WRX Enhancement - Electronics

Part 5 of the most complete WRX parts buyers guide - EVER!

By Michael Knowling

Last time we covered intercoolers - this time it's ECUs, interceptors and boost controllers. Note that we've included a list of direct plug-in replacement computers, but universal aftermarket computers (that don't plug straight into the WRX loom) have not been included. These can already be found at "Programmable Management Mania - Part 1".

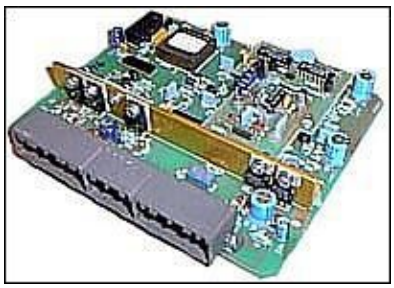
The Standard ECU...

Like most turbocars after the mid-1990s, the WRX has a full engine management system - it controls fuel, ignition and boost pressure. Changes were made to its EPROM format for the MY97 and running changes have occurred in its program mapping. Some of these re-maps include changes to run a larger airflow meter and different boost solenoids.

The single biggest change came in the MY97, when the WRX moved from having direct-fire ignition to having two double-ended coils and a set of hi-tension leads. The injectors were also revised.

The WRX's computer controlled boost pressure has gradually increased over the car's lifetime. The MY94 started off with just over 11 psi, while later models run to around 13.5 (though certain cars are known to spike higher than this). Australian-spec STis boost up to approximately 15 psi and use bigger injectors (with the appropriate software changes to go with it). Note that stock WRXs run quite rich at full rpm and load - their air/fuel ratios are said to be mid-to-high 10s. Oz STis, however, are slightly leaner - though there is still significant room for more power.

Plug-in Replacement ECUs



Developed in conjunction with Possum Bourne Motorsport, the **PossumLink** management systemis an adjustable computer that controls fuel, ignition and boost specifically for the WRX. Interfacing with the factory sensors, the unit fits into the factory ECU housing and is adjustable via a backlit handheld remote (for easy dyno or road tuning). It features soft rev limiting, cooling fan control, voltage correction, fuel pump control, acceleration enrichment, cold start enrichment, over-run fuel cut, closed-loop lambda (open-loop also possible) and the choice of MAP or MAP/TPS load inputs. In all, there are 96 fuel and ignition zones - plus full interpolation. The ignition side of things can manage up to six ignition drivers (easy direct-fire on a four cylinder WRX) and the ignition table mirrors the fuel table in layout. Closed-loop knock control with "resettable knock logging" is also available. In addition to this, the replacement ECU controls turbo boost pressure in 16 separate zones - again with interpolation.

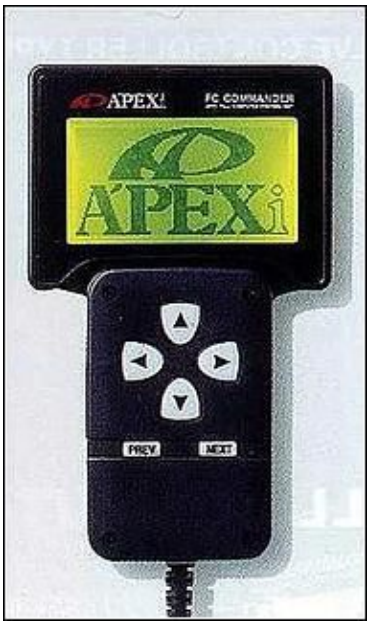
Special PossumLink software programs and add-ons include anti-lag, IC water spray, high boost applications, closed-loop idle, rpm switching and two-speed fuel pump control. There's also a serial output, printer driver and data logging available.

Note that the PossumLink plug-in is delivered with (safely) pre-tuned base maps to help you save on expensive dyno tuning time. Available to suit all model WRXs, get the PossumLink at Possum Bourne Motorsport, AVO, MRT, WAR Motorsport and ScoobyMania. Note that AVO can also sell the PossumLink programmed to suit specific engine configurations.

GEMS Subaru Impreza plug-ins "are being extensively used in rallying across the world and have proven themselves time and again". These UK-sourced implants bolt straight into the factory ECU housing and are fully pin-to-pin compatible with the standard loom and sensors. Load inputs can be from either an airflow meter or MAP sensor. Other ECU inputs include engine speed and position, air temp, barometric pressure, TPS, EGO, knock detection, vehicle speed and dash switches for anti-lag and launch control. The GEMS unit has outputs for 4 injectors, an idle control motor/anti-lag, fuel pump and speed control, 2 ignition outputs, EGR control valve (for anti-lag), wastegate control, twin thermo fan control, water spray/injection, 2 rev lights and a tacho. Phew! Note that anti-lag (ALS) and launch control is automatically provided in the upgrade.

These GEMS implants are very user-friendly and are fully programmable via an IBM lap-top PC. They also interface with GEMS data loggers and displays.

See the GEMS UK website for more.



The **A'PEXi** Power FC "is one of the most technologically advanced management systems for today's racecars". This Japanese plug-in allows access to adjust every vital parameter of tuning within the ECU. Installation - as with any plug-in - is dead easy. Simply detach the factory ECU from the body and loom and plug in the Power FC - it takes just minutes. This high quality product's programmable capabilities include fuel and ignition control, MAP/airflow meter signal adjustment, injector pulse timing adjustment, boost control, acceleration enrichment compensation, fuel/ignition test, ignition cranking fuel adjustment, water temperature correction and rev-limiter control. All the above parameters of the vehicle (plus water temp, oil temp, oil pressure) can be monitored in real-time from the hand-held display. The A'PEXi Power FC is available to suit post MY97 WRXs and comes supplied with Japanese derived base-maps.

It can be purchased through BGT, Jap Trading, G-Tech, BEL Performance and the AutoSpeed Shop.

The **BGT** programmable ECU "is a state of the art engine management computer that allows you to fine tune and optimize for reliability, performance and economy". Based on an Australian MicroTech computer, this device is capable of making 500,000 decisions per second and offers full interpolation between load, rpm, water temp, air temp and throttle position points. The fuel section gives 16 load points via an in-built MAP sensor, adjustable WOT enrichment, dual-stage configurable acceleration pump and road speed enrichment/enleanment. There is also the capability to control the manufacturer's cold-idle bypass valve. Boost pressure is controlled in 500 rpm intervals and a knock sensor automatically subtracts (an adjustable amount of) ignition timing whenever varying degrees of knock are detected. Ignition is set in 16 points, with dual-stage acceleration advance, coolant and air intake temperature inputs.

Notice that there are also two memory programs, intercooler spray control, data logging, rev limit control (soft cut, hard cut adjustable separately), boost-cut adjustment and programmable injector staging. The BGT ECU also comes with a conservative base-map already programmed as a platform for tuning.

BGT are in Melbourne. See our story on their ECU at "New Brainpower".

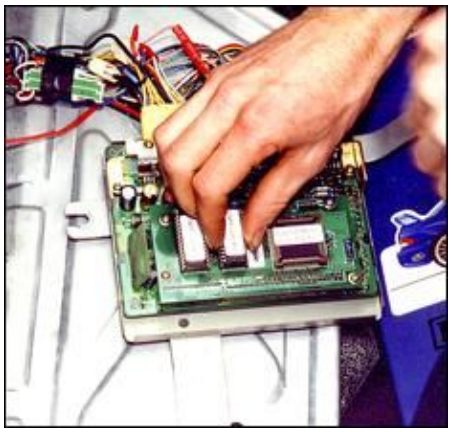
MoTeC don't offer what's technically called a plug-in computer, but they do have a specially developed adapter loom that you can use to link the Subaru loom to any MoTeC programmable computer. This adapter loom is only around 20cm in length and makes light work of the conversion. When we spoke to MoTeC, they most highly recommended using their M48 model on the WRX. This unit gives the ability to deliver sequential injection and individual cylinder trimming (fuel and ignition), closed loop lambda control, 5 parameter cold-start and more. The 3D main table for fuel has 20 rpm sites and 11 load sites (giving a total 220 points), while the Advanced Tuning option gives 40 rpm sites and 21 load sites (giving a massive 840 points). RPM sites are user programmable - and load sites are also adjustable with Advanced Tuning option. All M48s feature outputs can be used for idle speed control - or whatever else you desire. More outputs are available with the Tuning option. The ignition side of things has two outputs and possesses 0.25 degree accuracy. Like the fuel main table, there are 220 points of adjustment (again, 840 with the Advanced Tuning option). Boost control is spread over a main table with 20 rpm sites (the Advanced Tuning option gives this against 10 throttle sites and water and air temp compensation).

As you've probably guessed, the Advanced Tuning option gives you a whole lot of flexibility. It also brings traction control and launch control, the option for data logging and more. Further up-market from this is the MoTeC M48 Clubman and Pro. These units feature the Advanced Tuning options as standard plus such niceties as telemetry and real-time monitoring. Note that all MoTeC ECUs are also built to internationally recognised quality control standards (ISO 9001).

In addition to offering the WRX adapter loom, MoTeC also sell a Group N box, which complies with all rallysport regulations. This sees the factory computer box, loom and plug retained - but a M48 board slipped inside. Again, this has all of the features as above - but it's all integrated inside the OE box. The M48 - in any of its forms - can suit all WRX models.

MoTeC is based in Melbourne. Check out the M48 system details at their website (listed at bottom).

Factory ECU Re-Maps (Chips)



The Gold Coast's ChipTorque offers re-mapped chips to suit all model WRXs with just about any type of mods. Tell ChipTorque what's been done to your WRX and the car's application and they'll give you a tailored chip to suit (which is based on their extensive WRX dynoing experience). Either that or take your car in for a dyno-developed chip. What you invariably receive is increased boost (around 15.5 psi on early models, 18 psi on post-97s and around 16 psi for autos), plus revised fuel volumes and ignition timing. A little more advance is usually dialled in on light loads and transitions, and full rpm/load mixtures are usually eased off to maximise top-end power. See our comments on the tuning of ChipTorque's own promo WRX at "Sensory Overload".

Fueltronics sell hot chips to suit only the pre MY97 WRX. Probably tuned with similar emphasis as the ChipTorque unit, the Fueltronics chip varies slightly by keeping boost to a more conservative 14.5 psi ceiling. Notice that they do not sell chips for vehicles later than October '96.

Fueltronics is based in Adelaide.

POWER CHIP

Powerchip retail plug-in chips to suit MY94 - MY97s. These chips come programmed by PowerChip and claim to boost power from 155kW to 175kW (with 308Nm of torque). Note that this is achieved without any changes to fuelling in the top-end. For post '97 Rexes, PowerChip retail an interceptor to cover for the absence of a chip. This is said to give similar power increase as with a chip. Both set-ups come in a package that give an increase in boost pressure.

Powerchip is based in Melbourne and have approved fitters Australia-wide.

Signal Interceptors

Interestingly - in addition to manufacturing a plug-in programmable ECU - **A'PEXi** also have two separate interceptor modules for fuel and ignition control. The A'PEXi Super ITC (Ignition Timing Converter) taps into your crank angle sensor signal and gives instant ignition timing adjustment - up to +/- 15 percent. This adjustment can be set at specific rpm levels to give a tailored ignition timing curve.

The fuel side of things can be taken care of by the separate Super AFC (Air Flow Convertor) - which is the best-selling universal fuel computer in Japan. This unit is compatible with almost all vehicles that use an airflow meter. Just like the ITC, the AFC is designed to modify the output signal from an airflow meter. "By allowing the user to modify the signal, the Super AFC indirectly gives the user access to change the fuel curve at specified, preset RPM ranges."

A'PEXi is sold at BGT, Jap Trading, G-Tech, BEL Performance and the AutoSpeed Shop.

APS (and its distributors) offer the **UniChip** as an effective, adjustable management upgrade for the WRX. It delivers a total of 408 adjustments - with 17 rpm sites between 500 and 8000 rpm, plus 12 load sites - quality cold starts, air temperature compensation and more. The function of the factory knock sensor is retained, and the UniChip also allows for closed-loop under light throttle cruise. Options include boost control, extra injector control (up to 4), intercooler water spray control (with boost and rpm inputs) and dual sets of ignition maps. The UniChip suits all WRXs.

Air Power Systems is based in Melbourne.

Boost Controllers

A'PEXi offers two levels of electronic boost control. Their AVC-D is a "drag racing" boost controller designed to provide maximum performance, improved traction and diversified boost control parameters.

Unlike its Super AVC-R boost controller cousin, this unit does not include a MAP sensor for electronic feedback - enabling this model to control beyond 2.0 Bar. It also offers three rpm-based control points as well as a unique speed sensor input. This allows the user to either raise or lower boost levels up to a certain road speed. The AVC-D's "Scramble Boost" function can allow the driver to use an override to raise or lower boost for a preset amount of time.

Next in the A'PEXi line-up is the Super AVC-R (Actuator Valve Controller Type R). "This is one of the most technologically advanced boost controllers on the market, yet it is one of the most easiest to use." The Super AVC-R is the only boost controller that integrates injector pulse monitoring and it also incorporates a MAP sensor for closed-loop operation. Accordingly, this unit is dubbed "self learning". The Super AVC-R has two user preset modes (to suit, say, different fuels) and it is suitable for internal or external wastegates.

Get either A'PEXi electronic boost controllers from BGT, Jap Trading, G-Tech, BEL Performance and the AutoSpeed Shop.

Advanced Vehicle Operations (**AVO**) sell their EBC (Electronic Boost Control) to deliver tight control of the turbocharger wastegate. By preventing wastegate creep, this unit brings boost up as quickly as possible and holds it to a constant maximum. It can manage up to 2 Bar of pressure. With fingertip control, boost pressure is easily turned down to accommodate that bad batch of fuel. With 3 main components - the electronic control box, dash knob and engine bay solenoid - this system is also quite easy to install

AVO is in Melbourne.

Starting off at entry-level, "the **HKS** EVC Ez is designed to provide precise boost control at the touch of a knob". Boost pressure is adjusted via a variable resistor type knob, so it's extremely easy to set up and use. The Ez then utilises a Fuzzy Logic controlled stepper motor type operating system (which controls up to 2.5 Bar) and is compatible across both internal and external wastegates. Boost pressure is not displayed on the HKS Ez, so an external boost gauge will be necessary for calibration.

The ancestor of the HKS boost control range is the EVC. This device features Fuzzy Logic boost control, a stepper motor control system, adjustable duration Scamble boost, push button high/low boost, adjustable over-boost protection, an LCD display for real-time boost/vacuum, automatic altitude compensation and it is said to have extremely high accuracy (to 0.01 Bar). Just to be safe, it can also be locked to prevent inadvertent boost alterations.

Ideally suited to ultra high power applications, the HKS EVC Pro serves to optimise driveability in cases where torque is either too low or uncontrollably high. With the EVC Pro, it is now possible to control boost relative to engine rpm and throttle position or road speed. The advantage of this is you can map your own boost curve (within the limits of the turbocharger). Again, the EVC Pro features Fuzzy Logic control, stepper motor, high/low boost settings, over-boost protection, boost setting lock, Scramble boost and automatic altitude compensation. Its LCD screen - in addition to displaying load - can also show real-time engine rpm, road speed and throttle position. To top it off, the EVC Pro can capably control up to 3 Bar boost.

HKS boost control can be found at Evolution R, BD4s and WAR Motorsports (NZ).

The Pneumatic Option!

We can't really talk about electronic boost controllers without bringing up pneumatic systems. The fact is, a pneumatic system costs way less and works almost as well as some electronic units. There are numerous ways to get your WRX running more boost. This can range from a simple wastegate line T-piece with, perhaps, a restrictor - to a heavy-duty adjustable pressure regulator. Companies such as TurboSmart will be happy to sell you one of their wastegate bleeds or - alternatively - these links will take you to previous AutoSpeed DIY methods of boost control...

"The Audi's DIY Boost Control - Part 1"

"Project EXA - Part 3 - DIY Boost Control"

"Brilliant Boost"

FCDs (Fuel Cut Defenders)

The Subaru WRX has a pre-programmed fuel-cut that's triggered by anything more than around 18 psi boost. If you are confident that your WRX can withstand even more boost pressure and still maintain acceptable air/fuel mixtures, a FCD is a cheap and viable option. These products are produced by such companies as **Fueltronics** and **HKS** and offer adjustable critical points at which the fuel-cut will take hold. With a fuel-cut set at (say) 22 psi, you'll then be able to run to up to 20 pounds of boost without a problem. But, again, only if your fuel system and engine can cope with it!

Contacts:

APS (VIC)
+61 3 9720 9170

www.airpowersystems.com.au

Evolution R (VIC)
+61 3 9543 6255

www.evo-r.com

ChipTorque (QLD)
+61 7 5596 4204

www.chiptorque.com.au

MRT (NSW)
+61 2 9809 2110

http://www.mrtrally.com.au/

MoTeC (VIC)
+61 3 9761 5050

http://www.motec.com.au/home.htm

PowerChip (VIC)
+61 3 9681 6888

www.powerchip.com.au/chips/subaru.asp

BGT (VIC)
+61 3 9874 8866

www.bgtperformance.com.au

G-Tech (VIC)
+61 3 9813 0722

www.gtech.com.au

ScoobyMania (UK)
http://www.scoobymania.co.uk/

AVO (VIC)
+61 3 9584 4499

http://www.avoturbo.com/

BR Developments (UK)
www.brdevelopments.com

WAR Motorsport (NZ)
www.warmotorsport.com

Jap Trading (VIC)
+61 3 9879 7799

www.jap-trading.com.au

GEMS
http://www.gems.co.uk/

BEL Performance (NSW)
0412 262888

www.belperformance.com.au

Possum Bourne Motorsport (NZ)
http://www.possumbourne.co.nz/

Fueltronics
+61 8 8363 2199

www.fueltronics.com.au

BD4s (NSW)
+61 2 9879 3322

www.bd4s.com.au

Electronics

Selecting the right electronic accessories can be very, very difficult. Firstly, if you're just aiming for just a bit more power from your car, the most cost-effective methods of achieving that are an exhaust, free-flow intake and a little more boost. These steps are relatively cheap to carry out, effective, and will generally not cut down on reliability to a noticeable degree, especially if you take it easy on the throttle when the day is very hot. A front-mount intercooler is the next logical step, followed by more boost or a turbo swap.

But it's about now that your car is starting to get a long way from the parameters that the Subaru engineers designed the standard ECU to cope with. Typically, this will mean that the engine starts running overly rich at high loads, while the ignition retard that occurs with knock sensor activation can also hit performance. Too rich a mixture won't cause any engine longevity concerns, but power will be lower than that which you could get with a leaner mixture. Revising the engine ECU (either by fitting a programmable unit, fitting an interceptor or having the chip re-written) can be used to reduce this excessive richness. And, since you're at it, you may as well get the light-load ignition timing advanced a little, the high-load timing pulled back a bit, and the turbo factory electronic boost control configured to bring on boost as quickly as possible. Getting all of these things done can result in much better driveability, as well as proven engine safety and more power.

If factory driveability and economy are important to you, retain as much of the factory ECU capability as possible unless you're going absolutely ballistic in power upgrades. That is, for Rexies being modified for genuine street applications, have the factory chip re-written or use a good interceptor. If you're after a helluva lot of power - and driveability and economy are for old farts - a cheap aftermarket ECU will probably provide what you want. And if you're after lots of power **and** driveability **and** economy **and** emissions compliance? Then you'll need to select from the best (ie most expensive) aftermarket ECUs around. And that latter step could cost you as much as you've so far spent on all the mods to the car....

So it's important to realise that the costs involved in going the next step after doing the basic mods (exhaust, intake, bit o' boost) can rise very quickly, and the ECU modification approach that you adopt (if you choose to do any at all) can be a major part of that. It very much depends on how fussy you are about all the engine parameters - reliability, power, economy, driveability, idle smoothness and so on. Remember, any old ECU or interceptor can make good full throttle power - it's the subtleties that are much harder to get right. Of course, if you do decide to go for a major engine ECU change or upgrade, one thing you won't need is an electronic boost controller. Any ECU change should also incorporate turbo boost control.

So it's very much a situations where it's horses for courses. Our preference is for ECU changes to be in this order of preference (from mild to wild): do nothing, interceptor, chip re-write, programmable management.

Julian Edgar