The Ultimate 83 GTI Project

Kees Nierop
former Porsche
Factory Race Driver

Vancouver Island Motorsports Circuit


GTI
GTI
BRITISH COLUMBIA


GTI
GTI
BRITISH COLUMBIA


VOLKSWAGEN
RABBIT GTI
GTI
BRITISH
24
OCT 2019
COLUMBIA


VOLKSWAGEN
RABBIT GTI
GTI
BRITISH
24
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COLUMBIA


VOLKSWAGEN
RABBIT GTI
GTI
BRITISH
24
OCT 2019
COLUMBIA


RABBIT GTI


GTI


Left Turn
Right Turn
14:01:42
RPM
Stall!
Fuel Flow
3.0 lb/hr
AFR
16.4 A/F
Speed
Odometer
9794.3 km
-3.0 Amps
Oil Temp
Oil Press
Battery
CTS
Fuel


GTI

Project Goals & Results

The project goal was to create a 'cost is no object' Ultimate VW GTI by going back to the simplicity of the VW Mk1 with its tossable fun factor and old school mechanical connection between the driver and the road, and then working to improve chassis rigidity, and cranking up acceleration, corning and braking performance, while also sneaking in modern creature comforts.

As guiding references to this project effort, there were 2 great Mk1 GTI variants back in the day: the bad-ass Callaway stage 2 turbo; and the ultra-rare Oettinger 16s which was a factory supported car in Europe in 1981. To me the lighter 16s was the way to go – but in a more modern format, borrowing the Mk2 16V cylinder heads and keeping everything close to 'stock' configuration while maxing out all performance parameters.

The result is a car that looks inside and out like it just rolled off the 1983 VW showroom floor with a totally stock looking exterior and interior, but being a true 'Wolf in Sheep's Clothing' under the covers – resulting in a totally cool retro driving experience that can outrun a modern VW Golf R or a Porsche 718 Cayman S on the street or the track.

Performance: 240hp + 1950lbs = one very quick little car: 0-60mph in <5s, 0-100mph in 11s, and >1g corning and braking on street tires (a progressive nitrous system adds up to 100hp more).

Creature comforts include electric windows; forward and backup cameras – displayed on the rear-view mirror; adjustable heated seats; push-button engine starting; electronically adjustable brake pedal pressure; 1200W RMS bluetooth audio system with a hands-free cel phone interface; full data logging with 2 axis accelerometers; convex side mirrors; touch-screen digital dash (analog and digital gauges); electrical A/C system with central dash vents; infinitely variable blower speed, a stunning 'new' OEM sunroof; all original NOS seat fabric with sport-firm foam padding front and rear; custom leather wrapped OEM steering wheel, adjustable pedals (perfect for heel and toe shifting), driver adjustable brake vacuum assist, plush OEM grade carpeting, floor mats and sound deadening insulation.

When driven by Kees Nierop (former Porsche factory race driver at Le Mans) at the Vancouver Island Motorsports circuit (a tight 2.3kms 19 corner racetrack) the Ultimate 83 GTI was faster than a 2018 Porsche 718 Cayman S (also driven by Kees). Project goals met!

Ultimate 83 GTI Specifications Summary

- US$140,000 invested plus thousands of hours of time
- 6,000 miles since complete bare metal restoration
- 4,000 miles since engine, transmission & brakes rebuilt, no high rpm or nitrous use
- 600 miles since new KW V3 suspension
- 0 miles since new windshield and paint (2/3rd of car, bumpers & fender flares)
- 1800lbs in track trim, 1950lbs in street trim (with some options removed)
- 240hp from 7,250-8,000rpm w/o catalyst or air box, 220hp from 7,000-7,400rpm with catalyst, air box and filter
- Up to +100hp with progressive ECU controlled nitrous system
- Hidden chassis frame and stiffening throughout
- Carbon fiber hood, hatch and bumpers, Lexan rear window
- Epoxy primer -> wet sanded glossy clearcoat
- New OEM interior throughout – gorgeous NOS seat fabric, new firm foam
- Mk3 ABA block, Mk2 16V heads, 288 solid lifter cams, oversized 34/29.5mm valves
- 95.5mm stroker crank, 11.5:1 83.5mm pistons (2092cc)
- Custom curved ITB intake, Lexan air box, with dual fuel rails
- Stainless steel braided hoses with race spec AN fittings used throughout
- 1.75” primaries stainless steel race header, 2.25” stainless steel exhaust, 2.50” tip
- Custom built VW 020 5 speed close ratio transmission with Quaife LSD, 100mm flanges
- Stage 3 and stage 5 clutch systems (stage 5 currently installed)
- 500hp rated race axles
- Custom radiator, electric water pump/controller
- Custom oiling system with external filter and oil intercooler
- 25Amp-Hour 13.5V Lithium battery system, computer controlled alternator charging
- Holley Dominator ECU with 150 inputs/outputs
- Holley touch screen digital dash, Holley individual coil race ignition
- Wilwood/Tech-53 big 4 piston calipers, 10” rotors, Hawk pads, adjustable proportioning valve, rear disks, ECU controlled servo vacuum – console adjustable
- KW V3 stainless steel struts/shocks compression/rebound adjustable in 16 steps, multiple spring sets for street and track use
- Hollow rear 28mm sway bar
- Urethane and Delrin bushings used throughout suspension and steering system
- Special shift linkage – ultra precise shifting
- Leather wrapped OEM steering wheel, custom steering column & u-joints
- Quaife close-ratio rack & pinion - blissful steering precision & feel
- Brand new sunroof mechanism
- Electric windows, seat heaters, Air conditioning system
- 1200W Bluetooth audio system
- Philips LED headlights, LED bulbs used throughout
- Looks dead stock inside and out but outperforms a Porsche 718 Cayman S on the track
- Meticulously documented on youtube with 180 videos and 830 photos online

My Original 1983 Rabbit GTI as inspiration for the Ultimate 83 GTI Project

I was an original 83 Rabbit GTI owner, my car having a November 1982 build date. I was proud to be one of the first GTI owners in Canada after ordering my car in October '82 moments after I had finished reading the November magazine issues of Car & Driver, Motor Trend and Road & Track which universally praised the new US spec GTI at its long awaited North American debut.

I made the many of the usual Mk1 GTI mods to the car plus a few unique ones:

- Euro G grind cam
- adjustable cam sprocket
- upgraded fuel pressure regulator
- Canton Mecca oil filter with synthetic oil
- Mecca external temperature controlled oil cooler
- Webber big throat throttle-body
- Callaway cast aluminum valve cover
- Performance ignition wires, re-curved distributor
- Euro GTI exhaust manifold and dual downpipe
- Gillette Exhaust (cat delete)
- Bilstein BTS-172 suspension system (springs, struts, shocks)
- Suspension Techniques race front & rear sway bars with adjustable heim joints
- Upper and lower front strut/control-arm cross-braces
- stainless steel brake lines & sport brake pads
- 15x7 Ronal wheels and tires
- Concord HPL-130 cassette deck with dBx noise reduction module, Proton 222 power amp with upgraded coax speakers front and rear and an 8" passive Sub-woofer
- Hella headlights with 90W bulbs
- Hella dual air horns
- Escort radar detector
- Modified/tucked-in bumpers
- White bumpers & mirrors
- Rear hatch winglet

… All in all I ended up doubling the price of the car with the add-ons.

I did quite a few weekend autocross events during the 4 years I owned the car – it cornered very flat with neutral front/rear balance, acceleration was in the range of 0-60mph in 7.5s, and it had decent but not exceptional braking. I loved the car but always wanted more engine and dreamed about owning one of the super rare factory 16V GTI models from Europe (the Oettinger GTI 16s) or a stage 2 Callaway turbo setup, which would have turned my GTI into the ultimate bass-ass GTI of its day. Fast forward 30 years to 2012 when I started to turn my attention to revisiting my true automotive 'first love' and embark on a new no-budget limit ultimate 83 GTI project car …

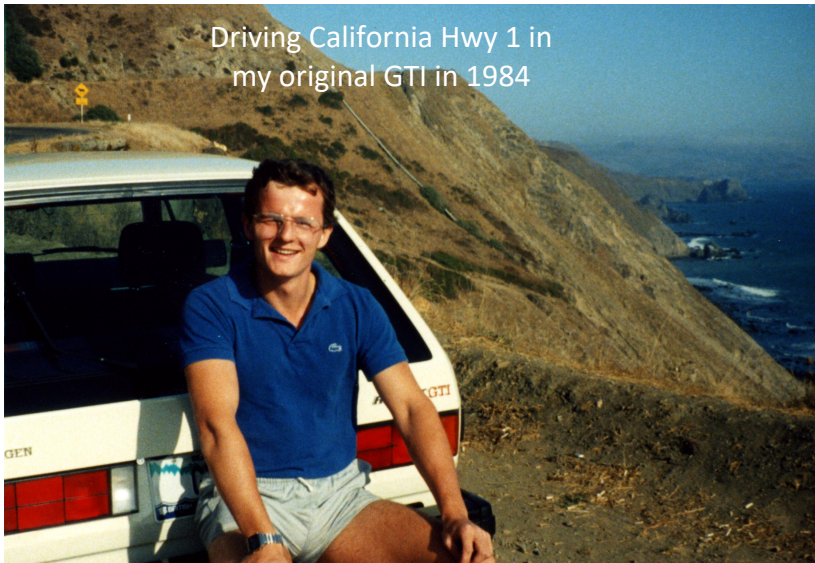
I had learned quite a few lessons from my 1st GTI mods:

- the mk1 car is already very front-end heavy, causing it to understeer, so keeping the weight off the front wheels was goal #1 – make the car as light as possible – especially up front
- make the chassis much stiffer than stock – the mk1 unibody is very weak and flexes far too much, which is especially noticeable once stiffer suspension parts are bolted on
- the OEM body panels are non-galvanized mild steel and rust is a big problem in all of the pinch-weld areas – strip the car to bare metal and epoxy coat it
- add power but keep it within usable limits – and don't add weight while doing so
- improve braking performance but don't add unsprung weight to the front suspension
- don't lower it too much – it messes with the bump-steering
- don't have a loud exhaust as it quickly gets tiring
- remember the fun factor of the original OEM setup – toss-ability, great steering feel, great shifting

I wanted the car to weigh 1800lbs in 'track ready trim', about 250lbs less than US spec 'stock' weight and I also wanted to target around 7lbs/hp which is a typical modern supercar weight/power ratio which meant an engine with around 250hp. Keeping weight off the front-end also meant saying 'no' to shoe-horning in a more modern turbo-charged engine with the need for a much heavier transmission as well – so the decision was to max out a Mk2 16V design, mated to an original Mk2 020 transmission (also to keep the spirit of semi-originality to the engine/transmission design).

I also wanted to keep the suspension in keeping with the original car and spent some time driving the GTI with Bilstein Rally Race front struts but they were too stiff for street use so opted for the high dollar KW variant 3 coil-overs, but using springs that were 20% softer than KW V3 specs to provide for a more comfortable, compliant ride on everyday road surfaces.

Finally, the need for brake rotors and calipers that would fit inside the OEM 14x6 snowflake wheels limited me to 10.1" rotors but I was able to source custom large 4 piston calipers that provide world-class brake torque.


Driving California Hwy 1 in my original GTI in 1984

Ultimate 83 GTI Engine

This is a very special one-of-a-kind normally aspirated engine that can be driven on pump gas, idling smoothly at 1000rpm, producing usable torque from 1500rpm+ with a flat torque curve all the way up to 6500rpm and peak power extending past 8000rpm. There are no pulley driven accessories to rob horsepower (electric water pump & A/C compressor, manual R&P steering, 50amp racing alternator with WOT disconnect – this is one of the reasons the 2.1L motor puts out close to 250hp at the crank – at least 15hp is saved by keeping parasitic power losses to an absolute minimum).

And this engine is light weight in comparison to a VR6 or a later model turbo engine setup. In comparison to the original 90hp Mk1 GTI engine this combination produces more torque at all rpms and puts out 3 times the power – but at a high enough rpm that if you don't want the buzzing rpms you can simply keep the revs below 5000rpm and enjoy a more stock-like street driving experience. The ITBs are large as they are optimized for high rpm power production so the throttle is a bit sensitive in comparison to the OEM engine but it is a learned behaviour to be a bit cautious about throttle inputs – and if you keep the rpms down it really does tame the engine, generating a more relaxed driving experience when you are not in the mood to accelerate with 0.6g of force at >100kmh:

240hp @ 7250-8000rpm, catalytic converter and air box removed

220hp @ 7000-7400rpm, with catalytic converter and air box/filter installed

Mk3 ABA tall-deck block, 2092cc (83.5x95.5mm) w crank position sensor

ARP rod bolts, head studs & crank sprocket M16 bolt w dowel pins

11.5:1cr forged Weisco pistons

Rotating assembly dynamically balanced

Mk2 9A 16V heads (34mm x 5.5mm stem intake valves, 29.5mm x 7mm stem exhaust valves), extensive porting and polishing

288° Cam set - solid lifter (254° @.050", .456" lift, 105° LC)

4% leakdown test results on all cylinders – perfect!

Adjustable cam sprocket, cam position sensor

DLC coated solid bucket lifters

VR6 HD valve springs

Titanium retainers

45mm tapered/curved independent throttle bodies (ITBs)

Dual rail 19lbs/hr x 4, 30lbs/hr x 4 fuel injectors (idle-low speed, high power)

All stainless steel braided fuel lines and fittings

Lexan air box with K&N filter

Digital idle speed control

4 port PWM ECU controlled nitrous system, 25-100hp, adjustable

Holley Dominator ECU & ignition system

8.5mm custom length racing ignition wires

Denso IK20 spark plugs

Billet aluminum alternator bracket

Racing damper, serpentine alternator belt

Racing 50amp alternator, ECU controlled output voltage

Solid rubber engine mounts (will never wear out but also keeps vibration down)


Weisco 83.5mm 11.5:1 pistons

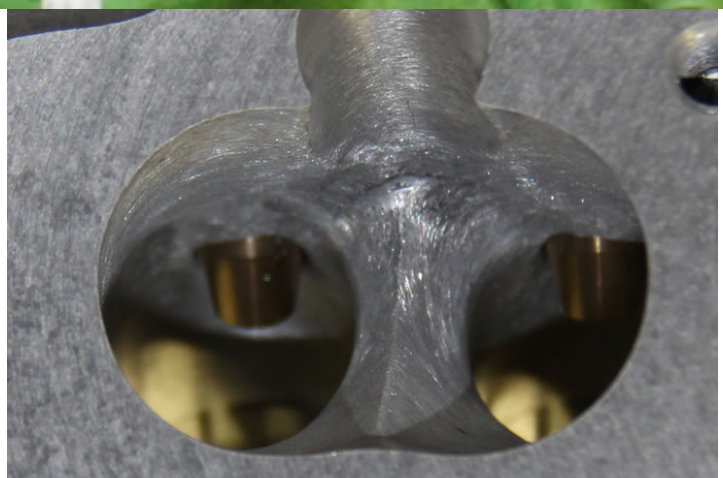

VW 95.5mm stroker crank


34mm Intake Valves
5.5mm stems

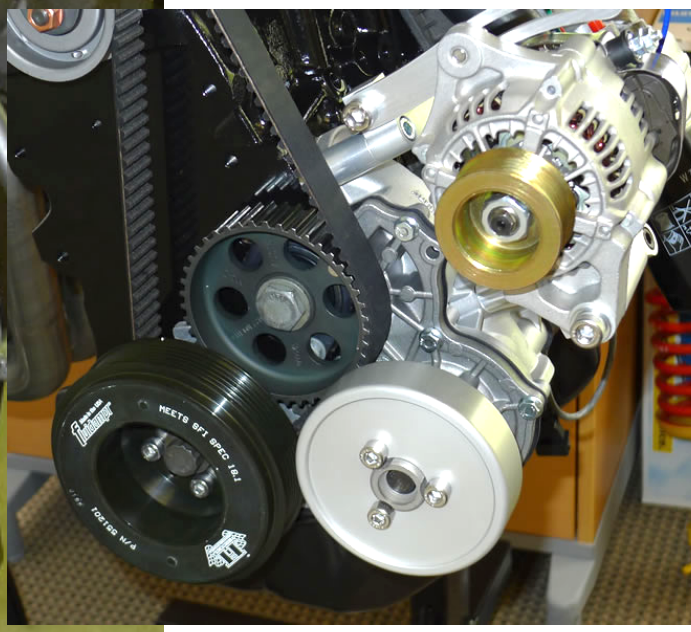

29.5mm Exhaust Valves
7mm stems, undercut to 6.5mm


Extensive Porting & Polishing

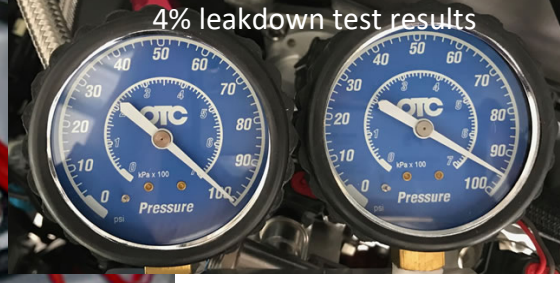

288 solid lifter cams, DLC coated bucket lifters, VR6 HD springs, titanium retainers



EAA Engineering CNC Alternator mount & serpentine belt system

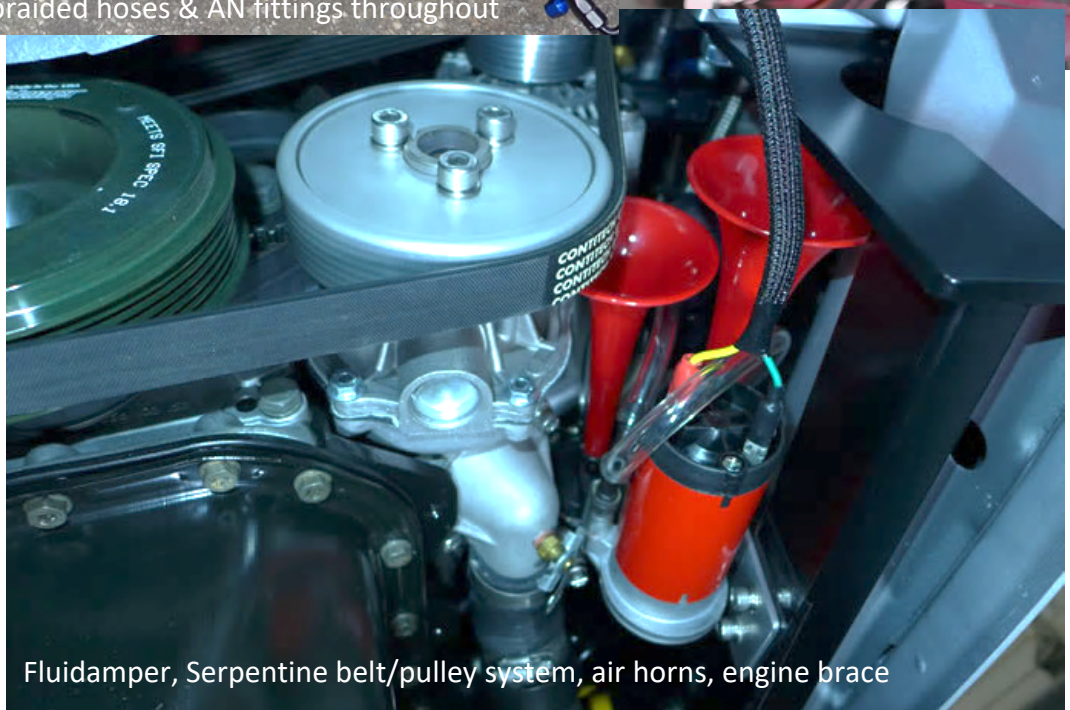


Independent Throttle Bodies (ITBs) with unique curved runners and dual fuel injector rails

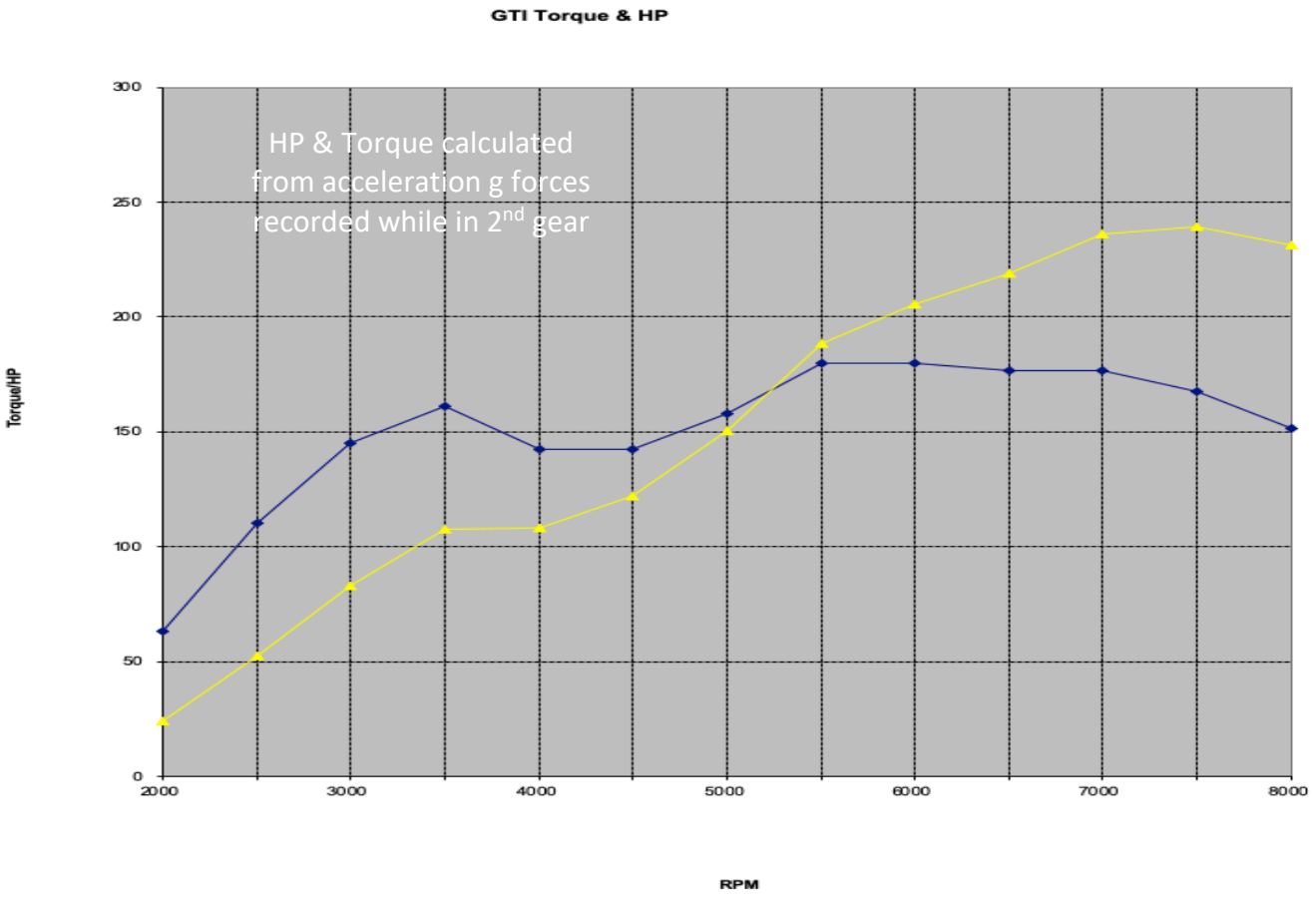

4% leakdown test results
OTC
Pressure
OTC
Pressure

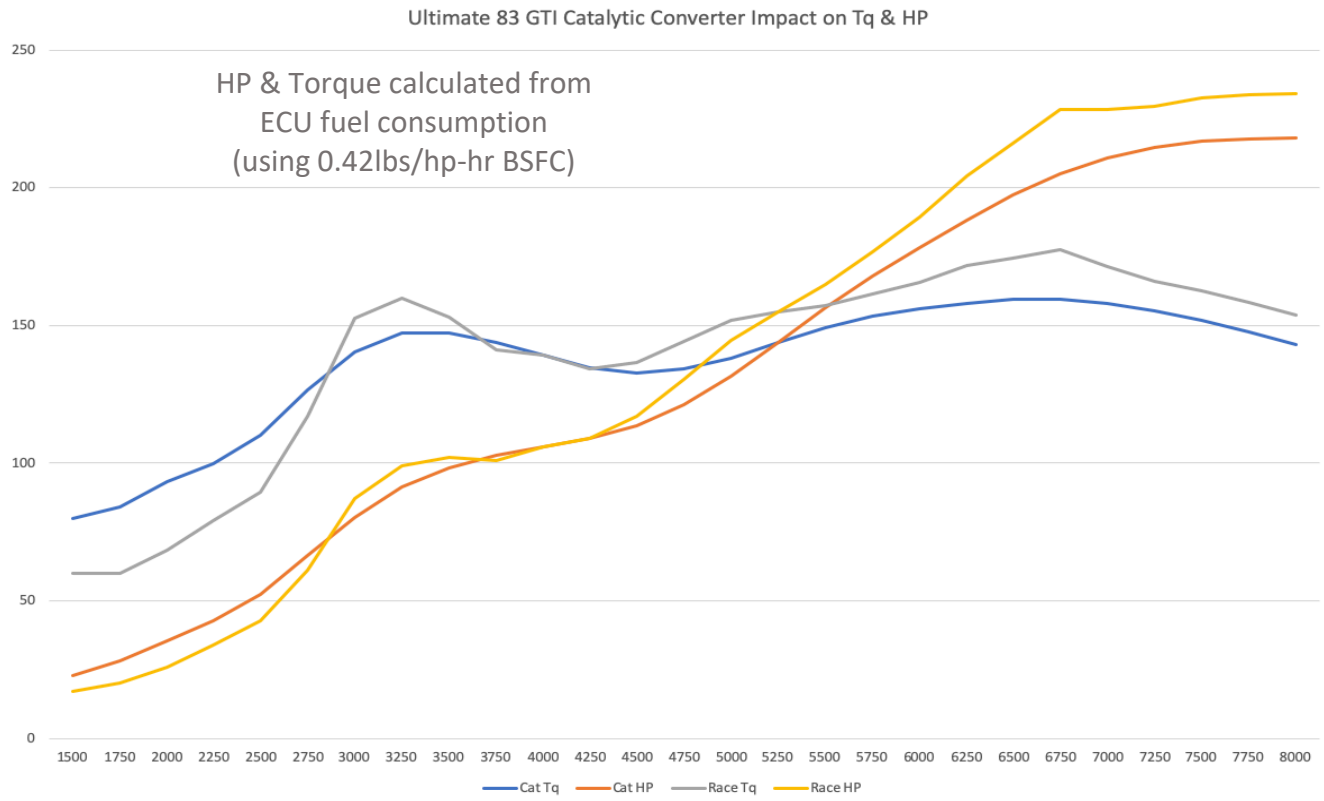

VW Motorsport windage tray


Stainless Steel braided hoses & AN fittings throughout


Fluidamper, Serpentine belt/pulley system, air horns, engine brace

204hp @ 7200+rpm, 164ft-lbs @ 5400rpm at the wheels
Est 15% drivetrain losses -> <u>240hp & 193ft-lbs at the crank</u>


GTI Torque & HP
HP & Torque calculated from acceleration g forces recorded while in 2nd gear
Torque/HP
RPM
300
250
200
150
100
50
0
2000
3000
4000
5000
6000
7000
8000


Ultimate 83 GTI Catalytic Converter Impact on Tq & HP
HP & Torque calculated from ECU fuel consumption (using 0.42lbs/hp-hr BSFC)
250
200
150
100
50
0
1500 1750 2000 2250 2500 2750 3000 3250 3500 3750 4000 4250 4500 4750 5000 5250 5500 5750 6000 6250 6500 6750 7000 7250 7500 7750 8000
Cat Tq
Cat HP
Race Tq
Race HP

GTI Valve Lash												
01-Mar-19					*Lash Cap*	*Lash Cap*	*Delta*	*Target*	*Target*	*Final*	*Lash Cap*	*New Lash*
		2017	*2018 pre*	*2019 post*	*mm*	*inches*	*0.013-0.018*	*Lash Cap*	*Lash Cap*	Choice	*inches*	Measured
							0.015	*inches*	*mm*	*mm*		
Exhaust	1A	0.013	0.013	0.014	1.85	0.073	0.001	0.072	1.82	1.85	0.073	0.015
	1B	0.013	0.013	0.014	1.85	0.073	0.001	0.072	1.82	1.80	0.071	0.015
	2A	0.013	0.013	0.013	1.85	0.073	0.002	0.071	1.80	1.85	0.073	0.014
	2B	0.014	0.013	0.013	1.85	0.073	0.002	0.071	1.80	1.85	0.073	0.015
	3A	0.014	0.013	0.015	1.85	0.073	0.000	0.073	1.85	1.95	0.077	0.014
	3B	0.013	0.013	0.014	1.85	0.073	0.001	0.072	1.82	1.80	0.071	0.015
	4A	0.012	0.011	0.012	1.9	0.075	0.003	0.072	1.82	1.80	0.071	0.015
	4B	0.012	0.011	0.011	1.85	0.073	0.004	0.069	1.75	1.70	0.067	0.014
							0.007-0.011					
							0.009					
Intake	1A	0.007	0.006	0.005	1.75	0.069	0.004	0.065	1.65	1.65	0.065	0.010
	1B	0.010	0.008	0.006	1.75	0.069	0.003	0.066	1.67	1.70	0.067	0.010
	2A	0.009	0.007	0.007	1.75	0.069	0.002	0.067	1.70	1.70	0.067	0.010
	2B	0.010	0.008	0.007	1.75	0.069	0.002	0.067	1.70	1.70	0.067	0.010
	3A	0.008	0.007	0.005	1.75	0.069	0.004	0.065	1.65	1.70	0.067	0.009
	3B	0.011	0.008	0.007	1.75	0.069	0.002	0.067	1.70	1.75	0.069	0.009
	4A	0.008	0.007	0.007	1.75	0.069	0.002	0.067	1.70	1.75	0.069	0.009
	4B	0.008	0.007	0.007	1.75	0.069	0.002	0.067	1.70	1.60	0.063	0.009

Ultimate 83 GTI Oiling System

Keeping a high rpm, high compression engine properly lubricated with cool, clean oil is important. I ran a metal mesh filter back in the day with my first GTI and so it was nice to spec in a remote mount high flow K&N washable 25 micron metal mesh filter with a Mocal/Laminova oil thermostat and coolant intercooler – when racing at WOT on a hot day the engine oil temperatures might reach 230 degrees F which is great cooling performance, and on the street the oil temperature always stays in the range of 200-210 degrees F – the oil stays clean and the filter is easy to remove/clean as it is mounted below the radiator and is easy to reach:

16V 36mm/high volume oil pump and pickup tube

VW Mk3 motorsport windage tray

Full Synthetic 5W40 Joe Gibbs DT40 oil

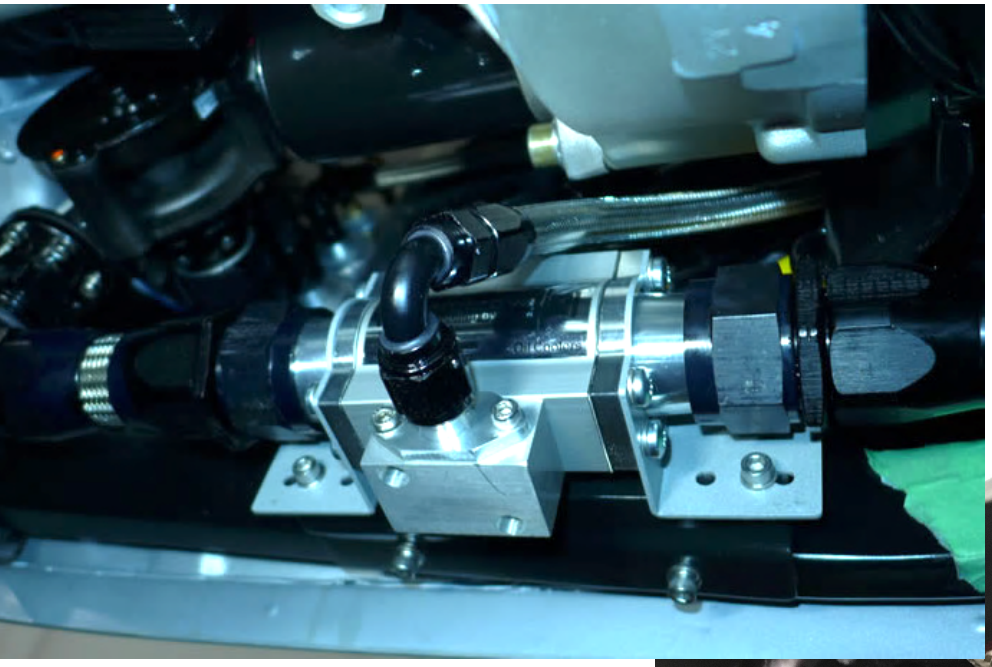
Custom crankcase breather system

Mocal 200 degree F oil thermostat plate

Mocal/Laminova oil to coolant intercooler

K&N external oil filter with 25 micron metal mesh element

All stainless steel braided oil lines and AN fittings



Ultimate 83 GTI Cooling System

In order to make room for the long curved ITB intake runners the stock radiator had to be removed and a custom high capacity radiator e fabricated that would fit under the front cross member – the design includes two 10” Spal puller fans, one driven at 7V for low speed cooling when the radiator exit temperature reaches 170 degrees F, and the other fan driven at 13.5V for high speed cooling when temps exceed 180 degrees F – this setup works very well indeed.

The electric water pump is an OEM quality unit that also works very well: the controller module varies the speed of the pump based on the coolant temperature and allows for programmable coolant temperatures – and it also provides for ‘engine-off’ cool-down by continuing to circulate the coolant while the ECU controls the Spal radiator fans – an excellent feature for high performance driving use.

Again, all stainless steel braided coolant hoses with AN fittings/coupling used throughout. A Canton coolant recovery tank mounted on the side of the engine bay near the front makes it easy to check and fill the coolant level.

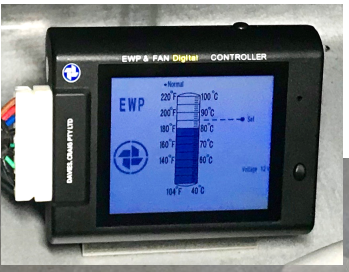
Aluminum TIG welded custom racing radiator with AN fittings

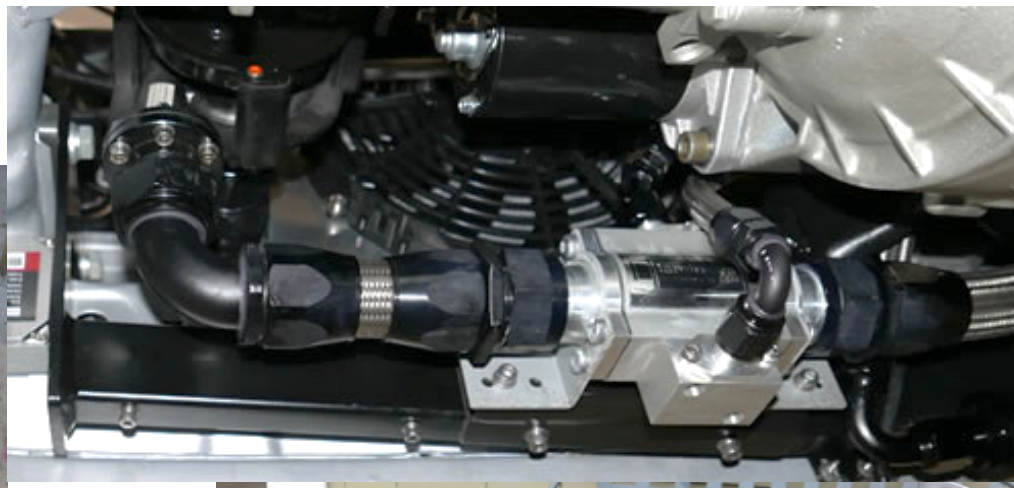
2 Spal 10” puller fans (low and high speed, ECU controlled)

Electric water pump and digital controller (190 degree F setpoint for street use)

Aluminum TIG welded Canton Mecca coolant recovery tank

Stainless Steel braided cooling hoses and AN fittings throughout





Ultimate 83 GTI Exhaust System

Achieving the right balance of power & torque while also ending up with a nice mellow sound and longevity requires moderate stainless steel pipe sizing and lots of race-spec stainless resonators. After years of racing and designing exhaust systems I have learned the art of efficient, quiet exhaust system design (the exhaust is not 'quiet' by street car standards, but is very quiet by race car standards – it sounds very serious but not irritating on the street, especially with the catalytic converted installed):

Custom 1.75" primaries race header for tall-deck block, stainless steel

Vibrant stainless resonator or highflow catalytic converter with flex pipe

Quick-connect stainless steel couplings

Tectonics tuning 2.25" cat-back exhaust system, stainless steel

Borla stainless steel rear resonator/muffler

2.5" custom stainless steel exhaust tip

Ultimate 83 GTI Transmission

The original Mk1 and mk2 GTIs came with variants of the VW 020 5 speed close-ratio transmission which has a practical upper power limit of 150hp but it can be built to stronger specs to (barely) withstand a 200+hp engine if driven with some respect for the transmission. The 020 transmission is very light and compact so it keeps the weight down up front and it does utilize the original OEM mechanical linkage which is a unique aspect to these early Mk1 GTIs. The final choice was a Mk2 020-2Y 16V transmission with internal upgrades and California stage 3 and stage 5 clutches (street/race). The 020 mechanical shifter linkage remains in an updated state with heim joints and adjustable linkages, and an adjustable short throw shifter lever, for quick and precise shifts – old school, but really nice as an alternative to more modern cable-shift systems:

Hardened gear sets

ARP pinion gear fasteners

3.67 final drive (16V) ratio

0.76 5th gear swap

Quaife limited slip differential

California Clutch 1800lbs pressure plate, 6 puck stage 5 clutch disk, dynamically balanced

ARP pressure plate bolts

100mm output flanges

500hp rated axles with XL splines/hubs/12mm stud conversion

USRT clutch cable termination hardware

USRT heim joint adjustable shift linkages

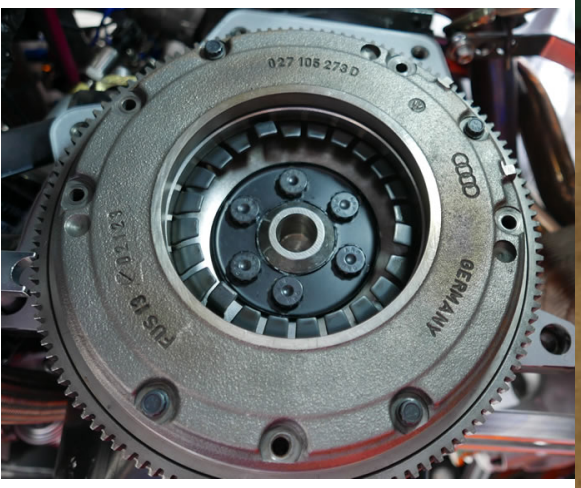
Solid rubber transmission mounts (will never wear out but also keeps vibration down)

USRT Heim joint
shift linkage

Stage 3 Street Clutch Disk

Stage 5 Street & Track
Clutch Disk

ARP Pressure Plate
to Crank Bolts



Ultimate 83 GTI Suspension

One of the challenges encountered when upgrading the stock Mk1 GTI suspension relates to improving chassis stiffness and the other is dealing with the limited front-end suspension travel once the car is lowered 1.5" (leaving a tire to fender gap of ¾"). The Mk1 GTI needs compliance to keep tires firmly planted on the road but also enough stiffness to allow for aggressive steering/corning inputs. Old school shocks have a single valve/fixed orifice that may control the springs when steady-state forces are involved but when a bump is encountered the car is thrown into the air, losing the tire contact on the road. The modern KW coil-overs not only have 16 way adjustable compression/rebound settings but also employ 2 circuits – one is the bypass which opens up and allows the suspension to travel when bumps are encountered – allowing the tires to keep in contact with the road when FIA curbs or large road bumps are encountered. When setup properly the original playfulness of the OEM Mk1 GTI is maintained with far higher grip/performance, assuming the chassis is up to the challenge (which in this case is far stiffer than OEM). On the street with 250/200lbs springs and soft shock settings the car is now capable of 1g corning forces, and with slicks, 440/350lbs springs and stiffer shock settings (and slicks) over 1.4g of corning is possible.

Febi Bilstein Upper Strut Mounts/Urethane added to underside for stiffness/support/longevity

KW Variant 3 coilovers, stainless steel, compression and rebound adjustable - 16 steps

250lbs/in Eibach/Ground Control front springs (vs. 342 stock KW V3 – both sets inc)

200lbs/in Eibach/Ground Control rear springs (vs. 285 stock KW V3 – both sets inc)

Autotech 28mm hollow rear sway bar with urethane bushings

Delrin rear axle bushings

Urethane front A-arm bushings

5mm front wheel spacers to allow OEM snowflake wheels to clear calipers

15mm rear axle spacers + 3mm wheel spacers (front/rear track is now equal)

1.2 degrees of negative camber front/rear, 1/16" toe out front

KW Variant 3 Coilovers with Eibach 250/200lbs-in springs

Autotech 28mm hollow rear swaybar

Ultimate 83 GTI Steering

Modern cars have a lot going for them but steering 'feel' is not one of them. Get behind the wheel of any modern sports car and you immediately feel isolated from the road and the driving experience. Much of this has to do with the software and hydraulic systems that are in-between your hands and the tie-rod ends connected to the wheels. The old-school Mk1 GTI had a completely manual rack & pinion steering system – you felt everything in your hands. But one problem with the OEM R&P was the high number of turns lock-to-lock and upgrading to a quick ratio Quaife R&P solved that problem but makes the steering very high effort when the car is not moving – so to get the benefit of a manual quick-ratio R&P you also have to learn to get the car moving before you start to turn the wheel – this is a learned behaviour in parking lots.

The reward is very precise, high road-feel steering which is a real treat to experience in this day and age. Note: the OEM manual steering racks use a simple pinion depth adjustment bolt/spring and it is a long process of trial and effort to get the setting 'right' – in my case the R&P came in and out of the car 6 times before it was deemed 'perfect', and involved machining a small bushing to improve the on-center feel and precision. Perfection does not come easy with these old-school R&P boxes.

The Mk1 GTI has a large plastic steering wheel that to my tastes is a bit dated and dull feeling so I had the steering wheel slightly ground down, adding a thin layer of high density foam and then Italian leather wrapping to create a very nice 'feel' to it with all of the retro looks of the original wheel – one of the best aspects of this project!

Mk1 GTIs also suffer from worn out steering U-joints and there are no after-market replacements available. I found a work-around/upgrade that involved fabricating a new double-u-joint system from late model Mercedes parts – I now have a built-proof, zero-play steering column connection to the R&P that is a thing of beauty. Finally, the OEM steering column is not very precisely located in the dash so a stainless steel support bracket was fabricated to keep it in place plus upper and lower bearings were installed as well – now the steering wheel is rock solid.

Custom leather wrapped GTI wheel

Custom upper and lower steering column bearings

Custom stainless steel steering column support brace

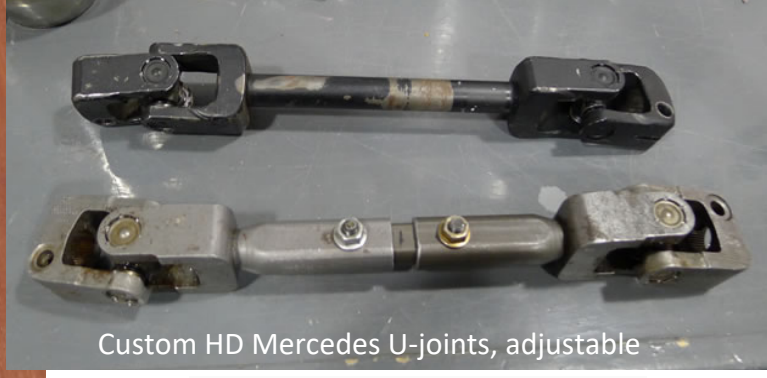
Quaife quick-ratio R&P gears

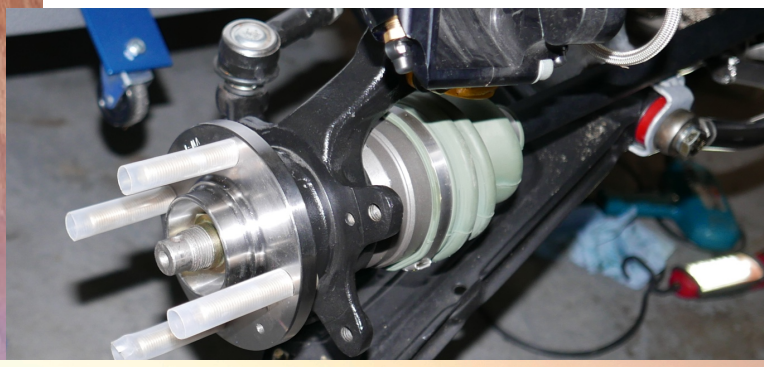
Custom bushing for pinion depth setting

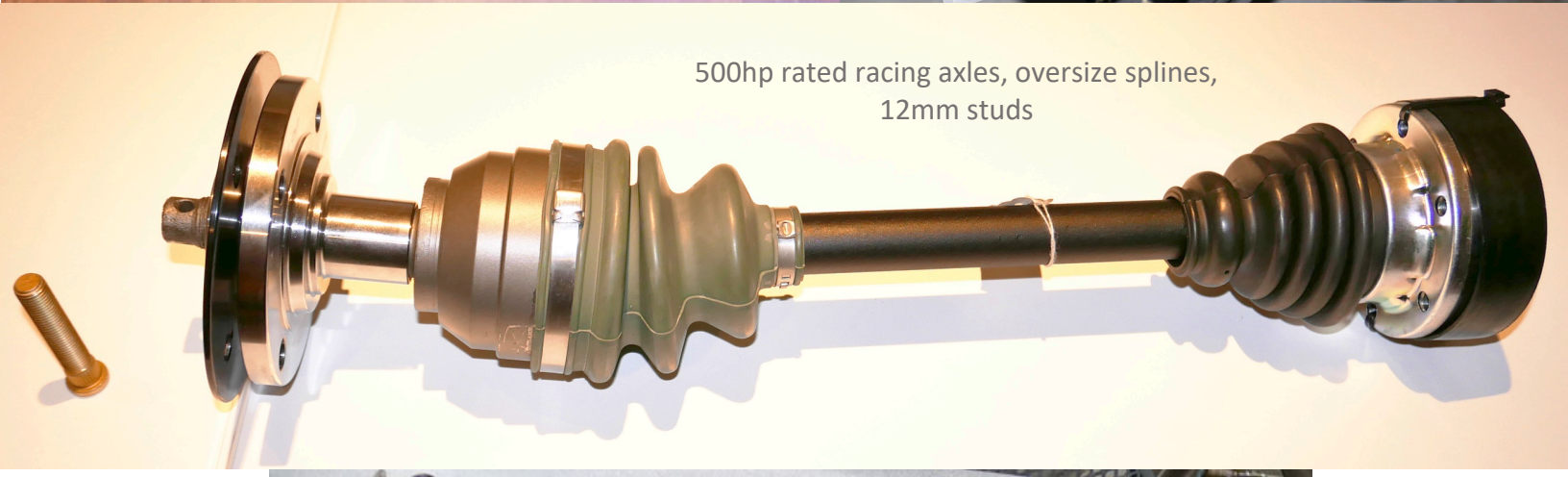
Custom double-U-joint coupler, ends taken from late-model Mercedes

Urethane R&P bushings

Italian leather wrapped wheel


Custom HD Mercedes U-joints, adjustable




500hp rated racing axles, oversize splines,
12mm studs


Quaife quick-ratio steering rack gearing

Ultimate 83 GTI Brakes

One area where the original Mk1 GTI did not excel was in the braking department with its tiny single piston caliper 9.4" front rotors and rear drums. Stuffing in large 11" front rotors is not the answer though as it puts too much unsprung weight in play, keeping the wheels/tires from staying in in contact with the road over rough surfaces – unsprung weight is a killer and so big brakes are to be avoided if possible. And 11" rotors simply will not fit inside an OEM 14x6 snowflake rim which is an absolute requirement for my car. The correct spec is 10.1" front rotors with special calipers …

Another area of concern is the ugly problem of front/rear brake bias when upgrading to the Mk2-4 rear disk brakes as the increased braking torque at the rear causes rear-wheel lockup if the correct proportioning valves are not installed – and the stock prop valves were designed to vary pressure according to the rear twist-beam axle movement during panic braking which doesn't make any sense with stiffer after-market suspension setups. So an after-market prop valve needs to be installed but it still isn't enough to completely tame the balance problem … unless you use the unique Tech-53/Wilwood 4 piston front calipers which have 60% more surface area and stopping torque in comparison to other calipers – and in one simple swap they eliminate the balance problem, allowing for optimum braking.

Running the e-brake cables usually involves having them hang under the rear twist-beam axle trailing arms in an unsightly manner so I welded in new e-brake tubes that tuck the cables under the fuel tank and route the brake lines and e-brake cables to the rear calipers which are inverted so all lines are above the trailing arms. The only issue created is that the calipers need to be unmounted and flipped around when bleeding the lines.

There are 2 recommended brake pads for the Tech-53/Wilwood 4 piston front calipers: a Hawk street performance compound which provides for dust and noise free braking with significant braking torque without eating the rotors, and a race-only Hawk DTC-60 compound which dramatically increases the stopping power when slicks are used but also kills a set of rotors in less than 2 hours of racing – the pads are also very dusty and noisy. On the track they allow for serious levels of braking forces, above 1.4g but you simply have to keep an eye on the rotors as they will wear very quickly and start to crack if you are using drilled rotors – slotted-only rotors are the right choice for track days. Cooling ducts are also important additions for track use – keeping the rotor temperatures under control. High temperature Castrol SRF brake fluid is used to keep the need for flushing/replacing fluid to a minimum.

The engine with its ITBs and 288 cams doesn't produce enough manifold vacuum to operate the brake servo so an ECU controlled electric vacuum pump is employed, allowing for dashboard control over the amount of brake pressure desired – a nice feature that allows for higher brake pressures on the track and less pressure on the street …

Front: 10.1" slotted/vented high performance rotors

Front: Tech-53/Wilwood aluminum 1.625" dia 4 piston calipers

Rear: VW Mk2-4 slotted solid rotors

Rear: VW Mk4 aluminum calipers, axle offset 15mm with CNC spacers

Wilwood proportioning valve

25.4mm master cylinder

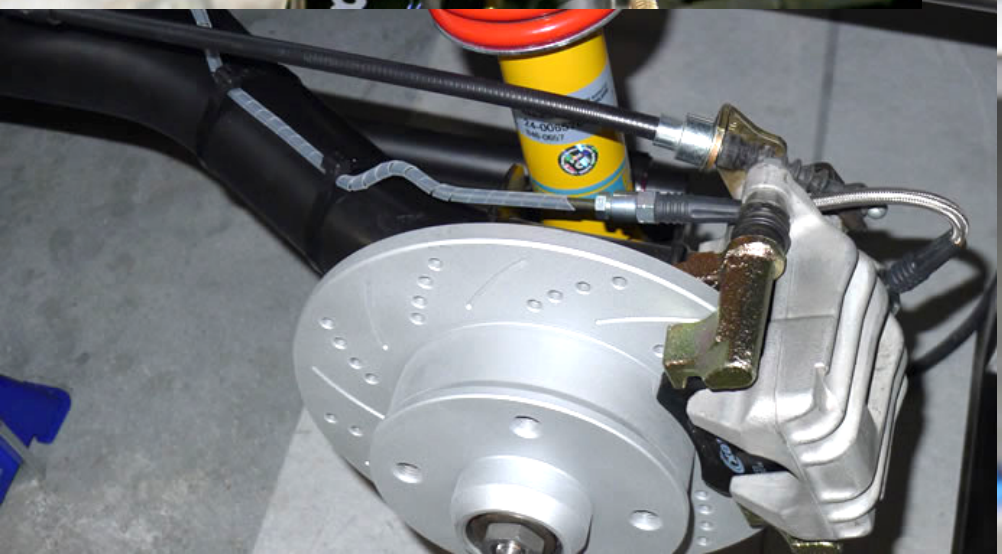
Castrol SRF racing brake fluid

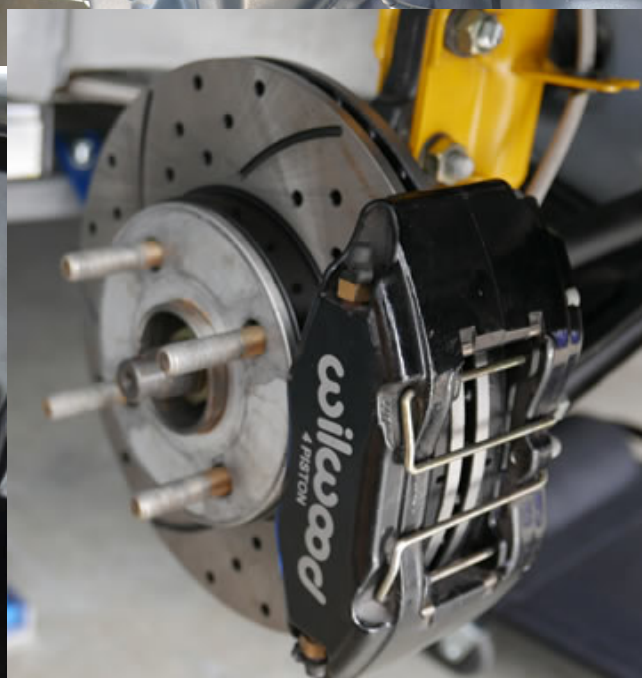
ECU controlled vacuum pump for the brake servo

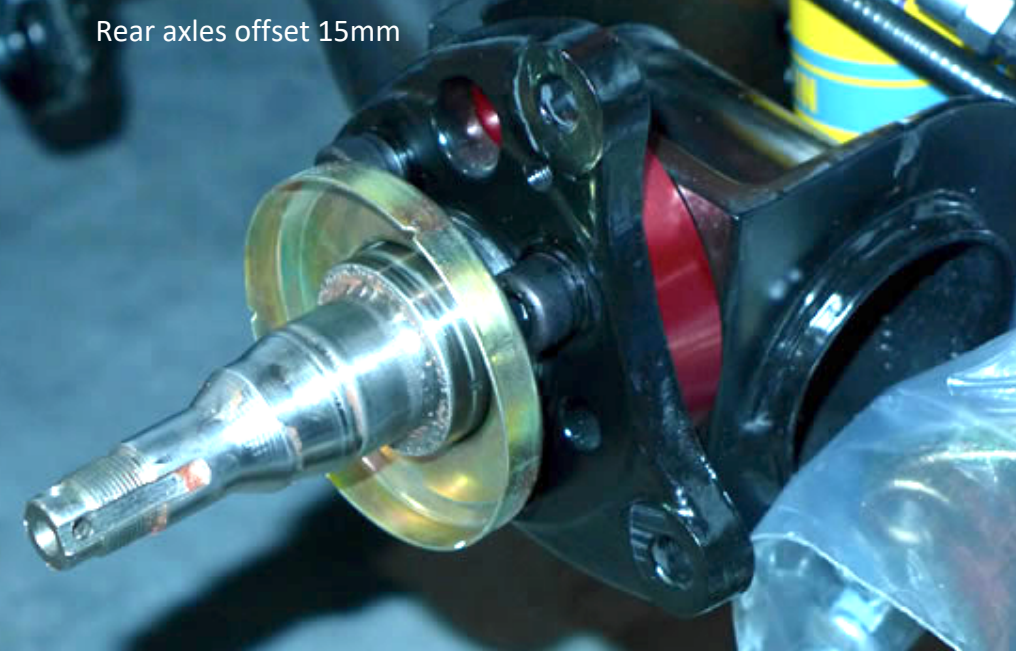
Adjustable brake pedal position to allow for accurate heel-and-toe foot positioning relative to the throttle pedal

Tech-53 1.625" dia pistons vs std Wilwood 1.25" dia

25.4mm MC with Wilwood proportioning valve






Rear axles offset 15mm


mandarine


Brake pedal has adjustable position
(optional race throttle pedal not
shown)

VW mk1 Big Brake Conversion Analysis

Derek Spratt / March 7, 2017

	Front Rotor Dia (")	Front Rotor Dia (mm)	Brake Pad Mean Torque Radius (mm)	Piston Dia (mm)	# of pistons	Piston Area (mm^2)	Clamping Torque	Front Clamping Torque vs OEM GTI	Rear Rotor Dia (")	Rear Rotor Dia (mm)	Brake Pad Mean Torque Radius (mm)	Piston Dia (mm)	Piston Area (mm^2)	Rear Clamping Torque	Rear Brake Bias
Stock 83-84 GTI with Scirocco Rear Disk Conversion	**9.4**	**239**	**97**	**44**	**1**	**1,520**	**147,652**	**100%**	**8.9**	**226**	**91**	**36**	**1,017**	**92,381**	**38%**
14" wheels, Wilwood Powerlite 4x1.25" piston Callipers with Scirocco Rear Disk Conversion	10.1	257	106	32	2	1,608	170,486	115%	8.9	226	91	36	1,017	92,381	35%
15" wheels, Wilwood Powerlite 4x1.25" piston Callipers with Scirocco Rear Disk Conversion	11.0	279	117	32	2	1,608	188,862	128%	8.9	226	91	36	1,017	92,381	33%
14" wheels, Tech-53 4x1.625" piston Callipers with Scirocco Rear Disk Conversion	10.1	257	106	42	2	2,769	293,690	199%	8.9	226	91	36	1,017	92,381	24%
15" wheels, Tech-53 4x1.625" piston Callipers with Scirocco Rear Disk Conversion	11.0	279	117	42	2	2,769	325,345	220%	8.9	226	91	36	1,017	92,381	22%
14" wheels, Wilwood Powerlite 4x1.25" piston Callipers with G4 Aluminum Rear Disk Conversion	**10.1**	**257**	**106**	**32**	**2**	**1,608**	**170,486**	**115%**	**8.9**	**226**	**91**	**38**	**1,134**	**102,931**	**38%**
15" wheels, Wilwood Powerlite 4x1.25" piston Callipers with G4 Aluminum Rear Disk Conversion	11.0	279	117	32	2	1,608	188,862	128%	8.9	226	91	38	1,134	102,931	35%
14" wheels, Tech-53 4x1.625" piston Callipers with G4 Aluminum Rear Disk Conversion	**10.1**	**257**	**106**	**42**	**2**	**2,769**	**293,690**	**199%**	**8.9**	**226**	**91**	**38**	**1,134**	**102,931**	**26%**
15" wheels, Tech-53 4x1.625" piston Callipers with G4 Aluminum Rear Disk Conversion	11.0	279	117	42	2	2,769	325,345	220%	8.9	226	91	38	1,134	102,931	24%
14" wheels, Wilwood Powerlite 4x1.25" piston Callipers with Polo Rear Disk Conversion	10.1	257	106	32	2	1,608	170,486	115%	8.9	226	91	32	804	72,993	30%
15" wheels, Wilwood Powerlite 4x1.25" piston Callipers with Polo Rear Disk Conversion	11.0	279	117	32	2	1,608	188,862	128%	8.9	226	91	32	804	72,993	28%
14" wheels, Tech-53 4x1.625" piston Callipers with Polo Rear Disk Conversion	10.1	257	106	42	2	2,769	293,690	199%	8.9	226	91	32	804	72,993	20%
15" wheels, Tech-53 4x1.625" piston Callipers with Polo Rear Disk Conversion	11.0	279	117	42	2	2,769	325,345	220%	8.9	226	91	32	804	72,993	18%

Notes:

Above calcs assume same brake pad material - high performance front pads can increase braking torque by an additional 20-25% (when warmed up), thereby reducing the need for rear circuit pressure reduction

Stock Front/Rear Weight distribution for the mk1 GTI with driver is approx 63/37

Dynamic braking causes Fr/Rr dist to shift to as much as 75/25 or more - hence the need for a proportioning valve - and in the case of the OEM valve - variable depending on rear axle beam load

Many aftermarket proportioning valves can only reduce rear pressure to 57% of front pressure, a few can reduce it further

Most proportioning valves operate in such a way that creates a slow ramp up in rear pressures - causing some non-linearity in their response during fast transient braking maneuvers

In my situation, I am upgrading from the Wilwood callipers to the Tech-53s with my 10.1" rotors as I use the OEM 14" snowflakes on the street, I also have lighter G4 rear calipers with larger 38mm pistons which makes matters worse ...

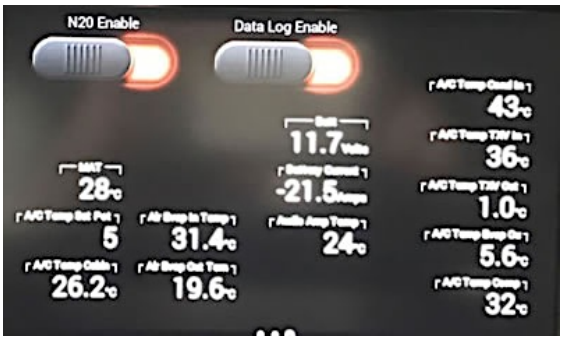
I was having problems with too much rear brake torque, requiring excessive pressure reduction to the rear circuit to avoid premature rear wheel/tire lockup during max braking efforts

Not only will the Tech-53 callipers give me far more front brake torque for more stopping power with less brake pedal force, but I will be able to significantly reduce the need for pressure reduction to the rear circuit

Ultimate 83 GTI Air Conditioning

The Mk1 GTI had A/C as a dealer installed option, adding almost 100lbs of weight to the front-end of the car with an awkwardly mounted compressor and lines. Most GTIs were delivered to their owners without A/C, and in those days most people, including myself, didn't seem to mind leaving the windows rolled down, but today it seems crazy to own a car without A/C, or electric windows for that matter. I had 2 rules to obey: minimal weight and no parasitic power loss from the engine so an electric A/C compressor was the only path forward. Belt driven A/C compressors have >10,000BTU of cooling capacity while a 12V compressor has 3,000BTUs of cooling. The good news is that most of the 10,000BTU capacity of automotive compressors is not used during steady-state operation – only the initial cool-down period, so 3,000BTUs is not that far off the amount needed for continuous use.

I ended up mounting a small condenser under the car with 6 waterproof fans blowing air across it, and welded up 1/3 of a GM evaporator core to mount next to the blower in the rain tray. The system only weighs 20lbs total and can cool incoming air from >90 degrees F to around 75 degrees F at a medium blower setting and the compressor running at 80% of full speed, pulling around 25amps of current.



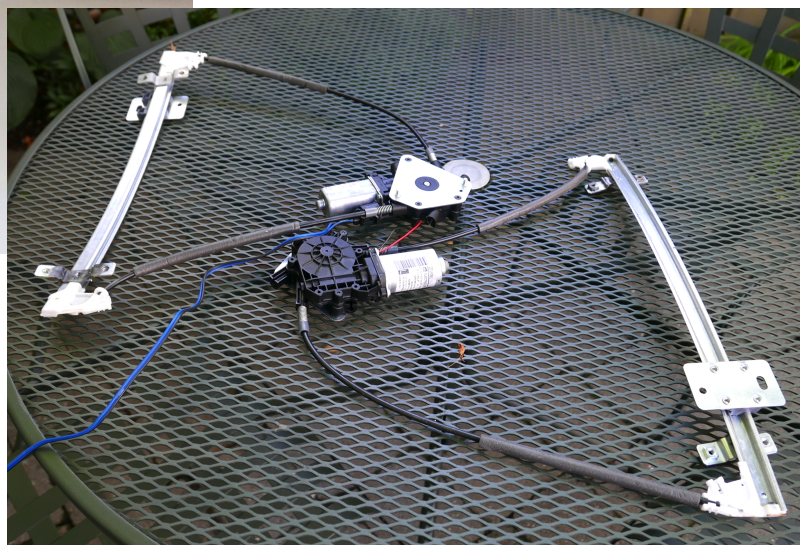
Ultimate 83 GTI Interior

I knew that all of the work to get the car mechanically perfect would be generally hidden from view so I wanted the interior to really stand-out as being 'mint condition' all original looking. 35+ year old Mk1 GTIs never have perfect interiors but I wanted mine to be. I must say that I am the luckiest Mk1 GTI owner in North America as I sourced the very last bolt of original factory OEM seat cloth, so the finished seats are amazing. Before the upholstery work was done though, the seat frames had cracked so they were rewelded and strengthened before black epoxy painting, and then new foam was added that has a firm inner core and a softer outer layer to create seats that are very supportive but comfortable – firmer than stock but in the same range as more modern sports-car seats feel.

Matching the seats is a plush carpet and new OEM-style headliner. The dash and all interior plastic parts were refinished and re-painted with plastic paint and the results are stunning – everything is 'as new', crisp and clean. All rubber moldings have been replaced. The windshield is new, the side window glass has all been re-polished.

The original dash console has been replaced by a touch screen unit that mimics the original analog gauges. The center of the console now hosts the additional air vents that came with the A/C equipped cars. The little pull-out change drawer below it now hosts the electronic switches and knobs to control various aspects of the ECU – when closed there is nothing the eye can see which would give away the high-tech modern nature of the car …

The windows are now electrically powered; there are front and rear facing cameras that display their images inside the rear-view mirror; the side mirrors now have a convex shape so those tiny mirrors actually show the activities in the lanes on either side of you; mild electric A/C cools the interior on hot days; the 1200W blue-tooth audio system with hands-free cel phone will blow people away; every light bulb in the car is LED based so lighting is crisp and clean, and the OEM sunroof works beautifully with all new metalwork, cables, handle and hardware.



Ultimate 83 GTI Bodywork & Paint

The weak link in any Mk1 Golf is the rust hidden in the pinch welds beneath the thick layers of latex sealant – after 35+ years the latex has often shrunk, cracked and moisture has found its way into the non-galvanized mild steel unibody chassis to rot away silently. I hear stories of rust-free Mk1 cars and I find it hard to believe them as you need to spend the time and effort to strip the underside of the chassis to its bare metal state to know what you are really dealing with – it is a long, slow, painful process that involves vibrating tools, wire wheels, solvents and a host of techniques to slowly remove the messy latex, and then you need to grind off all of the factory pinch-welded tabs that hold wires and hoses through-out the car – these are prime areas where rust will re-emerge.

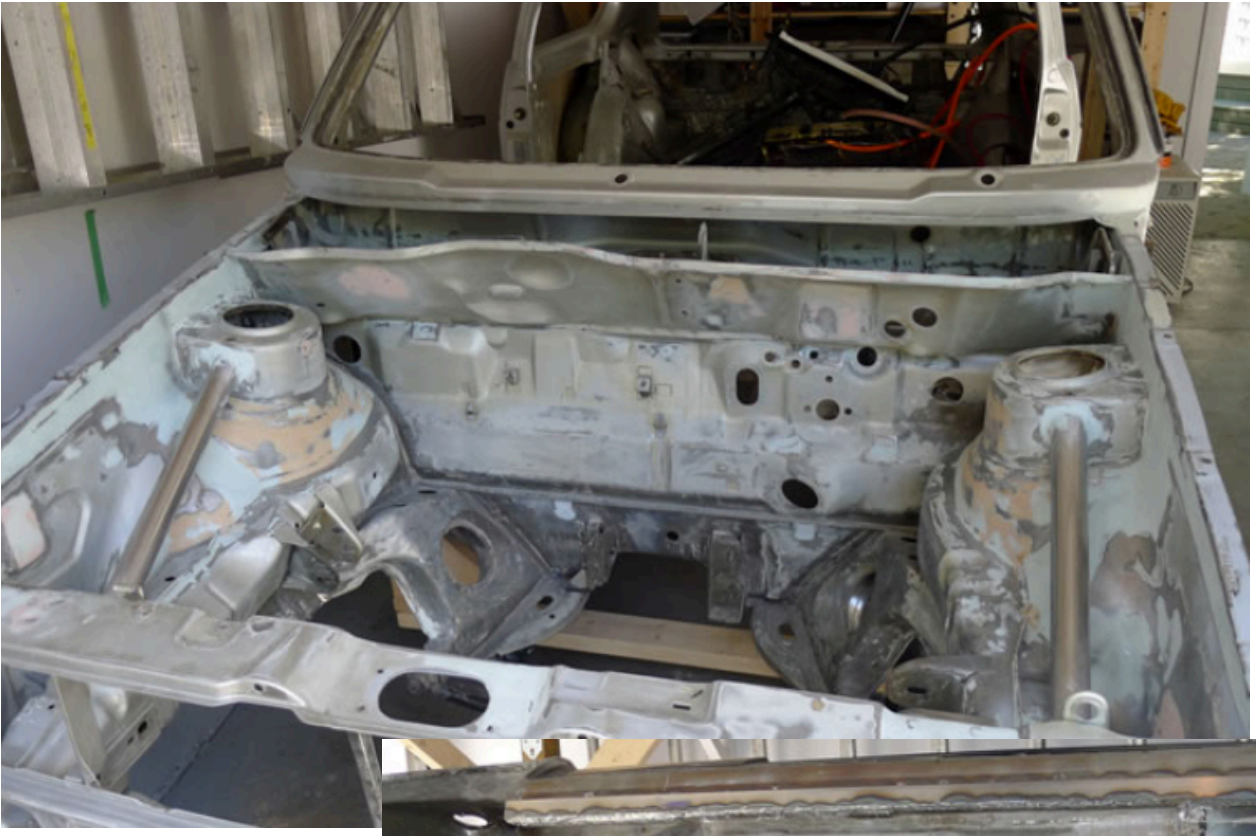
Once the rust is discovered you have 2 choices: cut it out or acid etch it away, and then fill the spaces with new sheet metal and/or brazing techniques to fill in pitted thin sheet metal – depending on the car this is typically an additional 500-1000 hours of effort if done thoroughly and correctly.

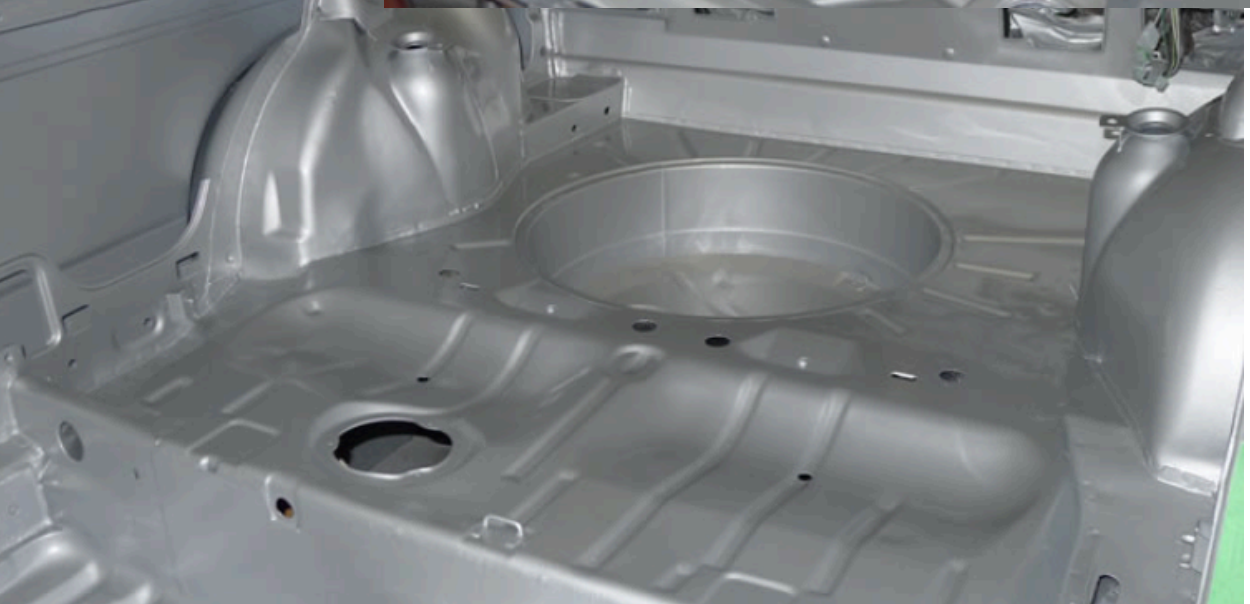
At the bare metal stage I had the opportunity to stiffen the unibody frame. This involved welding in a rectangular tube sub-frame along each side of the car and also boxing in the interior floor-boards with 1/8" steel plating, and doubling up the firewall and rear seat vertical walls – creating a very stiff sub-structure for the rest of the car to leverage. In the engine bay tubular braces were added that extend forward from the strut towers to the front of the horns, supporting a bolt-in engine brace that connects the horns/bumpers to the front engine mount – another especially weak area for the Mk1s. In the back, the area around the rear axle mounts was strengthened and tied into the frame rails.

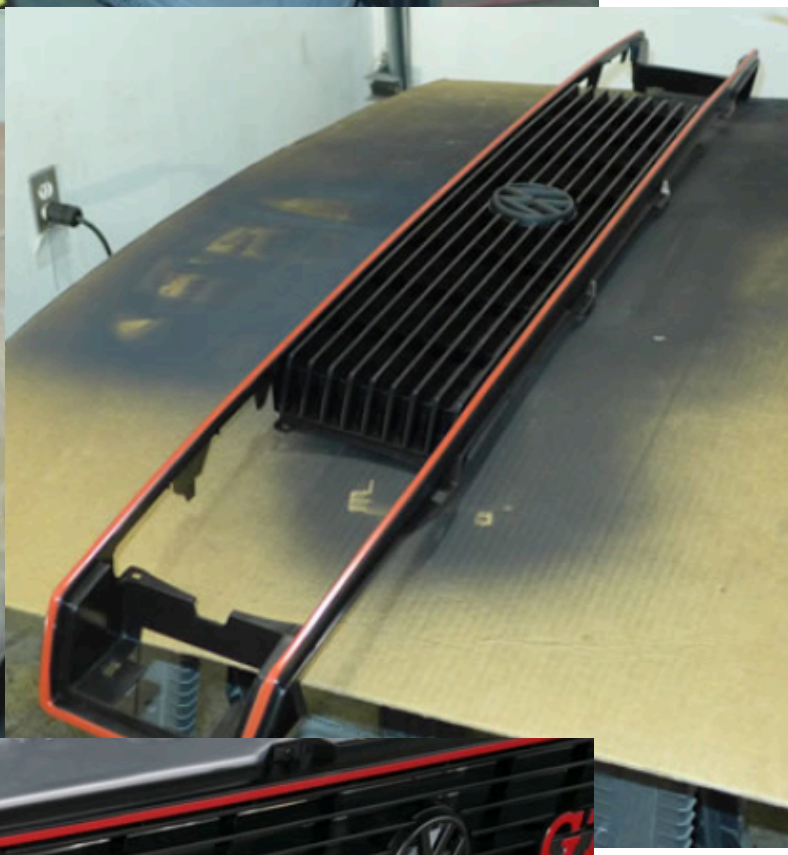
Further stiffening is provided by a bolt-in upper strut brace and a lower A-arm brace. Together this bracing eliminated all chassis flex thereby providing for a level of handling and responsiveness that few if any Mk1 Golf owners have experienced (mainly full-caged race cars).

The factory hood, hatch and bumpers were replaced by carbon fiber units that required careful fitting to ensure consistent gaps and a smooth finish. New aluminum sub-structures were fabricated for the euro sized carbon bumper skins to glue onto and then they were painted in black epoxy – the completed bumpers only weigh 5lbs each now but they are surprisingly strong.

After the metalwork and fiberglassing was completed the bodywork and paint began. For my car there were 3 coats of epoxy paint applied to the bare metal, then rubberized undercoating in the wheel wells, then high-build primer on the exterior panels, then block sanding and more high-build primer, over and over until the panels were dialed in, then another sealer coat of epoxy, sanding from 400-1000 grit, then 3 coats of silver base, then 3 thick coats of clear, then endless hours of hand wet sanding of the clearcoat, starting at 1000 grit, and eventually moving all the way up to 3000 grit before the machine polishing work began, then a final hand application of finishing wax. This was a long process that took over 2 years end-to-end.



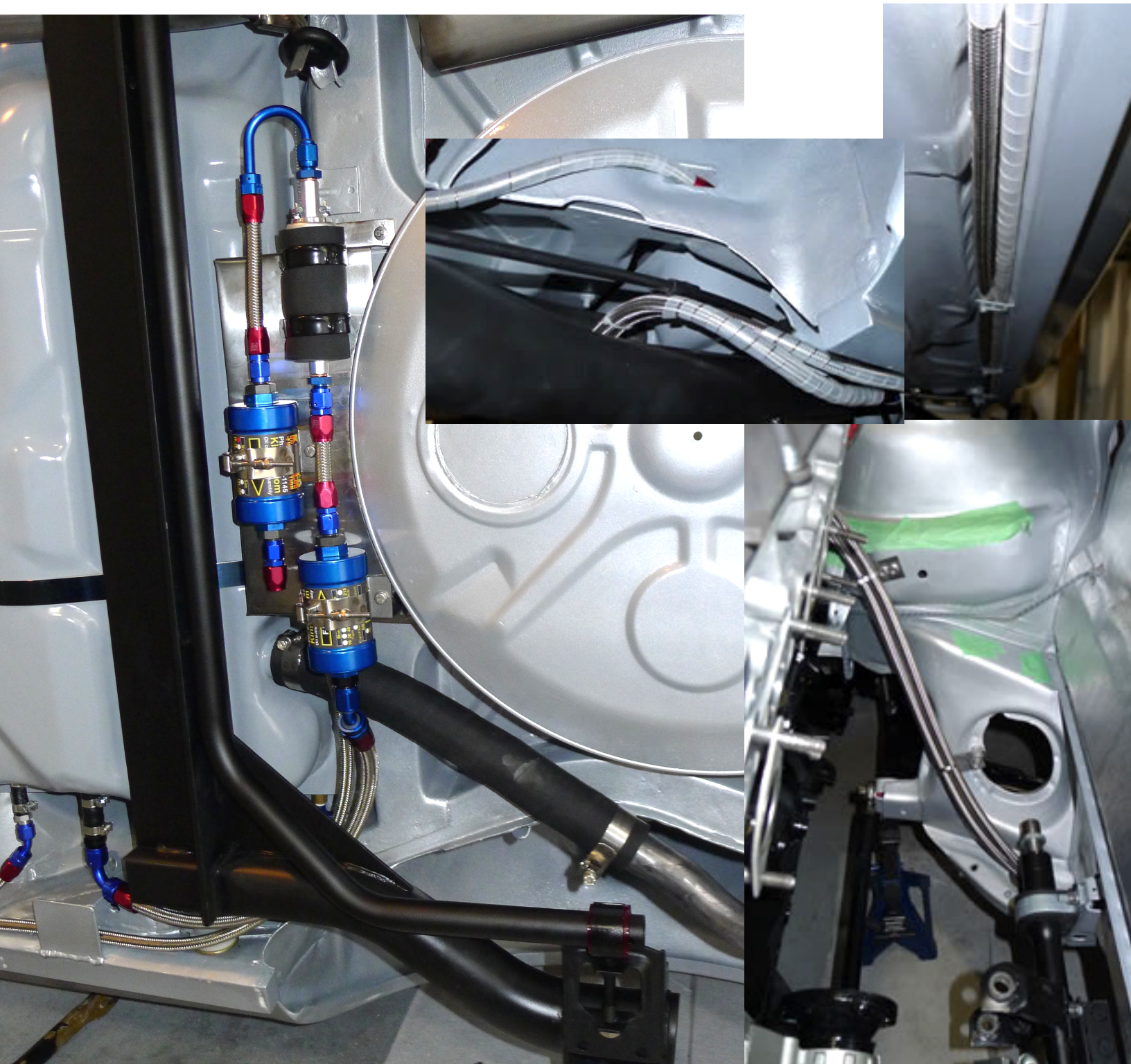





GTI

Ultimate 83 GTI Fuel System

A new epoxy coated fuel tank has been mounted with stainless steel straps and a mounting panel has been placed between it and the wheel well under the back of the car where the fuel pump and filters are mounted for easy servicing as required. Filter housings are CNC aluminum with a 25 micron inlet filter and a 10 micron outlet filter with stainless steel braided fuel supply and return lines with AN fittings run inside the chassis frame rails to the engine. The fuel tank employs a 2 way pressure release valve that keeps fuel vapours contained in the tank unlessdifferential pressures exceed 1psi. Up at the engine the dual fuel injector rails have their pressure controlled by a high volume regulator.



Ultimate 83 GTI Electrical/Computer Systems

The Holley Dominator electronic computing unit (ECU) and digital dash is the heart of the GTI, monitoring and controlling a vast array of parameters throughout the car. All manuals, software and firmware can be found on Holley's website (https://www.holley.com/products/fuel_systems/fuel_injection/dominator_efi/dominator_ecu/parts/554-114). You can download the V5 application on a windows PC and load my global config files which can be found here (www.derekspratt.com/Misc/GTI_Holley_Global_Files.zip :

Engine inputs

- Manifold Absolute Pressure (MAP)
- Barometric Pressure
- Air Inlet Temperature
- Cam Position
- Crank Position
- Throttle Position
- Knock Sensor
- Fuel Pressure
- Oil Temperature
- Oil Pressure
- Coolant Temperature – cylinder head
- Coolant Temperature – radiator outlet
- Transmission Speed
- Fuel Tank Level
- Nitrous Enable Switch

Misc inputs

- 24AH LiFePO4 Battery Voltage & Current
- Electric Water Pump Status
- Acceleration/Braking Gs
- Cornering Gs
- Headlight Switch
- Hi-Beams Switch
- Turn Signals Switch x2
- Kill Switch
- Horn Switch
- Parking Brake Switch
- Seat Heater Temp Setting x2
- Brake Servo Vacuum
- Brake Pressure Setting
- Blower Speed Setting
- Audio Amplifier Temperature
- A/C Enable Switch
- A/C Compressor Speed
- Cabin Air Temperature
- Outside Air Temperature
- Evaporator Air Outlet Temperature
- A/C Compressor Temperature
- A/C TXV R134a output Temperature
- A/C Condenser R134a output Temperature
- A/C Evaporator R134a output Temperature

Engine Outputs

- Fuel Pump Power
- Nitrous Bottle Heater Power
- Nitrous PWM Solenoid
- Nitrous Purge Solenoid
- Fuel Injectors x8
- Radiator Fans PWM x2
- Alarm Speaker

Misc Outputs

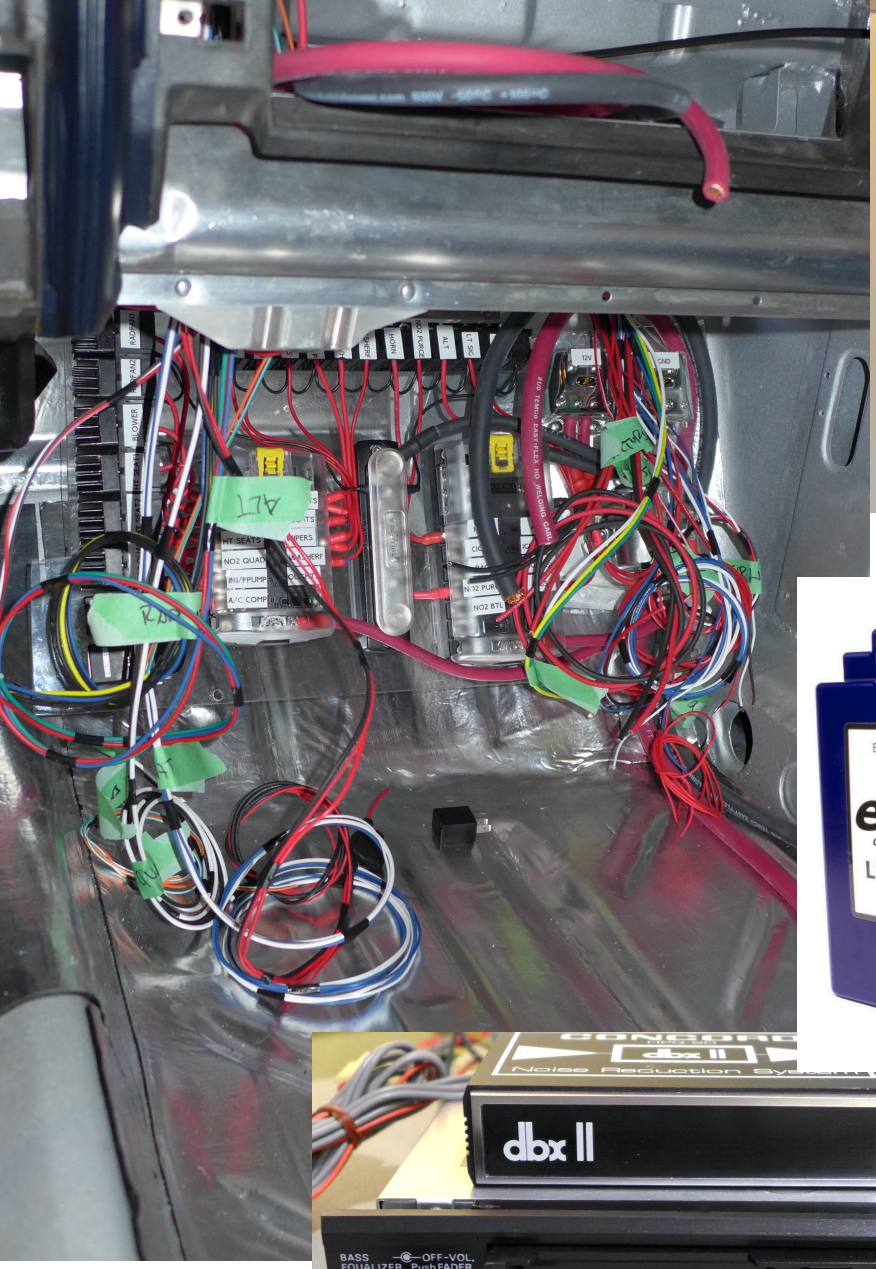
- Horn
- Blower PWM
- Seat Heaters PWM x2
- Turn Signals x2
- Emergency Flasher
- Headlights On
- Hi-Beams
- Parking Lights
- Brake vacuum pump x4
- Audio Amplifier Fan PWM
- A/C Compressor Fan PWM
- A/C Condenser Fans PWM
- A/C Compressor Power
- A/C Compressor Speed x4
- Alternator Voltage Control

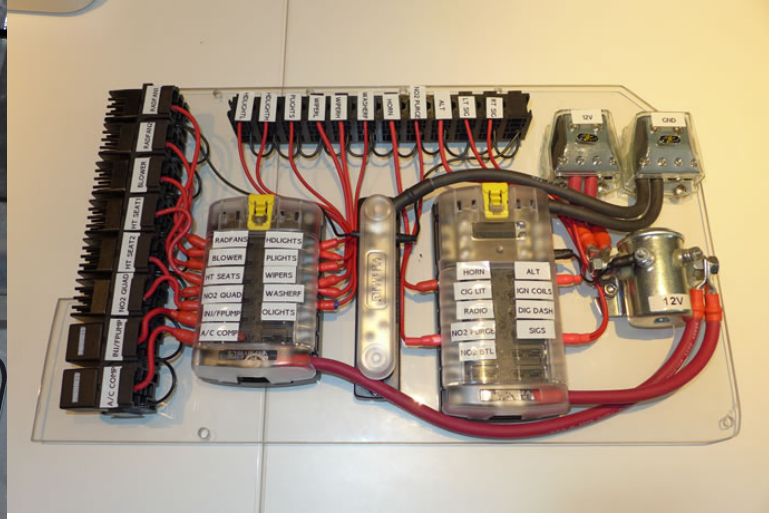
Programming the Holley ECU's dozens of screens and hundreds of parameters was an exhausting and time consuming process but in the end all systems work pretty much flawlessly with the engine starting cold or hot, idling nicely and having very good drivability manners. The ECU controls almost all aspects of the car's functions, as can be inferred from the list of almost 100 inputs and outputs, and the digital touch screen dash is very customizable, with multiple screens available as desired. Plugging in a PC allows for quick updating and data logs analysis. Data logging of all parameters at 30 samples/second means that literally any transient condition can be captured accurately for later analysis.

See appendix for detailed Holley ECU programming screenshots …

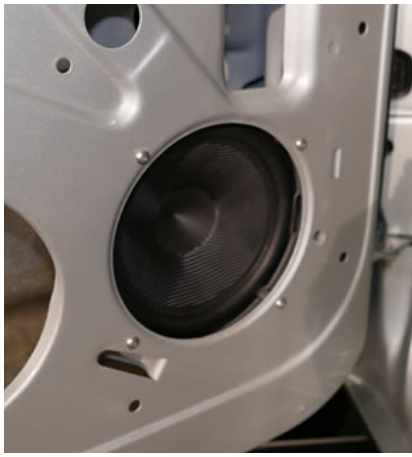
One of the key aspects of the electrical system is the LiFePO4 25amp-hour Lithium battery which only weighs 7lbs but has the power and reliability to outperform a 40lbs lead-acid battery. It is placed in the rear wheel-well alongside the current monitoring and battery wireless disconnect circuits, as well as the 1200W 5 channel audio amplifier and Bluetooth module. While a lithium battery provides much less voltage drop when cranking the engine than a lead-acid battery experiences, and maintains a usefully higher nominal voltage of 13.4V vs 12.8V, it can be damaged by long term over-charging if connected to an old-school 14.5V alternator – anything over 14.0V for an extended period of time is ultimately going to shorten the life expectancy of a Lithium battery, even if the manufacturer claims that its internal BMS can protect it. The solution is to use an adjustable voltage alternator – one that allows for an initial output float voltage to be set around 14.0V, and then a control signal from the ECU to lower the voltage further when the battery reaches a full state of charge – this is the system I have employed which allows for rapid charging but keeps the battery in its happy float state of 13.6-13.8V.

The location chosen for the fuse & relay panel is under the glovebox with a Lexan hinged plate that the fuses and high powered relays are mounted to – remove 2 allen-head bolts and the panel will drop down for servicing needs. Or remove 5 screws and pull out the glove box and service the panel without dropping it down – but you will want to reach in and pull out the passenger side air duct to make it easier to see what you are doing. The original fuse panel location is now occupied by the A/C compressor control module.

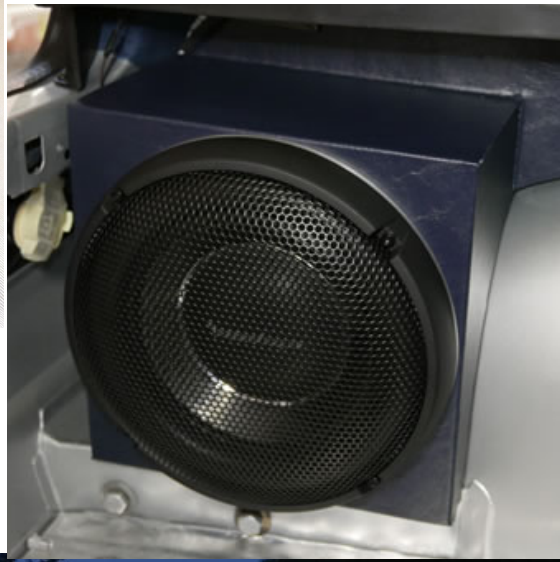





Fault
Indicator
Engineered and Manufactured
in the USA
earthX
charge your ride
Lithium Battery
www.earthxmotorsports.com




dbx II
Noise Reduction System
BASS
EQUALIZER
LEVEL
OFF-VOL.
Push FADER
CONCORD
HPL-130
DOLBY SYSTEM
TUNING
Push SCAN
TREBLE
TONE
AUX
TAPE
ST
STD
NR
LD
MT
BL
DX
FM
TUN
40 80 120 Hz
Quartz
Digital
AM
FM
ME
BASS EQ. FREQ.

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HERTZ

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SYSTEM HI energy

HSK 165 250 Watt

Technical Specifications

Component		2 way system
Size mm	HV 165 woofer HT 25 tweeter	165 (6"1/2) 25 (1")
Power Handling	W peak W continuous	250 125
Impedance	Ω	4
Frequency response	Hz	50 ÷ 22k
Sensitivity	dB/SPL	92
Crossover included	LO/HI-pass	3.2 kHz @ 12/12 dB OCT.
Component adjustment	Tweeter	-2; 0; +2
Outer Ø mm	Woofer Tweeter	167 44
Mounting Ø mm	Woofer Tweeter	146 41
Total depth mm	Woofer Tweeter	79 26
Mount. depth mm	Woofer Tweeter	69 15
Magnet size mm	Woofer Tweeter	85 24,5
Weight of one component kg	Woofer Tweeter	1,13 0,06
Voice coil Ø mm	Woofer Tweeter	30 25

HV 165 Electro-Acoustic Parameters

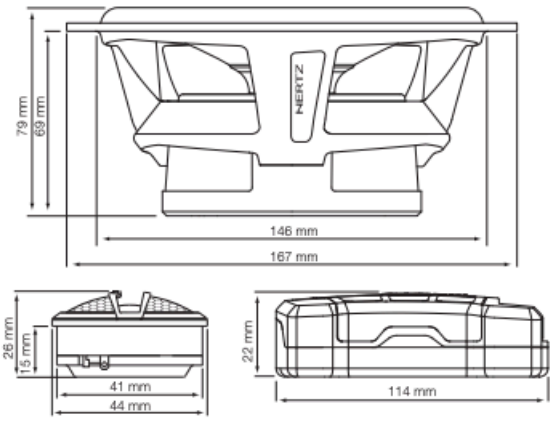
D	mm	130
Xmax	mm	3
Re	Ω	3,0
Fs	Hz	70
Le	mH@1kHz	0,40
Le	mH@10kHz	0,23
Vas	l	8,00
Mms	g	13,5
Cms	mm/N	0,32
BL	T-m	6,00
Qts		0,60
Qes		0,65
Qms		10,00
Spl (1m/2,83V)	dB	92

Tweeter:

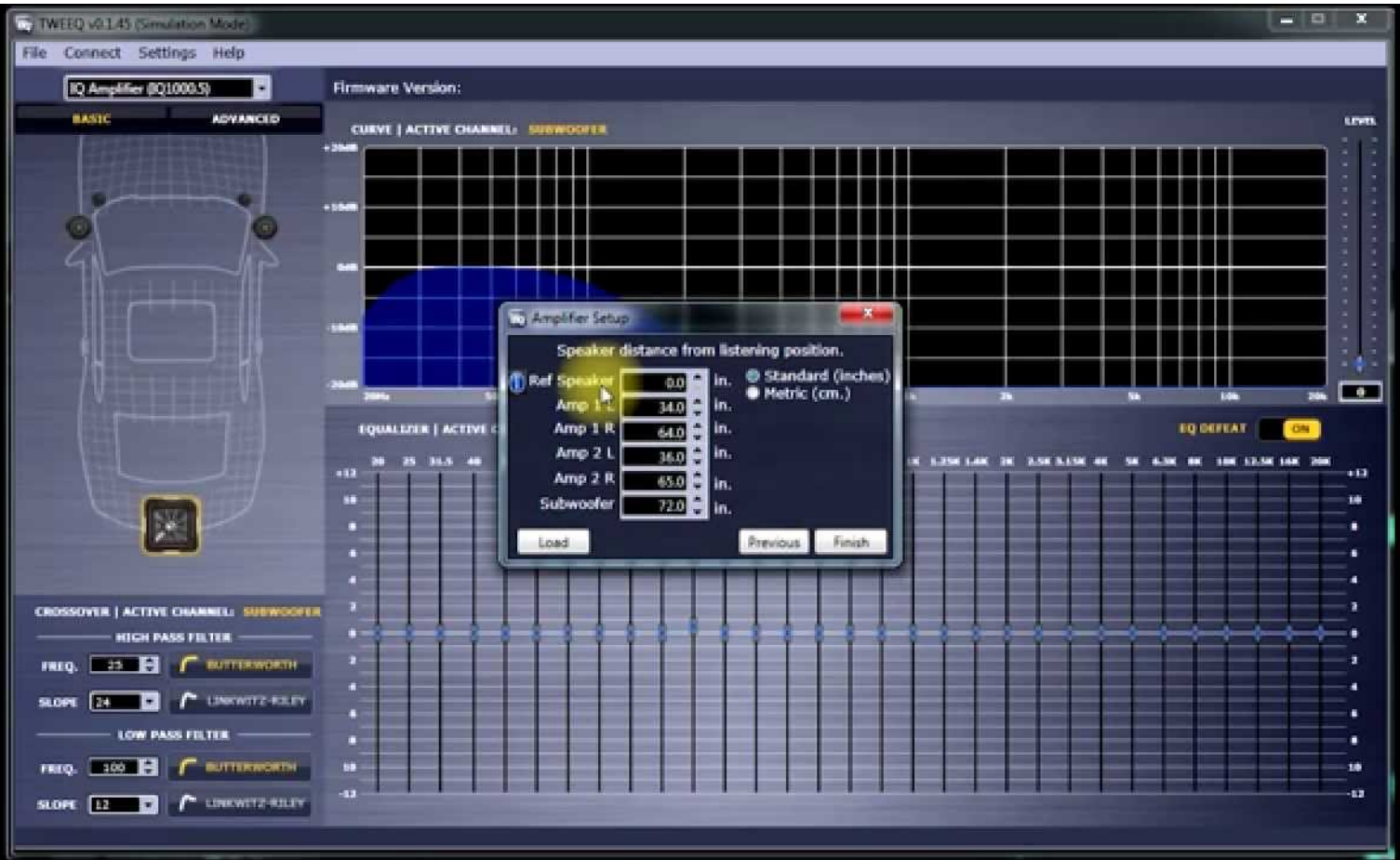
1 Tetolon® soft dome tweeter.
2 25mm ø, ferrofluid-cooled mobile voice coil.
3 High energy Neodymium magnet.
4 Rear acoustic chamber.
5 Revolving support and accessories for factory location and flush mounting.
6 Very flexible, high current input cable.

Woofer:

1 Soft iron plates for high heat dissipation, part of the symmetrical magnetic flux motor.
2 Over-sized magnet; provides outstanding energy for maximum control.
3 Pure copper voice coil wound on a KSV former; for excellent thermal and mechanical capability.
4 Vented bottom plate; improves linearity and thermal dissipation.
5 Damped Mesh Fibre Cone; for extended bandwidth and smooth response.
6 V-cone®; for the best off-axis dispersion and mid-high frequency detail.
7 Anti-vibration rubber magnet cover; damps spurious vibrations.
8 Aerodynamic die-cast aluminium basket; eliminating rear wave reflections.
9 Radial Venting System; for efficient thermal management.
10 Loss-less Polymer Rubber Surround; for long throw and maximum damping.
11 Grille included.



The Kicker IQ1000.5 amplifier is a very sophisticated audiophile grade product with 5 channels, each with their own programmable cross-over frequencies and slopes, 30 band EQ per channel, individual time delays, and more – the TweEQ iphone app (https://apps.apple.com/us/app/tweeq/id1001591656) and Android app can be used to program the amplifier but I have found that it is much more reliable to plug a USB cable directly into the amplifier and use the Kicker Tweeq app (found here: https://www.kicker.com/tweeq) to edit on a larger screen with a mouse or trackpad. The audio system has been professionally calibrated for flat frequency response and that configuration file can be found here: (www.dereks pratt.com/Misc/GTI_Kicker_TweEQ_Config.CFG)




KICKER
IQ
INTERFACE


POWER


GAIN
BOOST
C.FREQ.
B.WIDTH
IQ


KICKER

All electrical/electronic lines from the front dashboard to the rear of the car run inside the frame rails on the passenger side of the chassis as follows:

- 4/0 +V battery cable to the starter and front electrical fuse/relay panels
- Remote amplifier 'power on' signal from the Concord HPL-130 head unit
- +V battery voltage sense line to the ECU
- Battery current monitoring circuit signal to the ECU
- Concord HPL-130 head unit antenna coax cable
- Remote camera video cable
- Concord HPL-130 stereo RCA level output cable to the power amplifier
- Power amplifier remote control cable to the dash module (sub-woofer parameters and hands-free mic)
- Rear lights wiring harness: turn signals, brakes, backup, license plate and side running lights, rear hatch courtesy light
- Nitrous fluid line from the bottle to the engine
- Nitrous bottle heater line

There are also additional speaker output cables and the cooling fan cable running separately down the centre of the chassis thru to the front console under the carpet.

The audio system is very advanced, with the amplifier providing a 30 band EQ for each channel plus an active cross-over for the sub, mid-woofers and tweeters. The Hertz speakers are audiophile quality with the tweeters mounted in the dash and the woofers custom mounted in the doors – completely hidden behind the car cards with small perforated holes in the cards. The 10" carbon-fiber Rockford-Fosgate sub-woofer provides tight, powerful bass. The system has been accurately calibrated so that it has a completely flat frequency response from 20-20,000Hz.

My choice for a head end unit was to re-source my original GTI's Concord HPL-130 cassette deck which was the top unit back in 1982-1983 and I was lucky enough to locate a NOS unit from the original Los Angeles Concord dealer – it doesn't do anything other than look pretty mounted in the dash but it does remotely turn on the power amplifier, allowing a smart-phone to connect via Bluetooth for audio streaming purposes – the cassette deck can be played but it simply doesn't sound a good as a digital streaming source.

Spare parts & tools included with the Ultimate 83 GTI

Bentley VW Mk1, Mk2 and Mk3 manuals (engine block is Mk3, head and transmission is Mk2)

Engine related: spare timing belt; timing belt tension adjusting wrench; K&N filter cleaner and oil; ARP 83.5mm piston installation tool; piston knocker tool; longer set of AT-Power ITB 60mm trumpets (will improve mid-range power at the expense of top-end power); Denso IK22 spark plugs (nitrous use); misc cylinder head valve/valve-spring/seal installation tools/shims

Cooling system: EWP-80 water pump; electric water pump wiring harness to externally power pump for testing purposes

Fuel system: fuel ump, spare paper and metal mesh filters; filter housing o-rings; -6AN fitting aluminum crush washers; and -6AN and -8AN hose end plugs

Oiling system: -8/-10/-12AN fitting aluminum crash washers

Transmission: inner CV joint socket wrench installation tool; inner CV gaskets; street stage 3 pressure plate; street stage 3 clutch; flywheel; clutch alignment/installation tools; spare shifter gear lever; Shift rod bushing/bracket; various access covers; OEM 16V 5th gearset, 29mm allen wrench

Brakes: 2 sets of high quality UK made 10.1" front rotors (needs machining to 10.0"); set of Hawk front street performance brake pads (slightly used)/anti-sqeek compounds; rear axle nuts, covers and misc h/w;

Wheels: spare wheel nuts, wheel nut/lock tool; low profile aluminum jack stands with rubber lift surfaces; OEM wheel nut covers;

Exhaust: spare copper nuts and mounting h/w, rubber hangers; Vibrant Stainless Steel Resonator & flex pipe (catalyst replacement)

Suspension: KW compression/rebound adjustment tools/kit, KW 342/285 lbs-in spring set (track oriented); Front strut upper bearing assembly socket tool;

A/C: spare access caps; R134a refrigerant

Exterior/Paint: paint chip touch-up kit; silver base coat spray cans; silver base coat partial gallon can; black plastic paint, red accent plastic paint, GTI lower stripe kit; waist molding; plastic/lexan 'glass' cleaner; Spare 'flat' driver side mirror (convex mirror is installed now); windshield 19mm surround molding; spare grill mounting h/w; spare front fender screws; set of aluminum low profile jack stands with rubber lift points; rust preventative spray; deluxe car cover

Interior: midnight blue plastic paint; many spare fasteners, bushings, screws, pins, clips, covers; rear shock covers; rear entrance hand support loops; seat track covers; rear seat rests; misc seat assembly and mounting h/w; spare rear tray hangers

Electrical/computer: ECU spare input/output wiring pins; spare wireless battery disconnect remote control fob; ECU USB to PC cable; dash touch screen pointer; LiFePO4 10A battery charger with software controlled disconnect module; spare LED bulbs (interior/exterior); 3 spare alternator belts of different lengths for swapping in other alternators; EAA stainless steel alternator bracket; RCA inline ground isolator for analog audio (AM/FM, Cassette) noise filtering to trunk mounted amplifier

Ultimate 83 GTI Operation & Maintenance

Starting/stopping the engine:

Make sure the battery is not disconnected and that the key is inserted and turned to the 'on' position (it is not a starter any longer but simply a redundant ignition power switch)

Turn on the ignition power, wait until the dash boots up and sensor values are displayed

** If the engine has not be fired in more than a month, turn 'on' the kill switch, then press the starter and rotate the engine until the oil pressure starts to climb and you know there is oil in all of the important areas of the engine

With the kill switch in the 'off' position press the starter button and keep holding it until the engine is fully fired up – there are cases when the engine is warm where it may stumble a bit and stop running so holding it a bit longer than you might think is necessary. The ECU needs a few revolutions of the engine to sync the crank and cam sensors so it usually won't fire up for the first 2 seconds.

To stop the engine you can simply turn off the ignition power. If the engine is hot you have the option of using the kill switch to let the electric water pump and its controller keep circulating the coolant, and the ECU controlling the radiator fans for a few minutes of cool-down prior to powering down everything. The low speed radiator fan will run until the coolant temperature falls below 169 degrees F and if the engine is really warm the high speed fan will likewise run until the temp is below 179 degrees F (at the outlet to the engine).

The rear-view mirror has 2 camera inputs: front (defaults 'on' when powering up the car – simply press the button for 1s to kill it), and rear – only active when in reverse.

Engine:

The engine has just been completely rebuilt with all new bearings, seals, gaskets, rings, valve springs, etc – the only longer term maintenance you need to perform will be replacing the HD VR6 valve springs and seals every 3 years (or less if you are driving the car a lot and subjecting it to a lot of high rpm use). This is not a mileage issue but simply age as the springs are a critical component of the 288 solid lifter race cams and will get soft over time. Techtonics carries replacement springs (see parts list in appendix). When you replace the springs check the solid lifter gaps and adjust as may be necessary. Since pulling the head is basically required to complete this step you will have the opportunity to change to the Mk3 head gasket if you want to slightly reduce the compression ratio. You could also swap in a set of milder cams as well at that time if you wanted to.

You should change the cam sprocket bolt out when you change springs (or sooner if you want maximum reliability for high revving engine operation) as that is a known weakness area in the timing belt system. The crank sprocket bolt is now a high strength ARP/ESC Tuning M16 fastener (p/n ARP06A01/2794733) and adding a higher strength reusable ARP M10x1.25x30 fastener on the top end would complete the upgrade (ARP bolt p/n 673-1003 and VW washer p/n 027 109 143). Torque to 55-ft-lbs with red locktite.

Fuel System:

** Premium/high octane fuel is required for this car – I also recommend adding quality octane boost to each tank of fuel (92-94 octane + boost) for best engine performance. It can run without octane boost but monitor the knock sensor and if you see it engaging to pull back the timing you are already risking damage to the engine so back off on the throttle and keep the rpms up until you get better gas in the tank and/or octane boost added. Swapping in a Mk3 head gasket for the Mk4 gasket that is currently installed will reduce compression from 11.5 to 11.0:1 and will also reduce the need for high octane fuel.

** When filling the tank with fuel, ease off on the trigger as you get towards the top of the tank, limiting the flow rate to ½ or less of the max the pump will go – this will avoid dumping fuel on the ground as the fuel will quickly fill the neck and reach the overflow outlet.

** I have found that California vapour recovery nozzles don't go very far into the fuel filler neck and you need to really press the nozzle firmly into the neck to avoid pouring fuel into the overflow outlet which is just below the flapper.

Every once in a while the fuel level float in the tank gets stuck momentarily – resulting in a frozen reading on the gauge (this doesn't happen too often). After some acceleration and/or braking the float will unstick.

The float tops out when the tank is about 80% full and 20% level – meaning that the gauge (any Mk1 Golf, not just mine) cannot tell you what the fuel level is above 80% or below 20% is, so I have programmed the gauge to read 100% when it is 80% of higher, and 0% if at 20% or lower.

The fuel filters are under the car at the back where the fuel pump is located – don't attempt to service them unless you have close to an empty tank or you will be pouring fuel all over yourself when you disconnect the fuel lines – I have supplied fuel line plugs for this servicing work to limit the amount of fuel that will spill out but it makes life easier when you start the job with a low fuel level. Spare filters are provided but don't likely need replacing for at least another year – you can run the metal mesh intake filter and clean it or use disposable paper elements. These filters are from Kinsler are $$$.

Brakes:

The level of brake servo vacuum is adjustable in 5 increments using the potentiometer on the console – more vacuum makes the brake pedal softer so when driving aggressively you might want a firmer pedal (like I do).

When washing the car before long term storage, if you are fussy like I am you can remove the wheels, wipe the moisture off the brake rotors and then apply a light coat of rust preventative spray (provided) – same for any other exposed metal parts that may start to rust during storage

The Tech-53/Wilwood calipers are as big as you can get for this application but they are a bit too close to the edge of the 10.1" rotors for my liking and can bind – especially if you are racing and the rotors are going to expand when over 1000 degrees F. I want to see a min 0.1" gap between the outside edge of the rotor and the inside of the caliper so I have been machining my rotors to 10.0" outside diameter (taking 0.050" off the outside edge) to provide for this additional safety tolerance.

If you mount slicks you will want to swap to the original KW springs and also run DTC-60 race brake pads and find a way to route brake cooling ducts to keep the rotors and pads cool and then you will be blown away by the capabilities of this car on the track.

You should flush the brake fluid in 2020 and again every 2 years and replace with fresh Castrol SRF racing fluid – it is very long lasting and high performing but $$$. You will need to unbolt the rear calipers and flip them upside down to bleed the rear lines.

Oil System:

Use Joey Gibbs DT40 or equivalent SAE 5-40 full synthetic oil and replace every 3,000 miles or every 2 years. This is $$$ oil but well worth it.

The oil filter uses race spec quick-connect AN fittings (like most other Ultimate 83 GTI engine related hoses) and will leak if not used in conjunction with aluminum AN bushings/sleeves which take up any minor surface variations in the AN fittings – these are fragile and must be handled with care when removing and re-installing the filter. AN fittings in general are a bit tricky to get 'started' when threading them on – the trick is to have the fittings perfectly aligned and lightly greased or oiled when trying to get them started – the lubricant keeps the aluminum surfaces from binding as torque is applied. Manufacturers have slightly different fitting tolerances so sometimes the fittings are hard to get started and may leak slightly if the aluminum bushings/sleeves are not added. The new owner will be supplied with spare sets in various AN sizes).

Cooling System:

Use 50% antifreeze and 50% distilled water and should be replaced every 2 years – there is a drain cock under the engine block water pump housing – and when refilling there is an air release cock on the top driver side of the radiator that should be opened to release air. Fill the reservoir until you are about 3" below the cap – leave room for thermal expansion.

Steering/Suspension:

** Don't attempt to turn the wheels when stationary – move forward or backwards a small amount while turning the wheel – this will keep the stress off the rack and pinion and u-joints in the steering column with the high-ratio gearing involved

** There are a few road surface conditions on the highway when at speeds above 70mph/120kmh where a bit of steering wheel vibration may set in (it has only happened to me once). Just slow down a bit until the road surface improves – this is a natural artifact of having the pinion gear pressure set for optimum 'feel' vs 'slack' – if it is too tight the feel on center will be impaired so a tiny amount of 'slack' is required with these old-school fully mechanical steering systems (they are also a real joy to experience).

The KW coilovers are set to 2 clicks from full soft compression/rebound on the front, and 1 click on the rears. Do not set to 0 clicks. 1 click from full soft on the front is great for rougher streets when you are not in the mood for performance driving. >3 clicks is getting quite firm – but required if you swap in the 342/285lbs-in KW springs for track use.

Air Conditioning:

The electric compressor produces 3000BTUs of cooling, which pulls about 25A of current from the battery/alternator. It is enough to make a real difference in the comfort on a hot day but is not the same level of cooling as in a modern car – but by avoiding a full belt driven system I saved 70+lbs of weight on the front end of the car.

When you turn on the A/C it will take 2-3 minutes for the system to cool down and work fully. Setting the blower speed to 'low' is usually quite effective – the blower speed can be fine tuned with the console potentiometer. The A/C potentiometer is not currently programmed for use – use the dash touch screen A/C controls to monitor and set the speed of the system. On a 90 degree F day the air temperatures can be lowered as much as 15+ degrees F.

If you need to remove the A/C compressor for any reason (removing the transmission requires at least flipping it out of the way but you risk damaging the delicate A/C fittings

which are epoxied onto the compressor inlet/outlet tubes so simply removing the compressor is recommended) you will have to recharge the system with old-school R134a refrigerant after pulling a vacuum on the system for at least 10 minutes – the low side pressure should be set to 22.5psi when the compressor is running full speed and the air temperature is 85-90 degrees F – if it is cooler, set the pressure lower – e.g. 18psi at 70 degrees F. If you add too much fluid it will reduce the efficiency of this small scale A/C system which needs less pressure than a typical automotive system to operate at peak efficiency …

Seat heaters:

There are infinitely adjustable for your comfort on a cold winter day …

Nitrous System:

The system is enabled in the ECU software and via the control panel – there are many settings to be considered – full 'on' / 'off' or pulse width modulated for variable power levels – by RPM or speed, or what-ever you desire. I have found that nitrous is over-kill for this car as it can't be used without spinning the tires until 3rd gear and even then the car jumps around if the road isn't perfectly smooth and flat – it is a very fast car already but if you want to experience a really white-knuckle ride, mount a nitrous tank in the rear, purge the line and hit the bottle ….

A 2-3 second 60hp hit goes a long way (15hp jets are currently installed in each injector line). You can carefully screw down the solenoid plunger and reduce the flow rate too – I recommend starting with a 30hp setting – call me and chat about this before heading down this route though as there is a lot of complexity involved in getting the nitrous system to work well and not damage the engine – it has seen no nitrous use since its complete rebuild (or high rpm use for that matter – just a proper break-in period) and the piston ring gaps have been set for normally aspirated use only – a big hit of nitrous may cause piston expansion and cylinder wall scoring.

Hood operation:

Pull interior hood latch; then simultaneously press both hood pins; then release the latch; then place the hood support rod in the center of the hood at the latch to keep from twisting the carbon fiber hood. When lowering the hood place your hand directly above the latch and press down firmly but not violently – check that both hood pins are latched – if not, press on each one to secure.

Hatch operation:

Open normally – if removing the rear tray straps be careful not to force them on/off the plastic posts that are mounted to the carbon fiber hatch as you risk tearing them out of the carbon fiber. When closing the hatch, lower down and then place one hand on the latch mechanism and the other directly above it on the carbon fiber and press firmly down – the hatch flexes somewhat due to pressure from the rubber seals and won't close/seal up unless a fair amount of force is applied – but don't 'slam' the hatch down.

There is a hidden switch above the sub-woofer that enables/disables the light for the cargo area – I leave it off most of the time as I leave the hatch open for long periods when charging, etc.

Audio System:

The system power is controlled by the Concord headend unit – turn on the power by turning the volume control clockwise. Note, the cassette and AM/FM analog audio RCA inputs to the power amplifier are currently disconnected as there is a small amount of static noise that is transmitted when Bluetooth streaming is not active – there is no input selector switch, rather, when streaming audio is detected the analog audio input is disabled.

The radio and cassette deck work but in the modern age it really only makes sense to stream from your phone over Bluetooth. The initial pairing of your phone will require access to the blue-tooth module in the wheel well under the lexan cover – first flip the rear seats forward, then pull the carpet forward, then the mass-loaded vinyl, then unscrew the nut that holds the lexan down, then find the little module and press and hold the pairing button for a few seconds to clear prior pairing, then press once to initiate new pairing mode.

Overall volume is controlled by your phone while sub-woofer volume is controlled by the IQ module which is mounted under the dash.

The cellular handsfree works but if you are driving there is too much engine noise to allow people to hear you well enough – the microphone is hidden near the sub-woofer level control knob.

Cleaning:

** Do not apply wax to any of the rubber or plastic parts or you will bleach them

** The rear hatch window is Lexan – do not use harsh chemicals on it, only soap or plastic cleaner (supplied) – first spray with soap and water and then lightly wipe with a soft cloth to avoid scratching it

The rear plastic fender flares will get chips from road debris from the front tires – they are coated with satin black plastidip and can be refinished annually – remove them (after removing the wheels), fill any chips with flexible body filler, lightly sand with 320 grit paper, wipe down the while fender with alcohol to remove oils, then spray with multiple light coats of plastidip, let dry for 24 hours, wipe down with plastic protector, and then re-install (inspect wheel well areas for any paint chips and/or rust and address with galvanizing compound, also coat screw holes with this compound before re-installing screws and do not over tighten).

The bumpers and mirrors will also look better if given regular wipe-downs with plastic protector too.

** Do not attempt to twist the side mirrors as they have been secured in place with black windshield adhesive to keep them from shaking – the 40 year old internal springs no longer function well enough.

Lifting:

Align lift points with welded platform lift points front and rear when using a commercial 4 point lift – do not use frame rails unless lift point is within 6” of the welded platforms

When lifting one side of the car up to mount on jack stands, lift point should be 6” inside from welded platforms such that the car can be lowered front and rear onto jack stands that have been carefully positioned to align with welded platforms

** Do not attempt to lift at any other points on the car

** Always use rubber pads between the lift and the car body

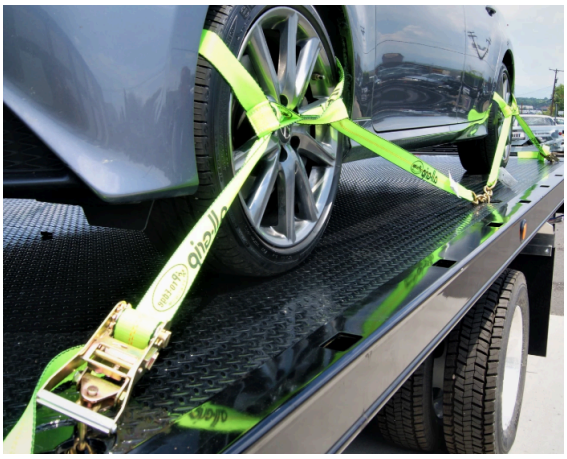
Towing:

** Do not apply force to the front or rear carbon fiber bumpers – they are quite strong with 1x2” aluminum rectangular tubing cores but can be bent or broken if used to push or pull the car around. Do not attempt to push the front of the car by touching the carbon fiber hood or fenders as you will damage them. Do not attempt to push the rear

of the car by touching the carbon fiber hatch either. Open the doors and push/pull using the door frames only.

When loading the car onto a trailer it is best to have a low mounted winch on the trailer that attaches to the lower front control arm cross brace, or attach a Y strap to each rear shock mounting point at the rear trailing twist beam ends – being careful to not have the straps applying pressure to any of the bodywork. If you need to pull from a high mounted winch use a Y strap and attach to the top of the front strut towers where the brace ends are.

The OEM bumper tow/tie-down lugs are not present on this car. At the front, use the lower control arms to attach any tie-down straps if required to be attached to the body, and use the shock mounting points at the rear trailing twist beam ends. The preferred method of securing this car on a trailer is using wheel straps:



Wheels & Tires:

** Always check to make sure that ball seat to conical washers are in place when mounting the OEM VW snowflake wheels onto the studs before threading on the conical nuts

** Always re-install 5mm front wheel spacers to avoid binding when using 14x6 OEM snowflake wheels, rear 3mm spacers are optional

Set to 30psi front and 28psi rear tire pressures

Use a torque wrench and set wheel nuts to 90ft-lbs torque.

Occasionally apply a small amount of silicon grease to studs and give front axle ends a light spray of WD-40 to keep them rust free

Battery:

When the battery voltage on the dash indicates 13.8V or higher the battery is fully charged. If you are operating the electronics with the engine off for an extended period of time and the indicated voltage is below 13.2V you may want to top up the charge with the supplied charger – see below.

When storing the vehicle for more than 1 week use the remote battery disconnect to shut off any parasitic battery drain – it can then be stored safely for several months without maintenance or charging.

The supplied 10A LiFePO4 charger does not disconnect once the voltage reaches 14.5V which can be damaging to the LiFePO4 battery if left in that high float voltage condition for extended periods of time. I have designed a module that sits between the charger and the battery and operates in 2 modes: maintain battery voltage between 13.4-14.0V for times when you want to work on the electronics without the engine on and keep the battery within the normal operating range; and fully charge the battery to 14.5V and then disconnect and do not attempt recharging until the battery voltage falls below 13.2V (blue light on when in this mode) – this is the charging mode I would select if charging the battery once every 3 months or so. The battery voltage display on the module reads high by about 0.4V when charging at the full 10A level due to line voltage drop between the charger and the battery – it reads accurately when not charging though. Make sure that the battery not disconnected when attempting to charge or nothing will happen.

When driving the car, it is possible to overly discharge the battery if a lot of electrical accessories are all turned on when the A/C is also running – it is tricky to operate the A/C for extended periods unless you avoid using the stereo system and keep the fan at the lowest speed setting. An alternator upgrade from 50A to 75A would solve this problem. Unless the alternator is swapped out to for a larger/heavier unit, watch the dash battery current gauge.

Weight savings:

The car has been converted to a comfortable, quiet street car with added sound isolation elements and comforts. To get back down to 1850lbs you need to strip out some of those items: unbolt the sub-woofer enclosure, remove the OEM seats and replace with Sparco race seats, remove the rear carpet and mass-loaded vinyl underlay, remove the A/C system, remove the catalytic converter, air box and air filter, and change to race wheels and tires. Add in DTC-60 brake pads and brake ducts and hit the track and tear the place up …

Various Specs:

Valve springs should test out at >95lbs closed/>220lbs open @ 0.5”, replace after 3 years regardless of use or pressures though

Fluidampr M8 bolts (only use grade 12.9): 7ft-lbs +90 degrees, locktite red

ARP Pressure Plate bolts: no washers, lubricate under bolt heads, locktite red on threads, 60ft-lbs - reusable

ARP Head studs: use ARP thread lubricant; progressively increase torque to 80ft-lbs using Bentley manual cross-tightening pattern, use Mk3 head gasket for 11.0:1 compression ratio, or use Mk4 gasket for 11.5:1 - reusable

ARP rod bolts: 55ft-lbs - reusable

ARP/Integrated Engineering crank sprocket bolt: 13/16” 12pt drive socket, 78ft-lbs with Loctite red + ¼ turn (if possible) - reusable

See Bentley manuals for all other torque settings

Note ARP rod bolts are also used, plus a special ARP integrated engineering crank sprocket bolt

** Every 6 months go through the entire car and check all fasteners for loosening – get the car up on a hoist to do this properly (safety issue!!!)

** Wash and re-oil K&N air filter every 5,000kms or when-ever you change the oil

Other matters to familiarize yourself with before driving or servicing

Engine:

ITBs are race oriented intake systems and are generally designed for maximum power at high rpm during racing, not street use, so they are not normally seen on street cars. The Ultimate 83 GTI engine uses them to produce as much power as possible but also compensates with sophisticated ECU programming which tames them somewhat. 16V engines are high revving and are well suited to ITBs but in combination with each other they tend to exaggerate the high rpm nature of an engine and make the throttle quite sensitive, especially at higher rpms where power production is higher. You have to develop a level of respect for the 16V/ITB engine combination and learn to be gentle with your throttle input above 4000rpm to avoid jerky acceleration when feathering the throttle.

Cooling System:

The electric water pump and controller works extremely well but there is a corner case during the winter when the system can't bypass the radiator as OEM designs allow for – the way the system works is to slow down and even pulse the water pump on/off/on when coolant temperatures are low but if you are driving when it is very cold outside the radiator will be extremely cold and therefore cold water will be entering the engine which creates a form of thermal shock when the engine itself is at operating temperature. I recommend blocking off the radiator the way truckers do in the winter to keep radiator temperatures up somewhat. If you see the outlet temperature of the radiator staying below 120 degrees F when the engine is warmed up and you are driving around you need to think about slipping a plastic sheet in front of the radiator – better yet, leave the GTI in a warm garage and don't drive it in the winter.

Exhaust System:

It took a lot of ECU tuning to get the engine to not produce a lot of hydrocarbons at idle so that the catalytic converter doesn't overheat. Long duration racing cams with lots of intake/exhaust valve overlap don't generally idle well and don't allow the engine to operate at high efficiency at low rpms so they can easily kill catalytic converters by causing them to overheat.

There is a way around this by tuning the engine at idle to a much higher 'indicated' air-fuel ratio than normal (16.5:1 vs 14.5:1) – it turns out that racing cams suck intake air right through into the exhaust system at idle making the indicated A/F ratio read higher than actually experienced during combustion – so the ECU is tuned to 16.5:1 at idle, 14.5:1 at part throttle, and 13.2:1 at WOT. And the timing is pulled back at idle relative to where you might want to see it for maximum idle stability as retarded timing at idle is

another way to tame race cams for emissions purposes – but it makes the engine more sensitive to idle instability – it is a very delicate tuning 'dance' to get the parameters right so that the catalytic converter works properly without overheating or the smell of rotten eggs being present. But beware of leaving the engine idling when it is hot for more than 5 minutes as the catalyst temperature will continue to climb – if you get stuck in traffic this might become an issue so if you are bumper to bumper for long periods, pull over and let the engine cool down.

You will also note that when you are decelerating the fuel flow is cut-off – this allows the catalytic converter to cool down rapidly as it blows cold air thru the exhaust and it saves on fuel too. So don't be alarmed when you see the A/F ratio jump to 35:1 when decelerating.

I have the ECU self-tuning feedback sensitively tuned quite low to help tame the idle but it does make the ECU react a bit slower than I would like to other A/F corrections that it sometimes needs to make – the new owner can play with these settings at will).

At some paint remove the catalytic converter and air intake box/filter and experience the full performance potential of this engine and car – it is certainly louder but it delivers stunning levels of acceleration in 2nd and 3rd gear between 4500 and 8000rpm – reprogram the ECU for a higher rpm limiter (currently set to 7500rpm).

Transmission:

** After the latest rebuild by Ken at German Auto Transaxle (GTA) in Bend, OR, the 2nd gear synchro has not worked as well as it should – if you rev match the gears the shift into 2nd is fine but if you are trying to shift when the engine is above the ideal rpm point (power shifting) the synchro/gears will grind. I have spoken to GTA and they will swap in another synchro the next time the transmission and/or clutch needs servicing at their cost. I have not addressed this as I am selling the car and the new owner may want changes to the clutch (see issue below), the 5th gear ratio, or the final drive ratio to suit their needs which will require the transmission to be pulled out as well.

The California stage 5 clutch has impressive holding power but it is a bit too 'grabby' for my tastes for street use. I had previously used their stage 3 clutch which sometimes slipped when hot on the race track but was fine for street driving needs – it would engage smoothly at any rpm in comparison to the stage 5 clutch which needs the rpms to be kept above 2200rpm when engaging and needs a smooth/slow engagement action to avoid pulsing of the clutch springs. But if the new owner is OK with this clutch it offers high holding power, especially if nitrous will be experimented with.

The basic procedure for pulling the transmission is as follows: remove the air filter and tubing; remove the air box; remove the ITB air horns; disconnect and remove the A/C compressor; use an allen socket head wrench to remove the 3 bolts that attach the

compressor base plate to the chassis horn (one of the bolts is hard to reach under the plate; disconnect the shifter linkage and completely remove the curved bracket which attaches to the transmission and the transmission mount at the rear; disconnect the exhaust system after the catalytic converter to let the system have some ability to move lower – no need to remove the exhaust header; disconnect the speedo cable and reverse switch cable; remove the front motor mount – it may be impossible to pull it out as things are very crowded in that area under the ITBs but you can simply leave it lose; remove the oil to coolant oil line at the bottom and move the line out of the way (let the line drain into a container); install the engine/transmission support cross-bar and lift up the engine slightly; remove the transmission side mount completely – again it is a tight fit trying to get the 2 bolts out but it is possible – just be patient; remove the axles – it is best to disconnect the struts from the spindle so you can pull the spindle away from the axles to help get them out of the car, supporting the spindle with a rope or a jack stand under it – you may have to use a chisel to tap on the inner CV joints to get them to separate from the transmission flanges – and you may also find an air hammer wrench useful for loosening the large axle nuts; after this point you can start to lower the transmission end until it clear the chassis, then unbolt the transmission and carefully pull it away from the engine. Then you can swap in a different PP and clutch and get the 2nd gear syncro serviced by Ken at GTA. It takes me 4 hours to do all of the above. Don't forget to use the higher required torque setting on the reusable ARP PP to crank bolts plus Locktite red. Replace the flywheel bolts too. I would be happy to talk you thru this.

Air Conditioning:

The 50amp alternator is a bit undersized relative to the A/C system current requirements so it is important to not overtax the batteries with a continuous negative current drain on long trips so trade-offs need to be made regarding blower speed and the use of the audio system and other electrical circuits but it all works well and makes a big comfort difference on hot days.

Ideally a 75amp alternator should be swapped into the car if you are living in a hot area that requires continuous A/C use. Additional thought to swapping in a larger capacity compressor could also be given if more supply current from the alternator is available.

Interior:

The stock seat mounts don't hold the seats absolutely firmly in place – they have a little bit of play in them. I have locked out the slider mechanism for the passenger seat (this can be changed back to OEM operation if required) – leaving it in the full back position – this can be changed back to the OEM mechanism as desired. The driver seat retains the slider adjustment mechanism but I would have liked to have found a way to make the seat absolutely rigid.

If you ever need to remove the door cards, have someone help you as you pull off the cards from the door after removing the various screws – you need to be careful to ease out the wiring bundles that attached to the window switches – pull the panel away slowly, supporting it in the air, and reach in and help pull out the wires until the connectors are out of the metal hole, then unwrap the cloth tape and disconnect each of the 2 wire harnesses. When re-installing make sure the cables are routed inside the doors in such a way that the window will not come down and get caught on the cables.

Paint & Exterior:

6,000 miles of driving on the track and street have resulted in a few minor paint chips below the door sills where the tires throw road debris rearwards that have been touched up. There is also a repaired rock chip on the lower passenger door just above the stripes. The paint is otherwise almost perfect as the front, rear, hood, and complete driver side of the car has just be repainted & re-wet sanded to remove small wounds from use. A new windshield has also been installed.

Electrical & Computer Systems:

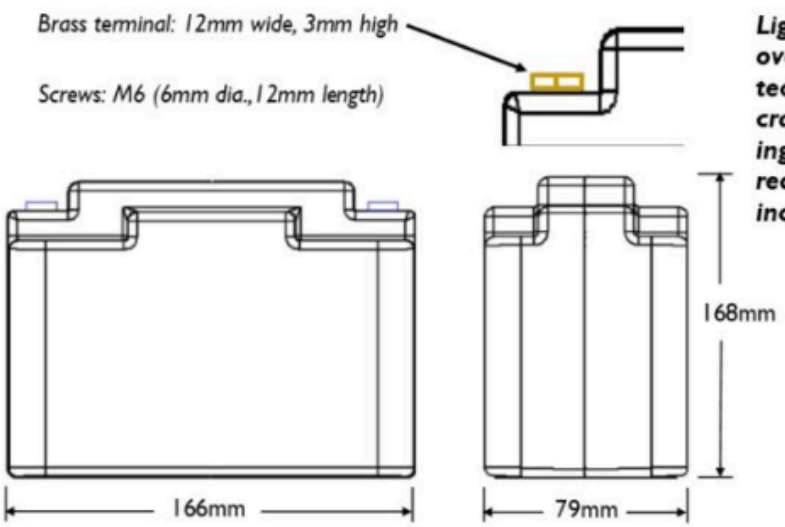
There is a lot to learn about the complex custom electrical system and ECU but there is also a lot of documentation to help you.

The easiest way to gain quick access to the fuse and relay panel is to remove the glove box (4 screws on the front and one under the dash on the left side – carefully pull it out, then reach in and disconnect the wiring harness, then remove and set aside. Then reach in and gently pull out the air duct and you will then have pretty good access to the panel below. For greater access you can remove 2 allen head bolts under the dash and the panel will swing down – just be careful with the fan on the right side which cools the ignition solenoid (it gets quite hot, therefore the need for the fan). It is a bit of a tight fit so be gentle/careful when lowering the panel and again when pushing it back up. I did not secure all of the wires because it is actually easier to make changes and find/route wires with them lose above the fuse panels. The fuse panels have labels printed on the chassis above.

Appendix A – Ultimate 83 GTI LiFePO4 Battery Specifications

ETX Series Lithium Batteries ETX1200

DIMENSIONS



Lightweight LiFePO4 battery with exclusive over discharge protection, over charge protection, short circuit protection, excessive cranking protection and built in cell balancing technology. All of these features are redundant with an LED battery fault light indicator.

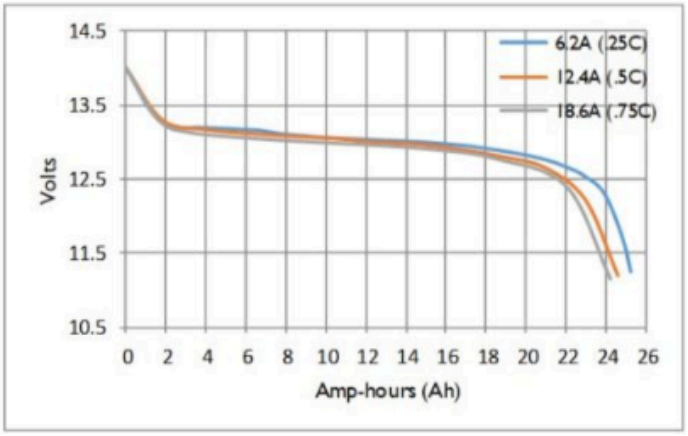
SPECIFICATIONS

Specifications

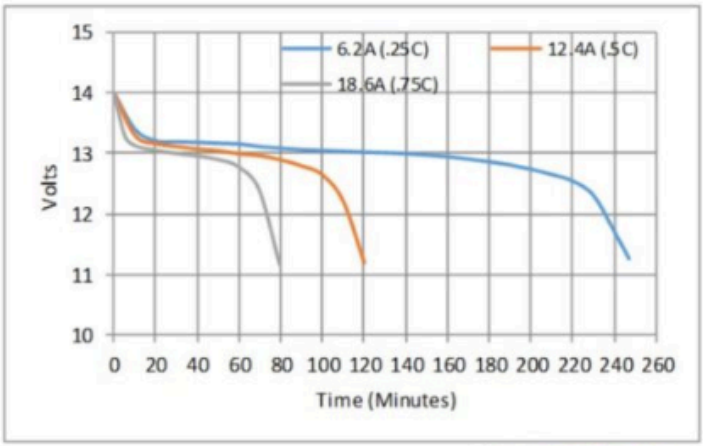
Voltage	13.2V
Capacity	24.8Ah (See charts)
Capacity vs Temperature	25 °C = 100% 0°C = 92% -30°C = 80%
Self-Discharge Rate	< 3% / month @ 25 °C
Pulse Crank Amps (PCA)	1200A (3 sec @ 25 °C, voltage >9V)
Cold Crank Amps (CCA)	600A (modified SAE test, 3 sec@ 0°F, volts >7.2V)
Continuous Discharge Amps	150A
Standard Charge Voltage	13.9 - 14.6 V
Maximum Charge Voltage	15V
Recommended Charge Amps	5 - 25A
Max Charge Amps	120A (from vehicle charging system)
Life (Charge cycles, 80% depth of discharge)	4000 cycles @ 1C discharge rate, 25°C 2000 cycles @10C discharge rate, 25°C
Life (Years)	8 Years
Weight	6.9 lb. (3.1Kg)
Dimensions	6.5 in (L) x 3.1 in (W) x 6.6 in (H) 166mm(L) x 79mm (W) x 168mm (H)
Environmental Rating (resistance to water intrusion)	IP 66 (wash down with a high pressure washer)
Operating Temperature	-30 °C to +60 °C
Storage Temperature	-40 °C to +70 °C

Discharge Characteristics

Discharge Ah (multiple discharge rates)



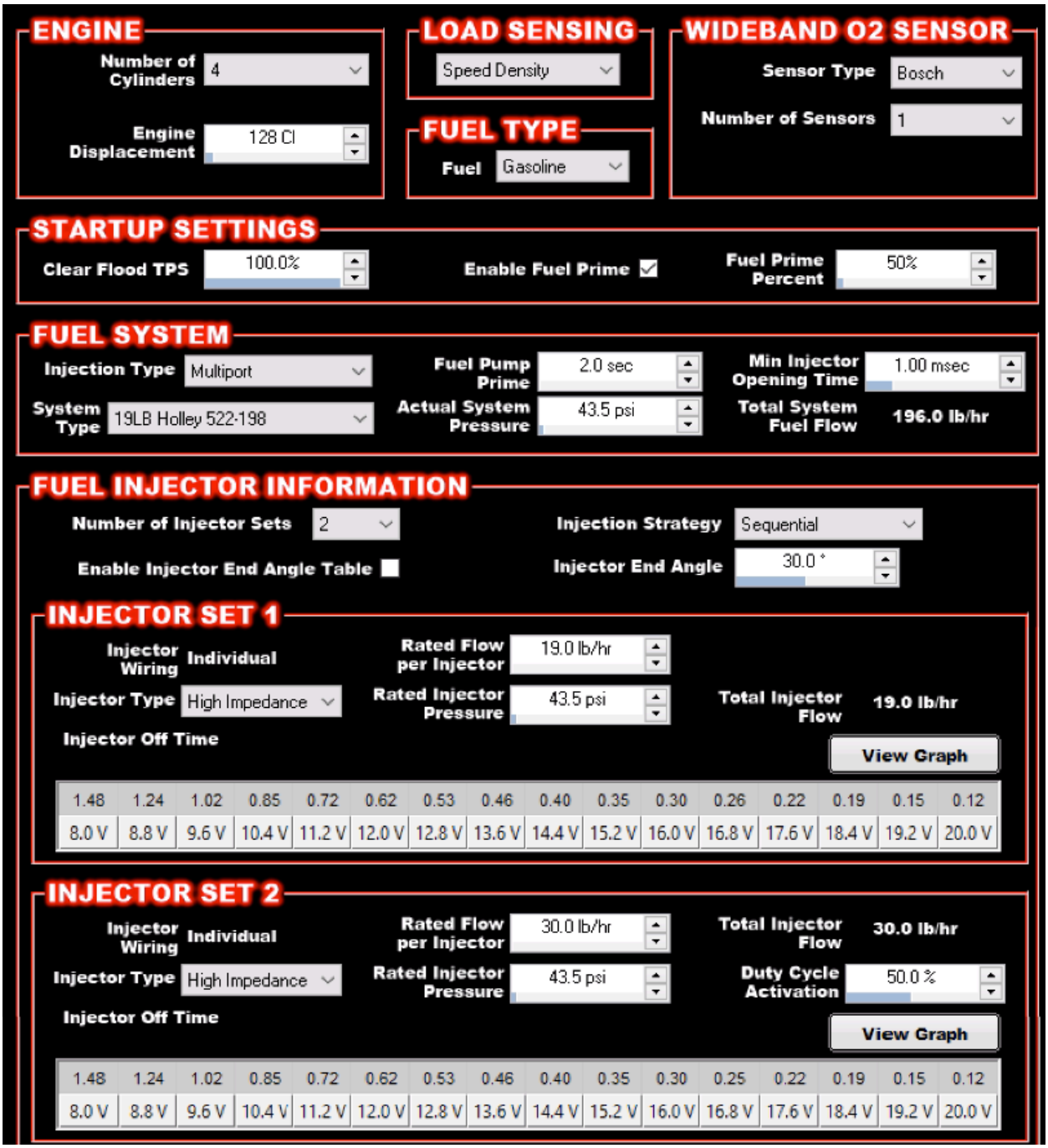
Discharge Minutes (multiple discharge rates)



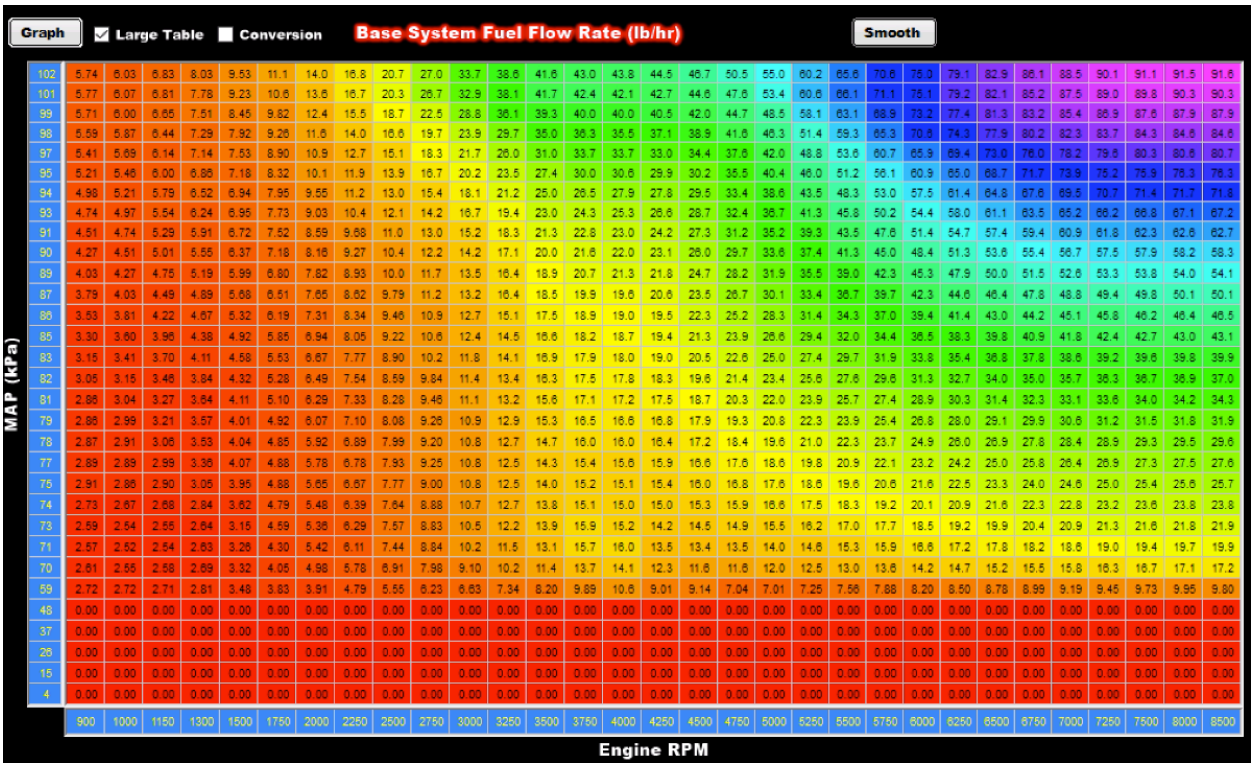
earthX charge your ride

Appendix B – Ultimate 83 GTI Holley ECU Programming Screenshots

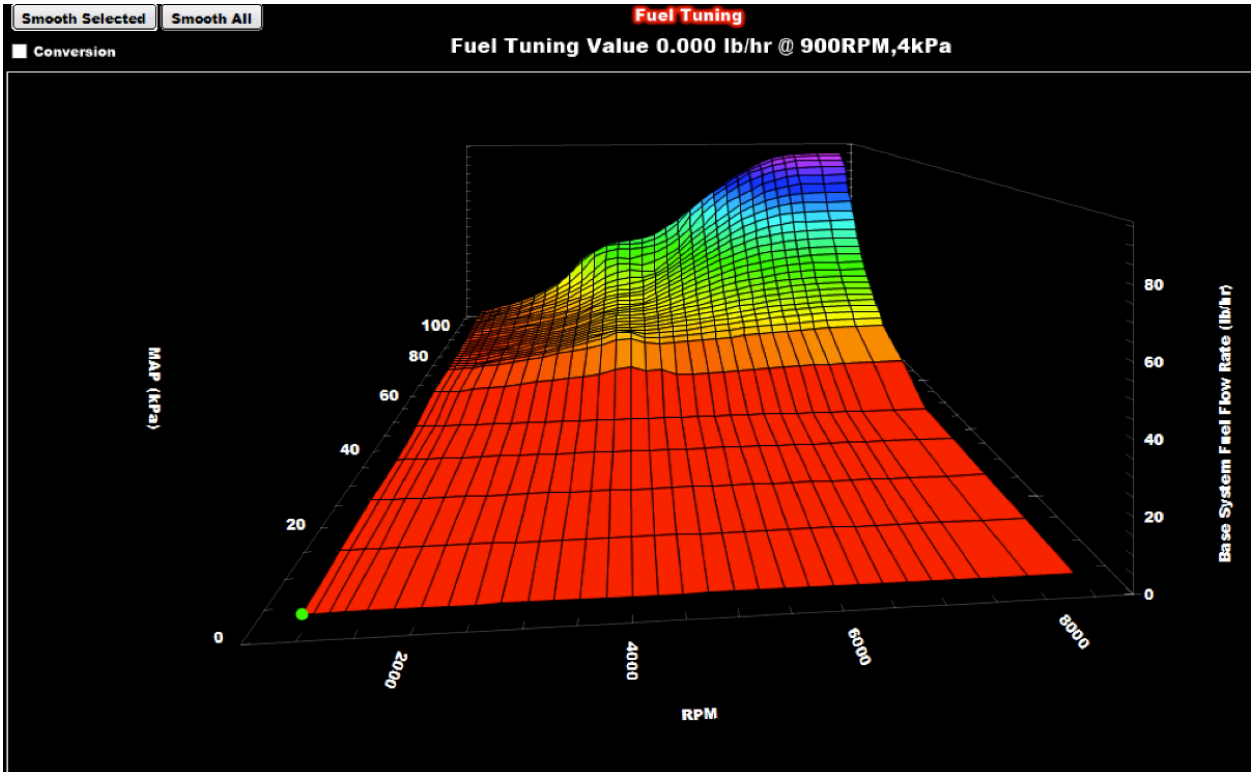
Main Config page …



Fuel tables for Catalytic Converter & Air box/filter use …



MAP (kPa)	900	1000	1150	1300	1500	1750	2000	2250	2500	2750	3000	3250	3500	3750	4000	4250	4500	4750	5000	5250	5500	5750	6000	6250	6500	6750	7000	7250	7500	8000	8500
102	5.74	6.03	6.83	8.03	9.53	11.1	14.0	16.8	20.7	27.0	33.7	38.6	41.6	43.0	43.8	44.5	46.7	50.5	55.0	60.2	65.6	70.6	75.0	79.1	82.9	86.1	88.5	90.1	91.1	91.5	91.6
101	5.77	6.07	6.81	7.78	9.23	10.6	13.6	16.7	20.3	26.7	32.9	38.1	41.7	42.4	42.1	42.7	44.6	47.6	53.4	60.6	66.1	71.1	75.1	79.2	82.1	85.2	87.5	89.0	89.8	90.3	90.3
99	5.71	6.00	6.65	7.51	8.45	9.82	12.4	15.5	18.7	22.5	28.8	36.1	39.3	40.0	40.0	40.5	42.0	44.7	48.5	53.1	63.1	68.9	73.2	77.4	81.3	83.2	85.4	86.9	87.6	87.9	87.9
98	5.59	5.87	6.44	7.29	7.92	9.26	11.6	14.0	16.6	19.7	23.9	29.7	35.0	36.3	35.5	37.1	38.9	41.6	46.3	51.4	59.3	65.3	70.8	74.3	77.9	80.2	82.3	83.7	84.3	84.6	84.6
97	5.41	5.69	6.14	7.14	7.53	8.90	10.9	12.7	15.1	18.3	21.7	26.0	31.0	33.7	33.7	33.0	34.4	37.6	42.0	48.8	53.6	60.7	65.9	69.4	73.0	76.0	78.2	79.6	80.3	80.6	80.7
95	5.21	5.46	6.00	6.66	7.18	8.32	10.1	11.9	13.9	16.7	20.2	23.5	27.4	30.0	30.6	29.9	30.2	35.5	40.4	46.0	51.2	56.1	60.9	65.0	68.7	71.7	73.9	75.2	75.9	76.3	76.3
94	4.98	5.21	5.79	6.52	6.94	7.95	9.55	11.2	13.0	15.4	18.1	21.2	25.0	26.5	27.9	27.8	29.5	33.4	38.6	43.5	48.3	53.0	57.5	61.4	64.8	67.6	69.5	70.7	71.4	71.7	71.8
93	4.74	4.97	5.54	6.24	6.95	7.73	9.03	10.4	12.1	14.2	16.7	19.4	23.0	24.3	25.3	26.6	28.7	32.4	36.7	41.3	45.8	50.2	54.4	58.0	61.1	63.5	65.2	66.2	66.8	67.1	67.2
91	4.51	4.74	5.29	5.91	6.72	7.52	8.59	9.88	11.0	13.0	15.2	18.3	21.3	22.8	23.0	24.2	27.3	31.2	35.2	39.3	43.5	47.6	51.4	54.7	57.4	59.4	60.9	61.8	62.3	62.6	62.7
90	4.27	4.51	5.01	5.55	6.37	7.18	8.16	9.27	10.4	12.2	14.2	17.1	20.0	21.6	22.0	23.1	26.0	29.7	33.6	37.4	41.3	45.0	48.4	51.3	53.6	55.4	56.7	57.5	57.9	58.2	58.3
89	4.03	4.27	4.75	5.19	5.99	6.80	7.82	8.93	10.0	11.7	13.5	16.4	18.9	20.7	21.3	21.8	24.7	28.2	31.9	35.5	39.0	42.3	45.3	47.9	50.0	51.5	52.6	53.3	53.8	54.0	54.1
87	3.79	4.03	4.49	4.89	5.66	6.51	7.65	8.62	9.79	11.2	13.2	16.4	18.5	19.9	19.6	20.6	23.5	26.7	30.1	33.4	36.7	39.7	42.3	44.6	46.4	47.8	48.8	49.4	49.8	50.1	50.1
86	3.53	3.81	4.22	4.67	5.32	6.19	7.31	8.34	9.46	10.9	12.7	15.1	17.5	18.9	19.0	19.5	22.3	25.2	28.3	31.4	34.3	37.0	39.4	41.4	43.0	44.2	45.1	45.8	46.2	46.4	46.5
85	3.30	3.60	3.96	4.38	4.92	5.85	6.94	8.05	9.22	10.6	12.4	14.5	16.6	18.2	18.7	19.4	21.3	23.9	26.6	29.4	32.0	34.4	36.5	38.3	39.8	40.9	41.8	42.4	42.7	43.0	43.1
83	3.15	3.41	3.70	4.11	4.58	5.53	6.67	7.77	8.90	10.2	11.8	14.1	16.9	17.9	18.0	19.0	20.5	22.6	25.0	27.4	29.7	31.9	33.8	35.4	36.8	37.8	38.6	39.2	39.6	39.8	39.9
82	3.05	3.15	3.46	3.84	4.32	5.28	6.49	7.54	8.59	9.84	11.4	13.4	16.3	17.5	17.8	18.3	19.6	21.4	23.4	25.6	27.6	29.6	31.3	32.7	34.0	35.0	35.7	36.3	36.7	36.9	37.0
81	2.86	3.04	3.27	3.64	4.11	5.10	6.29	7.33	8.28	9.46	11.1	13.2	15.6	17.1	17.2	17.5	18.7	20.3	22.0	23.9	25.7	27.4	28.9	30.3	31.4	32.3	33.1	33.6	34.0	34.2	34.3
79	2.86	2.99	3.21	3.57	4.01	4.92	6.07	7.10	8.08	9.26	10.9	12.9	15.3	16.5	16.6	16.8	17.9	19.3	20.8	22.3	23.9	25.4	26.8	28.0	29.1	29.9	30.6	31.2	31.5	31.8	31.9
78	2.87	2.91	3.06	3.53	4.04	4.85	5.92	6.89	7.99	9.20	10.8	12.7	14.7	16.0	16.0	16.4	17.2	18.4	19.6	21.0	22.3	23.7	24.9	26.0	26.9	27.8	28.4	28.9	29.3	29.5	29.6
77	2.89	2.89	2.99	3.36	4.07	4.88	5.78	6.78	7.93	9.25	10.8	12.5	14.3	15.4	15.6	15.9	16.6	17.6	18.6	19.8	20.9	22.1	23.2	24.2	25.0	25.8	26.4	26.9	27.3	27.5	27.6
75	2.91	2.86	2.90	3.05	3.95	4.88	5.65	6.67	7.77	9.00	10.8	12.5	14.0	15.2	15.1	15.4	16.0	16.8	17.6	18.6	19.6	20.6	21.6	22.5	23.3	24.0	24.6	25.0	25.4	25.6	25.7
74	2.73	2.67	2.68	2.84	3.62	4.79	5.48	6.39	7.64	8.88	10.7	12.7	13.8	15.1	15.0	15.0	15.3	15.9	16.6	17.5	18.3	19.2	20.1	20.9	21.6	22.3	22.8	23.2	23.6	23.8	23.8
73	2.59	2.54	2.55	2.64	3.15	4.59	5.38	6.29	7.57	8.83	10.5	12.2	13.9	15.9	15.2	14.2	14.5	14.9	15.5	16.2	17.0	17.7	18.5	19.2	19.9	20.4	20.9	21.3	21.6	21.8	21.9
71	2.57	2.52	2.54	2.63	3.26	4.30	5.42	6.11	7.44	8.84	10.2	11.5	13.1	15.7	16.0	13.5	13.4	13.5	14.0	14.6	15.3	15.9	16.6	17.2	17.8	18.2	18.6	19.0	19.4	19.7	19.9
70	2.61	2.55	2.58	2.69	3.32	4.05	4.98	5.78	6.91	7.98	9.10	10.2	11.4	13.7	14.1	12.3	11.6	11.6	12.0	12.5	13.0	13.6	14.2	14.7	15.2	15.5	15.8	16.3	16.7	17.1	17.2
59	2.72	2.72	2.71	2.81	3.48	3.83	3.91	4.79	5.55	6.23	6.63	7.34	8.20	9.89	10.6	9.01	9.14	7.04	7.01	7.25	7.56	7.88	8.20	8.50	8.78	8.99	9.19	9.45	9.73	9.95	9.80
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



One of the most important fuel tables – Target A/F to auto tune to …

Graph

Target Air/Fuel Ratio

Smooth

MAP (kPa)	900	1150	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8500
102	16.3	16.3	14.8	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
99	16.3	16.3	14.9	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
97	16.3	16.3	15.2	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.1
94	16.3	16.3	15.4	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
91	16.3	16.3	15.4	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
89	16.3	16.3	15.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
86	16.3	16.3	15.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
83	16.3	16.3	15.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
81	16.3	16.3	15.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
78	16.3	16.3	15.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
75	16.3	16.3	15.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
73	16.3	16.3	15.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
70	16.3	16.3	15.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
48	16.3	16.3	15.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
26	16.3	16.3	15.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
4	16.3	16.3	15.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7

Engine RPM

Setting the compensation limits to 'zero' to maintain complete fuel cut-off during deceleration …

Closed Loop Parameters | Learn Parameters

GENERAL

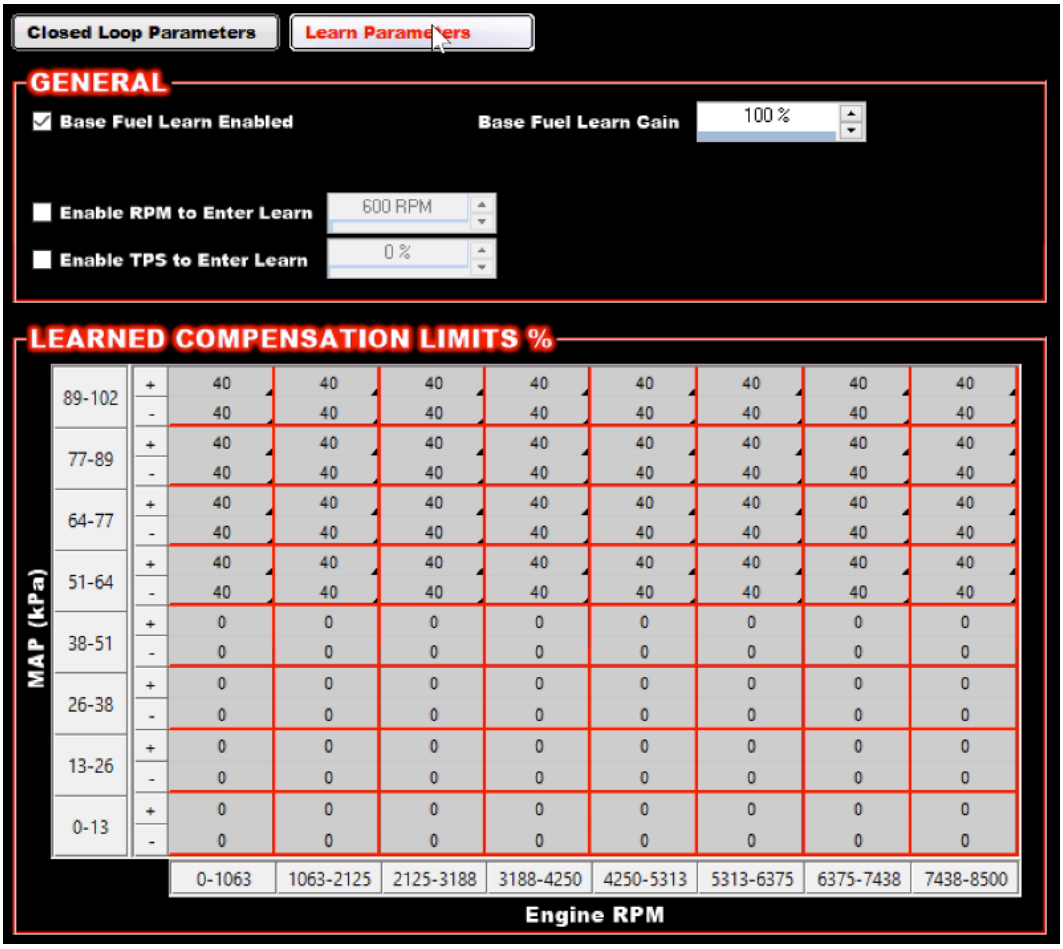
- ☑ Enable Closed Loop
- ☐ Enable Minimum Coolant Temp for Closed Loop — 120 °F
- ☐ Enable RPM to Enter Closed Loop — 1500 RPM
- ☐ Enable TPS to Enter Closed Loop — 0 %
- ☐ Enable TPS to Enter Open Loop — 0 %
- Advanced Control — 3

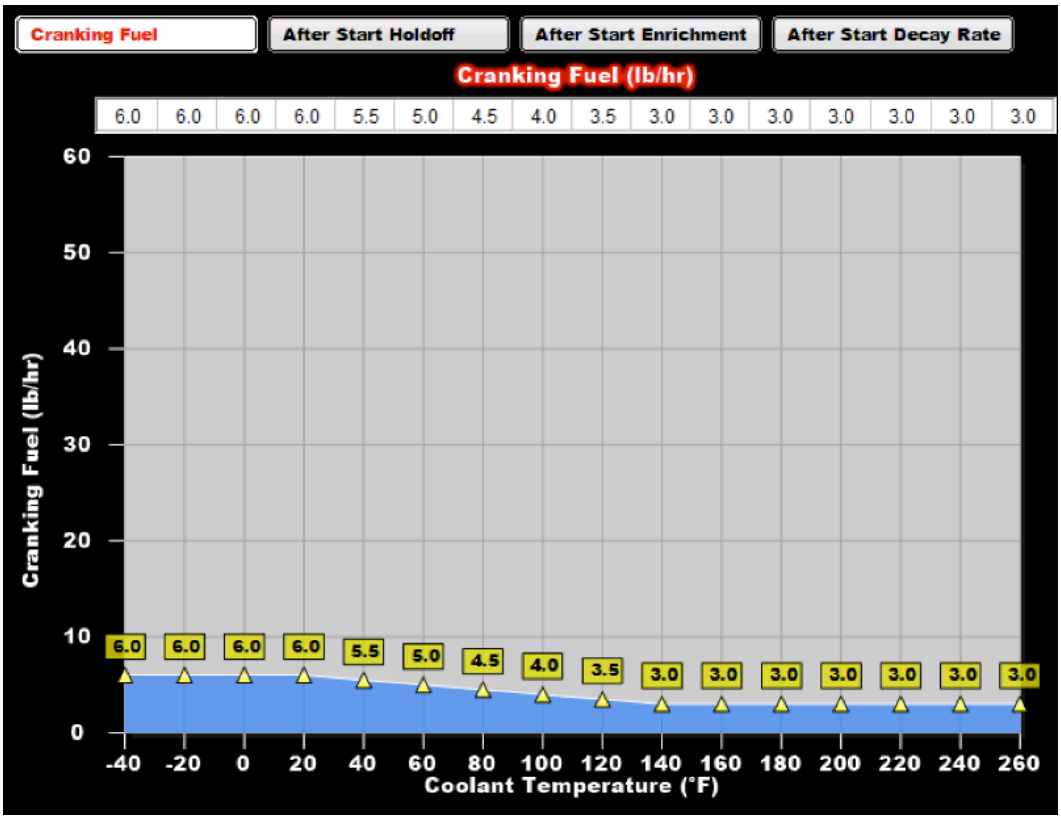
CLOSED LOOP COMPENSATION LIMITS %

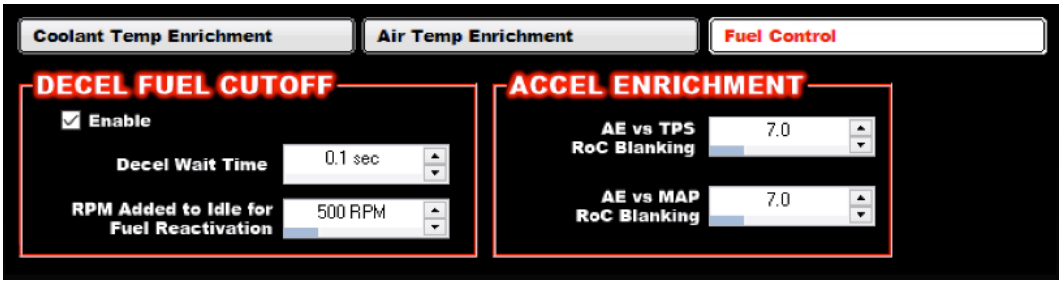
MAP (kPa)		0-1063	1063-2125	2125-3188	3188-4250	4250-5313	5313-6375	6375-7438	7438-8500
89-102	+	100	100	100	100	100	100	100	100
	-	100	100	100	100	100	100	100	100
77-89	+	100	100	100	100	100	100	100	100
	-	100	100	100	100	100	100	100	100
64-77	+	100	100	100	100	100	100	100	100
	-	100	100	100	100	100	100	100	100
51-64	+	100	100	100	100	100	100	100	100
	-	100	100	100	100	100	100	100	100
38-51	+	0	0	0	0	0	0	0	0
	-	0	0	0	0	0	0	0	0
26-38	+	0	0	0	0	0	0	0	0
	-	0	0	0	0	0	0	0	0
13-26	+	0	0	0	0	0	0	0	0
	-	0	0	0	0	0	0	0	0
0-13	+	0	0	0	0	0	0	0	0
	-	0	0	0	0	0	0	0	0

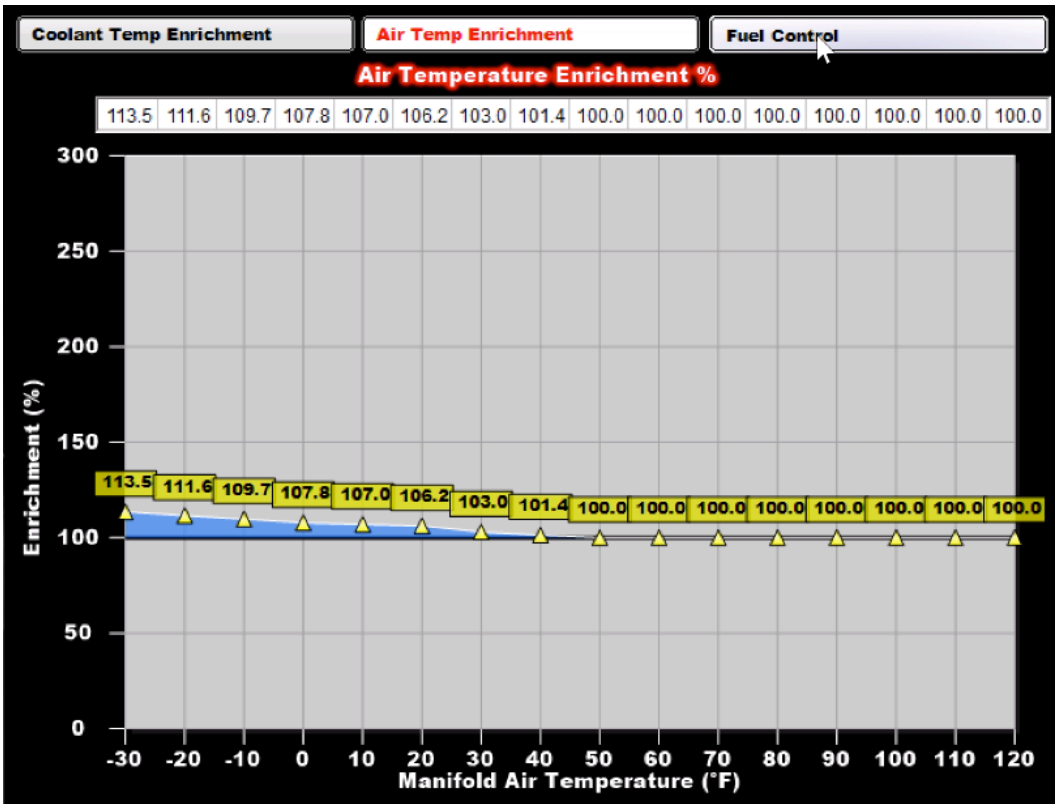
Engine RPM

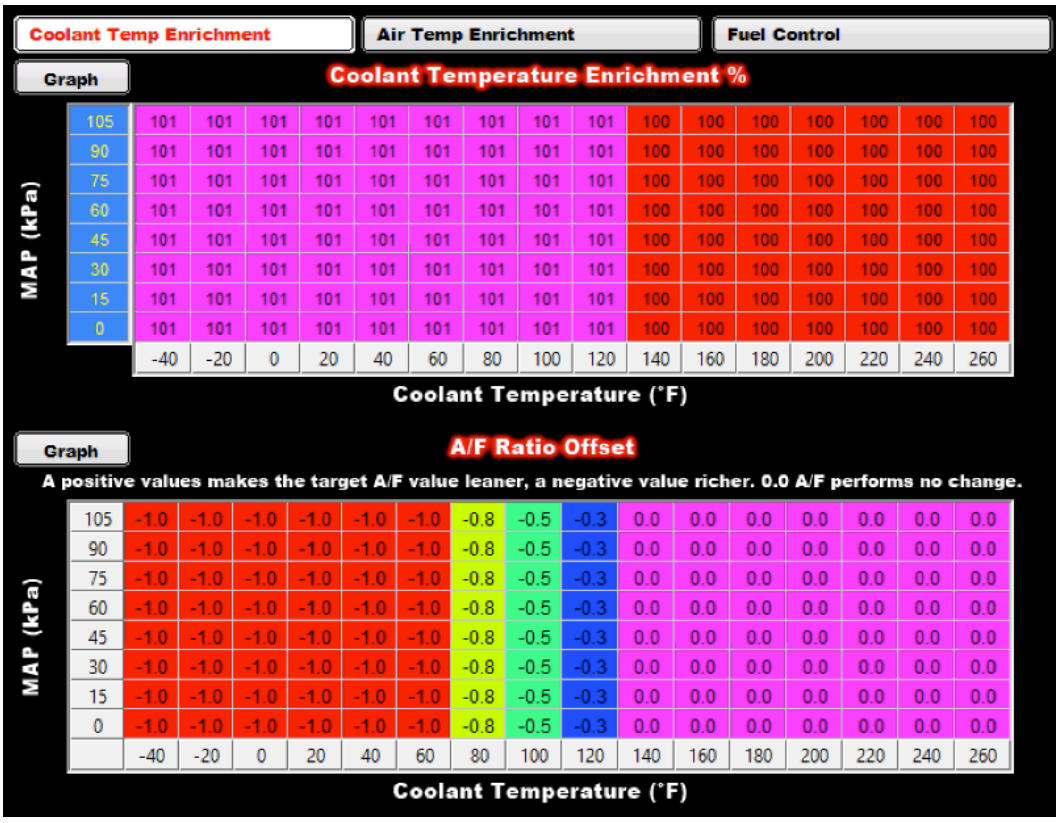
Setting related 'learning' delta – effectively limiting how much to 'learn' and alter the base fuel tables for any given session …

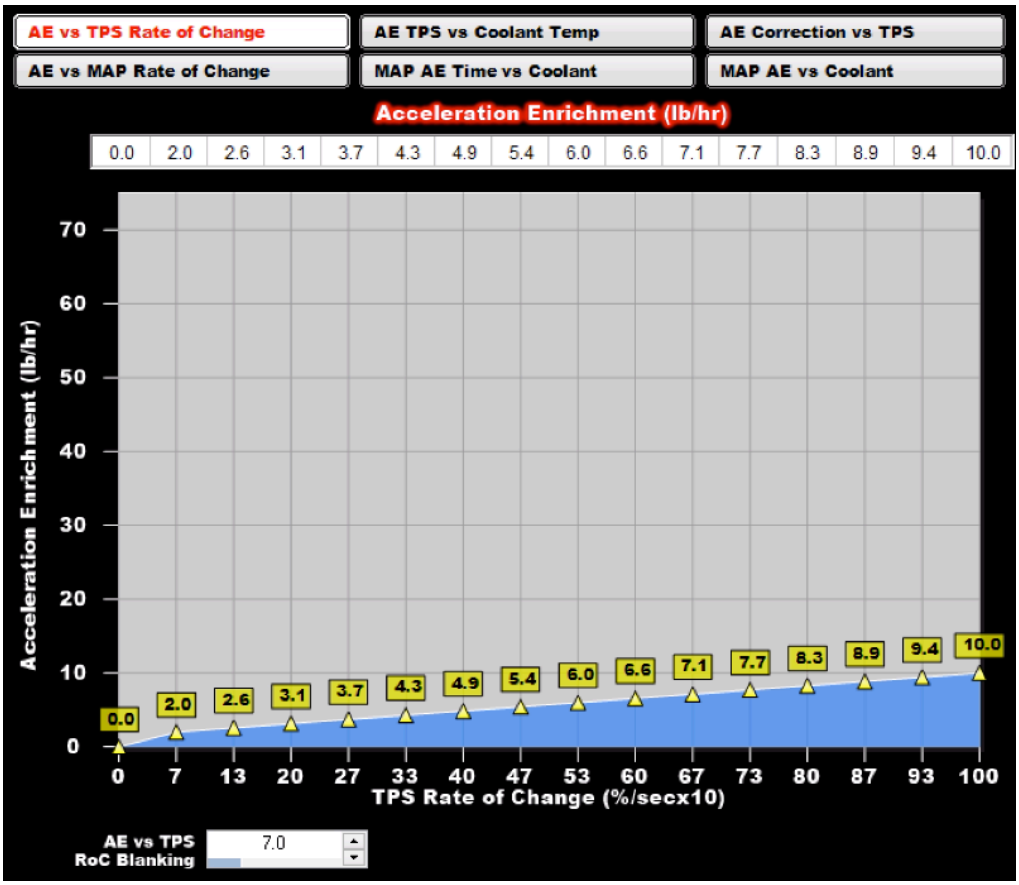

Closed Loop Parameters
Learn Parameters
GENERAL
Base Fuel Learn Enabled
Base Fuel Learn Gain
100 %
Enable RPM to Enter Learn
600 RPM
Enable TPS to Enter Learn
0 %
LEARNED COMPENSATION LIMITS %
MAP (kPa)
89-102
77-89
64-77
51-64
38-51
26-38
13-26
0-13
0-1063
1063-2125
2125-3188
3188-4250
4250-5313
5313-6375
6375-7438
7438-8500
Engine RPM

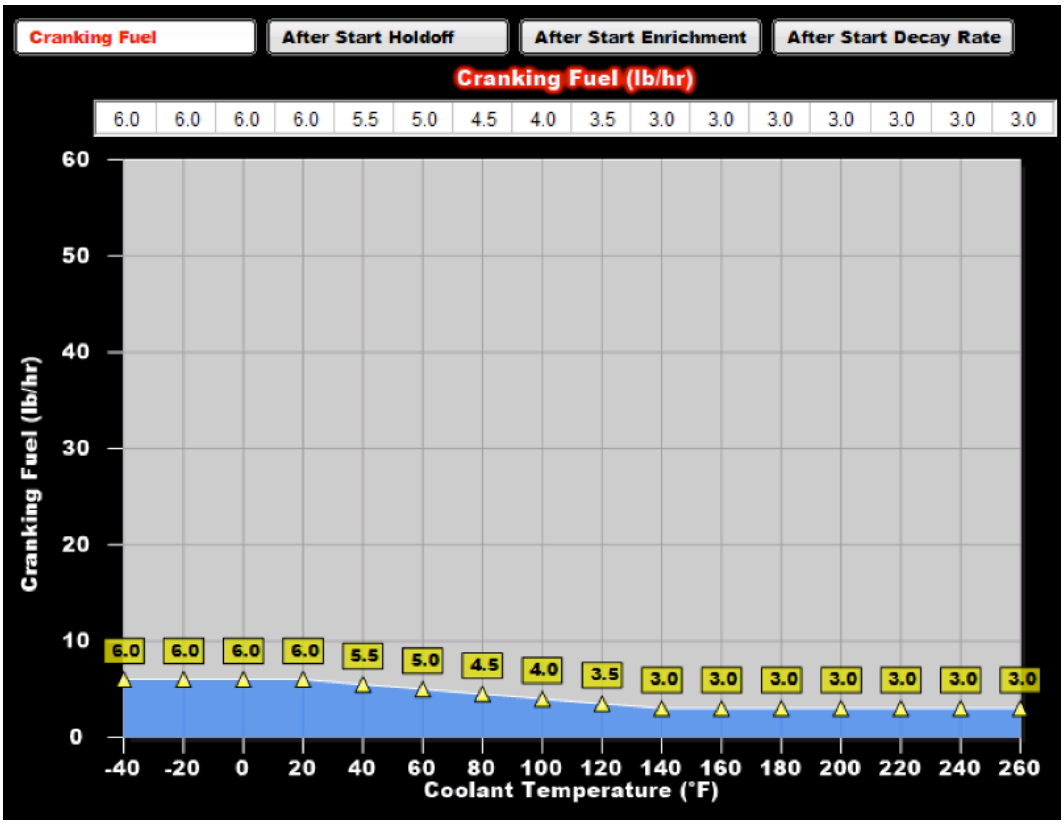

Cranking Fuel
After Start Holdoff
After Start Enrichment
After Start Decay Rate
Cranking Fuel (lb/hr)
6.0 6.0 6.0 6.0 5.5 5.0 4.5 4.0 3.5 3.0 3.0 3.0 3.0 3.0 3.0 3.0
60
50
40
30
20
10
0
Cranking Fuel (lb/hr)
-40 -20 0 20 40 60 80 100 120 140 160 180 200 220 240 260
Coolant Temperature (°F)

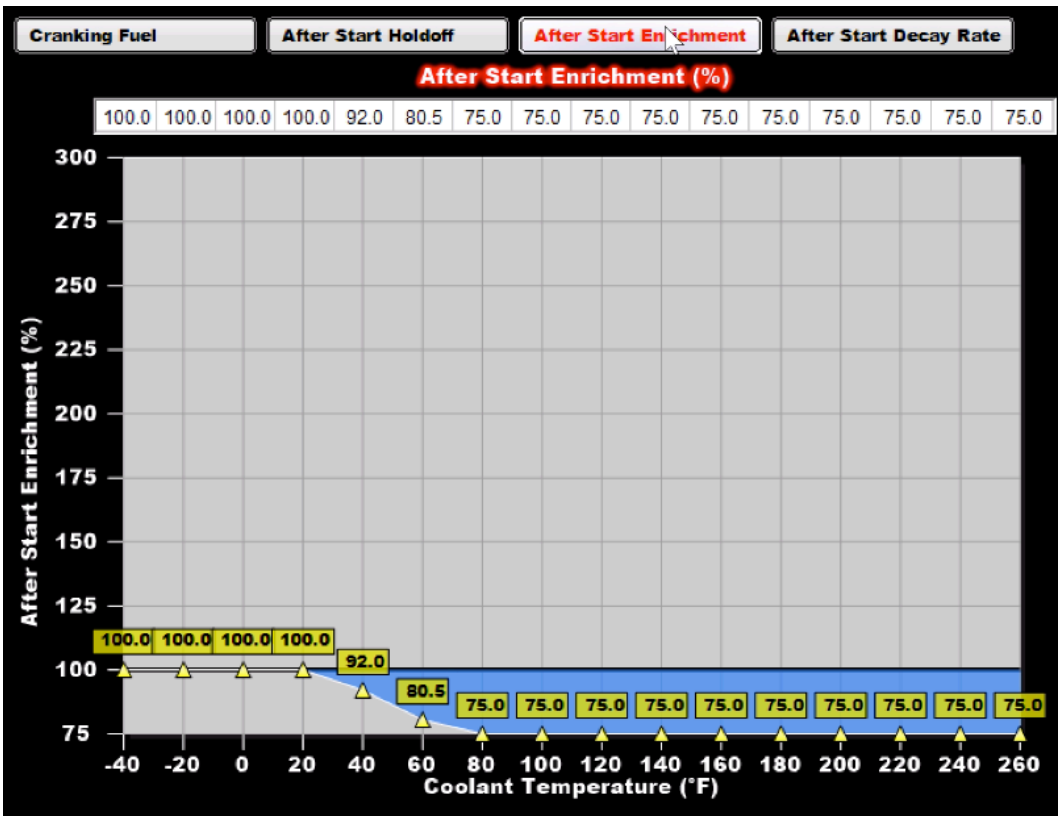

Coolant Temp Enrichment
Air Temp Enrichment
Fuel Control
DECEL FUEL CUTOFF
Enable
Decel Wait Time
0.1 sec
RPM Added to Idle for Fuel Reactivation
500 RPM
ACCEL ENRICHMENT
AE vs TPS RoC Blanking
7.0
AE vs MAP RoC Blanking
7.0

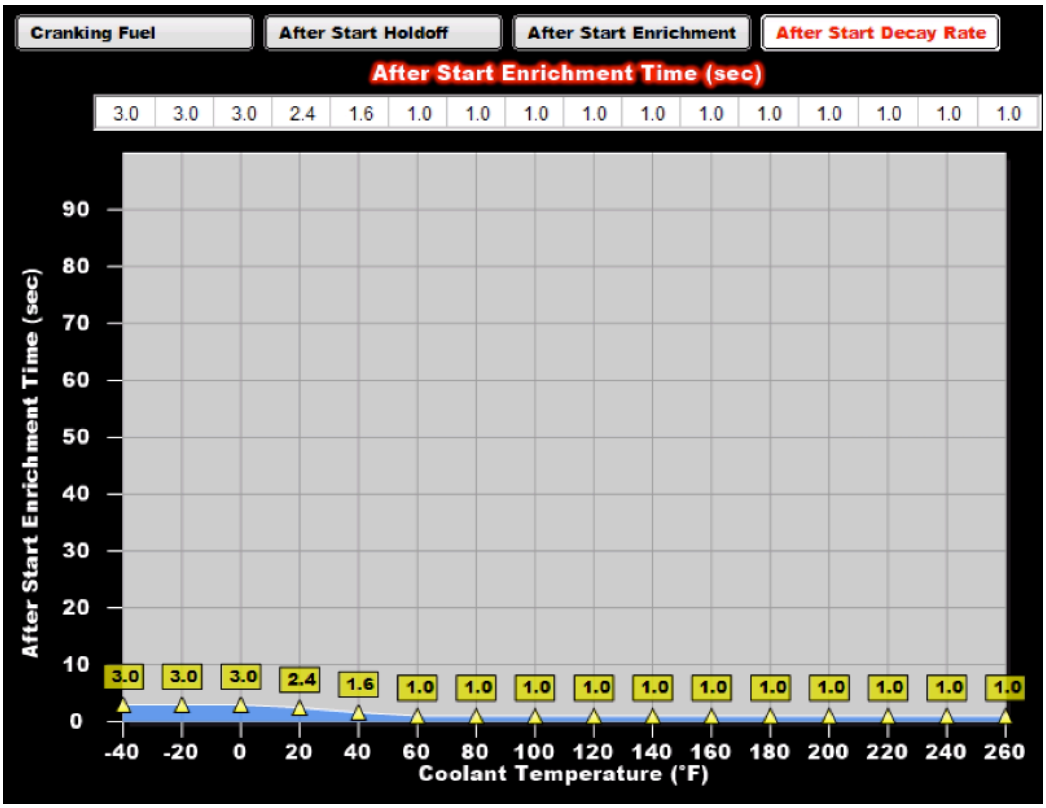

Coolant Temp Enrichment
Air Temp Enrichment
Fuel Control
Air Temperature Enrichment %
113.5 111.6 109.7 107.8 107.0 106.2 103.0 101.4 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0
300
250
200
150
100
50
0
Enrichment (%)
-30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120
Manifold Air Temperature (°F)


Coolant Temp Enrichment
Air Temp Enrichment
Fuel Control
Graph
Coolant Temperature Enrichment %
MAP (kPa)
105 101 101 101 101 101 101 101 101 101 100 100 100 100 100 100 100
90 101 101 101 101 101 101 101 101 101 100 100 100 100 100 100 100
75 101 101 101 101 101 101 101 101 101 100 100 100 100 100 100 100
60 101 101 101 101 101 101 101 101 101 100 100 100 100 100 100 100
45 101 101 101 101 101 101 101 101 101 100 100 100 100 100 100 100
30 101 101 101 101 101 101 101 101 101 100 100 100 100 100 100 100
15 101 101 101 101 101 101 101 101 101 100 100 100 100 100 100 100
0 101 101 101 101 101 101 101 101 101 100 100 100 100 100 100 100
-40 -20 0 20 40 60 80 100 120 140 160 180 200 220 240 260
Coolant Temperature (°F)
Graph
A/F Ratio Offset
A positive values makes the target A/F value leaner, a negative value richer. 0.0 A/F performs no change.
MAP (kPa)
105 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -0.8 -0.5 -0.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0
90 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -0.8 -0.5 -0.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0
75 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -0.8 -0.5 -0.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0
60 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -0.8 -0.5 -0.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0
45 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -0.8 -0.5 -0.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0
30 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -0.8 -0.5 -0.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0
15 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -0.8 -0.5 -0.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0 -1.0 -1.0 -1.0 -1.0 -1.0 -1.0 -0.8 -0.5 -0.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0
-40 -20 0 20 40 60 80 100 120 140 160 180 200 220 240 260
Coolant Temperature (°F)

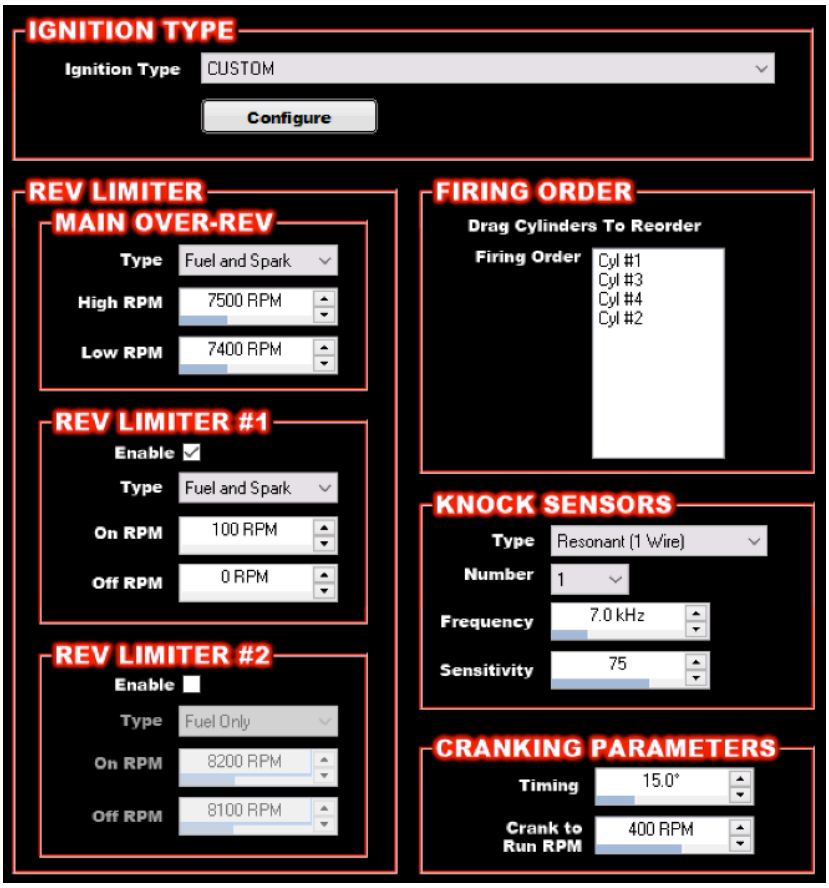

AE vs TPS Rate of Change
AE TPS vs Coolant Temp
AE Correction vs TPS
AE vs MAP Rate of Change
MAP AE Time vs Coolant
MAP AE vs Coolant
Acceleration Enrichment (lb/hr)
0.0 2.0 2.6 3.1 3.7 4.3 4.9 5.4 6.0 6.6 7.1 7.7 8.3 8.9 9.4 10.0
Acceleration Enrichment (lb/hr)
70
60
50
40
30
20
10
0
0.0 2.0 2.6 3.1 3.7 4.3 4.9 5.4 6.0 6.6 7.1 7.7 8.3 8.9 9.4 10.0
0 7 13 20 27 33 40 47 53 60 67 73 80 87 93 100
TPS Rate of Change (%/secx10)
AE vs TPS RoC Blanking
7.0

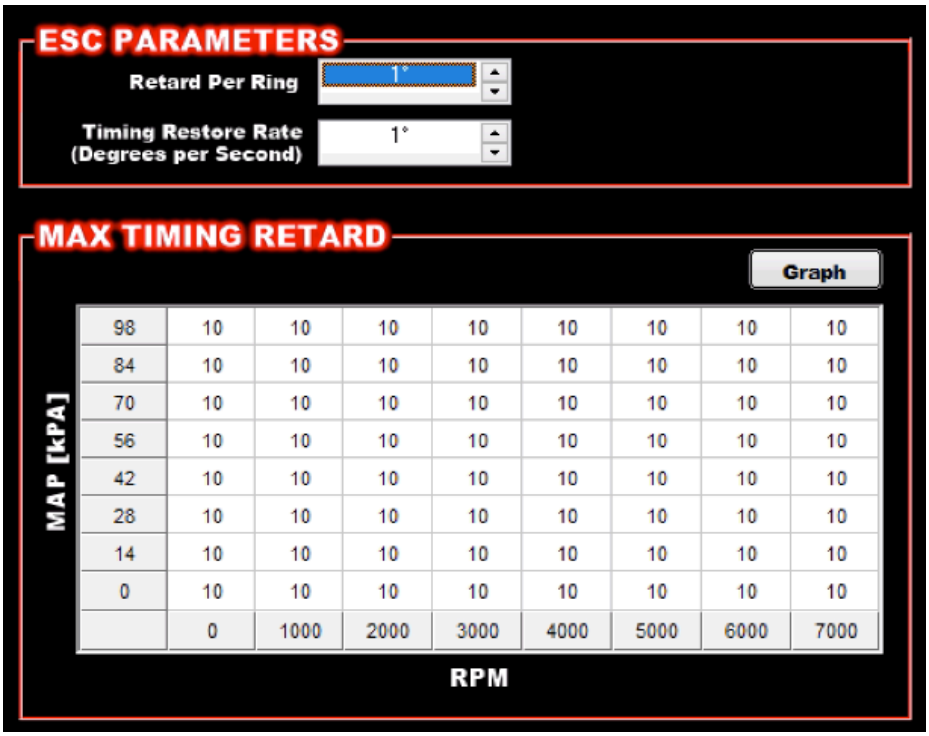

Cranking Fuel
After Start Holdoff
After Start Enrichment
After Start Decay Rate
Cranking Fuel (lb/hr)
6.0 6.0 6.0 6.0 5.5 5.0 4.5 4.0 3.5 3.0 3.0 3.0 3.0 3.0 3.0 3.0
Cranking Fuel (lb/hr)
60
50
40
30
20
10
0
-40 -20 0 20 40 60 80 100 120 140 160 180 200 220 240 260
Coolant Temperature (°F)


Cranking Fuel
After Start Holdoff
After Start Enrichment
After Start Decay Rate
After Start Enrichment (%)
100.0 100.0 100.0 100.0 92.0 80.5 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0 75.0
After Start Enrichment (%)
300
275
250
225
200
175
150
125
100
75
-40 -20 0 20 40 60 80 100 120 140 160 180 200 220 240 260
Coolant Temperature (°F)


Cranking Fuel
After Start Holdoff
After Start Enrichment
After Start Decay Rate
After Start Enrichment Time (sec)
3.0 3.0 3.0 2.4 1.6 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
After Start Enrichment Time (sec)
90
80
70
60
50
40
30
20
10
0
3.0 3.0 3.0 2.4 1.6 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
-40 -20 0 20 40 60 80 100 120 140 160 180 200 220 240 260
Coolant Temperature (°F)

Ignition …


IGNITION TYPE
Ignition Type
CUSTOM
Configure
REV LIMITER
MAIN OVER-REV
Type
Fuel and Spark
High RPM
7500 RPM
Low RPM
7400 RPM
REV LIMITER #1
Enable
Type
Fuel and Spark
On RPM
100 RPM
Off RPM
0 RPM
REV LIMITER #2
Enable
Type
Fuel Only
On RPM
8200 RPM
Off RPM
8100 RPM
FIRING ORDER
Drag Cylinders To Reorder
Firing Order
Cyl #1
Cyl #3
Cyl #4
Cyl #2
KNOCK SENSORS
Type
Resonant (1 Wire)
Number
1
Frequency
7.0 kHz
Sensitivity
75
CRANKING PARAMETERS
Timing
15.0°
Crank to Run RPM
400 RPM


ESC PARAMETERS
Retard Per Ring
1°
Timing Restore Rate (Degrees per Second)
1°
MAX TIMING RETARD
Graph
MAP [kPA]
98 10 10 10 10 10 10 10 10
84 10 10 10 10 10 10 10 10
70 10 10 10 10 10 10 10 10
56 10 10 10 10 10 10 10 10
42 10 10 10 10 10 10 10 10
28 10 10 10 10 10 10 10 10
14 10 10 10 10 10 10 10 10
0 10 10 10 10 10 10 10 10
0 1000 2000 3000 4000 5000 6000 7000
RPM

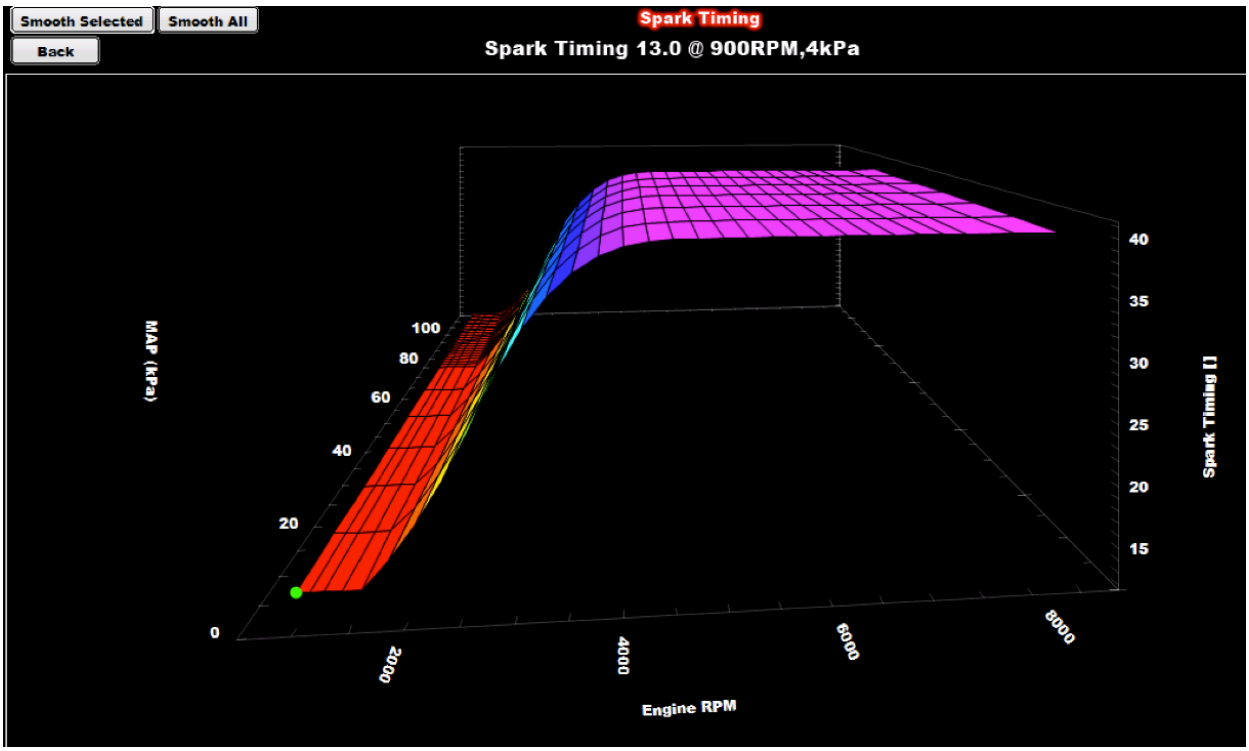
Copy Fuel Axes | Enable Large Table | Base Spark | Graph | Smooth

MAP (kPa) \ Engine RPM	900	1025	1150	1325	1500	1750	2000	2250	2500	2750	3000	3250	3500	3750	4000	4250	4500	4750	5000	5250	5500	5750	6000	6250	6500	6750	7000	7250	7500	8000	8500
105	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.0	21.0	22.0	23.0	24.0	25.0	25.0	26.0	26.0	27.0	27.0	28.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
104	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.0	21.0	22.0	23.0	24.0	25.0	25.0	26.0	26.0	27.0	27.0	28.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
102	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.0	21.0	22.0	23.0	24.0	25.0	25.0	26.0	26.0	27.0	27.0	28.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
101	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.0	21.0	22.0	23.0	24.0	25.0	25.0	26.0	26.0	27.0	27.0	28.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
99	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.0	21.0	22.0	23.0	24.0	25.0	25.0	26.0	26.0	27.0	27.0	28.0	29.0	31.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0
98	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.0	21.0	22.0	23.0	24.0	26.0	26.0	27.0	27.0	28.0	28.0	29.0	30.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0
96	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.0	22.0	24.0	25.5	25.0	27.0	27.0	28.0	28.0	29.0	29.0	30.0	31.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0
95	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.2	22.0	24.0	26.0	26.0	28.0	28.0	29.0	29.0	30.0	30.0	31.0	32.0	32.0	32.0	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1
93	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.2	22.0	24.0	26.0	28.0	29.0	29.0	30.0	30.0	31.0	31.0	32.0	32.0	32.0	32.1	32.3	32.4	32.4	32.4	32.4	32.4	32.4	32.4
92	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.2	22.5	25.0	27.0	29.0	30.0	30.0	31.0	31.0	32.0	32.0	32.0	32.0	32.1	32.3	32.6	32.7	32.8	32.8	32.8	32.8	32.8	32.8
90	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.2	22.5	25.5	28.0	30.0	31.8	31.9	32.0	32.0	32.0	32.0	32.0	32.0	32.3	32.7	33.1	33.3	33.4	33.4	33.4	33.4	33.4	33.4
89	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.2	22.5	25.9	29.1	31.1	31.8	31.9	32.0	32.0	32.0	32.0	32.2	32.4	32.9	33.4	33.7	33.9	34.0	34.0	34.0	34.0	34.0	34.1
88	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.2	22.5	25.9	29.1	31.1	31.8	31.9	32.0	32.0	32.0	32.2	32.6	33.3	33.8	34.2	34.5	34.7	34.7	34.8	34.8	34.8	34.8	34.8
86	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.2	22.5	25.9	29.0	30.9	31.7	32.2	32.4	32.4	32.5	32.9	33.5	34.2	34.7	35.0	35.3	35.4	35.5	35.5	35.5	35.5	35.5	35.5
85	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.2	22.5	25.9	29.1	31.2	32.4	33.0	33.3	33.4	33.6	33.9	34.5	35.1	35.5	35.8	36.0	36.2	36.2	36.2	36.3	36.3	36.3	36.3
83	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.2	22.5	26.1	29.6	32.1	33.4	34.2	34.5	34.5	34.8	35.1	35.6	36.1	36.4	36.7	36.8	36.9	37.0	37.0	37.0	37.0	37.0	37.0
82	13.0	13.0	13.0	13.0	13.0	14.8	16.8	18.5	20.2	22.6	26.5	30.5	33.2	34.7	35.4	35.8	35.9	36.1	36.3	36.7	37.0	37.3	37.5	37.6	37.7	37.7	37.7	37.7	37.7	37.8	37.8
80	13.0	13.0	13.0	13.0	13.0	14.8	16.9	19.1	21.6	24.8	28.8	32.4	34.6	36.0	36.8	37.1	37.3	37.4	37.5	37.8	38.0	38.2	38.3	38.4	38.5	38.5	38.5	38.5	38.5	38.5	38.5
79	13.0	13.0	13.0	13.0	13.0	14.8	17.2	20.0	23.3	27.3	30.9	33.8	35.8	37.1	37.9	38.3	38.4	38.4	38.5	38.7	38.8	38.9	39.0	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1
77	13.0	13.0	13.0	13.0	13.0	14.9	17.4	20.4	24.0	28.3	32.0	34.8	36.7	38.0	38.8	39.1	39.2	39.2	39.3	39.4	39.4	39.5	39.5	39.5	39.6	39.6	39.6	39.6	39.6	39.6	39.6
76	13.0	13.0	13.0	13.0	13.0	14.9	17.5	20.5	24.4	28.8	32.5	35.3	37.2	38.5	39.3	39.6	39.7	39.7	39.7	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8
74	13.0	13.0	13.0	13.0	13.0	14.9	17.5	20.7	24.5	28.9	32.7	35.5	37.4	38.7	39.5	39.8	39.9	39.9	39.9	39.9	39.9	39.9	39.9	39.9	39.9	39.9	39.9	39.9	39.9	39.9	39.9
73	13.0	13.0	13.0	13.0	13.0	14.9	17.5	20.7	24.6	29.0	32.8	35.6	37.5	38.8	39.5	39.8	39.9	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
71	13.0	13.0	13.0	13.0	13.0	14.9	17.6	20.8	24.7	29.1	32.9	35.6	37.5	38.8	39.6	39.9	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
70	13.0	13.0	13.0	13.0	13.0	14.9	17.6	20.9	24.8	29.2	32.9	35.7	37.5	38.8	39.6	39.9	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
59	13.0	13.0	13.0	13.0	13.0	14.9	17.6	20.9	24.8	29.2	32.9	35.7	37.5	38.8	39.6	39.9	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
48	13.0	13.0	13.0	13.0	13.0	14.9	17.7	21.0	24.9	29.2	32.9	35.7	37.5	38.8	39.6	39.9	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
37	13.0	13.0	13.0	13.0	13.0	14.9	17.7	21.0	25.0	29.3	32.9	35.7	37.5	38.8	39.6	39.9	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
26	13.0	13.0	13.0	13.0	13.0	14.9	17.7	21.1	25.0	29.3	33.0	35.7	37.5	38.8	39.6	39.9	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
15	13.0	13.0	13.0	13.0	13.0	14.9	17.7	21.2	25.1	29.4	33.0	35.7	37.5	38.8	39.6	39.9	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
4	13.0	13.0	13.0	13.0	13.0	15.1	17.9	21.2	25.2	29.4	32.9	35.5	37.4	38.7	39.5	39.8	39.9	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0

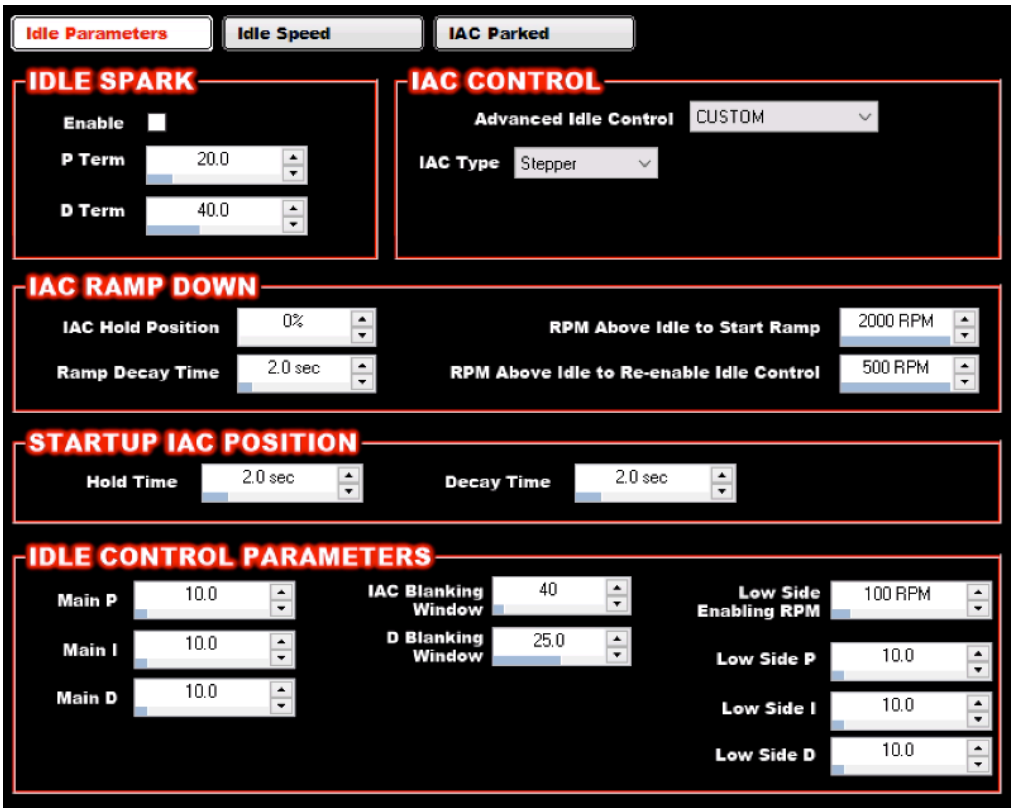
Smooth Selected | Smooth All | Back

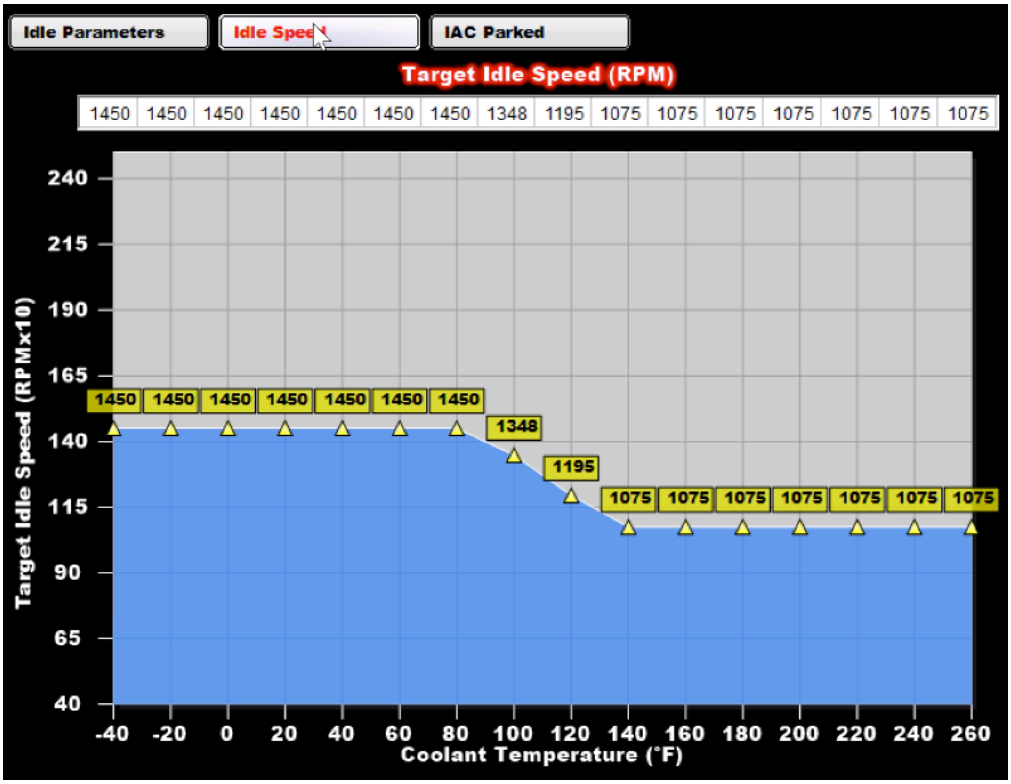
Spark Timing

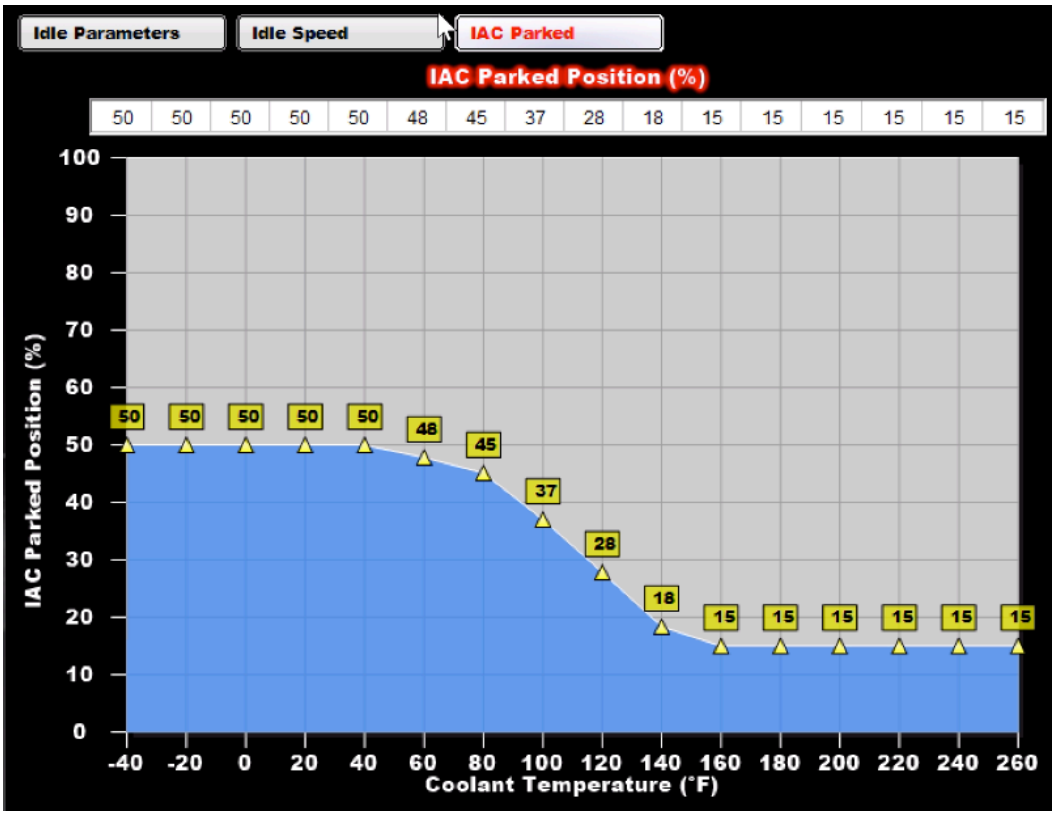
Spark Timing 13.0 @ 900RPM,4kPa



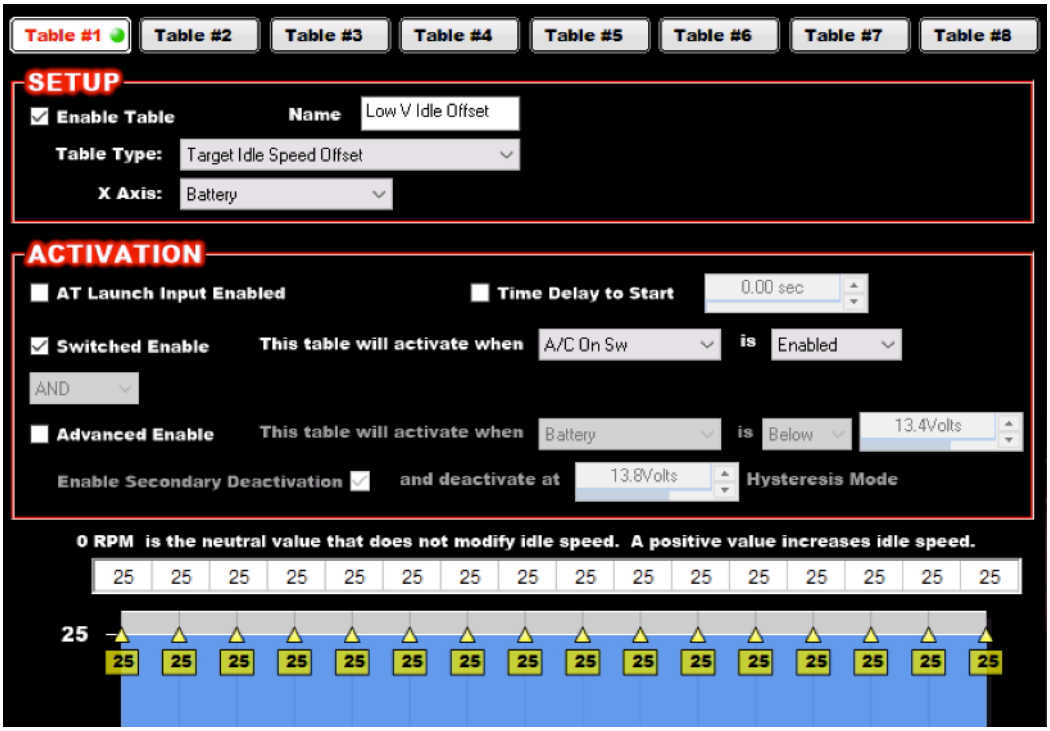
Idle control …



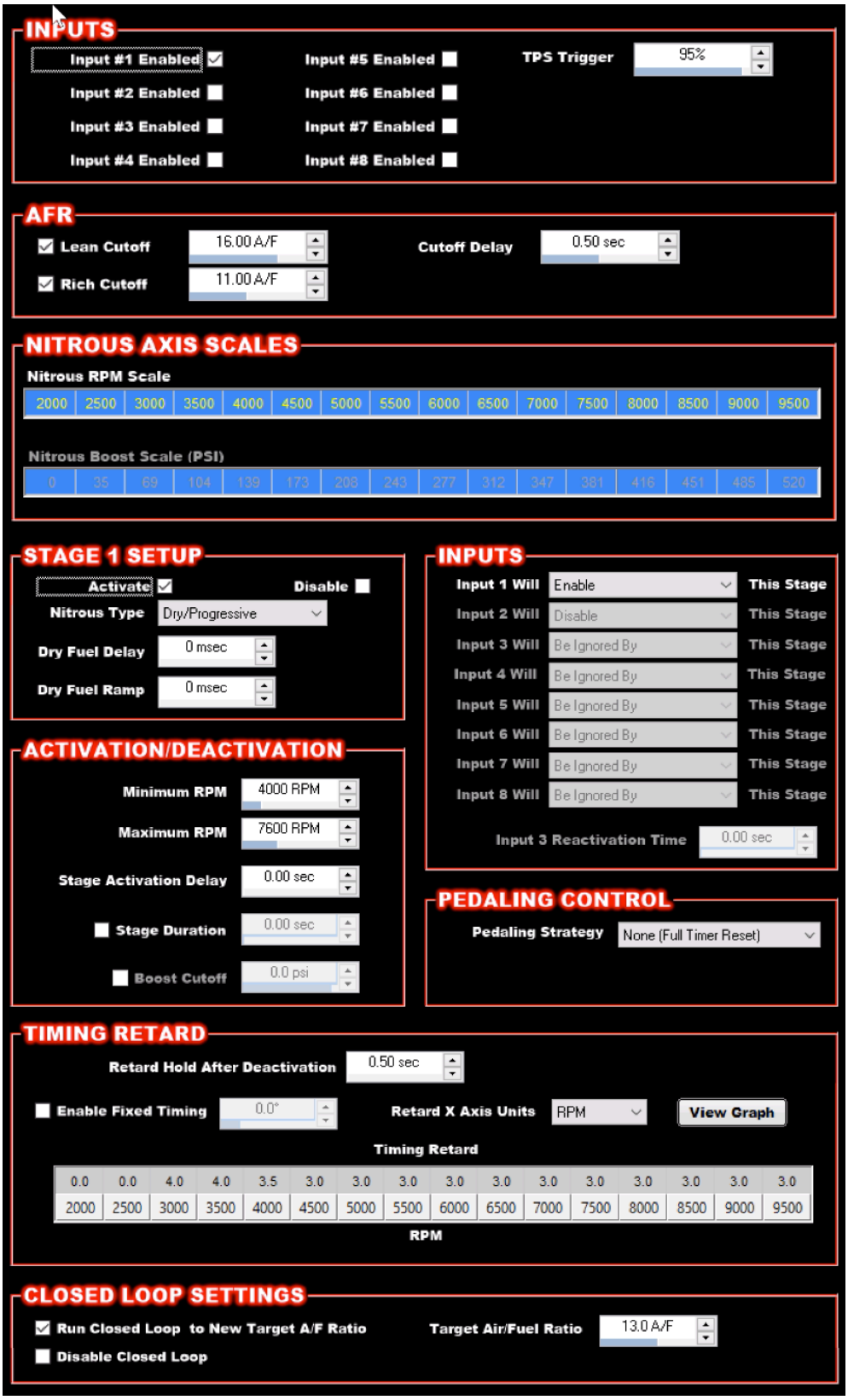


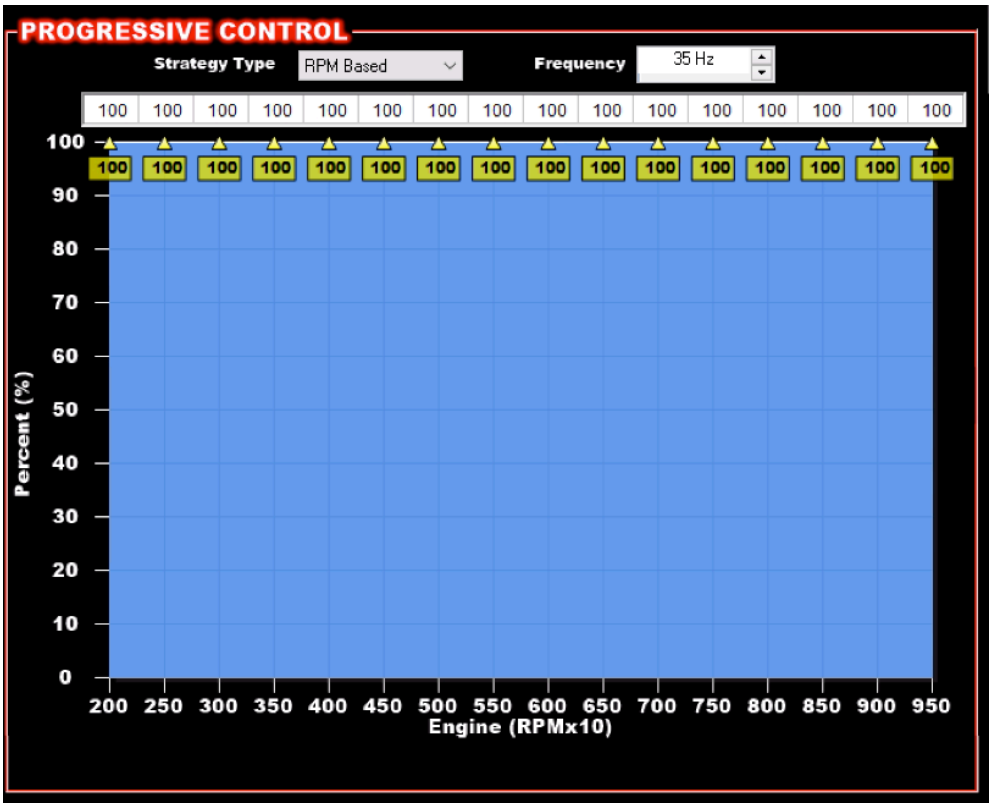


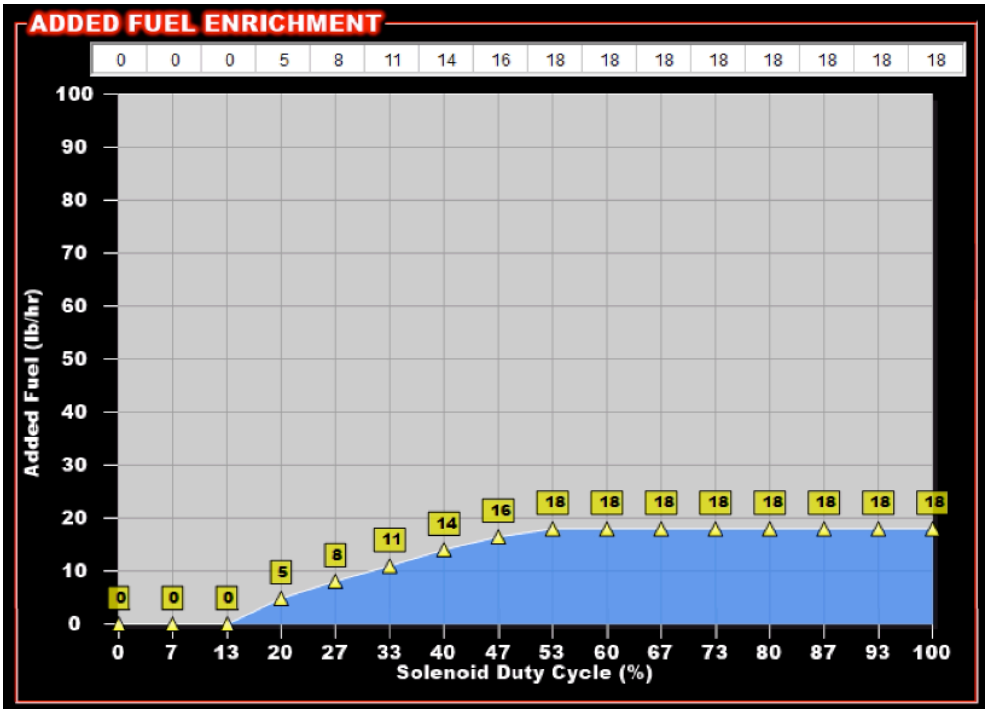
A/C idle speed offset …



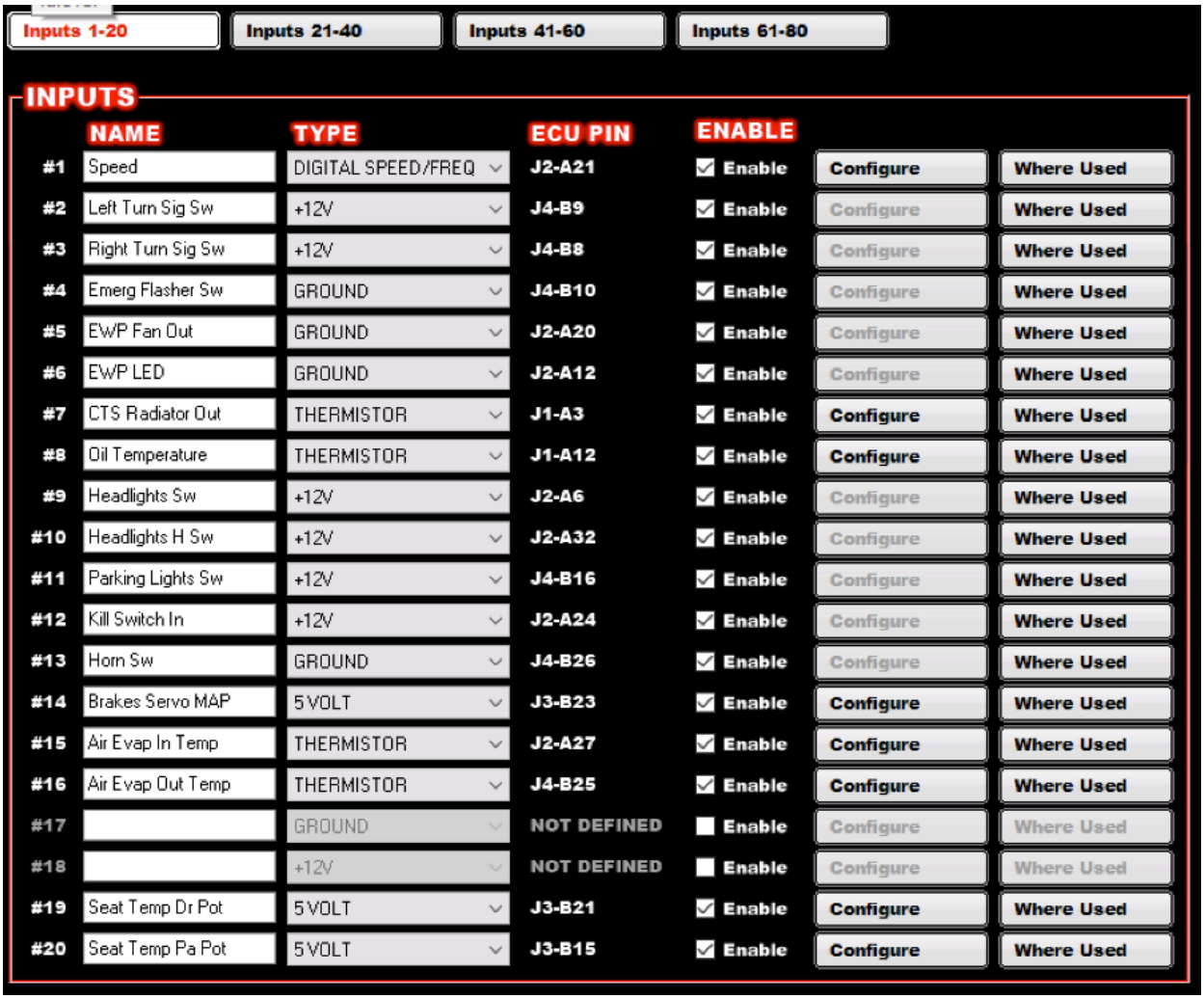
Nitrous …


INPUTS
Input #1 Enabled
Input #2 Enabled
Input #3 Enabled
Input #4 Enabled
Input #5 Enabled
Input #6 Enabled
Input #7 Enabled
Input #8 Enabled
TPS Trigger
95%
AFR
Lean Cutoff
16.00 A/F
Rich Cutoff
11.00 A/F
Cutoff Delay
0.50 sec
NITROUS AXIS SCALES
Nitrous RPM Scale
2000 2500 3000 3500 4000 4500 5000 5500 6000 6500 7000 7500 8000 8500 9000 9500
Nitrous Boost Scale (PSI)
0 35 69 104 139 173 208 243 277 312 347 381 416 451 485 520
STAGE 1 SETUP
Activate
Disable
Nitrous Type
Dry/Progressive
Dry Fuel Delay
0 msec
Dry Fuel Ramp
0 msec
INPUTS
Input 1 Will
Enable
This Stage
Input 2 Will
Disable
This Stage
Input 3 Will
Be Ignored By
This Stage
Input 4 Will
Be Ignored By
This Stage
Input 5 Will
Be Ignored By
This Stage
Input 6 Will
Be Ignored By
This Stage
Input 7 Will
Be Ignored By
This Stage
Input 8 Will
Be Ignored By
This Stage
Input 3 Reactivation Time
0.00 sec
ACTIVATION/DEACTIVATION
Minimum RPM
4000 RPM
Maximum RPM
7600 RPM
Stage Activation Delay
0.00 sec
Stage Duration
0.00 sec
Boost Cutoff
0.0 psi
PEDALING CONTROL
Pedaling Strategy
None (Full Timer Reset)
TIMING RETARD
Retard Hold After Deactivation
0.50 sec
Enable Fixed Timing
0.0°
Retard X Axis Units
RPM
View Graph
Timing Retard
0.0 0.0 4.0 4.0 3.5 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0
2000 2500 3000 3500 4000 4500 5000 5500 6000 6500 7000 7500 8000 8500 9000 9500
RPM
CLOSED LOOP SETTINGS
Run Closed Loop to New Target A/F Ratio
Disable Closed Loop
Target Air/Fuel Ratio
13.0 A/F

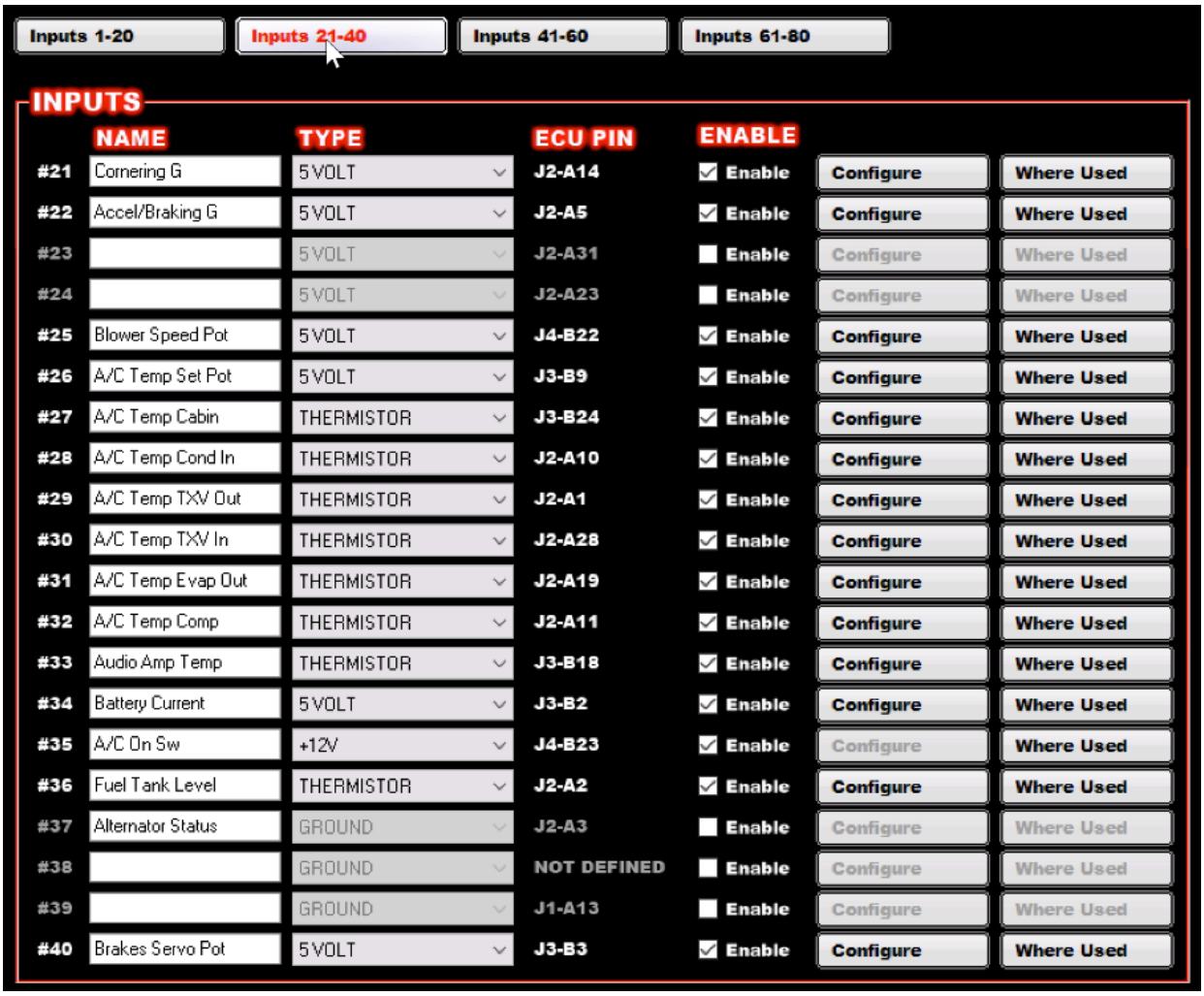

PROGRESSIVE CONTROL
Strategy Type
RPM Based
Frequency
35 Hz
100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100
Percent (%)
100 90 80 70 60 50 40 30 20 10 0
200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950
Engine (RPMx10)

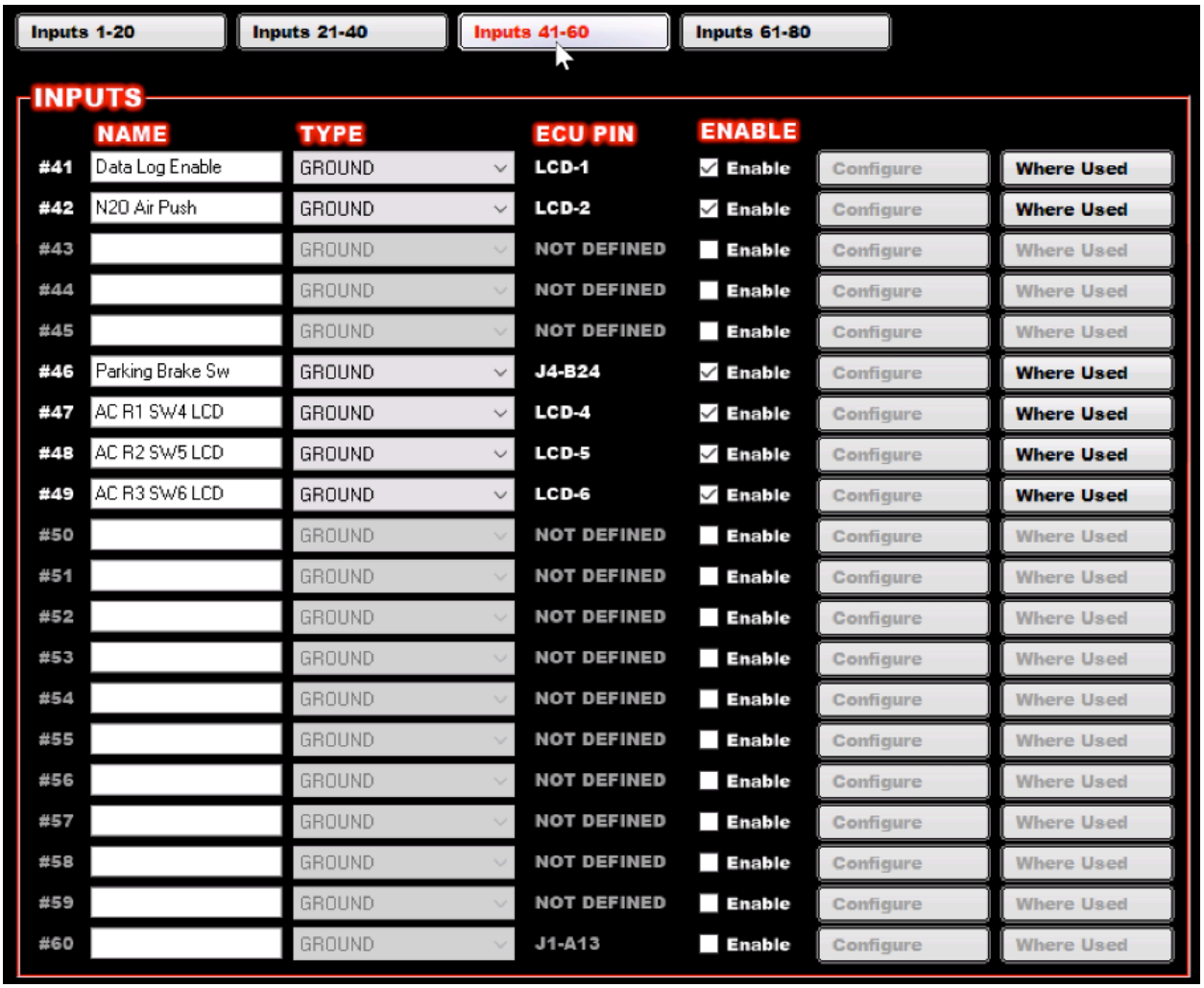

ADDED FUEL ENRICHMENT
0 0 0 5 8 11 14 16 18 18 18 18 18 18 18 18
Added Fuel (lb/hr)
100 90 80 70 60 50 40 30 20 10 0
0 7 13 20 27 33 40 47 53 60 67 73 80 87 93 100
Solenoid Duty Cycle (%)

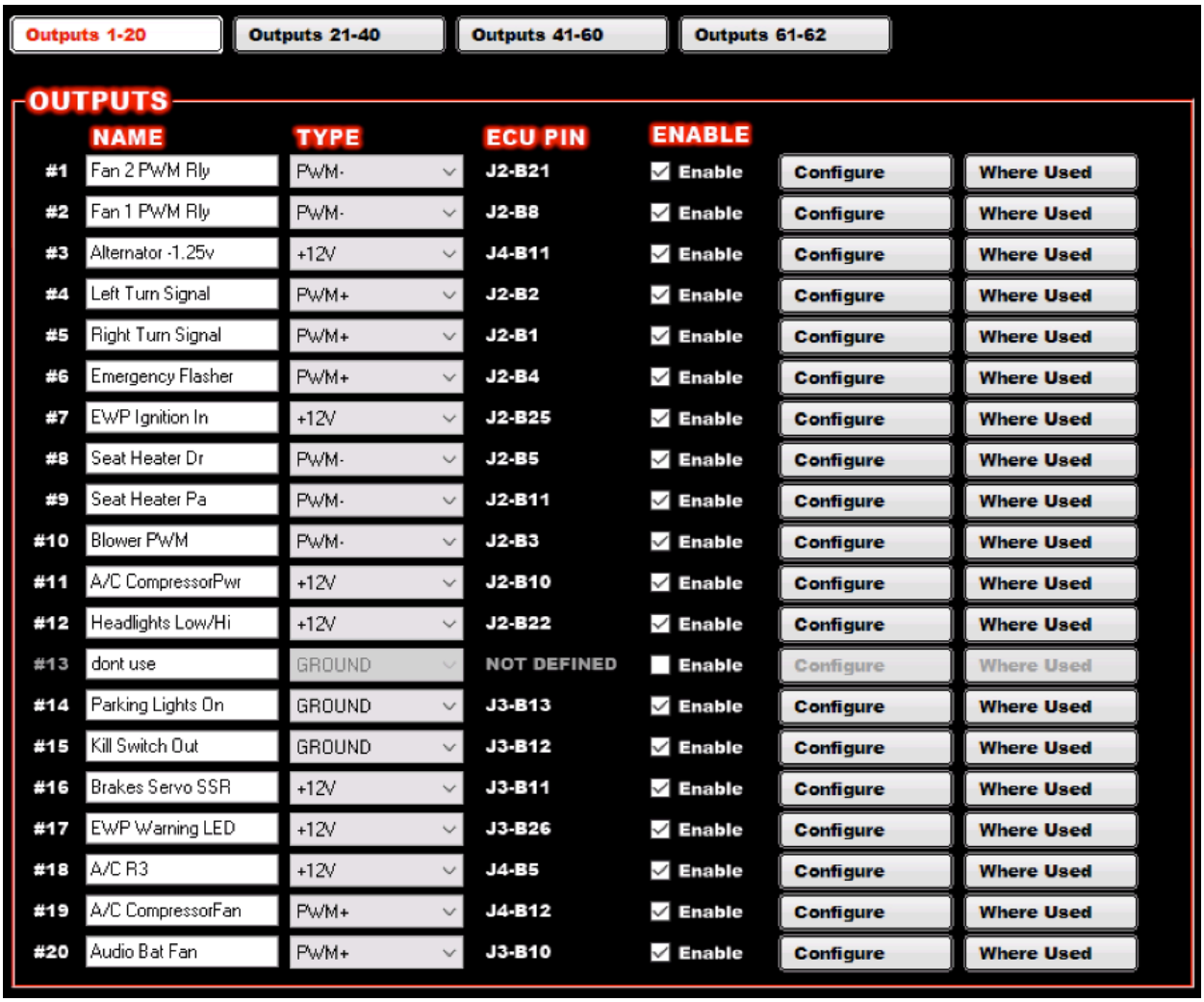
Inputs and Outputs …

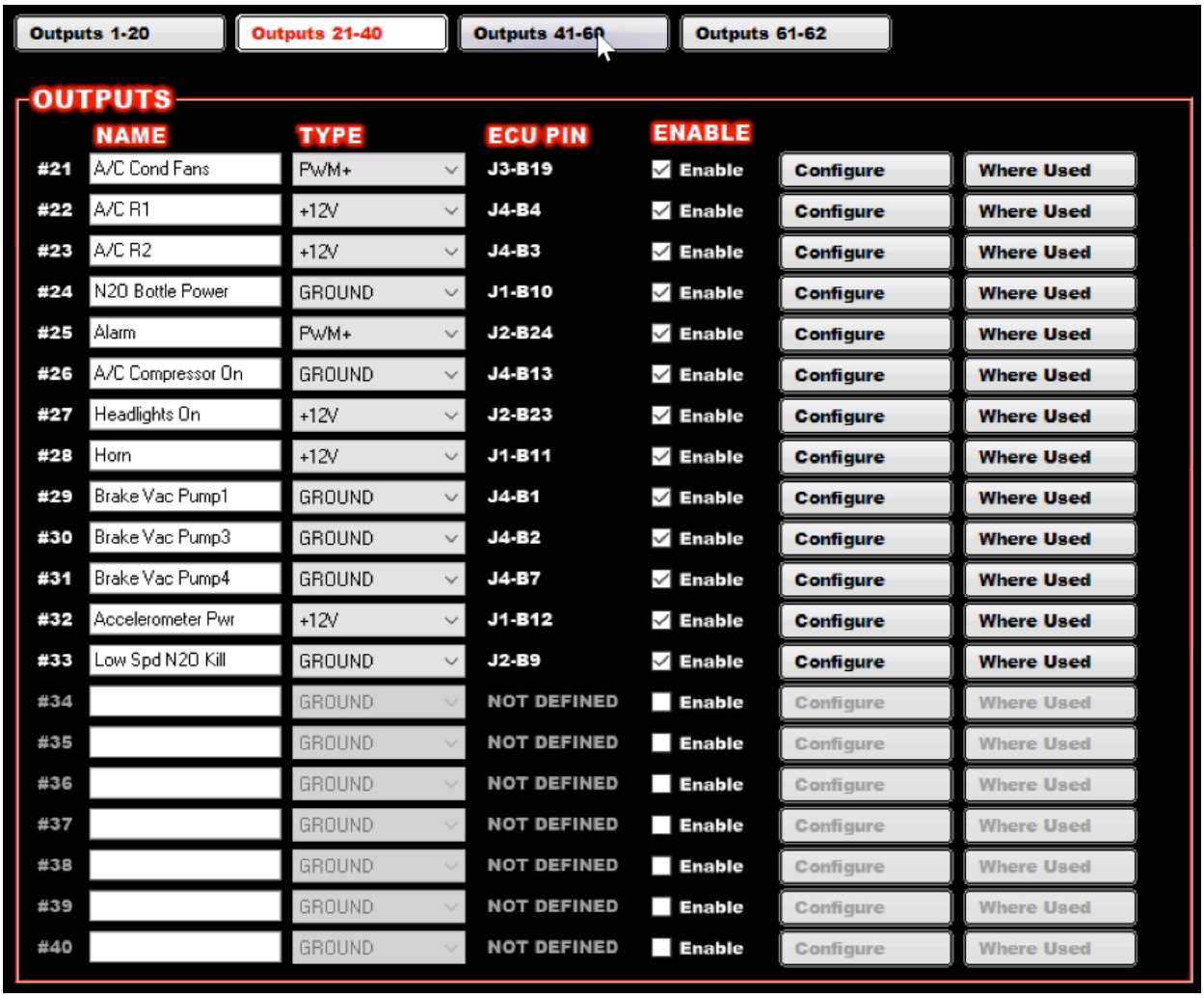


	NAME	TYPE	ECU PIN	ENABLE		
#1	Speed	DIGITAL SPEED/FREQ	J2-A21	Enable	Configure	Where Used
#2	Left Turn Sig Sw	+12V	J4-B9	Enable	Configure	Where Used
#3	Right Turn Sig Sw	+12V	J4-B8	Enable	Configure	Where Used
#4	Emerg Flasher Sw	GROUND	J4-B10	Enable	Configure	Where Used
#5	EWP Fan Out	GROUND	J2-A20	Enable	Configure	Where Used
#6	EWP LED	GROUND	J2-A12	Enable	Configure	Where Used
#7	CTS Radiator Out	THERMISTOR	J1-A3	Enable	Configure	Where Used
#8	Oil Temperature	THERMISTOR	J1-A12	Enable	Configure	Where Used
#9	Headlights Sw	+12V	J2-A6	Enable	Configure	Where Used
#10	Headlights H Sw	+12V	J2-A32	Enable	Configure	Where Used
#11	Parking Lights Sw	+12V	J4-B16	Enable	Configure	Where Used
#12	Kill Switch In	+12V	J2-A24	Enable	Configure	Where Used
#13	Horn Sw	GROUND	J4-B26	Enable	Configure	Where Used
#14	Brakes Servo MAP	5 VOLT	J3-B23	Enable	Configure	Where Used
#15	Air Evap In Temp	THERMISTOR	J2-A27	Enable	Configure	Where Used
#16	Air Evap Out Temp	THERMISTOR	J4-B25	Enable	Configure	Where Used
#17		GROUND	NOT DEFINED	Enable	Configure	Where Used
#18		+12V	NOT DEFINED	Enable	Configure	Where Used
#19	Seat Temp Dr Pot	5 VOLT	J3-B21	Enable	Configure	Where Used
#20	Seat Temp Pa Pot	5 VOLT	J3-B15	Enable	Configure	Where Used

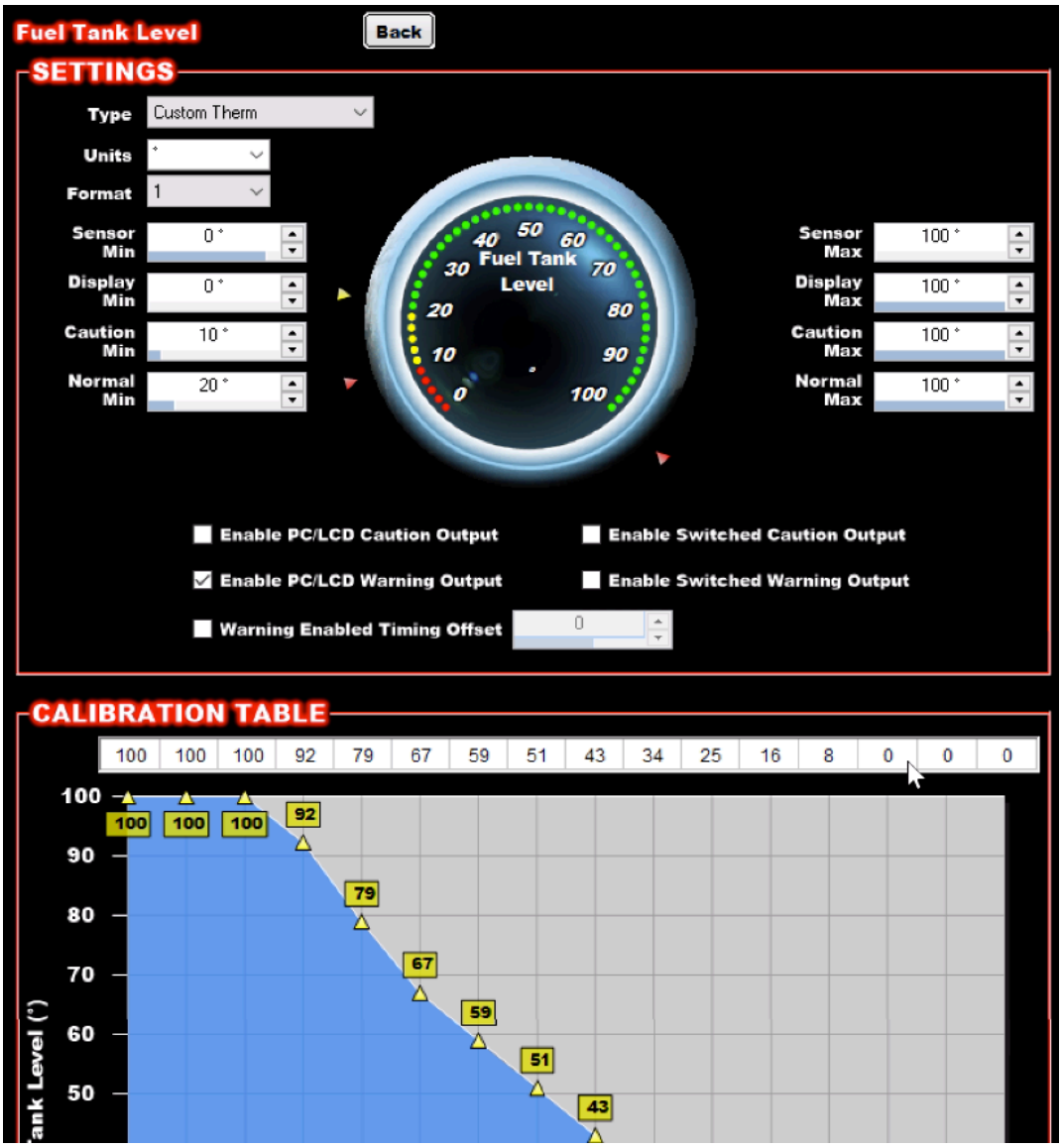

Inputs 1-20
Inputs 21-40
Inputs 41-60
Inputs 61-80
INPUTS
NAME
TYPE
ECU PIN
ENABLE
#21 Cornering G 5 VOLT J2-A14 Enable Configure Where Used
#22 Accel/Braking G 5 VOLT J2-A5 Enable Configure Where Used
#23 5 VOLT J2-A31 Enable Configure Where Used
#24 5 VOLT J2-A23 Enable Configure Where Used
#25 Blower Speed Pot 5 VOLT J4-B22 Enable Configure Where Used
#26 A/C Temp Set Pot 5 VOLT J3-B9 Enable Configure Where Used
#27 A/C Temp Cabin THERMISTOR J3-B24 Enable Configure Where Used
#28 A/C Temp Cond In THERMISTOR J2-A10 Enable Configure Where Used
#29 A/C Temp TXV Out THERMISTOR J2-A1 Enable Configure Where Used
#30 A/C Temp TXV In THERMISTOR J2-A28 Enable Configure Where Used
#31 A/C Temp Evap Out THERMISTOR J2-A19 Enable Configure Where Used
#32 A/C Temp Comp THERMISTOR J2-A11 Enable Configure Where Used
#33 Audio Amp Temp THERMISTOR J3-B18 Enable Configure Where Used
#34 Battery Current 5 VOLT J3-B2 Enable Configure Where Used
#35 A/C On Sw +12V J4-B23 Enable Configure Where Used
#36 Fuel Tank Level THERMISTOR J2-A2 Enable Configure Where Used
#37 Alternator Status GROUND J2-A3 Enable Configure Where Used
#38 GROUND NOT DEFINED Enable Configure Where Used
#39 GROUND J1-A13 Enable Configure Where Used
#40 Brakes Servo Pot 5 VOLT J3-B3 Enable Configure Where Used

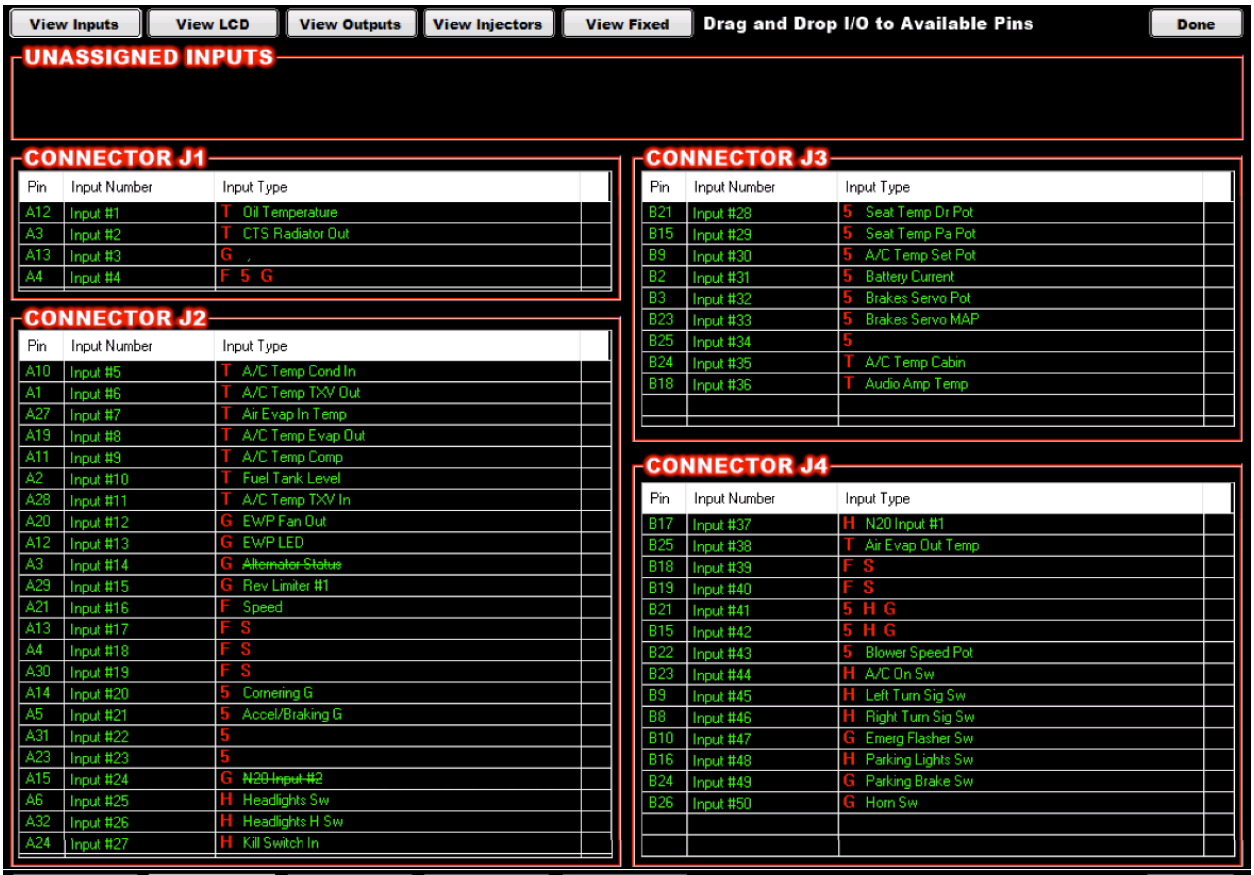

Inputs 1-20
Inputs 21-40
Inputs 41-60
Inputs 61-80
INPUTS
NAME
TYPE
ECU PIN
ENABLE
#41 Data Log Enable GROUND LCD-1 Enable Configure Where Used
#42 N20 Air Push GROUND LCD-2 Enable Configure Where Used
#43 GROUND NOT DEFINED Enable Configure Where Used
#44 GROUND NOT DEFINED Enable Configure Where Used
#45 GROUND NOT DEFINED Enable Configure Where Used
#46 Parking Brake Sw GROUND J4-B24 Enable Configure Where Used
#47 AC R1 SW4 LCD GROUND LCD-4 Enable Configure Where Used
#48 AC R2 SW5 LCD GROUND LCD-5 Enable Configure Where Used
#49 AC R3 SW6 LCD GROUND LCD-6 Enable Configure Where Used
#50 GROUND NOT DEFINED Enable Configure Where Used
#51 GROUND NOT DEFINED Enable Configure Where Used
#52 GROUND NOT DEFINED Enable Configure Where Used
#53 GROUND NOT DEFINED Enable Configure Where Used
#54 GROUND NOT DEFINED Enable Configure Where Used
#55 GROUND NOT DEFINED Enable Configure Where Used
#56 GROUND NOT DEFINED Enable Configure Where Used
#57 GROUND NOT DEFINED Enable Configure Where Used
#58 GROUND NOT DEFINED Enable Configure Where Used
#59 GROUND NOT DEFINED Enable Configure Where Used
#60 GROUND J1-A13 Enable Configure Where Used

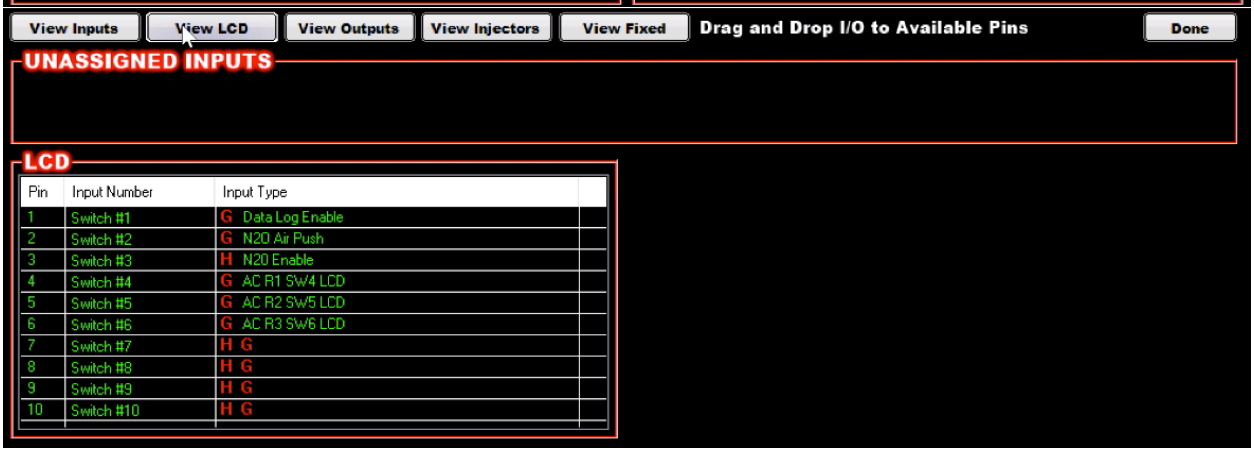

Outputs 1-20
Outputs 21-40
Outputs 41-60
Outputs 61-62
OUTPUTS
NAME
TYPE
ECU PIN
ENABLE
#1 Fan 2 PWM Rly PWM- J2-B21 Enable Configure Where Used
#2 Fan 1 PWM Rly PWM- J2-B8 Enable Configure Where Used
#3 Alternator -1.25v +12V J4-B11 Enable Configure Where Used
#4 Left Turn Signal PWM+ J2-B2 Enable Configure Where Used
#5 Right Turn Signal PWM+ J2-B1 Enable Configure Where Used
#6 Emergency Flasher PWM+ J2-B4 Enable Configure Where Used
#7 EWP Ignition In +12V J2-B25 Enable Configure Where Used
#8 Seat Heater Dr PWM- J2-B5 Enable Configure Where Used
#9 Seat Heater Pa PWM- J2-B11 Enable Configure Where Used
#10 Blower PWM PWM- J2-B3 Enable Configure Where Used
#11 A/C CompressorPwr +12V J2-B10 Enable Configure Where Used
#12 Headlights Low/Hi +12V J2-B22 Enable Configure Where Used
#13 dont use GROUND NOT DEFINED Enable Configure Where Used
#14 Parking Lights On GROUND J3-B13 Enable Configure Where Used
#15 Kill Switch Out GROUND J3-B12 Enable Configure Where Used
#16 Brakes Servo SSR +12V J3-B11 Enable Configure Where Used
#17 EWP Warning LED +12V J3-B26 Enable Configure Where Used
#18 A/C R3 +12V J4-B5 Enable Configure Where Used
#19 A/C CompressorFan PWM+ J4-B12 Enable Configure Where Used
#20 Audio Bat Fan PWM+ J3-B10 Enable Configure Where Used

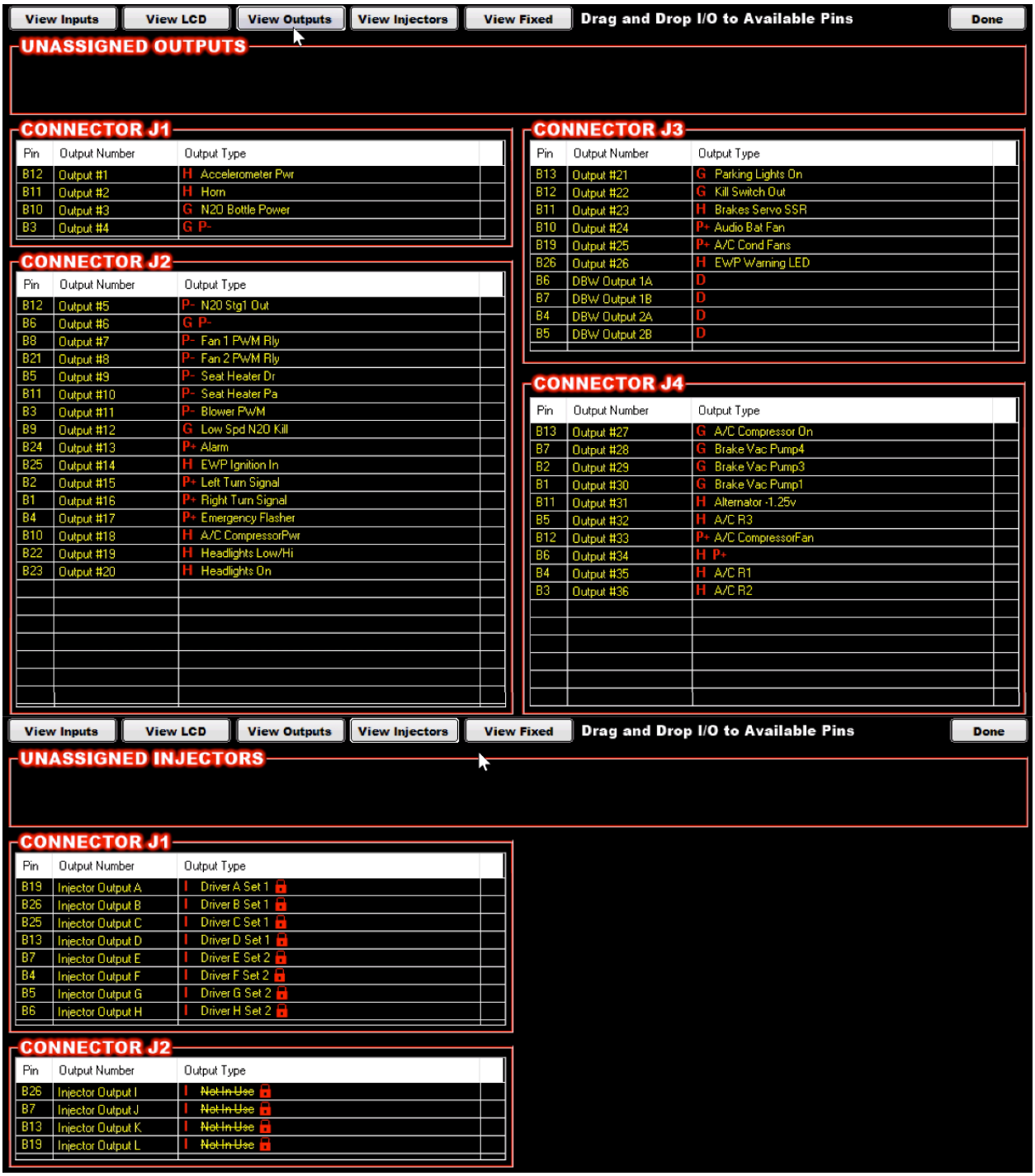

Outputs 1-20
Outputs 21-40
Outputs 41-60
Outputs 61-62
OUTPUTS
NAME
TYPE
ECU PIN
ENABLE
#21 A/C Cond Fans PWM+ J3-B19 Enable Configure Where Used
#22 A/C R1 +12V J4-B4 Enable Configure Where Used
#23 A/C R2 +12V J4-B3 Enable Configure Where Used
#24 N2O Bottle Power GROUND J1-B10 Enable Configure Where Used
#25 Alarm PWM+ J2-B24 Enable Configure Where Used
#26 A/C Compressor On GROUND J4-B13 Enable Configure Where Used
#27 Headlights On +12V J2-B23 Enable Configure Where Used
#28 Horn +12V J1-B11 Enable Configure Where Used
#29 Brake Vac Pump1 GROUND J4-B1 Enable Configure Where Used
#30 Brake Vac Pump3 GROUND J4-B2 Enable Configure Where Used
#31 Brake Vac Pump4 GROUND J4-B7 Enable Configure Where Used
#32 Accelerometer Pwr +12V J1-B12 Enable Configure Where Used
#33 Low Spd N2O Kill GROUND J2-B9 Enable Configure Where Used
#34 GROUND NOT DEFINED Enable Configure Where Used
#35 GROUND NOT DEFINED Enable Configure Where Used
#36 GROUND NOT DEFINED Enable Configure Where Used
#37 GROUND NOT DEFINED Enable Configure Where Used
#38 GROUND NOT DEFINED Enable Configure Where Used
#39 GROUND NOT DEFINED Enable Configure Where Used
#40 GROUND NOT DEFINED Enable Configure Where Used

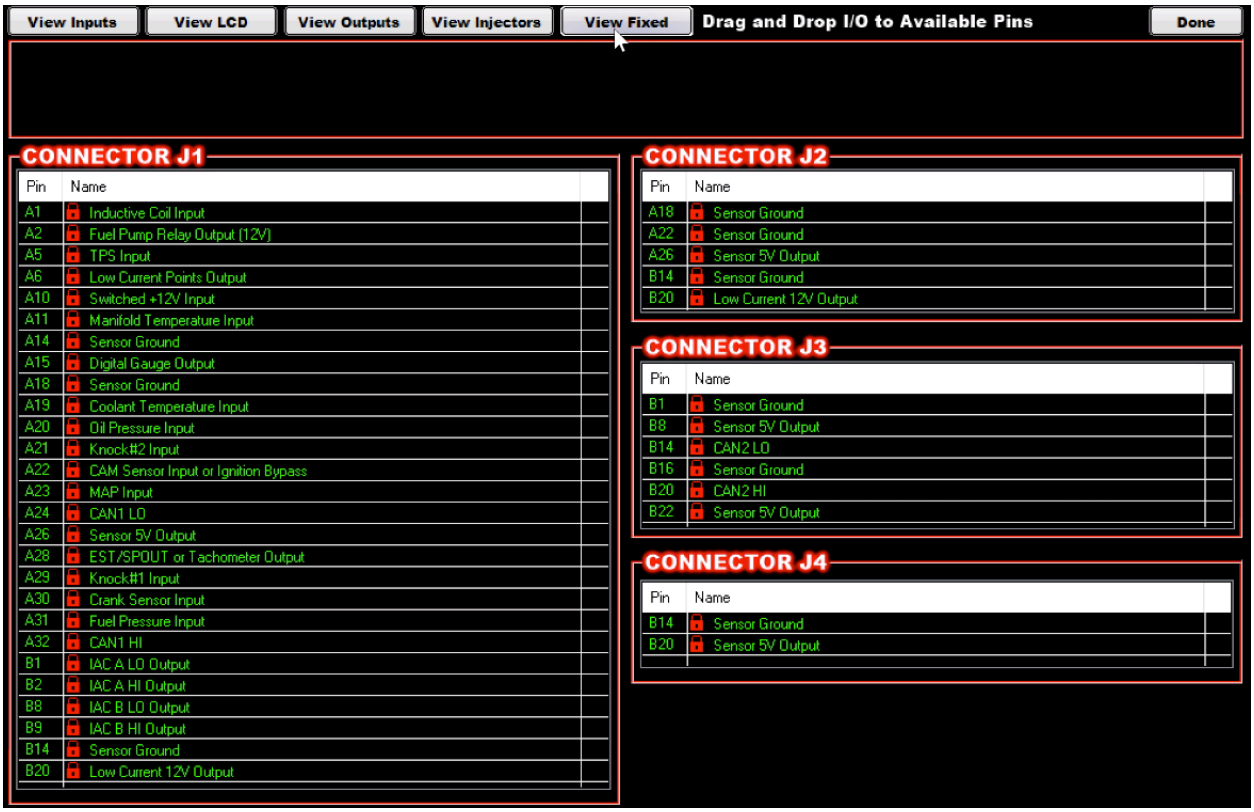
Example input config




View Inputs
View LCD
View Outputs
View Injectors
View Fixed
Drag and Drop I/O to Available Pins
Done
UNASSIGNED INPUTS
CONNECTOR J1
Pin Input Number Input Type
A12 Input #1 T Oil Temperature
A3 Input #2 T CTS Radiator Out
A13 Input #3 G ,
A4 Input #4 F 5 G
CONNECTOR J2
Pin Input Number Input Type
A10 Input #5 T A/C Temp Cond In
A1 Input #6 T A/C Temp TXV Out
A27 Input #7 T Air Evap In Temp
A19 Input #8 T A/C Temp Evap Out
A11 Input #9 T A/C Temp Comp
A2 Input #10 T Fuel Tank Level
A28 Input #11 T A/C Temp TXV In
A20 Input #12 G EWP Fan Out
A12 Input #13 G EWP LED
A3 Input #14 G Alternator Status
A29 Input #15 G Rev Limiter #1
A21 Input #16 F Speed
A13 Input #17 F S
A4 Input #18 F S
A30 Input #19 F S
A14 Input #20 5 Cornering G
A5 Input #21 5 Accel/Braking G
A31 Input #22 5
A23 Input #23 5
A15 Input #24 G N20 Input #2
A6 Input #25 H Headlights Sw
A32 Input #26 H Headlights H Sw
A24 Input #27 H Kill Switch In
CONNECTOR J3
Pin Input Number Input Type
B21 Input #28 5 Seat Temp Dr Pot
B15 Input #29 5 Seat Temp Pa Pot
B9 Input #30 5 A/C Temp Set Pot
B2 Input #31 5 Battery Current
B3 Input #32 5 Brakes Servo Pot
B23 Input #33 5 Brakes Servo MAP
B25 Input #34 5
B24 Input #35 T A/C Temp Cabin
B18 Input #36 T Audio Amp Temp
CONNECTOR J4
Pin Input Number Input Type
B17 Input #37 H N20 Input #1
B25 Input #38 T Air Evap Out Temp
B18 Input #39 F S
B19 Input #40 F S
B21 Input #41 5 H G
B15 Input #42 5 H G
B22 Input #43 5 Blower Speed Pot
B23 Input #44 H A/C On Sw
B9 Input #45 H Left Turn Sig Sw
B8 Input #46 H Right Turn Sig Sw
B10 Input #47 G Emerg Flasher Sw
B16 Input #48 H Parking Lights Sw
B24 Input #49 G Parking Brake Sw
B26 Input #50 G Horn Sw


View Inputs
View LCD
View Outputs
View Injectors
View Fixed
Drag and Drop I/O to Available Pins
Done
UNASSIGNED INPUTS
LCD
Pin Input Number Input Type
1 Switch #1 G Data Log Enable
2 Switch #2 G N20 Air Push
3 Switch #3 H N20 Enable
4 Switch #4 G AC R1 SW4 LCD
5 Switch #5 G AC R2 SW5 LCD
6 Switch #6 G AC R3 SW6 LCD
7 Switch #7 H G
8 Switch #8 H G
9 Switch #9 H G
10 Switch #10 H G


View Inputs
View LCD
View Outputs
View Injectors
View Fixed
Drag and Drop I/O to Available Pins
Done
UNASSIGNED OUTPUTS
CONNECTOR J1
Pin Output Number Output Type
B12 Output #1 H Accelerometer Pwr
B11 Output #2 H Horn
B10 Output #3 G N2O Bottle Power
B3 Output #4 G P-
CONNECTOR J2
Pin Output Number Output Type
B12 Output #5 P- N2O Stg1 Out
B6 Output #6 G P-
B8 Output #7 P- Fan 1 PWM Rly
B21 Output #8 P- Fan 2 PWM Rly
B5 Output #9 P- Seat Heater Dr
B11 Output #10 P- Seat Heater Pa
B3 Output #11 P- Blower PWM
B9 Output #12 G Low Spd N2O Kill
B24 Output #13 P+ Alarm
B25 Output #14 H EWP Ignition In
B2 Output #15 P+ Left Turn Signal
B1 Output #16 P+ Right Turn Signal
B4 Output #17 P+ Emergency Flasher
B10 Output #18 H A/C CompressorPwr
B22 Output #19 H Headlights Low/Hi
B23 Output #20 H Headlights On
CONNECTOR J3
Pin Output Number Output Type
B13 Output #21 G Parking Lights On
B12 Output #22 G Kill Switch Out
B11 Output #23 H Brakes Servo SSR
B10 Output #24 P+ Audio Bat Fan
B19 Output #25 P+ A/C Cond Fans
B26 Output #26 H EWP Warning LED
B6 DBW Output 1A D
B7 DBW Output 1B D
B4 DBW Output 2A D
B5 DBW Output 2B D
CONNECTOR J4
Pin Output Number Output Type
B13 Output #27 G A/C Compressor On
B7 Output #28 G Brake Vac Pump4
B2 Output #29 G Brake Vac Pump3
B1 Output #30 G Brake Vac Pump1
B11 Output #31 H Alternator -1.25v
B5 Output #32 H A/C R3
B12 Output #33 P+ A/C CompressorFan
B6 Output #34 H P+
B4 Output #35 H A/C R1
B3 Output #36 H A/C R2
View Inputs
View LCD
View Outputs
View Injectors
View Fixed
Drag and Drop I/O to Available Pins
Done
UNASSIGNED INJECTORS
CONNECTOR J1
Pin Output Number Output Type
B19 Injector Output A I Driver A Set 1
B26 Injector Output B I Driver B Set 1
B25 Injector Output C I Driver C Set 1
B13 Injector Output D I Driver D Set 1
B7 Injector Output E I Driver E Set 2
B4 Injector Output F I Driver F Set 2
B5 Injector Output G I Driver G Set 2
B6 Injector Output H I Driver H Set 2
CONNECTOR J2
Pin Output Number Output Type
B26 Injector Output I I Not In Use
B7 Injector Output J I Not In Use
B13 Injector Output K I Not In Use
B19 Injector Output L I Not In Use


View Inputs
View LCD
View Outputs
View Injectors
View Fixed
Drag and Drop I/O to Available Pins
Done
CONNECTOR J1
Pin
Name
A1 Inductive Coil Input
A2 Fuel Pump Relay Output (12V)
A5 TPS Input
A6 Low Current Points Output
A10 Switched +12V Input
A11 Manifold Temperature Input
A14 Sensor Ground
A15 Digital Gauge Output
A18 Sensor Ground
A19 Coolant Temperature Input
A20 Oil Pressure Input
A21 Knock#2 Input
A22 CAM Sensor Input or Ignition Bypass
A23 MAP Input
A24 CAN1 LO
A26 Sensor 5V Output
A28 EST/SPOUT or Tachometer Output
A29 Knock#1 Input
A30 Crank Sensor Input
A31 Fuel Pressure Input
A32 CAN1 HI
B1 IAC A LO Output
B2 IAC A HI Output
B8 IAC B LO Output
B9 IAC B HI Output
B14 Sensor Ground
B20 Low Current 12V Output
CONNECTOR J2
Pin
Name
A18 Sensor Ground
A22 Sensor Ground
A26 Sensor 5V Output
B14 Sensor Ground
B20 Low Current 12V Output
CONNECTOR J3
Pin
Name
B1 Sensor Ground
B8 Sensor 5V Output
B14 CAN2 LO
B16 Sensor Ground
B20 CAN2 HI
B22 Sensor 5V Output
CONNECTOR J4
Pin
Name
B14 Sensor Ground
B20 Sensor 5V Output

Ultimate 83 GTI Cost List								
Last Updated: October 9/19								
							Total US$	**137,791**
							Total C$	**186,205**
Description	**Manufacturer**	**Part #**	***C$***	***US$***	***UK$***	***S&H***	***Duties & Taxes***	***Total USD***
						@10%	**@12%**	
Car Initial Purchase & Delivery								
Car Purchase	VW Canada		4,900	3,675		1,157	441	5,273
Inspection	Weissash Porsche		180	135				135
Engine/Trans/Glass removal	Weissash Porsche		400	300				300
Sub-total:								**5,708**
Engine - Short Block								
VW 2.0 ABA tall deck block core	VW			480		48	63	591
Block clean, detail, paint	Josh/Mark's VW Service			200		20	26	246
Bore & Hone 83.5mm	Josh/Mark's VW Service			225		23	30	277
Machine deck	Josh/Mark's VW Service			80		8	11	99
Machine intermediate shaft, lighten, balance	Josh/Mark's VW Service			65		7	9	80
95.5mm Crank	VW/Techtonics Tuning	105 955		800		80	106	986
Crank position sensor wheel	VW			150		15	20	185
Crank position sensor wheel welding to crank	Josh/Mark's VW Service			125		13	17	154
159mm Rods for tall deck ABA block x4	VW			450		45	59	554
Side clearance rods	Josh/Mark's VW Service			80		8	11	99
Hi-strength Rod bolt kit	ARP	104-6002		151		15	20	186
11.5:1 Pistons x4	Weisco	6611M835		625		63	83	770
Piston Ring Set x4	Weisco	8350XX		100		10	13	123
Rod Bearing Set	Techtonics Tuning	104 050		50		5	7	62
Main Bearing Set	Techtonics Tuning	104 101		85		9	11	105
Intermediate Shaft Bearings	Techtonics Tuning	104 150		35		4	5	43
Intermediate Shaft Seal	Techtonics Tuning	198 200		6		1	1	7
Crank driver side seal	Techtonics Tuning	198 191		45		5	6	55
Crank passenger side seal 1	Techtonics Tuning	GSK 010		4		0	1	5
Crank passenger side seal 2	Techtonics Tuning	198 200		6		1	1	7
Mk4 head Gasket (increasess CR by 0.5 over Mk3 gasket)	VW	06A 103 383 AS		70		7	9	86
Dowel pins/machining for crank sprocket	Josh/Mark's VW Service			120		12	16	148
Balance rotating assembly	Josh/Mark's VW Service			325		33	43	400
Mechanical Water Pump, internals machined out	PS			175		18	23	216
Crank Cam Timing Sprocket	BBM	027 105 263 B		75		8	10	92
Crank Sprocket machining (16mm ID)	PS			25		3	3	31
Crank Sprocket High-Strength M16x85 bolt (Mk7)	ARP/ESC Tuning	ARP06A01/2794733		50		5	7	62
M16 bolt length reduction (2mm)	PS			25		3	3	31
Distributor block-off plate	Josh/Mark's VW Service			60		6	8	74
Short block Assembly	Josh/Mark's VW Service			780		78	103	961
Sub-total								**6,735**

Engine - Cylinder Head								
VW 9A Cylinder head core	VW			480		48	63	591
Cylinder head prep, decking	Josh/Mark's VW Service			350		35	46	431
34mm valve seats x8	Techtonics Tuning	109 161		80		8	11	99
29.5mm valve seats x8	Techtonics Tuning	109 163		80		8	11	99
5.5mm tapered Valve Guides x8	Techtonics Tuning	109 225		60		6	8	74
7mm high-flow tapered valve guides x8	Techtonics Tuning	109 221		60		6	8	74
Cylinder head porting	Josh/Mark's VW Service			1,250		125	165	1,540
288 Cams set - solid lifter (254° @.050", .456" lift, 105° LC)	Techtonics Tuning	109 576		650		65	86	801
Timing Chain	Techtonics Tuning	109 062		17		2	2	21
Camshaft passenger side seal	Techtonics Tuning	198 200		6		1	1	7
34mm x 5.5mm stem Intake Valves x8	Techtonics Tuning	109 121		272		27	36	335
29.5mm x 7mm stem, 6.5mm undercut Exhaust Valves x8	Techtonics Tuning	109 431		248		25	33	306
High Lift Valve Springs (for VR6 application)	Techtonics Tuning	109 082H		240		24	32	296
Valve Bucket Solid Lifters	Techtonics Tuning	109 088AD		360		36	48	444
Lower Valve Seats	Techtonics Tuning	056 629		96		10	13	118
7mm Titanium triple-groove Valve Retainers x8	Techtonics Tuning	109 139		130		13	17	160
5.5mm Valve Keepers	Techtonics Tuning	109 292		32		3	4	39
7mm Valve Keepers	Techtonics Tuning	109 294		24		2	3	30
5.5mm Valve Lash Caps	Techtonics Tuning	-		60		6	8	74
7mm Valve Lash Caps x8	Techtonics Tuning	-		60		6	8	74
7mm Valve Stem Seals	Techtonics Tuning	109 321		16		2	2	20
5.5mm Valve Stem Seals	Techtonics Tuning	109 326		16		2	2	20
Cam cap studs 7x45mm x24	Techtonics Tuning	030103397A		144		14	19	177
Hi-strength undercut head stud kit	ARP	204-4702		201		20	27	248
16V ABF Valve Cover Gasket Set	Techtonics Tuning	109 321		65		7	9	80
Cylinder Head Assembly	PS			350		35	46	431
9A Valve Cover, blasted, anodized	PS			325		33	43	400
Sub-total								**6,988**

Engine Intake System								
45mm Independent throttle bodies, ABF direct-to-head mounting	AT Power			1,852	1,195	185	244	2,282
Dual fuel injector rails	AT Power			116	75	12	15	143
Mounting h/w	AT Power			39	25	4	5	48
40mm ram pipe set	AT Power			116	75	12	15	143
60mm ram pipe set	AT Power			116	75	12	15	143
45x110mm curved runners	AT Power			349	225	35	46	430
Throttle position sensor	AT Power			116	75	12	15	143
TPS Wiring harness	PS			25		3	3	31
Throttle cable	AT Power			93	60	9	12	115
ITB cylinder head heat insulator	AT Power			85	55	9	11	105
Throttle cable spring return assembly	PS			25		3	3	31
Lexan Air Box	PS			400		40	53	493
Air Box to Filter connector	PS			150		15	20	185
Air Filter	K&N			40		4	5	49
Vacuum log	PS			150		15	20	185
Vac log to ITB stainless hoses	PS			100		10	13	123
Vac log sender and wiring harness	GM/PS			75		8	10	92
ITB/Ram pipe mounting bracket	Performance Solutions			250		25	33	308
Misc h/w	PS			50		5	7	62
Subtotal								**5,110**

Engine Accessories								
Kent Adjustable Cam Sprocket	Kent Cams	15CA68		200		20	26	246
Intermediate Shaft Sprocket	VW	049 109 111 C		32		3	4	39
Timing Belt Tensioner	Techtonics Tuning	109 056		35		4	5	43
Timing Belt Tensioner Tool	Techtonics Tuning	864 000		18		2	2	22
Engine/trans mount brackets, prep, painted	VW/PS			225		23	30	277
Passenger side engine mount aluminum spacer	PS			25		3	3	31
Engine/trans solid rubber mount bushings - stage 1	Blackforest Industries	EBFIMK1ST1K		150		15	20	185
ABF timing belt	Techtonics Tuning	109 053		85		9	11	105
Spark plug wires, Competition KV85, 8.5mm, custom lengths	Magnecore	KV85-custom		275		28	36	339
Spark Plug Wire Support Bracket	PS	-		125		13	17	154
Shielding	PS			25		3	3	31
Spark plugs - medium heat range	Denso	IK20		25		3	3	31
Knock sensor and wiring harness	Bosch/PS			78		8	10	96
Crank position sensor and wiring harness	Bosch/PS	021907319b		85		9	11	105
Cam position sensor and wiring harness	Bosch/PS			275		28	36	339
EAA billet aluminum alternator mounting bracket/serpentine belt kit	EAA			685		69	90	844
Water Pump	Techtonics Tuning	121 010		85		9	11	105
Water Pump machining for EWP conversion, block offs	PS			75		8	10	92
Alternator adjustable tension mechanism	PS			75		8	10	92
50amp racing adjustable voltage alternator, XS-Volt	PowerMaster	8168		305		31	40	376
Alternator pulley	PS/Summit Racing			15		2	2	18
Alternator belt. 865mm 6v	Bendo			15		2	2	18
Alternator power cable	PS			35		4	5	43
Alternator ECU wiring harness	PS			25		3	3	31
Racing damper with custom offset spacer	Fluidampr/INA Engineering	551201		550		55	73	678
Damper 12.9 allen head bolts	Bolt Depot			8		1	1	10
Damper & Crank sprocket protector cover	PS			150		15	20	185
Starter Motor, power cable & wiring harness	VW/PS			90		9	12	111
Subtotal								**4,646**

Engine Oiling System								
36mm 16V German Oil Pump	Techtonics Tuning	115 208 NP		190		19	25	234
Oil Pump Pickup Tube	Techtonics Tuning			82		8	11	101
German Oil Pan	VW			40		4	5	49
5L full synthetic engine oil 5W40	Joe Gibbs	DT-40		55		6	7	68
VW Mk3 Motorsport Windage Tray	VW	037115220B		45		5	6	55
Oil DipStick, tube	VW			40		4	5	49
Oil pump priming tool	VW/PS			150		15	20	185
Crankcase breather system	PS/K&N			350		35	46	431
Oil filter system, reusable metal 25micron mesh filter element, -12AN	K&N	81-1002		120		12	16	148
Oil filter block adapter plate	Improved Racing			105		11	14	129
Oil filter stainless hoses -12AN x2	PS			150		15	20	185
Oil thermostat 200 deg F sandwich plate, -10AN fittings	Mocal	SP1XT		120		12	16	148
Mocal/Laminova oil cooler	Mocal			310		31	41	382
Oil Cooler custom mounting bracket	PS			50		5	7	62
Block oil filter bracket	VW	053 115 417 A		45		5	6	55
Oil cooler stainless hoses - 10AN x2	PS			125		13	17	154
Oil temperature sender & wiring harness	VW/PS			50		5	7	62
Oil Pressure sensor	Holley	554-102		120		12	16	148
Oil Pressure sensor wiring harness	PS			25		3	3	31
Subtotal								**2,676**

Engine Intake System								
45mm Independent throttle bodies, ABF direct-to-head mounting	AT Power			1,852	1,195	185	244	2,282
Dual fuel injector rails	AT Power			116	75	12	15	143
Mounting h/w	AT Power			39	25	4	5	48
40mm ram pipe set	AT Power			116	75	12	15	143
60mm ram pipe set	AT Power			116	75	12	15	143
45x110mm curved runners	AT Power			349	225	35	46	430
Throttle position sensor	AT Power			116	75	12	15	143
TPS Wiring harness	PS			25		3	3	31
Throttle cable	AT Power			93	60	9	12	115
ITB cylinder head heat insulator	AT Power			85	55	9	11	105
Throttle cable spring return assembly	PS			25		3	3	31
Lexan Air Box	PS			400		40	53	493
Air Box to Filter connector	PS			150		15	20	185
Air Filter	K&N			40		4	5	49
Vacuum log	PS			150		15	20	185
Vac log to ITB stainless hoses	PS			100		10	13	123
Vac log sender and wiring harness	GM/PS			75		8	10	92
ITB/Ram pipe mounting bracket	Performance Solutions			250		25	33	308
Misc h/w	PS			50		5	7	62
Subtotal								**5,110**

Nitrous System								
Nitrous solenoid	Wizards of Nitrous	X-10		758	489	76	100	934
4mm line fittings	Wizards of Nitrous							
5mm line fittings	Wizards of Nitrous							
Olives	Wizards of Nitrous							
15 & 20hp jets	Wizards of Nitrous							
4mm and 5mm lines	Wizards of Nitrous							
5mm line extention coupler	Wizards of Nitrous							
5mm to -4AN coupler	Wizards of Nitrous							
Intake Manifold injectors x4	Wizards of Nitrous							
Purge solenoid	Edelbrock	72000		86		9	11	106
Solenoid to solenoid stailness steel teflon -4AN hose, fittings	PS			65		7	9	80
PWM Solid state relay for nitrous solenoid	Holley	54-111		105		11	14	129
relay for purge solenoid	PS			20		2	3	25
arming switches	PS			20		2	3	25
related wiring harnesses	PS			75		8	10	92
custom brackets	PS			75		8	10	92
Sub-total								**1,483**

Engine - Cooling System								
Radiator, shroud	BS&B Custom Radiators		658	487		49	64	600
-10/-12/-16/-20AN to O-ring fittings	Summit Racing			80		8	11	99
10" high volume Puller Fans	Spal	IX-30100374		156		16	21	192
Mounting h/w	PS			25		3	3	31
Adjustable Fan #1 voltage controller	PS			75		8	10	92
Fan Relays & wiring harnesses	PS			50		5	7	62
Electric Water Pump (EWP-80) Kit	Davies Craig	8005		255		26	34	314
-20AN EWP fittings	Davies Craig	1026		70		7	9	86
EWP Digital Controller Kit	Davies Craig	8001		285		29	38	351
EWP Controller mounting bracket	PS			25		3	3	31
-20AN coupler: EWP to Radiator	Earls	AT915120ERL		51		5	7	63
Temperature Sensors/harnesses x 3	PS			150		15	20	185
-20AN stainless hose to block mechnical pump housing	PS			90		9	12	111
-16AN hose to front of cylinder head	PS			110		11	15	136
-16AN fitting/coupler to cylinder head	PS			80		8	11	99
Coolant Expansion/Fill Tank, 1.25 Quart	Canton	2584		120		12	16	148
Cooling system pressure release cap, 16psi	Stant	10331		8		1	1	10
Heater Core	Techtonics Tuning	121 161		60		6	8	74
Heater Core hoses & valve	PS			45		5	6	55
-12AN stainless hose to side of cylinder head	PS			90		9	12	111
-10AN stainless hose to header core valve	PS			75		8	10	92
-6AN stainless hose and valve to overflow tank	PS			60		6	8	74
-6AN stainless return hose from overflow tank	PS			60		6	8	74
Subtotal								**3,089**

Exhaust								
Header-Engine Block support bracket	PS			225		23	30	277
2-1/4" Stainless Steel Cat-back exhaust system	Techtonics Tuning	252 409B		525		53	69	647
Borla T-304 Stainless Muffler	Techtonics Tuning					0	0	0
2.5"Stainless Tail Pipe/support	PS			150		15	20	185
Catalytic Converter + Flex Pipe Assembly	PS/Techtonics Tuning			375		38	50	462
Custom 1-3/4" Raace Stainless T-304 Header	Techtonics Tuning			750		75	99	924
Gaskets	Techtonics Tuning			35		4	5	43
Quick-connect Stainless T-304 couplings/fabrication	PS			275		28	36	339
Stainless Steel Exhaust clamps	Techtonics Tuning	254 050H/HD		32				
Stainless Resonator w flex pipe	Vibrant/PS			275		28	36	339
Polishing	JetFab/PS			200		20	26	246
High Temp wrap/shielding	PS			200		20	26	246
Electroplating Services	PS			75		8	10	92
Subtotal								**3,801**

Suspension/Wheels								
Front Steering Knuckles	Josh/Mark's VW Service			160		16	21	197
Front Bearings	Techtonics Tuning	400 100		66		7	9	81
Racing Axles, CV joints, boots (rated to 500hp)	The Driveshaft Shop			1,230		123	162	1,515
Front Axle wheel studs	The Driveshaft Shop			125		13	17	154
Wheel Stud Installer	Lisle	22800		25		3	3	31
Transmission Flange bolt driver				20		2	3	25
High performance street/track Coilover struts, front/rear	KW	Variant 3, 35280001		2,200		220	290	2,710
250lbs/in 7" & 200lbs/in 8" springs	Eibach/Ground Control			300		30	40	370
22mm Strut Nut Socket, 1/2" Drive	Techtonics Tuning	T30 780		50		5	7	62
HD Strut Mounts	Febi-Bilstein	171 412 329A		60		6	8	74
Strut Mount Urethane Injection	PS			35		4	5	43
Rear upper shock mount kit	KYB			20		2	3	25
28mm hollow rear sway bar kit	Autotech	10-525-1028GK		220		22	29	271
OEM rear sway bar mounting brackets	VW			120		12	16	148
Delrin rear bushings	Lella Autosport	100 105		105		11	14	129
Control Arms with Prothane Urethane Bushings, ball-joints	Blackforest Industries	SBFCAMKI-BJ		145		15	19	179
nuts, bolts, washers	PS			40		4	5	49
Rear Trailing Arm prep/paint	PS			400		40	53	493
Rear axles	Techtonics Tuning	333501117		126		13	17	155
Rear Bearings	Techtonics Tuning	405 620		50		5	7	62
15mm Rear axle spacers	Lella Autosport			72		7	10	89
Rear Axle wheel studs	The Driveshaft Shop			75		8	10	92
Rear 3mm wheel spacers	ESC Tuning	ECS10162KT		48		5	6	59
Front 5mm wheel spacers	ESC Tuning	ECS10164KT		48		5	6	59
Snowflake wheels - stripping/machining/painting	Greens Automotive		1,100	825		83	109	1,016
185/60-14 Sport tires	Dunlop	Direzza-zII		500		50	66	616
Tire mounting/balancing	Weissach Porsche			80		8	11	99
Wheel stud nuts - racing, open ends	Gorilla			75		8	10	92
Wheel stud lock nuts - racing, open ends	Gorrila			35		4	5	43
Alignment/R&P pinion depth calibration	Weissach Porsche		2,400	1,800		180	238	2,218
Sub-total								**11,156**

Transmission								
VW 020 2Y Transmission, Quaife LSD, ARP h/w	German Transaxle of America			2,855		286	377	3,517
Aluma Blast Silver Paint - 2 cans	Eastwood			35		4	5	43
Ring Gear Bolt Kit	ARP	204-3001						
6 puck 'stage 5' Clutch	California Clutch			550		55	73	678
Clutch alignment tools	Techtonics Tuning			35		4	5	43
1800lbs pressure plate	California Clutch							
ARP high strength Pressure Plate Bolts	Techtonics Tuning	141 108A		60		6	8	74
Flywheel Bolts	Techtonics Tuning	141 109		10		1	1	12
tranmission dust shields						0	0	0
Shift Kit	Techtonics Tuning	798 210-1		64		6	8	79
Shit Rod assembly with bushing	Techtonics Tuning	720 010		90		9	12	111
Racing adjustable shifter linkage system	USRT	SMARTSHIFT1		160		16	21	197
Clutch Cable Termination	USRT	SHIFTMUSHM		65		7	9	80
Clutch Cable	Mk1Autohaus			40		4	5	49
VW OEM shifter	Mk1Autohaus	171711247		30		3	4	37
Golfball Knob	Mk1Autohaus	171-711-141/E		55		6	7	68
Golfball knob extension	PS			25		3	3	31
0.76 5th gear, tools, gaskets	Broke VW/PS			275		28	36	339
Sub-total								**5,358**

Steering System								
Custom leather/foam GTI Steering wheel	Craft Customs			400		40	53	493
Custom steering shaft Upper bearing	PS			35		4	5	43
Lower steering column bearing inner race/Bearing/clamp	Tech-53	171-419-518A		93		9	12	115
Custom Support bracket	PS			200		20	26	246
Custom u-joint system	PS			300		30	40	370
Quaife quick ratio R&P	EAA/Quaife/Meyle			624		62	82	769
R&P Delrin inner sleeves	Tech-53			25		3	3	31
Tie-rod ends	Parts Place Inc	2070		50		5	7	62
Tie-rod boots	Parts Place Inc	2079		10		1	1	12
Urethane R&P bushings, black/race	PowerFlex	PFF85-230B		60		6	8	74
U-joint boot	VW			65		7	9	80
Sub-total								**2,294**

Brake System								
Tech-53/Wilwood large 4 piston front calipers	Tech-53	BBKMK1		700		70	92	862
Hawk Sport Front Pads x2 (spare pad set)	Hawk/Tech-53	HB542F.490		125		13	17	154
10.1" Slotted/Drilled Front Sport Rotors	EBC	USR478		200		20	26	246
9.4" VW Mk2 Slotted/Drilled Rear Rotors	Momentum Motorsports					0	0	0
VW Mk4 Aluminum Rear Caliper Kit	ESC Tuning	ECS698423424		210		21	28	259
Stainless Steel Brake lines	ESC Tuning	ES#248977		110		11	15	136
Adjustable Proportioning valve	Wilwood	260-11179		100		10	13	123
Mini proportioning valve	Speedway	91031357		35		4	5	43
VW Mk3 non-ABS Brake Servo	eEuroParts	1H1612107C		285		29	38	351
VW/Audi 25.4mm Master Cylinder	Bolt Action	#BLM_254		190		19	25	234
Coupling h/w	PS			75		8	10	92
Dual Wall hard steel brake Lines	Mk1autohaus			150		15	20	185
Fittings	Mk1autohaus			75		8	10	92
pedal rubber pads	Mk1autohaus			25		3	3	31
pedal cluster bushings	VW Heritage			20		2	3	25
Vacuum pump	GM/AC Delco	20939309		120		12	16	148
Vacuum pump sensor, hoses, clamps, wiring harness, bracket, relays	GM/PS			250		25	33	308
e-brake cables, mk2 for Disk brakes	Techtonics Tuning	609 130		60		6	8	74
e-brake h/w/cover	Mk1autohaus			20		2	3	25
SRF Brake Fluid - high temperature racing synthetic	Castrol			80		8	11	99
Sub-total								**3,487**

Air Conditioning System								
12V variable speed 3000BTU Compressor	Boyard	BOYANG JVB075Z12		570		57	75	702
Custom #6 & #8 male o-ring fittings installed	PS			50		5	7	62
Compressor mounting bracket and isolation system	PS			125		13	17	154
Variable Speed Controller	Boyard			inc				
Controller mounting bracket	PS			75		8	10	92
Wiring Harnesses, temperature sensors, relays	PS			225		23	30	277
Custom #6 & #8 A/C reduced barrier hoses	PS			450		45	59	554
Evaporator & Blower motor Shrouds	PS			225		23	30	277
Evaporator Core	Four Seasons	54277		75		8	10	92
Evaporator Machining, welding, custom fittings	PS/Jetfab			750		75	99	924
Condensor Core	AC & Collision Parts	CNFP1216		40		4	5	49
Condensor mounting brackets	PS			75		8	10	92
Filter/Accumulator				20		2	3	25
PAG Oil				50		5	7	62
Centre Vents (cabriolet)	PS			150		15	20	185
Fans x7, wiring harnesses	PS			210		21	28	259
Lexan Shroud	PS			75		8	10	92
R134a Charging	PS			200		20	26	246
Sub-total								**4,146**

Interior								
Molded Ultra-plush carpet kit	Stock Interiors	VW Midnight Blue		225		23	30	277
Matching ultra-plush floor mats (4)	Stock Interiors	VW Midnight Blue		125		13	17	154
Matching ultra-plush trunk carpet	Stock Interiors	VW Midnight Blue		150		15	20	185
Carpet Installation, glue	PS			250		25	33	308
Headliner	Stock Interiors			140		14	18	172
Headliner Installation, glue	PS			250		25	33	308
Seat Fabric	VW/SMS			800		80	106	986
Vinyl	subcontracted			250		25	33	308
Plastic & Vinyl custom colour paints/dyes	Parasol Inc.			1,000		100	132	1,232
Upper door trim	VW Heritage	171867220		110		11	15	136
Custom Flip-out panel	PS			200		20	26	246
Seat upolstering	subcontracted			4,000		400	528	4,928
Seat frame custom bracing/welding/painting	PS			400		40	53	493
Seat hardware, plastic parts, misc	VW			300		30	40	370
Mass loaded vinyl sound damping sheets 0.110"	FatMat	0.110"		250		25	33	308
Other parts	Heritage VW			250		25	33	308
Heated seats kits	amazon			120		12	16	148
Heated Seats Wiring harnesses, relays, potentiometers	PS			50		5	7	62
New locks rekey service - doors, hatch, stalk	CrazyQuiffs UK			150		15	20	185
Seat foam - high density, custom cutting	Foam Shop			400		40	53	493
Rear seat belts	ebay			75		8	10	92
Seat Belt mounting h/w	Bolt Depot			25		3	3	31
Rear Side Trays	ebay			50		5	7	62
Blower motor	VW OEM	251 819 015		75		8	10	92
Blower Motor wiring harness/PCB	PS			150		15	20	185
Visors	ebay			120		12	16	148
Floor foam, 1"	amazon			75		8	10	92
New centre console/gauges	VW OEM			150		15	20	185
New shift boot	Mk1autohaus			58		6	8	71
Electric Window Mechanism - VW Mk2	Aftermarket	191837481A		150		15	20	185
Electric Window custom mounting h/w	PS			175		18	23	216
Sub-total								**12,964**

Bodywork - metalwork								
Welding gases, Argon, CO2/Argon mix	various		400	296		30	39	365
Welding rods, mild and stainless	various		125	93		9	12	114
Brazing rods	various		50	37		4	5	46
Welding wire spools	various		100	74		7	10	91
Brazing wire spools	various		300	222		22	29	274
Torch tips consumed	various		250	185		19	24	228
1/16" and 3/32" cutoff wheels	various		125	93		9	12	114
Mild Steel panels, 0.040" 1/16" 3/32" 1/8"	Online Metals		250	185		19	24	228
Aluminum panels 0.040" 1/16" 3/32" 1/8"	Online Metals		100	74		7	10	91
Stainless Steel panels 0.040" 1/16" 3/32" 1/8"	Online Metals		250	185		19	24	228
Aluminum plate, 1/8x3/4", 1/8X1.5"	Online Metals		50	37		4	5	46
Mild steel plate, 1/8x3/4", 1/8X1.5"	Online Metals		50	37		4	5	46
Stainless steel plate, 1/8x3/4", 1/8X1.5"	Online Metals		75	56		6	7	68
Steel round tube, square tube, rectangular tube - frame	Online Metals		250	185		19	24	228
Aluminum rectangular tube - bumpers	Online Metals		75	56		6	7	68
Brass Rod stock, various diameters	Online Metals		100	74		7	10	91
Aluminum Blocks, various	Online Metals		250	185		19	24	228
replacement panel - passenger floor	PS/Klokkerholm	95-20-75-3	500	370		37	49	456
replacement panel - driver floor	PS/Klokkerholm	95-20-75-4	500	370		37	49	456
replacement panel - passenger front wing upper mount	PS/Klokkerholm	95-20-42-1	400	296		30	39	365
replacement panel - driver front wing upper mount	PS/Klokkerholm	95-20-42-2	400	296		30	39	365
replacement panel - lengthwise floor support x 2	PS/Klokkerholm	95-20-81-0	250	185		19	24	228
replacement panel - fuel filling panel	PS/Klokkerholm	95-20-52-2	500	370		37	49	456
replacement panel - driver rear frame side rail with support	PS/Klokkerholm	95-20-84-1	250	185		19	24	228
replacement panel - passenger rear frame side rail with support	PS/Klokkerholm	95-20-84-2	250	185		19	24	228
Strut Tower to front frame welded braces	PS		400	296		30	39	365
Double firewall welded	PS		300	222		22	29	274
Subframe welded	PS		1,500	1,110		111	147	1,368
Interior box frame welded	PS		1,500	1,110		111	147	1,368
Drill bits consumed	various		150	111		11	15	137
End-mills consumed	various		100	74		7	10	91
Vibrating Tool & bits consumed	various		150	111		11	15	137
Die Grinder consumed	Makita		325	241		24	32	296
Wire Wheels consumed	3M		150	111		11	15	137
Sand Blasting Media	Eastwood			130		13	17	160
3M paint removal disks, various	3M		125	93		9	12	114
Protective face shield screens	3M		40	30		3	4	36
Acid Etching - 2 gallons	Eastwood			125		13	17	154
Brushes	various		30	22		2	3	27
Sub-total								**9,996**

Bodywork - filling/sanding/painting								
Carbon Fiber Hood	PS/LWS Design - UK			1,875	500	188	248	2,310
Carbon Fiber Hatch	PS/LWS Design - UK			2,250	600	225	297	2,772
Carbon Fiber Bumpers	PS/LWS Design - UK			1,500	400	150	198	1,848
Lexan Rear Window	PS		250	185		19	24	228
Short-strand fiberglass filler - 2 gallons	Evercoat			96		10	13	118
Automotive body filler - 2 gallons	Evercoat			96		10	13	118
Glazing putty - 3 24oz tubes	Evercoat			176		18	23	217
Flexible filler	Evercoat			132		13	17	163
Filler mixing paper, application spatulas	3M			50		5	7	62
Sand paper rolls 80/120/220/320/400/600 grit x18	various			450		45	59	554
Sanding disks 80/120/220/320/400/600/800/1000/1200/1500/2000 - 11	3M			132		13	17	163
Sanding blocks	various			50		5	7	62
Wet sanding paper 600/800/1000/1200/1500/2000/3000	3M			300		30	40	370
Surface Degrease - 2 gallons	Southern Polyurethane			80		8	11	99
Acid Etch Primer - 10 rattle cans	Eastwood			175		18	23	216
Epoxy 2K primer, white/black/grey - 6 gallons	Southern Polyurethane		1,128	835		83	110	1,028
High-Build 2K primer - 2 gallons	Southern Polyurethane		310	229		23	30	283
Undercoating - 10 cans	Eastwood			105		11	14	129
Wax Door Panel spray kit	Eastwood			120		12	16	148
Seam Sealer - 2 tubes	Eastwood			30		3	4	37
Silver Base Coat - 3 gallons	Automotive Touchup			975		98	129	1,201
Silver Base Coat - 4 rattle cans	Automotive Touchup			80		8	11	99
Clear 2K top Coat - 4 gallons	Automotive Touchup			580		58	77	715
Clear 2K top Coat - 4 rattle cans	Automotive Touchup			64		6	8	79
Mixing cups, various	various			40		4	5	49
Aerosol Injected Cleaner - 10 cans	Eastwood			90		9	12	111
Xylene, Laquer Thinner - 6 gallons	various		150	111		11	15	137
Brake Cleaner - 36 cans	various		324	240		24	32	295
Paper towels	various			50		5	7	62
Organic canister masks	3M			100		10	13	123
Masking tape - various	3M/Norton			150		15	20	185
Masking paper & plastic sheeting	3M/Norton			250		25	33	308
Temporary paint booth, filters				1,500		150	198	1,848
Descecant filter canister	Devibliss			125		13	17	154
Spray guns/filters/accessories consumed	Eastwood			400		40	53	493
Polishing Compounds	3M			75		8	10	92
Polishing pads/cloths	3M			125		13	17	154
								17,027

Misc - braces, striping, seals, windows, shielding, hardware								
Sunroof - edge seal/molding	Mk1autohaus	321877209A		140		14	18	172
Sunroof - cable system	Mk1autohaus			140		14	18	172
Sunroof - wind deflector	ebay			150		15	20	185
Sunroof - misc parts/springs/bushings/winder handle	ebay			250		25	33	308
Replacement OEM side mirrors	ebay			150		15	20	185
Convex glass for side mirrors x2	Burco	BUR-3513-1983		50		5	7	62
Waist body moldings	Mk1autohaus			110		11	15	136
Lower rocker moldings	Mk1autohaus			75		8	10	92
Lower stripes	Mk1autohaus			80		8	11	99
Rear Hatch moldings	Mk1autohaus			80		8	11	99
Front Grill GTI emblem	Mk1autohaus			23		2	3	28
Rear hatch Rabbit GTI emblem	Mk1autohaus			29		3	4	36
Rear hatch Volkswagon emblem	Mk1autohaus			19		2	3	23
Custom car Cover	Car Covers	platnium series		195		20	26	240
Upper strut frame brace	Eurosport	430 110-1		190		19	25	234
Lower control arm brace	Neuspeed			100		10	13	123
Front engine mount/frame brace	GoKraut			175		18	23	216
Misc Glue & sealants	Amazon			500		50	66	616
zinc plating for various parts	PS/Caswell			250		25	33	308
Door Handles/Inserts/Seals	Mk1autohaus			91		9	12	112
Door Locks	Mk1autohaus			25		3	3	31
Cylinder Lock	Mk1autohaus			38		4	5	47
Keys	Mk1autohaus			54		5	7	67
Door Striker Pins	Mk1autohaus			30		3	4	37
Door Catches/Mechanisms	Mk1autohaus			48		5	6	59
Hatch Seal	Mk1autohaus			55		6	7	68
Hood Release cable/lever	Mk1autohaus			27		3	4	33
Engine area rain-tray seals	ebay			40		4	5	49
Front windscreen	FW443	FW443	550	407		41	54	501
Front windscreen seals/installation			inc	0		0	0	0

Driver/Passenger Window Seals - complete kit x 2	Mk1autohaus			930		93	123	1,146
Rear Quarter Window Seals	Mk1autohaus			90		9	12	111
Hatch Window Seal	Mk1autohaus			55		6	7	68
Glass Polishing Kit	ebay			125		13	17	154
Rain tray drain grommets	Mk1autohaus			44		4	6	54
Wiper arms/blades	Bosch			90		9	12	111
Wiper motor	Mk1autohaus			95		10	13	117
Wiper intermittent relay	Mk1autohaus			12		1	2	15
Wiper stalk	Mk1autohaus			38		4	5	47
Turn signal stalk	Mk1autohaus			38		4	5	47
Washer fluid pump, reservior, tubing, jet	PS			150		15	20	185
Fuel Filler Neck Sticker/Seal	Mk1autohaus			25		3	3	31
Hatch Strut/hardware	Mk1autohaus			47		5	6	58
Hood Pins	Quik Latch	QL-25S		80		8	11	99
Electricity consumed - heat, light, power (2kW av x 24 x 180 x 4 x $0.12)	BC Hydro		4,147	3,069		307	405	3,781
Stainless Steel fasteners	Bolt Depot			500		50	66	616
Heat shielding	Thermo-Tec	13575		192		19	25	237
								11,212

Fuel system								
Walbro 155lph Fuel Pump	Kinsler Fuel Injection	22003		195		20	26	240
Fuel Pump Mounting Kit, misc fittings	Kinsler Fuel Injection	22008		75		8	10	92
Fuel Pump/Filter Stainless Mounting Bracket	PS		150	111		11	15	137
Fuel Pump Monster Mesh Pre-Filter Housing #8 25micron	Kinsler Fuel Injection	8308-025		160		16	21	197
Fuel Pump Monster Mesh Post-Filter Housing #6 10micron	Kinsler Fuel Injection	8308-010		140		14	18	172
Filter Fittings	Kinsler Fuel Injection			80		8	11	99
Fuel Pressure Regulator/Aeromotive	Kinsler Fuel Injection	10745		220		22	29	271
19Lbs/hr Fuel Injectors x 4	Holley	522-191		200		20	26	246
30Lbs/hr Fuel Injectors x 4	Holley	522-301		200		20	26	246
Fuel tank, Epoxy coated	VW Heritage			235		24	31	290
fuel level sender & wiring harness	Mk1autohaus	171919051L		45		5	6	55
Stainless tank straps kit	Rabbit Parts/ebay			75		8	10	92
Tank vapour release distribution module/fittings	PS			225		23	30	277
Tank pressure release valve	Newton	TPV6		190		19	25	234
-6AN stainless line from tank to evap module	PS			150		15	20	185
-6AN line from evap module to pressure release valve	PS			150		15	20	185
Misc fittings and clamps				100		10	13	123
Stainless steel mounting bracket for pump & filters	PS			75		8	10	92
Fuel filler cap/seal	VW Heritage			30		3	4	37
35mm tank filler hose and clamps	VW Heritage	N90119601		37		4	5	46
-6AN stainless hose from fuel pump to engine	PS			300		30	40	370
-6AN stainless hose from regulator to tank	PS			300		30	40	370
-8AN stainlesss hose from tank to pre-filter	PS			150		15	20	185
-6AN stainless Y line to fuel injector rail	PS			75		8	10	92
-6AN stainless Y line to regulator	PS			75		8	10	92
-8AN stainless line from pre-filter to pump	PS			75		8	10	92
-6AN line from pump to port-filter	PS			75		8	10	92
Fuel Pressure Gauge	Aeromotive	15633		42		4	6	52
								4,663

Electrical/electronic								
Dominator ECU	Holley	554-114		2,150		215	284	2,649
Main Power Harness	Holley	558-308		55		6	7	68
Main unterminated wiring harness	Holley	558-105		280		28	37	345
8 Fuel Injector wiring harness	Holley	558-204		120		12	16	148
Ignition unterminated wiring harness	Holley	558-306		105		11	14	129
Ignition coils	Holley	556-104		225		23	30	277
Wideband Exhuast O2 sensor	Holley	554-101		95		10	13	117
Air Temperature Sensor	Kinsler Fuel Injection	10652		35		4	5	43
MAP Sensor	Kinsler Fuel Injection	10654		70		7	9	86
MAP Sensor Harness	Kinsler Fuel Injection	10410		5		1	1	6
Fuel Pressures Sensor	Holley	443-102		120		12	16	148
Idle Air Control (IAC) Motor	Kinsler Fuel Injection	10660		75		8	10	92
IAC Housing	Kinsler Fuel Injection	10662		70		7	9	86
IAC Air Filter	Kinsler Fuel Injection	10663		30		3	4	37
IAC wiring harness	PS			35		4	5	43
Dash Touch Screen	Holley	553-103		750		75	99	924
Touch Screen Mounting Bracket	PS			50		5	7	62
ECU Expansion wiring harness	Holley	558-400		70		7	9	86
2 axis accelerometer	Hyperaktive	HPS-DAA1		300		30	40	370
Accelerometer bracket & wiring harness	PS		50	37		4	5	46
Nitrous PWM Solid State Relay for X-10 Quadranoid	Holley	554-111		93		9	12	115
Nitrous Relay for purge solenoid/harness	PS			35		4	5	43
ECU/Ignition Module mounting bracket	PS			75		8	10	92
5 Channel 125W x 4 + 500W x 1 power amp/digital EQ	Kicker	IX1000.5		750		75	99	924
Blue-tooth controller	Kicker	IQI Interface		250		25	33	308
Remote control module	Kicker	IQ Remote		0		0	0	0
Carbon Fiber 10" sub-woofer	Rockford-Fosgate	T1S2-10	850	629		63	83	775
Sub-woofer enclsosure	PS		250	185		19	24	228
Mid-base drivers	Hertz	165		250		25	33	308
High frequency drivers	Hertz	inc		0		0	0	0

Head-end AM/FM/Cassette unit	Concord	HPL-130		700		70	92	862
Head-end Dolby B/C NR module	Concord	HPQ-89		200		20	26	246
Active antenna				50		5	7	62
Speaker brackets	PS			50		5	7	62
Mounting hardware	PS			50		5	7	62
Audio system wiring harnesses/100a breaker/power cables	PS			250		25	33	308
LiFePO4 main system 24Amp-hour battery	EarthX	ETX1200		725		73	96	893
Wireless main battery disconnect system	Battery Prog Brain	T3		80		8	11	99
Rear wheel-well Lexan mounting enclosure	PS		350	256		26	34	315
Main battery system battery cables	PS			250		25	33	308
Rear wheel-well misc harnesses	PS			250		25	33	308
Main fuse/relay panel system	PS			750		75	99	924
Current sensor system	PS		250	185		19	24	228
14.6V 10A LiFePO4 Charger	Tenergy	1034		40		4	5	49
Wheel well lexan mounting plates/brackets/hardware	PS		400	296		30	39	365
Rearview mirror	Boyo	VTM43M4		235		24	31	290
Front & rear cameras/mounting brackets	PS/ebay			150		15	20	185
LED headlights	Philips	12953BWX2		220		22	29	271
Running/brake/turn signal/stop/reverse/license plate lights	various			200		20	26	246
All Light Housings	various			250		25	33	308
All Light harnesses	PS			250		25	33	308
								15,253
							Total US$	**137,791**
							Total C$	**186,205**

Spare Parts List:								
Bentley VW A1/Mk1 Shop Manual	Bentley	VW A1		85		9	11	105
Bentley VW A2/Mk2 Shop Manual	Bentley	VW A2		85		9	11	105
Bentley VW A3/Mk3 Shop Manual	Bentley	VW A3		85		9	11	105
ABF timing belt	Techtonics Tuning	109 053		85		9	11	105
Timing Belt Tensioner Tool	Techtonics Tuning	864 000		18		2	2	22
Air filter cleaner	K&N			10		1	1	12
Air filter oil	K&N	inc						
83.5mm piston installing ring	ARP			31		3	4	38
Piston knocker tool	Summit Racing			20		2	3	25
60mm ram pipe set	AT Power			116	75	12	15	143
Set of colder spark plug for nitrous use	Denso	IK22		25		3	3	31
Set of intake and exhaust valve spare shims, installation tools, etc	Techtonics Tuning	misc		50		5	7	62
Crank sprocket dowel pins	misc			0		0	0	0
Electric Water Pump	Craig Davies	EWP-80		140		14	18	172
Electric Water Pump external power test harness	PS			5		1	1	6
Walbro 155lph Fuel Pump	Kinsler Fuel Injection	22003		195		20	26	240
Fuel Pump Monster Mesh Paper Pre-Filter 40 micron	Kinsler Fuel Injection	8320-040		40		4	5	49
Fuel Pump Monster Mesh Paper Post-Filter 10 micron (qty 2)	Kinsler Fuel Injection	8320-010		70		7	9	86
Fuel Pump Monster Mesh Metal (reusable) Pre-Filter 25 micron	Kinsler Fuel Injection	8325-025		60		6	8	74
-6AN and -8AN hose end plugs (male & female)	Aeromotive			30		3	4	37
-6AN, -8AN, -10AN & -12AN hose fitting aluminum crush washers	Spruce Aircraft			30		3	4	37
Inner CV joint installation tool				15		2	2	18
Inner CV gaskets				10		1	1	12
Stage 3 Pressure Plate, 2 clutch disks, flywheel	California Clutch/VW			400		40	53	493
Clutch installation and alignment tools	Techtonics Tuning			25		3	3	31
Shifter gear lever	Meyle	171 711 247		30		3	4	37
Shift rod bracket/bushing	Mk1Autohaus			20		2	3	25
5th Gear Set, 16V ratio, installation tools	VW/misc			225		23	30	277
EBC USR478 Sport Slotted Rotors, black powder coated (2 sets)	USR	478		450		45	59	554
Sport/Street front pad set	Hawk	HB542F.490		75		8	10	92
Anti-squeak compound, rear axle covers, nuts, washers, misc	misc			20		2	3	25
Wheel nuts, lock tool, OEM wheel nut covers	misc			25		3	3	31
Low Profile Aluminum Jack Stands: 3 Ton Capacity, 1 Pair	Torin			75		8	10	92
Stainless Steel Resonator/Flex pipe (Catalyst replacement)	Vibrant			250		25	33	308
Exhaust h/w, hangers	misc			15		2	2	18

KW Coilover adjustment tools kit	KW					0	0	0
KW 342/285lbs-in spring sets (track use)	KW			400		40	53	493
Front strut/bearing installation socket tool	Techtonics Tuning			35		4	5	43
R134a refrigerant (4 cans)	misc			40		4	5	49
Silver Paint touchup kits	Automotive Touchup			250		25	33	308
Silver Base Coat spray cans	Automotive Touchup			0		0	0	0
Silver Base Coat - gallon can (partial)	Automotive Touchup			0		0	0	0
Black plastic paint - spray cans	Parasol			0		0	0	0
Midnight Blue plastic paint - spray cans	Parasol			0		0	0	0
Midnight Blue plastic paint - quart	Parasol			0		0	0	0
Red accent plastic paint - quart	Parasol			0		0	0	0
GTI lower stripe kit	Mk1Autohaus			0		0	0	0
Waistline molding	misc			0		0	0	0
Windshield molding	misc			0		0	0	0
Plastic/Lexan 'glass' cleaner	misc			0		0	0	0
Rust Preventitive spray	misc			0		0	0	0
Deluxe car cover	misc			0		0	0	0
Driver side 'flat' mirror	misc			0		0	0	0
Spare fasteners/bushings/screws/pins/clips/covers	misc			0		0	0	0
Rear shock covers	misc			0		0	0	0
Seat track covers	misc			0		0	0	0
Rear seat carpet rests	misc			0		0	0	0
Seat mounting h/w	misc			0		0	0	0
Seat installation h/w	misc			0		0	0	0
Rear hatch tray hangers	misc			0		0	0	0
ECU wiring pins	misc			0		0	0	0
Relays, crimp ends	misc			1		0	0	1
Battery disconnect remote FOB (spare)	misc			0		0	0	0
Ignition/door key (spare)	misc			0		0	0	0
LiFePO4 battery charger w software controller module	misc			250		4	5	49
Alternator belts - various lengths	misc			0		0	0	0
Stainless Steel alternator bracket	misc			0		0	0	0
RCA inline noise filter	misc			0		0	0	0
ECU to PC interface cable, Kicker Audio amp to PC interface cable	misc			0		0	0	0
Holley dash pointer	misc			0		0	0	0
							Total US$:	**$4,412**