setting RPM bins and VE table generator.
- Pick Injectors
  - Use for choosing injector size (see Megamanual or check [http://www.ncs-stl.com/fuel/ReqInjectors03.xls](http://www.ncs-stl.com/fuel/ReqInjectors03.xls) (very good for high RPM/high output applications where ‘turndown’ is important.
  - Tip - find injectors off motor of similar size, # off cylinders and HP
  - High/Low Impedance (Z) Injector
    - Larger and better ground and power needed for Low impedance
- Start with known running car
  - Worst case- install many engine mods and Megasquirt at the time with no step by step testing.
Nothing is worse than trying to troubleshoot a MegaSquirt box in a car. Do your initial testing and setup on your stim.

Non-tuning setup to do on stim (*MS2):
- Trigger Type, edge and initial angle estimate
- Spark Output Polarity (avoid the funny smell in your garage)
- Sensor Calibrations*
  - MAP
  - AFR (EGO sensor)
  - Temp Sensors (EasyTherm for MS1)
- Turn off acceleration (throttle enrichments) and EGO correction. Turn off all extra features that are not yet tested.
- Enable over-boost protection
Harness made of low cost Auto-parts store components
Custom engine harness for BMW
Wiring

• Clean, waterproof wiring.
  – Drip loops – loop down after grommet
  – Central and adequate power and grounds.
    • Your glove-box hinge is not an adequate ground
  – Stranded wire rated for engine compartment.
  – Correct terminals and tooling for those terminals
  – Use extra rosin flux for difficult to tin wires.
  – Do not used tinned wire in crimp connectors. Ok to solder after crimped.

• Wire colors and quality
Wideband Grounding

- Wide-band controllers have heater circuits. Many use PWM and can generate noise.
- LC1 analog and power grounds should be grounded separately to central point.
Peter’s First time wiring checklist

1. Find your wiring diagram
2. Identify timing marks and pointers. Check documentation to be sure you understand their meaning. Clean and paint with contrasting color paint.
3. Disconnect the Squirt from the DB 37 (37 pin connector)
4. Check for fixed resistance to ground on 20 21 26 (around 3500 ohms depending on temp)
5. Check for resistance to ground that increases with throttle movement on 22 about 100ohms sweeping to about 4500 ohms
6. Turn key power on
7. Check pins 28, 32-35, 36 37 (and other ignition coil connections, boost, fan or other control device pins, if used) for 12 volts power
   a) (I used meter as I was fairly confident; test-light to gnd would be better) Fidle pin 30 should be included if used.
8. Check pins 28, 32-35, 36 37 (and other ignition coil connections, boost, fan or other control device pins, if used) again while cranking to make sure power is still there during cranking

9. Check to make sure there is no power on any other pin (test light still to gnd) Check for gnd (test light from +12v to tested pin) on pins 1-2 7-19

10. Connect Megasquirt to the DB37 and turn key on. Verify fuel pump runs and stops in two sec.

11. Connect laptop and check MAT, Coolant and TPS sensor. Datalog this process and view it with Megalogviewer
12 Check Map Sensor
   • See Table to right
   • MS2; this should have been calibrated on the stim. You do have a stim, don't you?

13 Calibrate TPS in Megatune, noting Idle and WOT TPS-ADC values in your log or other documentation - you'll need these later.

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<th>Elevation Above Sea Level</th>
<th>Atmospheric Pressure (kPa)</th>
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13. If you have a trigger wheel and MS1 Extra, check tooth values with Megatunix Tooth Logger or TunerStudio for MS2Extra. Crank with Trigger Logger active to make sure that the trigger times are clean and even. On my installation they were except nice sine wave from compression.
First Power Up

1. Turn on switch power to power on fuel pumps, but do not start it, check for fuel leaks. Fuel pump should run and then cut off as long as you have a non-zero priming pulse value.

2. Start it, check for leaks and check Timing so that it matches what Megatune thinks the timing should be. See trigger angle to sync the Squirt to where the crank trigger wheel really ended up.

3. Check for RPM and sensor noise in the early datalogs (above). Datalog everything!
   - Posting for help? Please include datalog, msq and basic installation details.

All this, except the trigger angle, should take around one to two hours.
Trigger Wheel Diagnostics
Trigger Wheel Problems

• Incorrectly VR sensor polarity or edge capture setting
• Incorrect R52 (hysteresis) R56 (threshold) adjustment. For most sensors, adjust both pots full CCW (until they click), then CW one turn.
• R52 R56 installed incorrectly so CCW means CW
• V3.0 VR input; incorrect build. Use Bill of Materials; don't use schematics.
  – DIYAutoTune and Glen's Garage both have correct BOM's in their kits
    • **C31** - 0.001 uf
    • **R44 R48 R53 R54** – 10k
    • **D24** - 1N4148
V3 VR Schematic Changes

- Was 0.22uf; Also 0.1uf
- R54, R44 Were 1K
- R48, R53 Were 100K
- D24 1N4001
- 1N4148
Log for correct 60-2 setup

Gap measures as tooth 300% of the other teeth
Why correct setup works

Trigger on these edges creates 300% tooth at gap.
Log for incorrect 60-2 setup
Log for incorrect 60-2 setup

Gap measures as 2 teeth approximately 150% long
Why incorrect setup doesn't work
Why incorrect setup doesn't work

Triggering on these edges creates phantom tooth in the gap.
Tuning

- Speed density, Alpha-N, and MAF. How will I ever decide?
- Do I need to have target AFRs in some sort of table?
- Verify timing real early and often.
- Basic tuning early
  - Stable RPM a must! **Do not tune with a noisy RPM signal.**
  - Get VE table close before making other adjustments
- Getting it to start and a reasonable pulse width
- Backfiring on overrun, is it lean or is it rich?
- All o2 sensors get real confused with a dead miss.
- When does the motor need to start getting rich?
- Tuning for mileage? Is this the same thing?
Oh Crap! - Troubleshooting

• Some common problems
  – No RPM
    • Tach input not modified correctly or firmware not configured correctly
  – Runs very rich at idle
    • No MAP signal connected
    • Accel Enrichment mis-triggering
  – Can't tune idle – works ok during load.
    • PWM TIP125 shorted on one bank causing longer closing times

• MegaManual Troubleshooting guide
Oh Crap! - more common problems

• Starts and shuts off.
  – High impedance injectors set for low impedance

• MS stays powered up with key off.
  – Injectors or idle valve not connected to same switched +12V as MegaSquirt box
Oh Crap! - MS is intermittent!

Not Soldered
Oh Crap! - Troubleshooting

• Getting help online:
  – Post MSQ and datalog. If you don't know what these are yet, DO NOT try to start your car!
  – When testing, if you find something funny, record amount of funny. In other words, if a suggestion doesn't help, tell us what it did do.
  – You don't have to follow every suggestion given, but you risk hearing: “Well, it sounds like you've got in under control. Let us know how it runs...”
Oh crap! ...continued

• Remember that stim we told you to buy?
  – Test on stim to verify MS box is still good and configured.

• Repair services available
  – Peter Florance (peter@pftuning.com) and others listed on MSEFI.com

• Support also available.
Sources

• Waytek Wiring – Wire, weatherpack and other connectors, tooling, heatshrink tubing
• Caig Labs – Deoxit paste and spray
• Howard Electronics – Solder tools, solder, flux Use megasquirt code for 5% discount
• Terminal Supply Company - Wire, weatherpack and other connectors, tooling
• Sewing store – seam ripper for slitting jacketed wire.
• Ebay or Craigslist – Craftsman timing light