MGB FUEL INJECTION

Modernizing a great ride - And the unwillingness to finish and drive

My stock restored 1975 MGB drove well to locations, but would not start for the return trip. The under hood temperature in Phoenix, AZ vaporized the fuel into the engine, flooding it. After a few hours, it would restart but I never found a cure.

The original one barrel carburetor setup show cased the performance inadequacies of early smog controls.

Switching to a weber two barrel carburetor served the car well until I got the injection itch.

COUNTER POINT

Earlier MGs had twin SU style carburetors. By 1975 these were dropped in a desperate attempt to complying with emissions and maintain the US market by.

Many US mechanics are unfamiliar with SU carbs and unfairly dismiss them. I feel they are the best MG choice as they're extremely reliable and do a great job.

If you haven't found a British mechanic in your area, take your fuel issues to a good motorcycle mechanic. Most bikes use similar setups and they will know how to deal with them.

-Ken Adkison

PROJECT GOALS

Improve power, economy, warmup and mixture control at all altitudes and reduce maintenance through cleaner combustion chambers.

Spark timing corrections are far more flexible with a computer tracking a fully a monitored engine.

Injecting fuel at high pressure very close to the intake valve allows better cold starts and overall vaporization.

Adding all the extra sensors to the engine really helps to get the tuning right and once setup, the engine management computer tracks goals by self-correcting mixture and to some extent, timing.

Top: *Layout and prototypes parts of an aluminum manifold*
Bottom: *Welding setup of subassemblies for final welding*

MECHANICAL CONSIDERATIONS

Electronic Fuel Injection (EFI) can be very simple to handle just fuel delivery or fuel and spark.

Engine Control Units (ECU's) infers, more complete control using more sensors for dynamic control of fuel, spark, idle, cooling fans and often the valve timing, transmission, cruise control, boost and more.

Expectations, system complexity and features have to be weighed against ability and cost to come a with a practical shopping list. Even though, I like the choices I made, it took a very long time to build and debug.

During this time, I was stressed out, and our MGB was off the road while costs rose much higher then expected.

Initially, I built the whole system for the original 5-port stock head, convincing myself that I had a strategy to fuel two cylinders with each intake runner and injector.

I finished up with a beautiful system that could not be tuned and had to start fabrication over with an aftermarket crossflow head. Although a substantial upgrade, providing a dedicated intake for each cylinder, I had never expected to spend the extra money and had to build the whole system twice!

> Getting over one's head and never finishing the project is a real possibility.

BIT OF KIT

DEVELOPING SKILLS FOR A BUSINESS

The point of this project was to build my confidence and skill set to a point where I could come up with a manufacturable kit to sell. Starting out, I had limited design, welding, and machining experience. I'd done them all, but not enough to consider a business plan. I knew up front this could never be a volume product or even a very profitable one. Adding in the new head made cost unmarketable.

MISTAKES WERE MADE IN REACHING THE FINAL SOLUTION

Above: *Oops! this manifold doesn't fix*

Below: *Second, stainless manifold fits beautifully, but doesn't run well*

The resulting design looks and is fairly simple; getting there incurred failures.

My aluminum manifold located the injectors for a straight shot but didn't leave room for fuel rails.

The stainless steel manifold incorporated the best packaging and long runner lengths but was extremely labor intensive to build and ultimately, I don't believe it could be made to run well.

BMC engines share an intake port between the first two cylinders. Firing order is 1-3-4-2 meaning the gap from 1 to 2 is 540 degrees and 2 to 1 is 180 degrees.

Stock, these engines pull fuel out of jets only when air is drawn in. Sequential injection sprays only when the intake valve opens at idle. At full power, injectors spray most of the time collecting fuel in the runner. Sharing a runner with pistons that don't fire at regular intervals, leads to a very rich cylinder and a lean one.

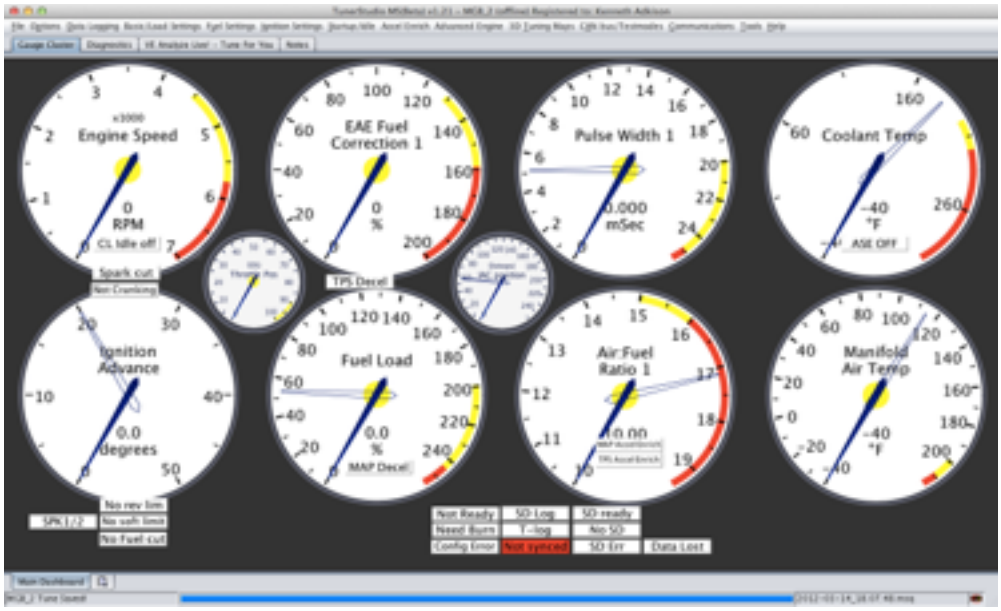
I feel the stock head, should be the exclusive domain of carbs.

This led to my starting over on the other side of the engine compartment. I bought a cross flow head, insuring all fuel for number one goes to number one.

Other projects claim good results with the stock head, but I don't have details and have not heard them run.

This should work, what could possibly go wrong? After all; only three false starts. O.K. - really four. Must I count that awful welding failure.

Software is the hard part



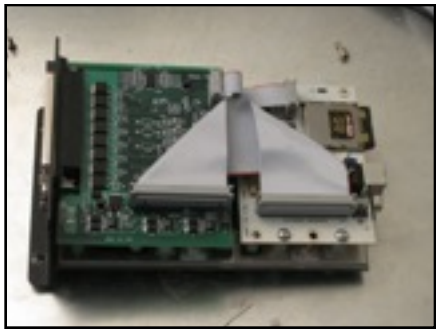
BLENDING CHOICES INTO MONOLITHIC SYSTEM

Settings define sensor inputs and driver outputs.

Testing and calibration is required for most parts. Each engine needs target fuel ratio, volumetric efficiency, ignition advance, idle and cold start tables.

Options exist for boost, nitrous, altitude correction, launch control, alternative fuels and more. Understanding and setting all the options, is a long process.

Fundamentals of tuning



MegaSquirtIII: *With MS3 processor and MSX I/O driver upgrades*

Without a preexisting kit to work from, engine tuning starts with best guess. Systematic testing and adjustment are needed to establish the proper values.

The process is to test and calibrate all possible inputs and outputs with the engine off. Fill out the target AFR and timing table with conservative settings and do what ever is needed to get the car started and warmed up.

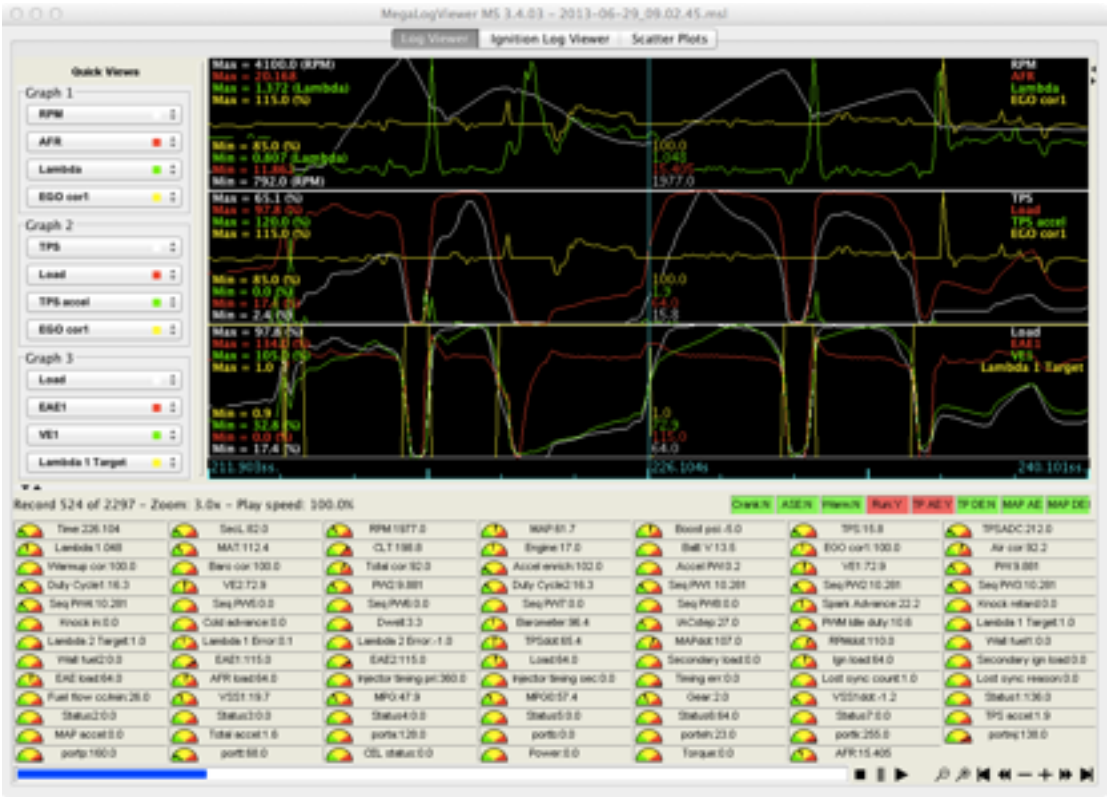
Then adjust the volumetric efficiency (VE) table up and down to get the oxygen sensor to read a reasonable mixture. Once the car can be made to drive an auto tune feature can be used to correct mixture across the whole RPM and engine load spectrum. Then the fine idle adjustments can be made.

The ignition timing really must be set on a dynamometer for best torque at minimum timing and without engine knock.

Subsequent fiddling is needed to get the cold start up, acceleration enrichment and other drivability details sorted out.

Reliability can be much better with EFI but a custom built system could fail for endless reasons. The builder must work very hard to improve a car with system that is more complicated than the original carburetor and distributer.

DATA LOGS ARE USED TO VISUALIZE IMPROVEMENT OPPORTUNITIES



You can compare easily 30 different data streams, visualizing how things are working to plan improvements. This software can playback everything in real time and even display scatter charts

Results

Fear of being ostracized by traditionalists at car shows has been dispelled as we are getting good feed back all around. We realize it is not a concourse car.

The car starts cold and runs very well at all altitudes. It pulls so well at lower RPM's that I shift down half as often and regularly putter though villages under two grand in fourth or fifth.

This setup really improves power at high altitudes through increased intake valve size and better fuel and spark management.

With the aluminum head and radiator, I can pull up mountains, in hot weather and high gear, without overheating.

Overall power is somewhat improved at sea level mainly through the cam and 9.5:1 compression. I do not feel the EFI and head greatly affect peak power. The stock head and SU carbs are very effective and should not be dismissed. This upgrade is too expensive and troublesome for most people. Power junkies are best served with a engine swap; at least it saves the sheet metal.

After ten thousand miles, in all weather and much of it over seven thousand feet the car runs very well and has not had any road side surprises.

FUEL INJECTED 1975 MGB	
MegaSquirt III ECU, Controller & MSX I/O Expander	
Sensors	**Outputs**
Crank Position	Fuel Pump
Cam Position	Injectors Drivers
Manifold Vacuum	Ignition Drivers
Wideband O2	Idle Air Controller
Pressure Altitude	Tachometer
Throttle Position	Speedometer
Water Temp.	Fan
Intake Air Temp.	USB
Vehicle Speed	SD Flash
	Bluetooth
Engine Build	
Fully Balanced	AE 9.5:1 Pistons
Displacement	1840 cc. 112 ci.
Bore & Stroke	3.18" x 3.54"
Injectors	Accel 17 lb./hr. @ 43.5 psi
Head	Alum Cross Flow w/1.7" intake valves
Camshaft	APT VP11-BK: 224°@ 0.050", 0.381" valve lift
Intake	Bespoke
Exhaust	Tourist Trophy
Transmission	T9 5-speed
Alternator	110 Amp