

**MICROTEC®**

Autotuning

DATE	DRAWER	REVISION	NOTE
10-07-2012	Mattia Stranges	1.00	First release of Autotuning strategy

MICROTEC S.r.l.

Sede Legale Via Avvis 3/A – 21032 CARAVATE (VA) ITALY

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Capitale Sociale € 10.200 i.v Reg. Imprese di Varese n. 02356120127 REA n. 251455



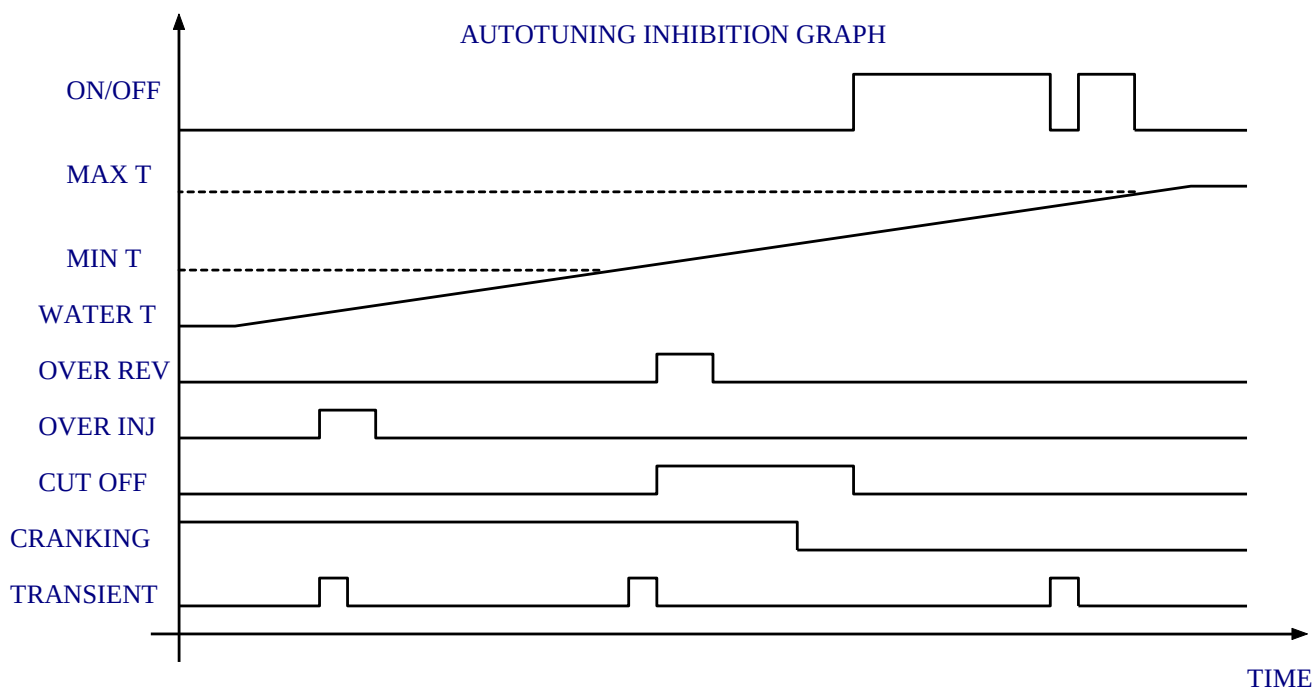
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General description:

Auto tune – In this mode a fixed AFR value is used as a target and the ECU will automatically adjust the injection time. Auto Tune can be used on the dyno and on the road.

Maps		Tuning OFF															Manual		Auto		Off													
Injection 1		RPM															1		2		3		4		5		6		7		8		by Throttle	
[ms]		1000	1500	3000	4000	4500	5000	5500	6000	6250	6500	6750	7000	7250	7500	7750	8000	8250	8500															
Throttle	0.0	2.325	2.369	2.510	2.603	2.649	2.695	2.742	2.789	2.813	2.837	2.860	2.882	2.904	2.929	2.951	2.974	2.999	3.021															
	3.0	2.318	2.363	2.507	2.602	2.649	2.696	2.744	2.792	2.817	2.841	2.865	2.887	2.910	2.935	2.958	2.981	3.007	3.029															
	5.0	2.313	2.359	2.505	2.602	2.649	2.697	2.746	2.794	2.819	2.844	2.868	2.891	2.914	2.940	2.962	2.986	3.012	3.035															
	7.0	2.309	2.355	2.503	2.601	2.650	2.698	2.747	2.797	2.822	2.847	2.871	2.894	2.918	2.944	2.967	2.991	3.017	3.041															
	10.0	2.302	2.349	2.500	2.600	2.650	2.699	2.749	2.800	2.826	2.851	2.876	2.900	2.923	2.950	2.974	2.999	3.025	3.049															
	12.5	2.296	2.344	2.498	2.600	2.650	2.700	2.751	2.803	2.829	2.855	2.880	2.904	2.928	2.955	2.980	3.005	3.032	3.056															
	15.0	2.290	2.339	2.496	2.599	2.650	2.701	2.753	2.805	2.832	2.858	2.884	2.909	2.933	2.961	2.985	3.011	3.038	3.063															
	17.5	2.284	2.334	2.493	2.598	2.650	2.702	2.755	2.808	2.835	2.861	2.888	2.913	2.938	2.966	2.991	3.017	3.045	3.070															
	20.0	2.278	2.329	2.491	2.597	2.651	2.703	2.757	2.811	2.838	2.865	2.892	2.918	2.943	2.971	2.997	3.023	3.051	3.077															
	25.0	2.266	2.320	2.486	2.596	2.651	2.705	2.760	2.816	2.844	2.872	2.900	2.926	2.953	2.982	3.008	3.036	3.064	3.091															
	30.0	2.255	2.310	2.481	2.595	2.651	2.707	2.764	2.821	2.851	2.879	2.908	2.935	2.962	2.992	3.020	3.048	3.077	3.105															
Foot	40.0	2.231	2.290	2.472	2.592	2.652	2.711	2.772	2.832	2.863	2.893	2.924	2.953	2.982	3.013	3.043	3.072	3.103	3.133															
	50.0	2.208	2.270	2.462	2.589	2.653	2.716	2.779	2.843	2.876	2.907	2.939	2.971	3.002	3.034	3.066	3.097	3.130	3.161															
	60.0	2.184	2.250	2.452	2.586	2.654	2.720	2.786	2.854	2.888	2.921	2.955	2.989	3.021	3.056	3.088	3.122	3.156	3.189															
	65.0	2.172	2.240	2.448	2.585	2.654	2.722	2.790	2.859	2.894	2.928	2.963	2.998	3.031	3.066	3.100	3.134	3.169	3.203															
	70.0	2.160	2.230	2.443	2.583	2.655	2.724	2.794	2.865	2.901	2.935	2.971	3.007	3.041	3.077	3.111	3.146	3.182	3.217															
	75.0	2.149	2.220	2.438	2.582	2.655	2.726	2.797	2.870	2.907	2.942	2.979	3.016	3.050	3.087	3.123	3.159	3.195	3.231															
	80.0	2.137	2.211	2.433	2.581	2.655	2.728	2.801	2.875	2.913	2.949	2.987	3.024	3.060	3.098	3.134	3.171	3.208	3.245															
	90.0	2.113	2.191	2.424	2.578	2.656	2.732	2.809	2.886	2.925	2.963	3.003	3.042	3.080	3.119	3.157	3.195	3.234	3.273															
	100.0	2.090	2.171	2.414	2.575	2.657	2.736	2.816	2.897	2.938	2.977	3.019	3.060	3.099	3.140	3.180	3.220	3.260	3.301															
	Over-Injection		Min.		Max.		Engine Working Point		Lambda 1		Lambda 2		Set-Point		Tolerance																			
TH20		0.0		60.0		90.0		RPM		0		0.0		0.0		0.0		12.8		13.0		12.5		+/-		0.2								
Over-Rev		Extra-Margin		150		Throttle		0.0		Tracking Mode		Fine																						
Cut-Off		Aspirated				Manual		Current		Corrected		Correction										Step												
Cranking						Injection		0.000		0.000												1.000		Freeze		0.010								
Transient		Save		Load		Advance		0.0		0.0												0.0		Freeze		1.0								

Enable condition :



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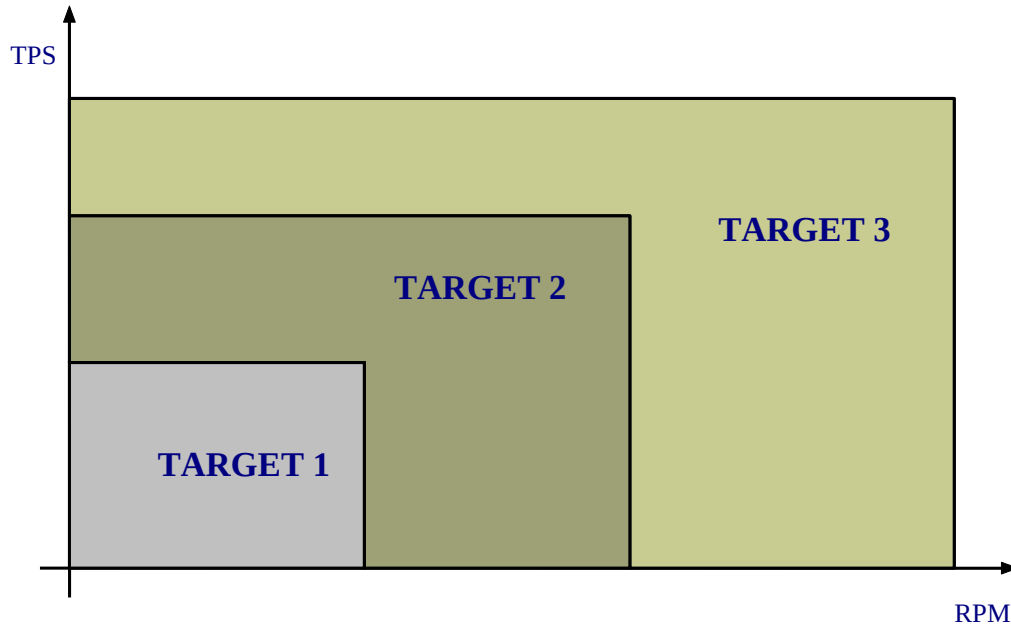
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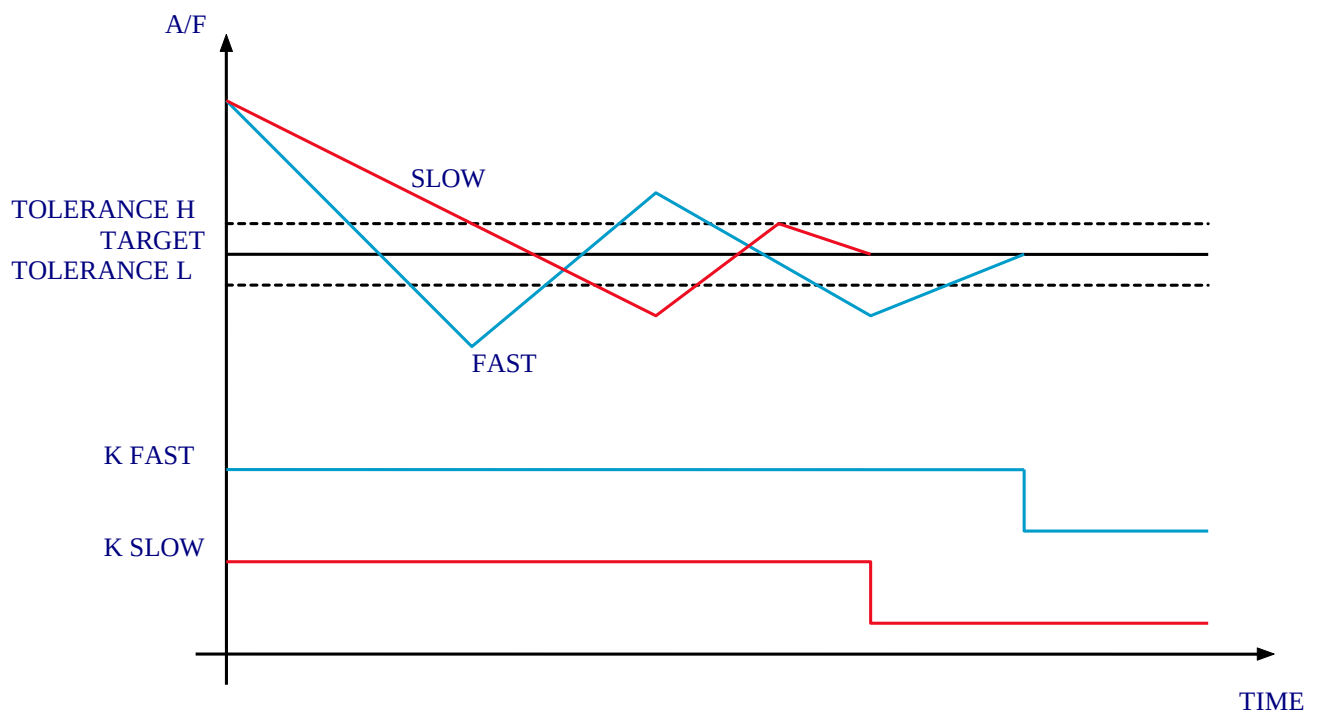

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General operation:

- 3 different target are available for set a different A/F for each rpm/tps breakpoint:



- 3 different “speed” strategy that influence accuracy and time for arrive at the target +/- tolerance lambda value.



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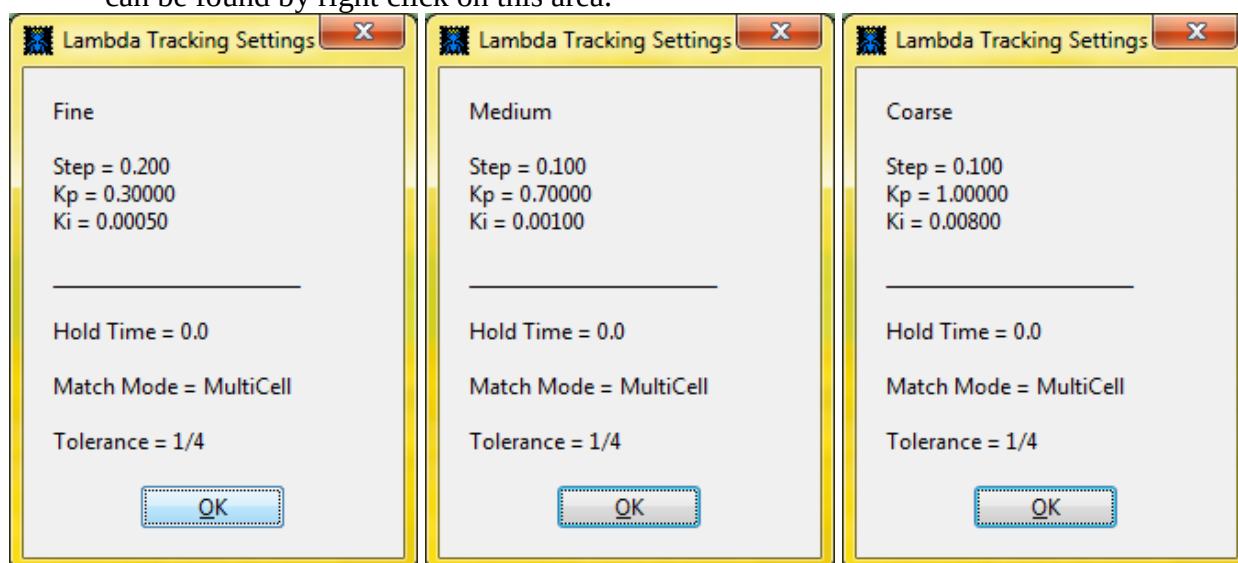
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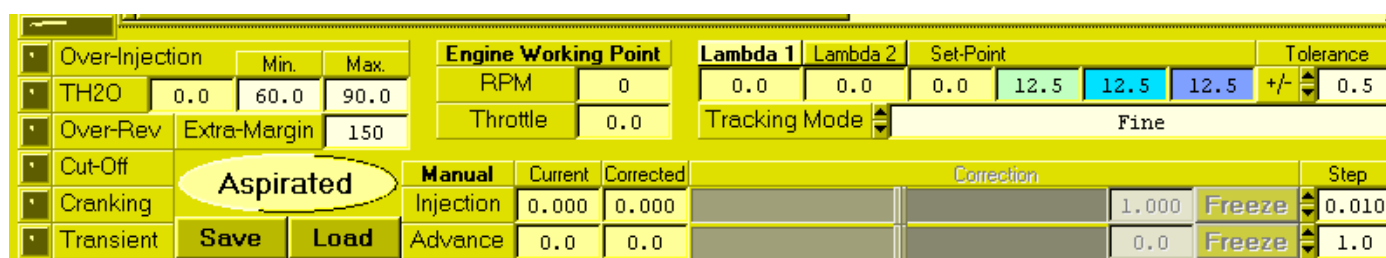

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Detailed operation:

- Correction on the injection map are made in proportional mode, refer to rpm and tps cells, by using a PI control.
- It's possible to select 1 or more cylinder simultaneous. In this way, the correction will be applied to all cylinder selected.
- Tracking mode selection allows the user to select a different execution speed. More detail can be found by right click on this area.



Software description:



RPM – value of engine RPM

Throttle – Value of Throttle sensor

Manual tuning / Injection / Current – Value of cell taken from the map

Manual tuning / Injection / Corrected – Value of injection time as a result of the manual adjustments.

Manual tuning / Advance / Current – Value of cell taken from the map

Manual tuning / Advance / Corrected – Value of advance as a result of the manual adjustments.

Freeze – Applies the adjustment to the specific cell within the ECU and then automatically returns to nil offset.

Lambda – Current value of the lambda sensor in AFR. Through the button Lambda 1 or 2 you can set with how lambda sensor make automapping. For example in the picture is set lambda 1.

Lambda / Set point - Your desired target AFR value. You can choose from 3 different set point.

Lambda tolerance - +/- gate around your target AFR that is deemed to be acceptable. Once within this boundary to further Auto tuning would occur in Auto tune mode.

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Auto-tuning – In Auto tuning mode the engine must be latched into a cell for this amount of time before any correction will occur. You can set this speed from the menu **tracking mode**. Fine, medium, coarse.

Enabled – This LED lights when the 'lambda searching phase' of the tuning strategy is permitted (not considering the enable setting of single cells). The lambda searching phase is inhibited during cranking, gear change, injection transients, engine cut-off, when the water temperature exceeds the given limits, or when the engine speed is near the limit set in the "Parameters" page..

Cranking – LED turns from brown to red during engine start. When active mapping will be inhibited.

Over rev – LED turns from brown to red when the engine is within 150RPM of the limiter for example.

Cut off – LED turns from brown to red when the 'cut off' strategy is enabled. When active mapping will be inhibited.

TH2O	84.1	60.0	90.0
------	------	------	------

Transient - LED turns from brown to red when the transient strategy is active. When active mapping will be inhibited.

TH2O – Value of water temperature.

TH2O / Min-Max – Values of water temperature which are considered as normal for the operation of the engine, when outside of these limits the LED will turn red and mapping will be inhibited

Injection 1		RPM												1	2	3	4	5	6	by Throttle
[ms]		700	800	900	1000	1100	1200	1300	1400	1500	1750	2000	2250	2500	2750	3000	3250			
T h r	0.0	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.640	4.000	4.000	4.000	4.000			
	2.5	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.640	4.400	4.400	4.400	4.400			
	5.0	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.276	3.640	4.400	4.400	4.400	4.400			
	7.5	3.276	3.733	3.757	3.783	3.808	3.833	3.858	3.883	3.908	3.971	4.034	4.096	4.159	4.222	4.285	4.347			

Injection 1 – Use the pull down to visualize the map that you plan to work with

Cylinders – This option lets you choose to apply your mapping to all cylinders equally or to specific cylinders. Set all the cylinder that you want to map simultaneous. In this example we activate cylinder 1,2. Also we can see from this picture, which input is active for automapping, between throttle or M.A.P.

Before you begin mapping it is important to make sure that you have transmitted the latest version of your configuration and **'start map' into map slot 1**. The ECU, the 'start map' is the one provided by your ECU supplier or one you believe to be closest to the one needed for this engine.

1. Make sure that your external map switch is in position 1 (open circuit)
2. Run the engine and check that all sensor readings are correct.
3. Warm up the engine until the water temperature value is within the correct zone
4. Ensure that there are no red LEDs showing
5. Enter values for your lambda and set the tracking mode
6. Define the cells that you want the Auto tuning to take place in. You can choose between 3 different break point by a single, double or triple click in cell. Also you can choose an entire row or column by a click on the desired breakpoint. It's also possible to select entire listed plan by a double click on RPM word.
7. Choose whether to map the injection on 'all cylinders' or an individual one
8. Use the left pull down to visualize the map you plan to work in.

It is very important when is used Auto tuning to specify which areas of the map this tuning should take place in.

These cells can be defined by a double click in the map cell window to change colors, an example of this is shown here.

[ms]	1000	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000	8500	9000	9500	10000
2.0	2.538	1.912	1.681	1.590	1.695	1.187	1.187	1.187	1.187	1.125	1.125	1.125	1.125	1.125	1.125	1.125	1.125	1.125
2.3	2.539	1.995	1.869	2.020	1.847	1.360	1.364	1.367	1.344	1.262	1.125	1.125	1.125	1.125	1.125	1.125	1.125	1.125
2.7	2.605	1.939	1.695	1.519	1.523	1.516	1.747	1.747	1.747	1.747	1.544	1.524	1.524	1.524	1.524	1.524	1.524	1.524
3.0	2.605	1.930	1.649	1.516	1.319	1.319	1.319	1.580	1.580	1.418	1.418	1.319	1.319	1.319	1.319	1.319	1.319	1.319
4.0	2.670	2.426	2.016	1.803	1.966	1.534	1.220	1.154	1.461	1.418	1.418	1.319	1.319	1.319	1.319	1.319	1.319	1.319
5.0	3.132	3.070	2.524	2.054	1.999	1.830	1.963	1.704	1.708	1.657	1.674	1.657	1.649	1.649	1.649	1.649	1.649	1.649
6.0	3.033	2.481	2.639	2.450	2.222	2.206	1.978	1.735	1.626	1.595	1.626	1.633	1.649	1.649	1.649	1.649	1.649	1.649
7.0	3.132	2.046	2.696	2.735	2.520	2.478	2.377	2.034	1.781	1.658	1.499	1.694	1.797	1.779	1.733	1.681	1.681	1.681
9.0	3.956	3.951	3.303	3.183	3.054	2.828	2.650	2.613	2.523	2.548	2.218	1.953	1.894	1.953	1.827	1.850	1.813	1.813
12.0	4.055	4.284	2.927	2.953	2.854	3.081	3.021	3.495	2.648	2.752	2.633	2.755	2.854	2.959	2.400	2.319	2.388	2.132
16.0	4.121	3.713	3.500	3.845	3.426	3.317	3.457	3.766	2.935	2.735	3.069	3.111	3.123	3.041	2.958	2.983	2.956	2.727
20.0	4.220	4.100	3.967	4.145	4.114	3.908	3.898	4.431	4.364	3.886	4.291	4.429	3.900	3.359	3.225	3.117	3.049	2.959
25.0	4.286	4.023	4.046	4.856	4.959	4.159	4.496	4.224	4.133	3.889	4.373	3.941	3.786	3.692	3.470	3.451	3.563	3.397
30.0	4.286	4.145	4.888	4.530	5.056	4.371	4.535	4.752	4.562	4.159	4.794	4.427	4.228	4.143	3.750	4.033	3.963	3.962
36.0	4.286	4.220	3.991	4.571	5.055	4.376	4.824	4.787	4.738	4.884	5.143	5.188	4.738	4.537	4.229	4.225	4.233	4.179
43.0	4.286	4.121	4.368	4.398	4.636	4.828	4.920	5.099	4.989	5.238	5.594	5.535	5.482	5.272	5.067	4.879	5.095	5.305
50.0	4.286	4.121	4.827	4.419	4.824	5.226	4.766	5.064	5.018	5.480	6.051	5.875	5.784	5.608	5.282	5.372	5.537	5.609
60.0	4.286	3.824	4.821	4.813	5.110	5.359	4.669	5.048	5.465	5.641	6.168	6.366	6.685	7.663	7.396	6.847	5.931	6.122
70.0	4.286	3.878	4.750	4.873	5.172	5.308	5.163	5.232	5.248	5.544	6.060	6.252	6.405	6.729	6.148	6.165	6.474	6.845
81.0	4.286	4.405	4.636	4.795	4.300	4.171	5.333	5.624	5.376	5.307	6.090	6.095	6.621	7.687	7.532	7.105	7.182	8.267



The end result can be saved and re-loaded at any time using these buttons.

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IMPORTANT – Auto mapping will only take place in a cell that has been activated in this way.

To begin Auto Tuning press the Auto button at the top of the page. The PC will now read back from the ECU the latest version of the injection and spark map. At the top of the page you will see a series of messages.

- Synchronising mapping data
- Loading injection data
- Loading advance data
- Lambda match or waiting for lambda (you are now ready to start)

53	4.232	3.989	3.91
32	4.432	4.313	4.2
15	4.701	4.485	4.3
34	4.726	4.495	4.2

You will notice that the file name you are now working with at the bottom of the screen is prefixed by a *, this is to indicate that the map has been taken from the ECU and not yet stored on your PC.

Adjust the engine using the dyno so that the throttle and RPM align with your chosen cell. Correct engine state will be indicated by the RPM and TPS values changing from yellow to red and the cell in the main window changing to grey as shown here.

Providing that all of the following conditions have been met, the ECU will begin to adjust the injection time to your target AFR. This will be seen in the main cell window by the text changing to red and the numbers moving. The manual sliders are inoperable during auto tuning.

- Cell must be activated for Auto Tuning
- Water temperature must be within limits
- No transient or start strategy active
- The engine is not in 'Cut off' or 'Over rev' status
- The engine has been locked onto the cell for at least the 'Hold time'
- The current lambda value must be outside of the target tolerance.

Once the target AFR has been achieved and the cell value stops changing, move onto the next cell and repeat

When all mapping work is done use the OFF button at top right. All of the modified cells are showing in bold red, including the ones in other cylinder pages.

If you want to make some manual changes at this stage you can exit the Map tuning page and use the Map edit page, this is easily done by pressing the Map button at the bottom of the page, the red bold cells are still showing and you are free to make manual changes. You can also make a map edit **during autotuning enable**, by right click on the listed plan.

This file must now be saved, use the Save button, choose Mapping and remember to remove the * prefix or you will not be allowed to save the file.



To finish the process, simply Transmit this map back to the ECU into either map 1 or map 2.

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