

EcuTek Tech

An in-depth look at the 'buzz' ECU tuning tool for late-model Subaru WRXs...

Words by Michael Knowing, Pix by Julian Edgar

If you own a late-model Subaru WRX and you're into go-fast goodies, chances are you've heard *someone* mention the UK-based company EcuTek. In this story we'll take an in-depth look at the abilities of EcuTek's new tuning tool - which is exclusive for Subaru - how it's programmed, quantify some results and, of course, examine the cost...

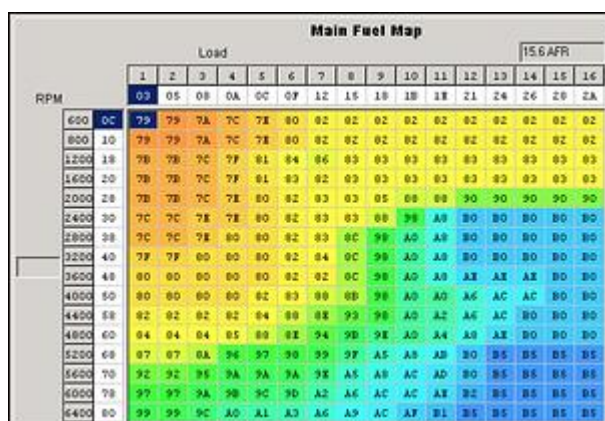
What is EcuTek's New Product?

EcuTek Flash2002 is a Windows based software package that allows certified agents to alter the data in the flash memory of 2001 - 2003 WRXs, Forester GTs and STis. A Flash99 version of the software is also available to cater for GC8-series 1999 - 2000 models. Note that updates are also being made, released on an on-going basis to accommodate the latest ECU variations.

The EcuTek Flash software is quite a different approach to the relatively common interceptor module or replacement ECU. It is simply a programming package that allows changes to the standard ECU; in many ways, it gives a similar end result to an aftermarket chip.

We should first point out that only accredited EcuTek agents have maximum access to the ECU via their licensed Flash2002 and/or Flash99 software. At the time of writing, however, limited ECU access was being made available to the home tuner - more on this later in the story.

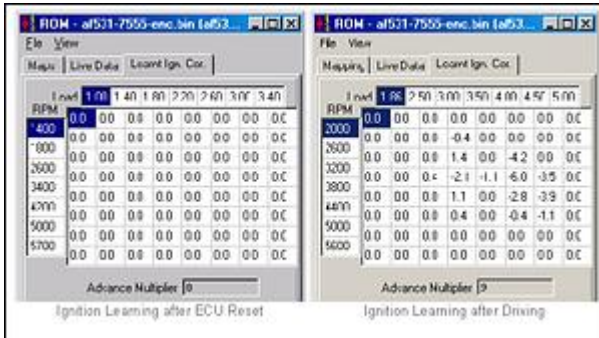
What Adjustment Does the EcuTek Flash Package Allow?



RPM		Main Fuel Map															
		Load															15.6 AFR
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
600	0C	79	79	7A	7C	7E	80	82	82	82	82	82	82	82	82	82	
800	10	79	79	7A	7C	7E	80	82	82	82	82	82	82	82	82	82	
1200	18	7B	7B	7C	7F	81	84	86	89	89	89	89	89	89	89	89	
1600	20	7B	7B	7C	7F	81	83	82	83	83	83	83	83	83	83	83	
2000	28	7B	7B	7C	7E	80	82	83	83	85	88	88	90	90	90	90	
2400	30	7C	7C	7E	7E	80	82	83	83	88	98	A8	B0	B0	B0	B0	
2800	38	7C	7C	7E	80	80	82	83	8C	98	A0	A8	B0	B0	B0	B0	
3200	40	7F	7F	80	80	80	82	84	8C	98	A0	A8	B0	B0	B0	B0	
3600	48	80	80	80	80	80	82	82	8C	98	A0	A8	AA	AA	AA	AA	
4000	50	80	80	80	80	82	83	88	88	98	A0	A0	A6	AC	AC	B0	
4400	58	82	82	82	82	84	88	8E	98	98	A0	A2	A6	AC	B0	B0	
4800	60	84	84	84	85	88	8E	94	98	9E	A0	A4	A8	AA	B0	B0	
5200	68	87	87	8A	86	87	88	89	8F	A5	A8	AB	B0	B5	B5	B5	
5600	70	92	92	95	9A	9A	9A	9E	A5	A8	AC	AD	B0	B5	B5	B5	
6000	78	97	97	9A	98	9C	9D	A2	A6	AC	AC	AE	B2	B5	B5	B5	
6400	80	99	99	9C	A0	A1	A3	A6	A9	AC	AF	B1	B5	B5	B5	B5	

EcuTek software allows the tuner to adjust fuel maps that contain hexadecimal values scaled against rpm and engine load (hexadecimal values are used throughout the program). Further to this, EcuTek software allows changes to fuel delivery during both open and closed-loop running, as well as altering the closed-loop switchover point - great for extracting improved fuel consumption. Injector compensation is also made for battery voltage.

Note that, in addition to the Flash software, EcuTek markets their so-called DeltaDash software. DeltaDash allows diagnostic functions as well as rapid data logging for all 1999-onward Subaru. Most importantly in this context, it can also accept external sensor inputs such as wide-band Lambda. The use of DeltaDash together with a wide-band Lambda sensor is the ultimate set-up for custom tuning.



The ECU's base ignition timing map can also be adjusted; base timing figures are referred to when the engine is running the lowest octane fuel it will encounter. Separate to this is the ignition advance map, which holds the timing values that may be added on top of the base map should fuel octane and conditions allow. The ignition base map and advance maps combine to the total timing that will be used when the absolute highest fuel octane is being used. EcuTek suggest not much alteration is usually required in the base timing map, since the factory ECU "learns upward." The advance map, however, is critical for setting the maximum advance at various rpm and load. In addition to allowing adjustment of the base timing and advance maps, EcuTeK Flash software enables correction for intake air temperature to be modified.

A knock correction table is incorporated into the standard WRX ECU. This table has eight columns for engine load and eight rows for rpm, and the EcuTeK software allows the tuner to rescale these zones as well as alter the knock correction values. Knock sensor sensitivity is also adjustable.



Note that a so-called Advance Multiplier - which is visible from the software's Live Map Access viewing mode - shows the willingness of the ECU to add ignition advance to the base ignition map. The tuner can adjust a changeover point on the Advance Multiplier range - this changeover is known as a Fuel Map Knock Switch Threshold. If the willingness of the ECU to add advance is below this threshold, a richer air-fuel mixture is referenced - this known as Hi Det. It is recommended to leave the Hi Det map alone in order to safeguard against detonation, but the Lo Det map can be used to slightly lean out mixtures (thereby maximising power) while the engine is operating above the Fuel Map Knock Switch Threshold.

And there's a lot more than just fuel and ignition related control...



The Flash program tuner can adjust turbo boost pressure characteristics by changing the so-called Desired Boost and Maximum Wastegate Duty maps as well as several other related maps. The Desired Boost map dictates the boost pressure the ECU tries to achieve at given rpm and throttle position - in other words, the shape of the boost curve as well as peak boost can be user defined. The Maximum Wastegate Duty map, meanwhile, must be set high enough for desired boost to be achieved but low enough to prevent overboosting.

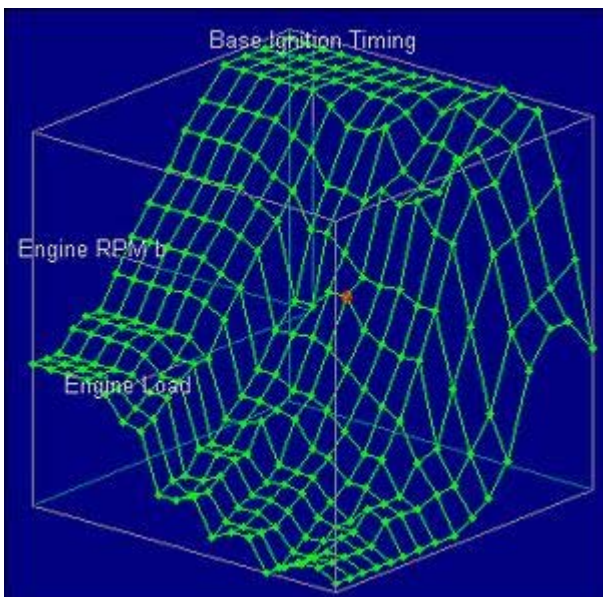
Boost pressure compensation - relating to coolant temperature, air temperature and air pressure - is also adjustable with the EcuTeK software. Further to this, a burst of wastegate duty cycle can be set to alter boost spool up when stamping on the throttle at any given rpm. This is known as the Proportional Burst compensation map.



For late STIs and Australian-delivered MY03 WRXs, the factory variable cam timing system can be changed relative to rpm and load; the advance of the inlet camshafts is infinitely variable.

Further facilities for adjustment across all models include the rev limit (adjustable in two stages), the trigger values for the check engine light and even airflow sensor scaling - this adjustment is ideal for accommodating a non-standard airflow meter, for example. Similarly, an injector flow scaling facility allows you to, for example, easily change from standard WRX injectors to STi injectors - it is said virtually no further adjustment of fuelling maps will be necessary.

Another useful feature is boost based speed limiting; this allows a soft limiting of the vehicle's top speed by limiting boost pressure all the way down to the spring tension of the WRX turbocharger's wastegate (about 7 psi). From another perspective, this is a good way of restricting boost pressure at very high speeds thereby preserving the engine.



In addition to allowing adjustment of data values, EcuTek software also allows the scale of nearly all maps to be altered. Without being remapped, it is said that where the scale of a map has been exceeded, the highest value within scale range is maintained from thereon. At very high boost pressure, for example, ignition timing is maintained at the same advance angle as seen at the top of the scale. This is obviously less than ideal, so the EcuTeK software allows the tuner to rescale the relevant axis and, accordingly, revise the associated data values. In the case of our example, this would allow ignition timing data points to extend higher so timing could be retarded at high boost (to reduce the likelihood of detonation and enhance engine durability). Note however, you cannot add more zones - you can only move them and let the ECU's in-built interpolation smooth the data.

Interestingly, EcuTek suggests the flash memory chip inside Subaru's factory ECU can be reprogrammed a maximum of 100 times. Flash software incorporates a Programming Statistics window that illustrates the "freshness" of a given ECU using two scales - Erase Pulses and Program Pulses. The maximum number of Erase Pulses is 5, while the maximum number of Program Pulses is 50; as the displayed numbers approach these maximums, the number of reprograms left in the ECU decreases.

What Does EcuTek Programming Involve?

Loading a Preset Program...

The EcuTek approach is by far the easiest way to achieve customised engine management - a new set of ROMs can be loaded in less than five minutes. And that's without needing to touch a spanner or lift the bonnet...

The tuner's first step is to hook a laptop into the vehicle's OBD-II diagnostic connector using the supplied programming interface and serial cable and, next, link the flash connector under the dashboard. Note that there's no need for direct access to the ECU or to alter the wiring loom.



In the majority of instances - where a preset program is to be loaded - the tuner will enter the software system's Utility Mode, select the appropriate ROM file (which is stored on the laptop hard-drive) and click on Program ECU. It's that easy. The new data will then be transferred to the vehicle's ECU during which time it is suggested that all non-essential vehicle accessories are switched off and there are no mobile phones or mains inverters nearby - these can otherwise cause electrical interference. Once the data transfer is complete, the hook-up is disconnected. At this point, EcuTeK advises resetting the ECU in order to clear any existing trouble codes, learnt ignition timing and air-fuel correction.

One extra step that the tuner might elect to take is to fill out the Registration Details that are logged into the ECU. Registration Details include the identification of the tuner, the vehicle's ECU version, the number of times the memory has been reprogrammed and comments on the mapping and general state of tune. These details are accessible only to EcuTek software users - it does not appear on a Subaru Select Monitor for example.

Job done.

Immobiliser Issue

Some Subaru ECUs incorporate an immobiliser feature that 'talks' to specific chip embedded keys.

This is of no concern when your existing ECU is being reprogrammed at an EcuTek agent, but in instances when an exchange ECU is being fitted - such as if you're purchasing from interstate or overseas - your keys must also be supplied for recoding. The vehicle will not start with an exchange ECU unless your keys are recoded to suit the new unit.

Note that US market WRX ECUs do not incorporate an immobiliser function.

Loading a Custom Program...

In situations where the maps are to be custom tuned, things are very much more complex - as you'd expect.

First - using their laptop - the tuner must open the ROM Editor window and then the appropriate ROM map. Note that map data is shown as hexadecimal - this is said to allow large maps to be visible on-screen in their entirety. Map data is displayed in either 1, 2 or 3 dimensional maps and, where required, can be viewed in a graphic model - these graphic models can be resized, rotated or inverted to allow best viewing of the data.

Data points are selected by clicking using a mouse. Upon clicking, the hexadecimal data is converted into the relevant unit in an area above the top of the map. Where desired, the data can be altered by plugging new hexadecimal values into the relevant data table. Configurable interpolation (essentially a data smoothing function) is applied to all input map data so there are no sudden transitions.

In some instances, a number of values might need alteration in which case a range of data points can be selected an adjusted with +/- keys.

		Load																16.0°
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
RPM		03	06	09	0C	0F	12	15	18	1B	1E	21	24	27	2A	2C	2E	
	600	0C	10	10	14	16	14	0F	0B	07	04	04	04	04	04	04	04	04
800	10	10	10	14	18	18	12	0D	0A	0B	04	04	04	04	04	04	04	
1200	18	14	14	18	2C	20	1D	18	13	0F	0B	0B	0B	0B	0B	0B	0B	
1600	20	18	18	1C	20	24	22	18	18	14	12	10	10	10	10	10	10	
2000	28	24	24	2A	2A	2A	28	24	1E	18	13	10	10	10	10	10	10	
2400	30	2E	2E	2E	2E	2E	2E	28	23	1E	19	15	12	10	10	10	10	
2800	38	2E	2E	2E	2E	2E	2E	28	24	1D	19	16	13	10	10	10	10	
3200	40	2E	2E	2E	2E	2E	2E	2C	28	23	1D	1B	17	13	12	11	11	
3600	48	2D	2D	2D	2D	2D	2D	2D	2B	25	1F	1B	17	12	11	10	10	
4000	50	2C	2C	2C	2C	2C	2C	29	26	22	1F	1E	1B	17	14	12	1A	
4400	58	2C	2C	2C	2C	2C	2A	27	22	1F	1E	1A	1B	16	14	14	14	
4800	60	2E	2E	2E	2E	2C	2A	26	21	1D	1B	19	16	15	14	14	14	
5200	68	30	30	30	30	2E	2E	2A	24	22	21	1F	1D	1A	19	1B	1B	
5600	70	30	30	30	30	30	2E	2B	29	27	24	22	1F	1D	1B	1B	1B	
6000	78	30	30	30	30	30	30	2D	29	27	25	23	20	1E	1C	1C	1C	
6400	80	30	30	30	30	30	30	2F	2B	29	25	23	20	1E	1C	1C	1C	

Some useful features for the tuner include the Show Map Coloured function, which colours each zone of the map depending on its value (allowing quick recognition of map data 'shape'). This example shows an ignition map where a portion has been affected by knock correction - the darker the red, in this case, the greater the amount of correction.

Similar in concept is the Colour Lambda function, which shades data tables dependant on the air-fuel ratio. Note, however, the OE front Lambda sensor won't read any richer than 11.25:1. As mentioned, an external Lambda sensor - with wideband capabilities - can be plugged directly into the tuner's laptop and used to provide a greater range of Lambda readings.

Flash2002 can also show live access to maps in the vehicle's ECU. Live data includes rpm, injector opening time and duty cycle, air-fuel ratio, air-fuel correction, ignition retard, ignition timing, knock correction, the aforesaid advance multiplier, boost pressure, wastegate duty cycle, atmospheric pressure, coolant temperature, exhaust gas temperature (where fitted), throttle angle and engine load.

The Offerings Here In Australia

EcuTek's primary Australian representative - MRT - has developed two different sets of maps to suit local vehicles in various states of tune and to suit local pump fuel. MRT has developed these maps using EcuTek's DeltaDash data analysis software.



The 'entry level' set of maps is referred to the Type 1 Tune and is suitable for cars with no or minimal mods - anything up to a cat-back aftermarket exhaust and high-flow air intake. The Type 1 Tune aims to bring the turbo on boost as early as possible, improve overall drivability and, of course, enhance top-end power.

For vehicles with more extensive mods (maybe a front-mount intercooler and larger turbo) the MRT Type 2 Tune is suggested. Like the Type 1, the Type 2 Tune is intended to improve drivability while also providing better torque and power to suit existing mechanical changes.

Finally, for vehicles with extensive modifications, a full custom mapping is required - the Type 3 Tune. This involves extensive dyno tuning to extract the desired results from, most typically, a highly modified engine. Since the custom tune allows every last kilowatt to be released, it is ideal for GT-P and rally cars or where the absolute maximum power must be obtained from an existing mechanical package.

And where can you get your ECU tweaked?

Well, if an EcuTeK agent is located somewhere in your area you can drive there to have the new maps loaded. If, however, you're nowhere near an agent MRT can send you an exchange ECU with the new maps already loaded. As mentioned, you will also need to send your keys for recoding to suit the new ECU.

Testing

To quantify the gains from a custom Type 3 Tune using EcuTeK software, we went along to MRT and test drove a privately owned 2002 STi fitted with a 3-inch turbo-back exhaust, intercooler water spray and intake 'resonator-ectimy'. We first drove the car with its standard ECU mapping and took various notes on its drivability, torque spread, maximum performance and we also listened carefully for detonation.

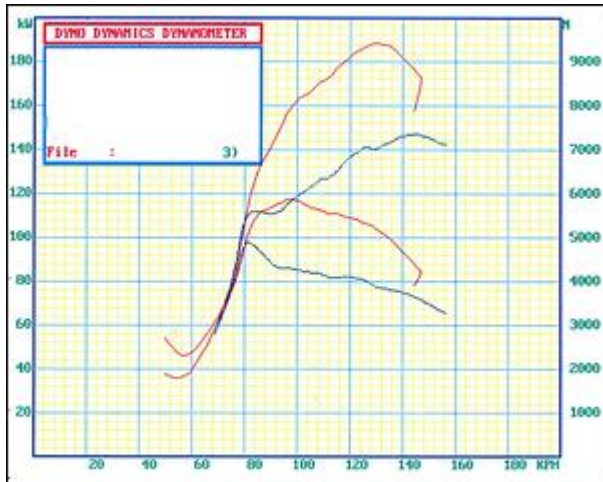


With its standard maps, the lightly modified STi felt pretty dead until boost arrived with a rush at about 4000 rpm in first gear or about 3000 rpm in fourth gear. In terms of maximum performance, we didn't want to break the vehicle so we elected for a couple of ease-off-the-line 0 - 100 km/h runs,

which returned times of 6.5 - 6.6 seconds (not surprisingly, quite a bit slower than with a 'proper' launch). At no time did we hear detonation.

Upon return to the MRT workshop, the guys took 5-minutes to load their Type 3 (custom) Tune and we returned the next day to assess the difference. Why not simply drive the car immediately after the new program was loaded, you ask? Well, once the new ROM files have been loaded, the vehicle must be driven "for a period of time" so that the ECU can learn the ignition advance parameters it can use. The computer needs time to run through coarse and fine phases of ignition learning.

The next day - with virtually identical weather conditions - the '02 STi pulled appreciably harder. Bottom-end torque was a little improved, there was an explosion of torque through the mid-range and top-end was now much smoother. Boost pressure kicked in about 500 rpm earlier (depending on the gear) and up to half a second was slashed from its 0 - 100 time (which, remember, involved merely easing off the line). We did not hear detonation at any time.



Prior to our on-road testing, this particular car had been tested on a Dyno Dynamics all wheel drive chassis dynamometer. This graph illustrates the improvement in torque and power - the blue plot represents the vehicle with its standard tune (but with the aforementioned mods and boost spiking to 17 psi), while the red plot represents the remapped ECU (with adjusted fuelling, timing and holding 18 psi boost through the rev range). As you can see, mid-range torque has skyrocketed and peak power has risen from 150 to 190kW - a peak gain of 26 percent.

Paul MacLeod - the vehicle owner - tells us the car is now easier to drive (thanks to improved low-down torque) and its overall performance has certainly been lifted a peg.

On the other hand, we spoke to another '02 STi owner who hadn't seen such dramatic gains with his more conservative Type 2 Tune. This particular vehicle started with 136kW at the wheels in standard form, increasing to 166kW with the fitment of a twin-dump exhaust and removal of the intake resonator. An off-the-shelf MRT Type 2 program followed (not the custom Type 3 Tune as mentioned in the previous vehicle) and yielded only 10kW more - a total of 176kW at the wheels. The owner commented that mixtures still seem very rich (the area of the rear bumper near the exhaust tip is blackened), bottom-end torque was not improved and an aftermarket boost controller has been required to deliver the desired boost characteristics.

So what is the reason for this chalk and cheese variation between these two similar vehicles? Well, our test car had been programmed with its own dyno tuned Type 3 maps whereas the second vehicle received the generic Type 2 Tune. Furthermore, MRT tells us massive power variations can come with different exhaust designs and fuel grades - their off-the-shelf Type 2 tune is, therefore, quite conservative.

Bottom Line

The standard ECU fitted to current generation Subarus is extremely complex and very efficient - EcuTeK Flash software retains all of the manufacturer's development, allowing adjustment of only the parameters you would typically want to alter. This means you won't have any problems obtaining a quality cold start, smooth idle or any other attributes that often end up pretty rough when mapping an ECU from scratch.

The biggest downside of the EcuTeK approach is the lack of a real-time programming capability, which would enable you to finely tune for maximum power and tractive effort on a chassis dyno. EcuTeK software does not allow you to hold a certain rpm and load and adjust timing and/or mixtures to find the greatest output. Without question, this is the system's biggest flaw.

So how much does it cost?



Well, the MRT Type 1 Tune (for standard or near standard vehicles) is offered at \$775 plus GST. The step up to the MRT Type 2 Tune (which is suitable for cars with a larger turbo and intercooler, for example) sees the cost increase to \$1365 plus GST; alternatively, if you already have a Type 1 Tune, you can upgrade to Type 2 for an extra \$600 (plus GST).

Note that the MRT Type 1 and Type 2 Tunes are the only remapped programs that are available off-the-shelf locally - they can be loaded without any further need for tuning.

MRT's Type 3 Tune is a custom remap that's specific to a more extensively modified vehicle. In the case of a Type 3 Tune, the accredited tuner performs a number of dyno runs and carries out on-road testing to extract the most out of a given vehicle. The Type 3 Tune costs \$1365 (the same as the Type 2) plus all associated tuning charges - and, of course, GST.

At these prices, the EcuTek remap approach is fairly decent value. In most cases it is more expensive than adding an interceptor, but in terms of tuning flexibility the EcuTeK software is *far* better. The EcuTeK software also allows much more adjustment than a chip cooker has access to. An aftermarket programmable management system is, in fact, closer to the level of fine-tuning achievable with the EcuTeK program. All that the EcuTeK approach lacks are some spare outputs, anti-lag and launch control. Then again, we'd much rather keep the standard knock sensor function that you must forgo when you fit an aftermarket management system...

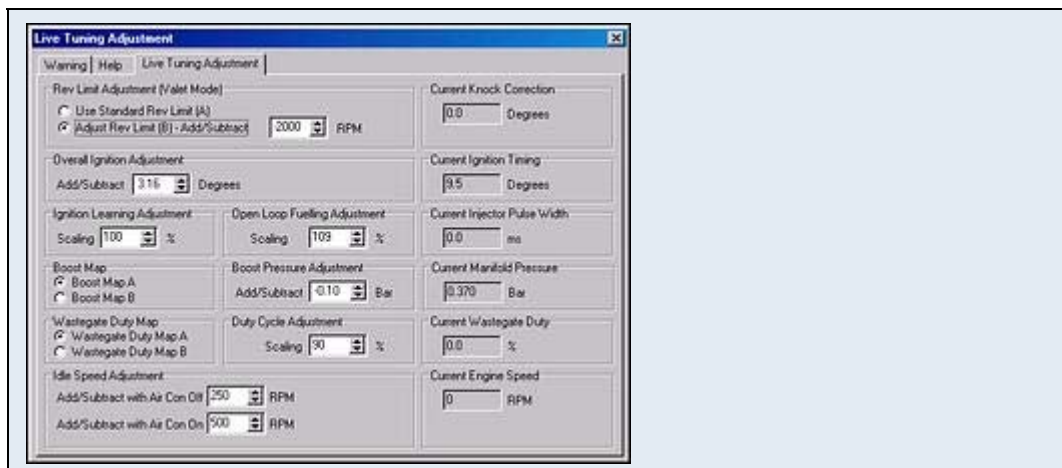
We must also point out that reprogramming the EcuTeK software is *much* easier - and therefore cheaper - than installing an interceptor or integrating an aftermarket management system.

Certainly, there is a lot of merit to the retuning using the EcuTeK Flash software. If you're considering a new set of maps for your vehicle you don't stand to lose anything by giving it a go - MRT is presently offering a money back satisfaction guarantee.

Update!

There have been two late-breaking advances in the flexibility of the EcuTeK programming system.

Owners of 2001 and later WRXs can now specify a so-called map switch, which enables you to switch between two sets of maps suited to specific roles and conditions. This lets you select, for example, a valet map that limits rpm and boost pressure. The technique for switching between maps involves holding full throttle and toggling the rear window demister switch (this can be done with the ignition on or with the engine running).



Perhaps more important is the availability of self-tuning for owners. This allows limited adjustment of ECU settings, including basic fuelling, ignition, boost, idle control and rpm limit functions. Self-tuning does, however, require the purchase of EcuTeK's DeltaDash software. Note that - unlike the Flash program - self-tune alterations can be made in real time.

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