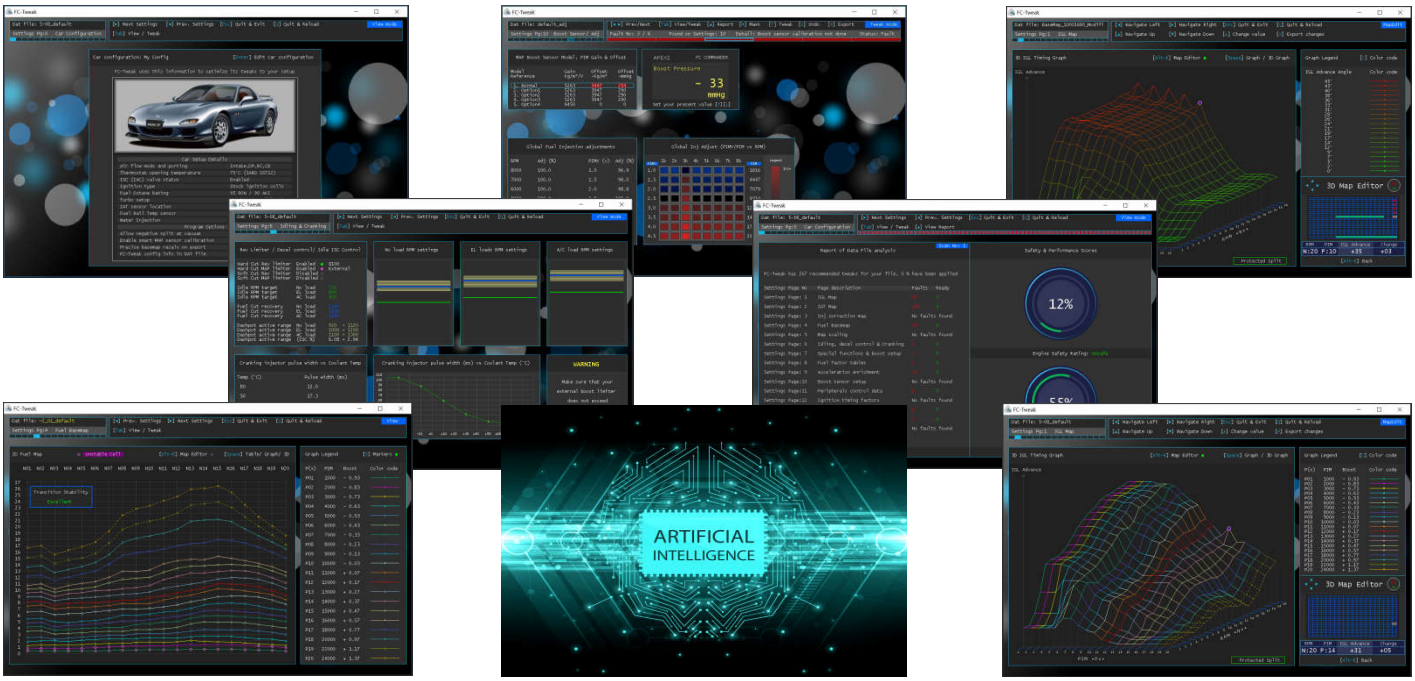
FC-Tweak

User Manual

The ultimate intelligent tuning software for

Mazda RX7 APEXI Power FC

Revision 32.0 Optimized for use with our new DL-340XB interface box



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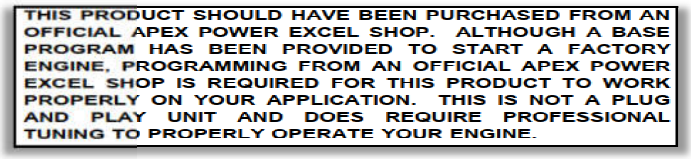
Introduction

FC-Tweak Software is to be used in conjunction with APEXI Power FCs designated for use with Mazda RX7. It has been developed by a fully qualified automotive electronics & telecoms engineer and is the first of its kind, in that, it loads, analyses, corrects, and regenerates PFC data files. This document is aimed for users who are using the latest DL-340XB interface box to communicate with the Power FC. This interface is supplied together with PFC-Connect software package with which you will perform file & data transfers from/to your Power FC.

The Power FC ECU is one of the most popular choices amongst RX7 owners, but unlike most of today's ECUs, it was not originally intended to be tuned by the owner. This job was left for authorized APEXI Power Excel shops around Japan, and later on, also in the US. With the introduction of FC-Edit software, PFC owners and tuners could finally start to explore the real power behind tuning these computers, but general lack of documentation and support meant that each setting change came with a level of unknown risk. It's not unheard of, that an RX7 had an engine failure upon its first Dyno run following changes to their PFC data using such dangerous software, sometimes even performed at a tuner garage. Also, even with a mildly modified car, the base maps that come with these units can create more damage than a factory computer would. Most RX7 owners who just left in APEXI's default base map had their cars destined to a very short lifetime. Just in case you missed the warning on the front page of your PFC owner's manual, here is what it says, and it must not be taken lightly:



FC-Tweak has been developed for both personal and professional use. It views, analyses and corrects APEXI PFC ECU data files based on reconfigurable car setups. It's like having a professional tuner at your service. All recommended tweaks have been tested on various rotary setups, and limits, rules of thumb, and recommendations from several professional tuners together with our own engineering knowledge have been incorporated into the working logic of the program. The main aim of the recommended tweaks is to make the data file safer whilst improving its overall performance. It's important that you understand what the program can and cannot do, in order to make the best use of it. The standard version, WILL NOT eliminate the requirement for real tuning sessions (performed by the Pro version), but there is a long list of things it can do which will save you a lot of time and money. If you are street tuning your car, it will accelerate your tuning process by eliminating crossing curves, estimating neighbouring cell values and smoothing your fuel and timing curves each time you manually update your map data. Proper data tweaking can save your engine. And if you are a tuner yourself, it could one day even save your reputation. It's virtually impossible, even for the most experienced tuner to spot all the bad settings within a data file. For a task that any human would take no less than a whole day, assuming you find a volunteer willing to do so, FC-Tweak will scan all your data and be ready with a list of recommended tweaks in a couple of seconds.

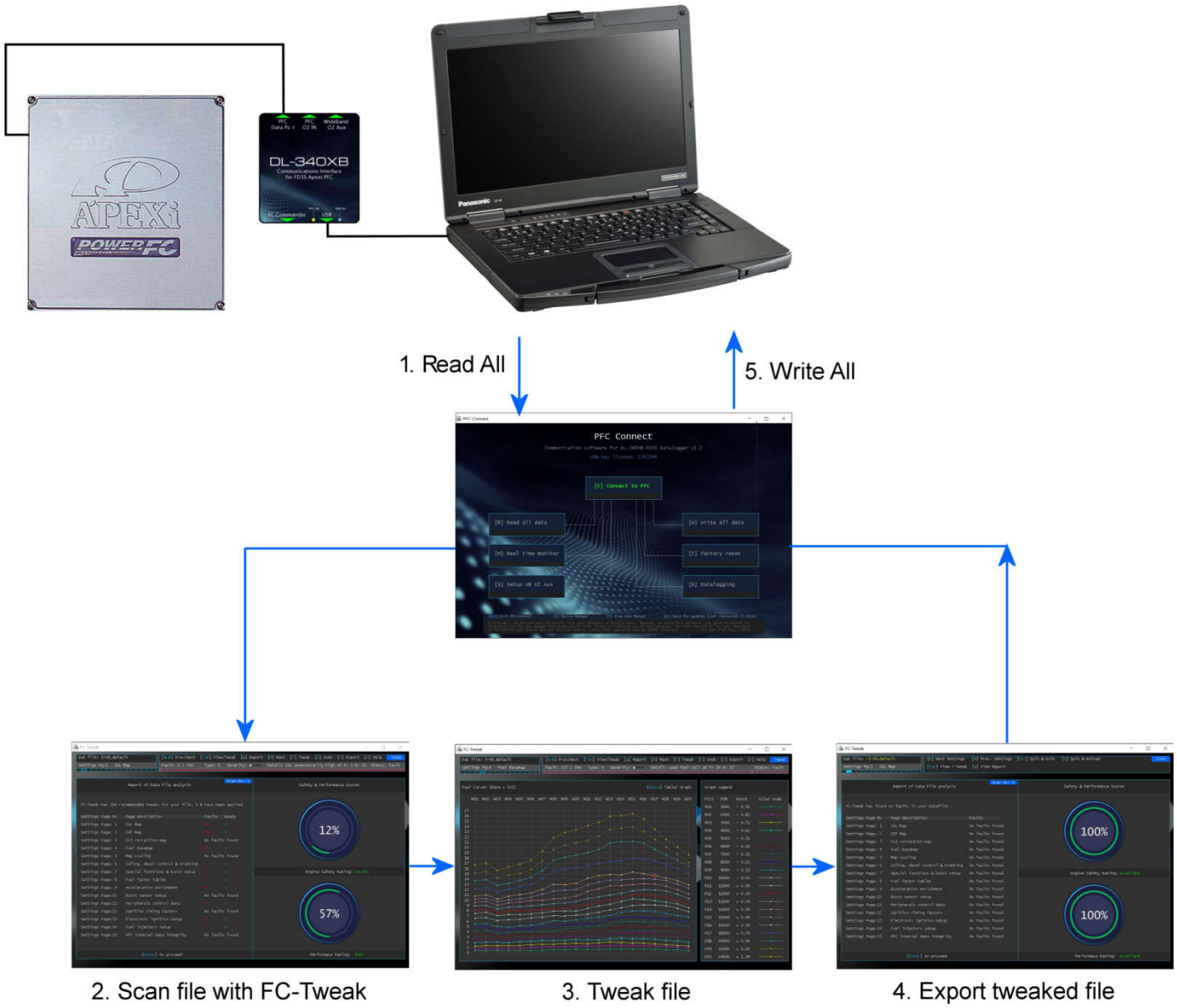
Please understand that tweaking a PFC file which has never had its fuel & timing maps tuned, will NOT necessarily make it safe to go on boost, or on a dyno!! If your car has never been properly tuned using a wideband O2 sensor, then you must do this before it's too late. Note that most dyno tuners do NOT perform fuel map tuning and in most cases the only way to do it properly is to do it yourself! Using the Pro version, one can automate map tuning based on real logged data. All you have to do is take your car for a drive, and the software prepares the new fuel map for you, based on the logged AFRs. Starting maps with ideal timing for various car setups are available upon request at a small cost.

Disclaimer

We did our best to ensure that FC-Tweak is totally safe. Unlike other data file editing software, the user is not allowed to enter damaging parameters, and all software recommended tweaks have to be individually confirmed by the user. This means that you are always in control of the changes affected. So, by using this software you agree to assume all responsibility for any damage that might result from direct or indirect use of this program.

Extra caution note for FC-Tweak Pro users: Unlike the standard license version, the Pro version allows direct to file map editing, and data log based map tuning. FC-Tweak Pro will not stop you from entering damaging data while using these powerful features. If you have any doubts about your ability to edit maps, or about the accuracy of your logged wideband readings, then please refrain from using these functions.

Using FC-Tweak



Connect the laptop to Apexi Power FC using the DL-340XB interface. Use PFC-Connect to 'Read All' data from the ECU, FC-Tweak to tweak all required file settings, and again PFC-Connect to 'Write All' the optimized file back to the Power FC.

Note that working with FC-Tweak may be done offline, that is, the interface box does not require to be connected to your computer during the tweaking process. This means that this software does not necessarily need to be installed on the same laptop you use for street logging. Also, once the software is installed, no internet connection or service is required for its use, other than when downloading new software versions.

FC-Tweak PRO Note: The Pro version now has also an Auto Tune module, which actually does the fuel tuning for you, based on Data log files you obtain from test drives. Together with the standard tweaking ability, the Pro version becomes the only software you'll ever need for both tuning & tweaking Apexi's Power FC. To use the auto tune features, your car must be equipped with a WBO2 sensor kit.

Using FC-Tweak (brief description)

FC-Tweak is meant to be very easy to use. It optimizes your data file with minimal input from your side. The procedure is as follows:

- Start FC-Tweak and import or select your data file from its file manager window
- Select your car mods and characteristics from a predefined list (only on first time use)
- Start data analysis which will scan all your data in a few seconds and display a fault report
- In Tweak mode, scroll between each error and choose either Tweak, Mask (Ignore) or Undo
- When finished, press Export to save your tweaked data file to disk
- Select 'Write All' on PFC Connect & send to your PFC

Capabilities and features:

View Mode

- Edit, save and reload your (or your customer's) car setup and modifications list
- Displays colour coded maps in both table format and Excel style charts
- Full screen charts for IGL, IGT, Split, AFR, Fuel (Base, Base x Inj, Duty [Global/Prim/Sec]) and Power (WHP)
- Displays Real pulse width basemap & highlights cells prone to instability upon injector transition
- Estimates and plots realistic horsepower at the wheels for each basemap cell
- Highlights closed loop O2 feedback control cells on AFR map and shows fuel cut limit on all timing & fuel curves
- Displays marker lines on AFR map showing upper and lower bounds for the O2 feedback control region
- Highlights single injector mode cells to easily visualize injector staging on fuel map
- Groups settings tables & their charts organized by function
- Easily interpreted graphs with auto-scaling co-ordinates and various format types
- Shows all parameters in their proper units, with temperature & boost in both SI & US standards
- Comprehensive and extra calculated information displayed on each settings screen
- Shows car setup details of other user files saved with FC-Tweak

Tweak mode

- Customizes file optimizations to reconfigurable car setup and mods list
- Accounts for various ignition systems, EBCs, porting, thermostats, turbos, water injection, OMP methods, and more
- Displays the severity rating for each individual fault for engine safety or performance on a 5-bar meter
- Displays further help and technical information on each recommended tweak upon demand
- Instantly rates your data file for safety and performance, and updates performance meters as you tweak the file
- Calibrates your boost sensor offset for correct boost readings and map tracing, before or after tuning
- Activates soft cut RPM limiter function before default hard fuel cut limiter kicks in, just like modern ECUs
- Activates soft cut boost limiter to avoid going off the mappable range or before hitting the hard cut overboost limit
- Checks timing & fuel maps for anomalous timing, lean cells, crossing curves, bad split, etc...
- Improves dashpot control, eliminating stumbling, sticking or surging idle upon deceleration
- Increases engine torque and optimizes fuel injection during cranking for faster starting
- Optimizes acceleration enrichment to eliminate tip-in problems & improve acceleration response
- Activates predictive power enrichment function to further improve acceleration response under load
- Inter-relates various settings located in different tables to make the best decisions
- Tweaks electronic ignition dwell parameters for optimal spark energy eliminating ignition breakup at high RPM
- Tweaks ignition coil calibration table for optimal spark ignition during starting (both stock & IGN-1A)
- Tweaks injectors transition settings for any injector size combination & sets overlap for smoother operation
- Activates PFCs internal injector transition protection
- Corrects injector staging settings, solving bucking during transition with large injectors
- Eliminates sputtering and exhaust popping during engine braking and overrun
- Eliminates twin turbo sluggishness during gear shifting
- Compensates for additional injector delay due to wiring harness and driver chip impedance
- Compensates for front to rear fuel injection timing due to irregular stock LIM design
- Optimizes heat soak enrichment table for either stock or relocated fast IAT sensors
- Optimizes compensation settings so that your tune holds the same AFRs throughout all seasons
- Tweaks OMP rates and fan trigger temperatures for best protection & efficiency
- Enables & tweaks catalyzer accelerated warm-up function depending on your exhaust setup
- Detects corrupt data files and dangerous junk data, which would otherwise be undetected
- Recovers missing data segments and corrects invalid values
- Ignores errors for parts marked as disabled in your setup
- Stores all your car details within your file without having to type in anything
- Manual confirmation required for every tweak, so you are always in control
- Capable of multi-pass analysis to further refine tweaked data
- Generates a log file including client's car mods & all tweak actions performed (Pro version only)
- Renders all maps in 3D with either contour color or PIM map color coding (Pro version only)
- Accurately re-calculates your fuel basemap to reduce ECU processor load
- Exports the tweaked Data file in *.dat format ready to be uploaded to the PFC

Explorer/ Map Edit & Auto-tune mode

- Explorer mode navigates through all cells in any of the 2D maps showing their value and all changes done during tweaking
- Map Edit mode – same as Explorer but enables the user to manually alter the value of any map in 2D or 3D (Pro version only)
- Automated AFR taget map generator, creates a customized AFR target map optimized for your car setup (Pro version only)
- Can import external AFR target maps from clipboard in manual override mode – for more advanced users (Pro version)
- Log file viewer, views wideband O2 and knock data directly from a Datalog file. Filters real knocks from logged false knocks.
- Fuel map Auto Tune – automated tuning of your fuel map based on wideband O2 data logged with PFC-Connect (Pro version only)
- Advanced map manipulation – Advanced tools able to reset or retune individual map cells based on data logs (Pro version only)
- True AFR Inj map REGEN function – rebuilds the Inj map reflecting true AFRs (Pro version only)

Downloading FC-Tweak shareware version

System requirements:

Supported Windows Operating Systems: Win XP, 7, 8, 10, 11 –> 32 or 64 bit versions
CPU speed: Preferably over 800MHz, ideally 3GHz or faster
Screen resolution: > 1200 x 768 (Laptops with 1200x768 will run FC-Tweak in full screen mode)
RAM used: ~100 Mb
Disk usage: < 30 Mb including User Manual

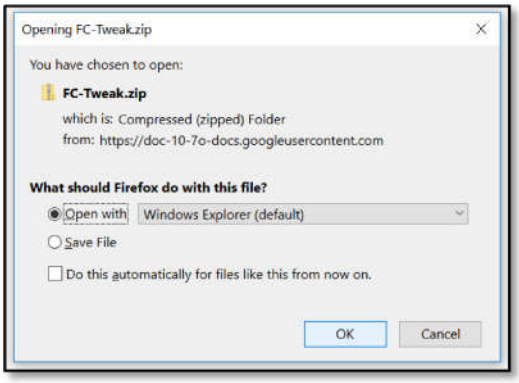
Note: FC-Tweak is stand-alone software, and does not require FC-Edit, Excel or any other external software installed to perform any of its tasks. This means that is can be used on any pc, and not necessarily the one you use for logging.

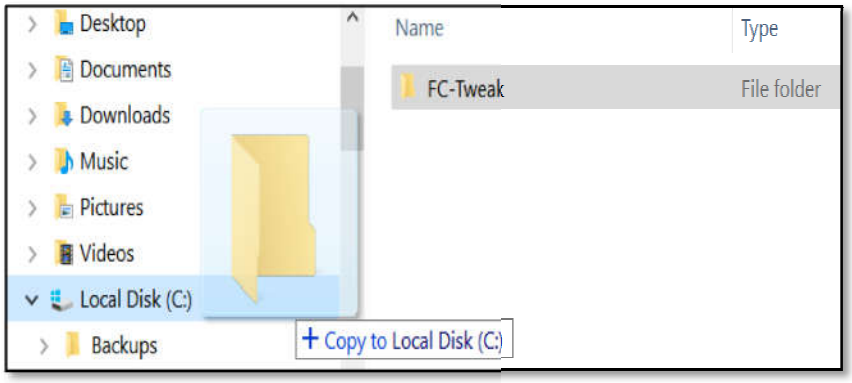
FC-Tweak is freely available as shareware and is upgradable to a full registered paid version. So, in order to upgrade to either the full or Pro version, you must first install and run the shareware version.

FC-Tweak shareware version comes as a single zipped folder ready to be extracted onto your hard disk. It has no Windows installer and no data is written to your Windows registry.

Click on the link below to start download of your shareware copy
https://tinyurl.com/getFCT

Once downloaded, select the option: Open with Windows Explorer (default), and simply drag and drop the FC-Tweak folder to your main local disk, as shown below.





Do not move it to your Program Files directory, as some Windows Home Versions won't like that.

This new folder contains all that is required to run the shareware version. All you have to do now is create a desktop shortcut.

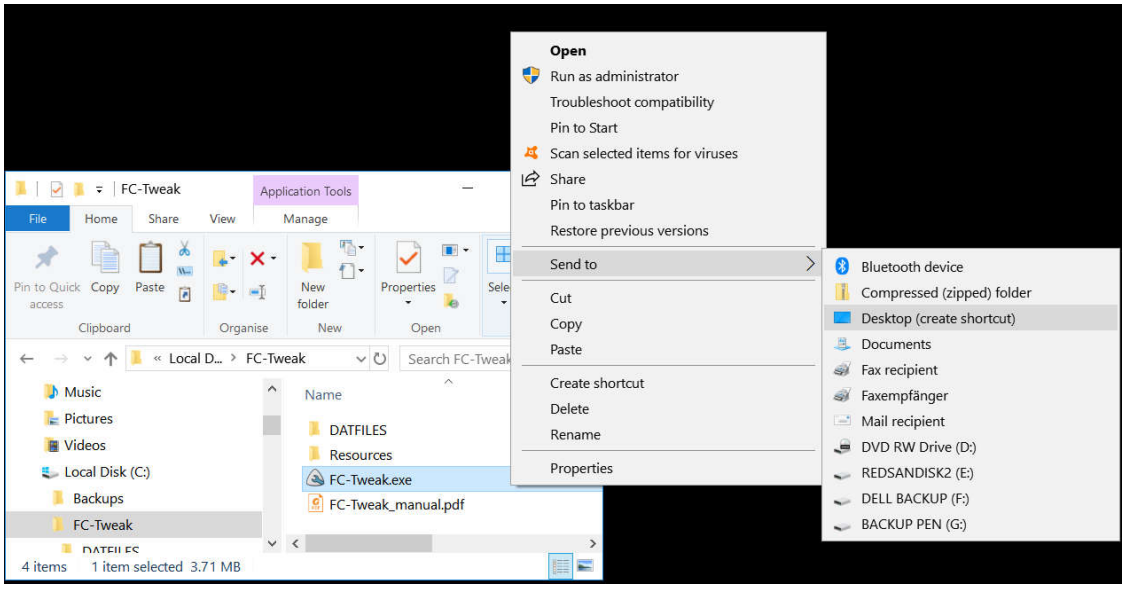
Note to Norton Symantec users: Please note that since we have not white listed our software with Norton, the security software may qualify our program as WS.Reputation.1 (no reputation score) and quarantine the file. All our software is scanned 100% clean, so if you run into such problem with Symantec, just click on its options button and select Restore.

Note to Mac users: Tested on Windows 10 Enterprise x64 installed in VMware Fusion Pro Version 11.1.0

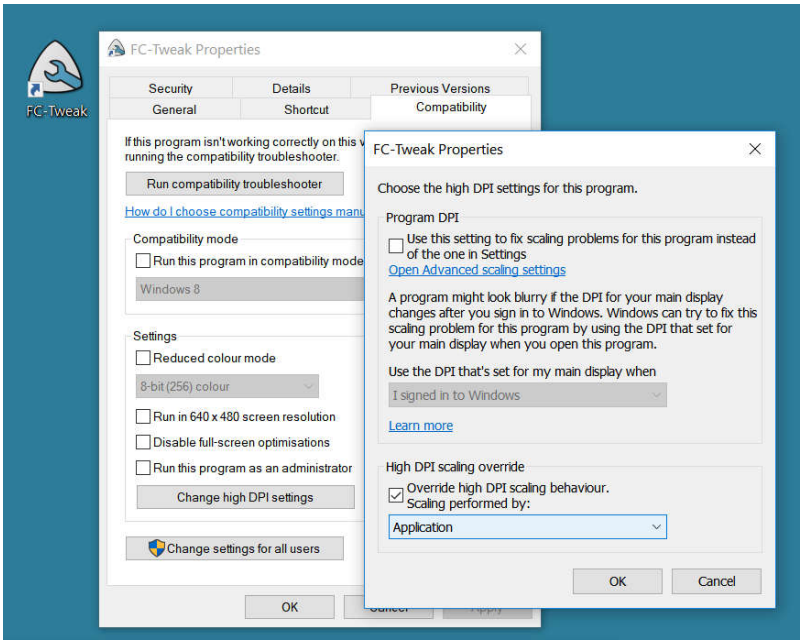
Note to Avast users: The only problem with Avast is that upon first execution of the program, sometimes, it wastes a couple of minutes sending it to their labs, until it comes back with a 'file is clean' message. If you want to avoid this from happening, go to Avast Menu – Settings – Protections – Core Shields – Turn off 'Enable Cyber Capture Technology'.

Installing FC-Tweak (Shareware version)

Using Windows Explorer, locate the executable FC-Tweak file (recognized by its rotary icon), right click on it, and select 'Send to'> Desktop (create shortcut)



Important: Some Windows versions have a bad habit of smudging graphics screens which are not in your native screen resolution, especially Windows 10, so to make FC-Tweak visible in its best appearance, just right click on FC-Tweak desktop icon, select Properties> Compatibility > Change high DPI settings and tick Override high DPI scaling capabilities, Scaling performed by > Application.



Your shareware version is now ready to be launched. Double click the FC-Tweak desktop icon to run the program. If you have Windows defender installed on your system, the first time you run the program, a warning screen may pop up because it's an unrecognized app. This is a very common problem with unsigned executable applications. In that case, simply press 'more info' and 'Run Anyway'. The program should then start straight away and Windows defender will not bother you ever again.

Starting FC-Tweak

The first screen is FC-Tweak's own file manager. From this window you can:

(a) Browse, load and delete PFC Data files
(b) Import dat & log files from a pen drive or other folders to FC-Tweak's file manager
(c) View this User manual in your PDF reader
(d) View your unique product ID for registration purposes
(e) Send Registration e-mail request (just sends an e-mail, no payment transactions)
(f) Download the latest software version online
(g) View revision history log
(h) Edit AFR target map – used by advanced users to override automated target maps

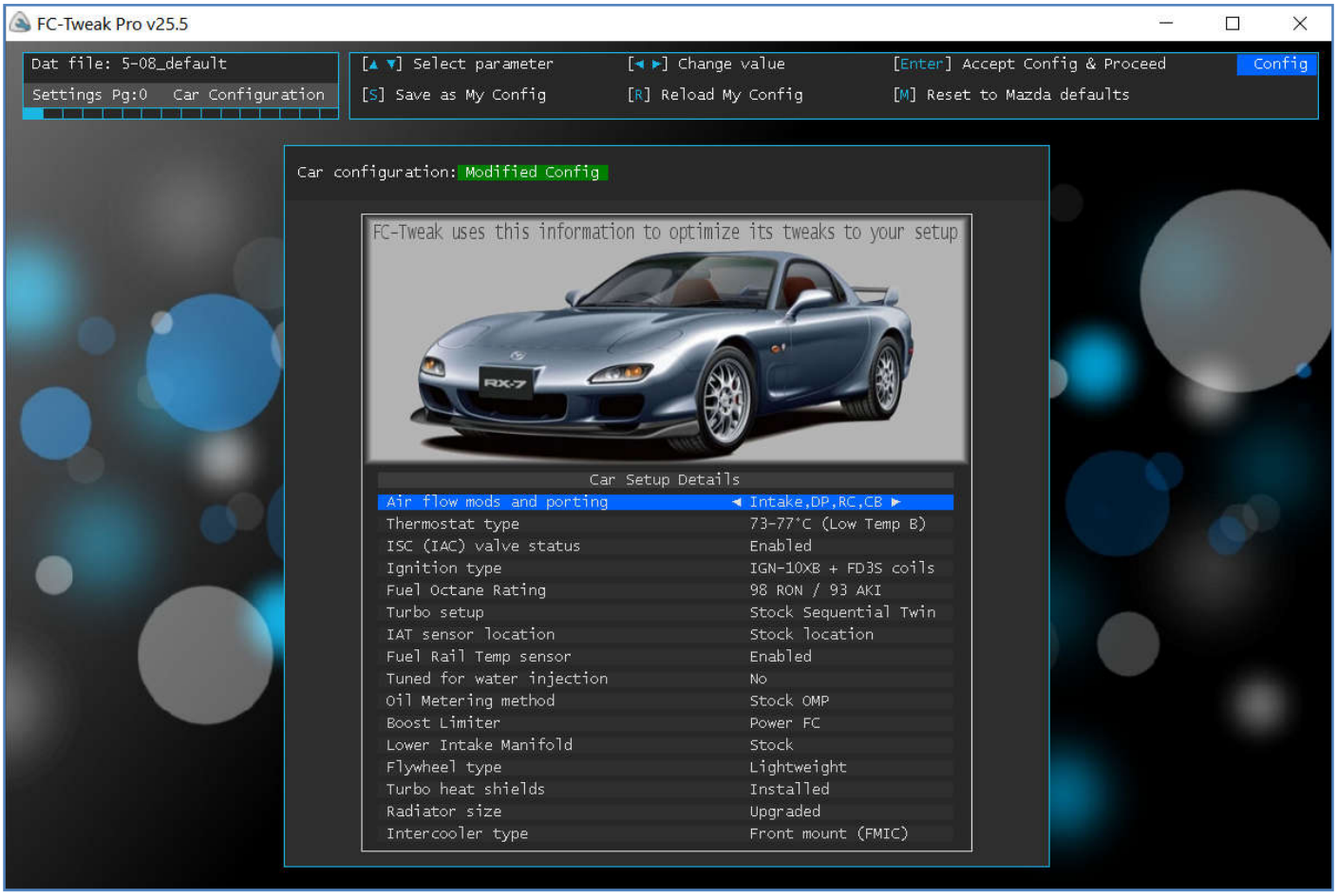
FC-Tweak is totally keyboard driven (mouse free), so once loaded you may put your mouse aside since all actions will only use the keyboard. A useful tip for small or low resolution LCD computer screens: pressing [Alt-Enter] will switch the program between five screen modes.

Each screen has its own keyboard shortcut keys to execute commands. Throughout the program these shortcut keys are printed in square brackets, for example, in the above screen, the cursor keys are used to navigate through your files list, [Enter] key is used to select and load your data file, [Delete] key to delete a file, and so on. Pressing [Delete] file, will ask for a confirmation.

This is FC-Tweak's directory physically located in folder FC-Tweak\DATFILES. Dat files may be manually added to this folder using [I]mport. If PFC-Connect resides in the FC-Tweak folder, any file you read from the PFC will immediately be visible in FC-Tweak's file manager.

Filenames are color coded as follows: grey for imported PFC files, yellow for tweaked (have a ~ prefix), blue for files having a saved session logfile (good for auto-tune), and orange for auto-tuned files (have a + prefix and a '–Auto' extension). If the selected file is corrupt or not recognized as an RX7 data file, you will be notified and prompted to select another file. Also, the program will not delete the file named 'default'.

Settings Page 0



Please note that the rest of the manual will describe all the features present in the full registered version. Although the shareware version is able to view all tables, graphs, and even analyse your file and give a brief report of all faults found, it cannot be used to generate and export a tweaked file. For that you will need to register your product. Once registered, all features will be activated with no license expiry, and you shall receive future updates free of charge.

FC-Tweak utilizes 15 settings screens to show all your data file contents, and all displayed data is organized by function.

Once you select your file, the program automatically enters 'View mode' on settings page 0 – The Car configuration & Session Options settings page. Here you will configure your car setup, and set your program preferences. If the loaded file comes from an FC-Tweak user, the filename will be printed in yellow, and the saved car configuration details will automatically be shown under heading 'Car Configuration: User data'.

FC-Tweak will use the car setup information to make basic decisions during its file analysis and tweaking process, so it's very important you enter the correct information. FC-Tweak is a very reliable tool because all tweaks are software controlled and the user cannot enter any harmful values. This is the only page that requires user selection, and a wrong choice on this page will result in a tweaked file which may not be the best for your car, or even result in damage. However, minimal knowledge of your car is all that is required to properly setup this page.

Your current car configuration settings group is displayed on the top left corner, and all settings can be changed, reset, saved or loaded. By pressing [Enter] you can modify any of the listed configuration entries as follows.

Editing Car Setup Details

Air flow mods and porting

Here you select the air flow mods combination that resembles your setup most.
The mods combinations use the following abbreviations:

Stock:	No mods – factory condition (including stock air intake, catalytic converter & muffler)
Intake:	Any aftermarket free flowing air intake
DP:	Downpipe, that is, no pre-cat (on US models), JDM RX7 have a DP from factory
RC:	Racing catalytic converter, that is any aftermarket non restrictive unit (<300cpi)
CB:	Catback, any high flow aftermarket muffler (aka silencer) unit
MP:	Midpipe – No catalytic converter, just a straight pipe
SSP:	Small street-ported engine
LSP:	Large street-ported or half bridge ported engine

Thermostat type
Select your thermostat type from the predefined list or 'Deleted' if no thermostat is fitted. The thermostat opening temperature range for each type is also displayed. For example, for a Sard SST12 (75°C) thermostat, select opening temperature range <73-77°C (Low Temp B)>. Note that thermostats are nominally fully open at about 10°C above their stated opening temperature value.

ISC (IAC) valve status
The idle speed control valve, a.k.a. Idle Air control valve, is sometimes removed, so the PFC can no longer use it to stabilize the idling speed and for its dashpot functions. Set <Disabled> if you have it removed or disconnected.

Ignition type
Select your ignition model from either Stock ignitor, IGN-1A, or our direct bolt on performance FD-IGN-10XB ignitor module with either stock FD3S or exchanged FC3S leading coil. HKS Twin Power, Okada and other 'Plasma boosters' are not really electronic ignitions but just resonators, so if you have such units installed, you must still select <Stock ignitor>.

Fuel Octane Rating
Normal pump fuel is 95RON/ 91AKI, usually sold under the name 'Premium'
High octane fuel 98RON/ 93AKI, is usually sold as 'Super', and is also more expensive
RON Ratings are most common in European countries, Australia, and New Zealand
AKI Ratings (also known as (R+M)/2) are most common in the US, Canada and Brazil

Turbo setup
Select between <Stock Sequential Twin> or <Single/ Non sequential>. For the latter option, the PFC will not control turbo transition. For those setups which use the stock sequential twin configured to operate in locked mode (as single), but have still the turbo control solenoids operated by the PFC, select 'Stock Sequential Twin'.

IAT sensor location
The intake air temp sensor is usually located underneath the UIM and may read higher than actual temperatures. If your sensor is a fast acting sensor such as the Triumph IAT, or has been moved to a colder location choose 'Pre-intake elbow'.

Fuel temperature sensor
This is located on the stock fuel rail, and usually gets removed in the process of fitting aftermarket fuel rails. Choose <Disabled> if it has been removed.

Tuned for water injection
Select <Yes> only if your car is equipped with such a system. If you need a map that can run safely even in the event of WI failure, then select 'No'.

Oil metering method
Select <Stock OMP> if your stock oil metering pump is in use, otherwise select 'Premix'
Note: If you are adding premix with a functional OMP, do NOT exceed 0.2oz oil/gallon of fuel!

Boost Limiter
Select <Power FC> if boost limiting is controlled by the PFC, otherwise select <External> if using an external boost controller.

Lower Intake Manifold
Select <Symmetric> only if you have an aftermarket symmetric design LIM, such as the Xcessive LIM.

Flywheel type
Select <Light weight> or <Stock> accordingly.

Turbo Heat shields
Select <Installed> or <Not present> accordingly.

Radiator size
Select <Stock> or <Upgraded> accordingly.

Intercooler type
Select <Stock mount (SMIC)> or <Front mount (FMIC)> accordingly. For V-mount intercoolers select FMIC.

Saving/ Loading user configuration settings

When finished configuring your car settings, press [S] to save your configuration file to disk. The saved configuration will be loaded by default each time you run FC-Tweak. This configuration is displayed as 'My Config'.

Pressing [M] will load Mazda's RX7 factory setup defaults. This configuration is displayed as 'Mazda stock config'.

Pressing [R] will reload your last saved 'My Config' car configuration settings

Loading an FC-Tweaked Data file will automatically change these settings to those contained in the Data file, since this configuration data is also stored in all FC-Tweak exported files. This way, FC-Tweak users can share and view each other's files and have access to the list of modifications of the car from which the file came from. When loading FC-Tweaked files, the car configuration is displayed as 'User data'.

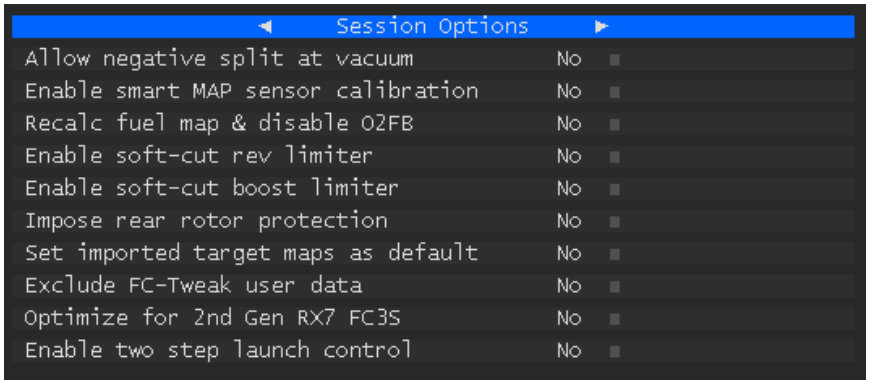
Pressing [Enter] accepts the listed options and proceeds to View mode.

Certified Fuel Maps

FC-Tweak's auto-tune function will mark a file as certified once its fuel map has been tuned to a very good level (AFR tune score>90%). Such maps will have a 'Certified Fuel Map' label shown on the car configuration screen. Files with this label are considered safe to be used on boost.

Editing Session Options

The 'Car Setup Details' & 'Session Options' menus are toggled using the left or right arrow keys over the menu title bar as shown here. From the 'Sessions options' menu, special functions can be temporarily activated for the particular scan session.



Allow negative split at vacuum: Disables detection of negative split cells in the vacuum range. This preference is stored on exit.

Enable smart MAP (boost) sensor offset calibration: Select Yes to enable FC-Tweak to guide you through this calibration (refer to pg39). You will need either an FC-Commander or PFC-Connect to perform this.

Recalc fuel map & disable O2FB: Disables O2 feedback and performs a high precision recalc on the fuel basemap. The Injector correction table is normalized to unity, lowering the computational load on your ECU. FC-Tweak's recalc is 4 times more accurate than FC-Edit's and is automatically performed during file export.

Enable soft-cut rev limiter: This option will safe guard your engine against over revving by gradually reducing ignition timing in order to reduce engine power as it approaches the hard cut limit. If enabled, FC-Tweak will recommend tweaks to add these functions to your maps on settings page 6. Tweaks are applied upon file export.

Enable soft-cut boost limiter: **Use this option only after all tuning and boost settings have been finalized.** This option will safe guard your engine against over boosting by gradually reducing ignition timing as the hard boost cut limit is reached. If enabled, FC-Tweak will recommend tweaks to add these functions to your maps on settings page 6. Limiter map changes are applied upon file export.

Impose rear rotor protection: Force rear rotor fuel bias protection even for low power setups.

Set imported target maps as default: Force autotune to auto-load and use your own imported AFR target map as default. Unlike automated target maps, imported maps may not be necessarily safe, so use this option only if you really need it, for example if tuning on a higher ethanol content. When this option is enabled, autotune will always run in manual override mode, using the target map you pasted last, eliminating the need to copy and paste your custom target map every time you run autotune. To revert back to using automatically generated target maps, turn this session option off. This preference is saved on exit.

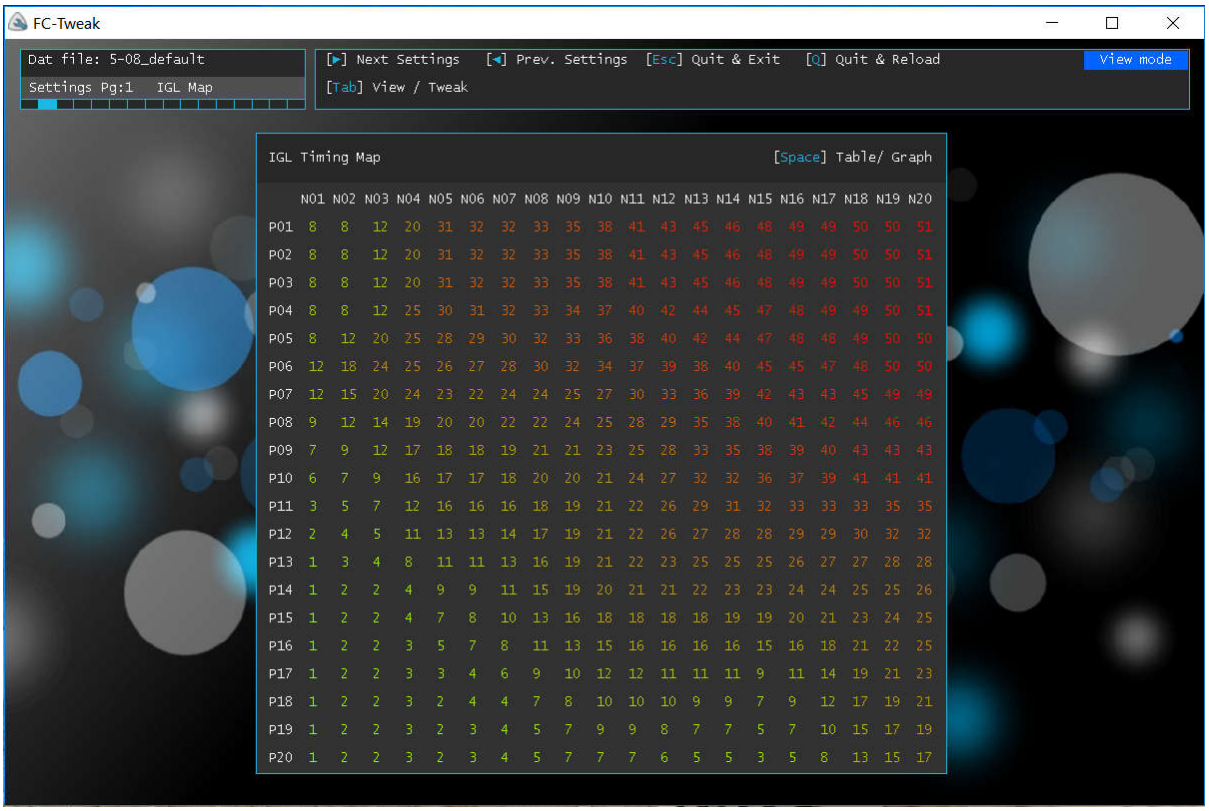
Exclude FC-Tweak user data: (Not recommended). This option excludes all car config data from the PFC file. Such files will no longer contain any car configuration information.

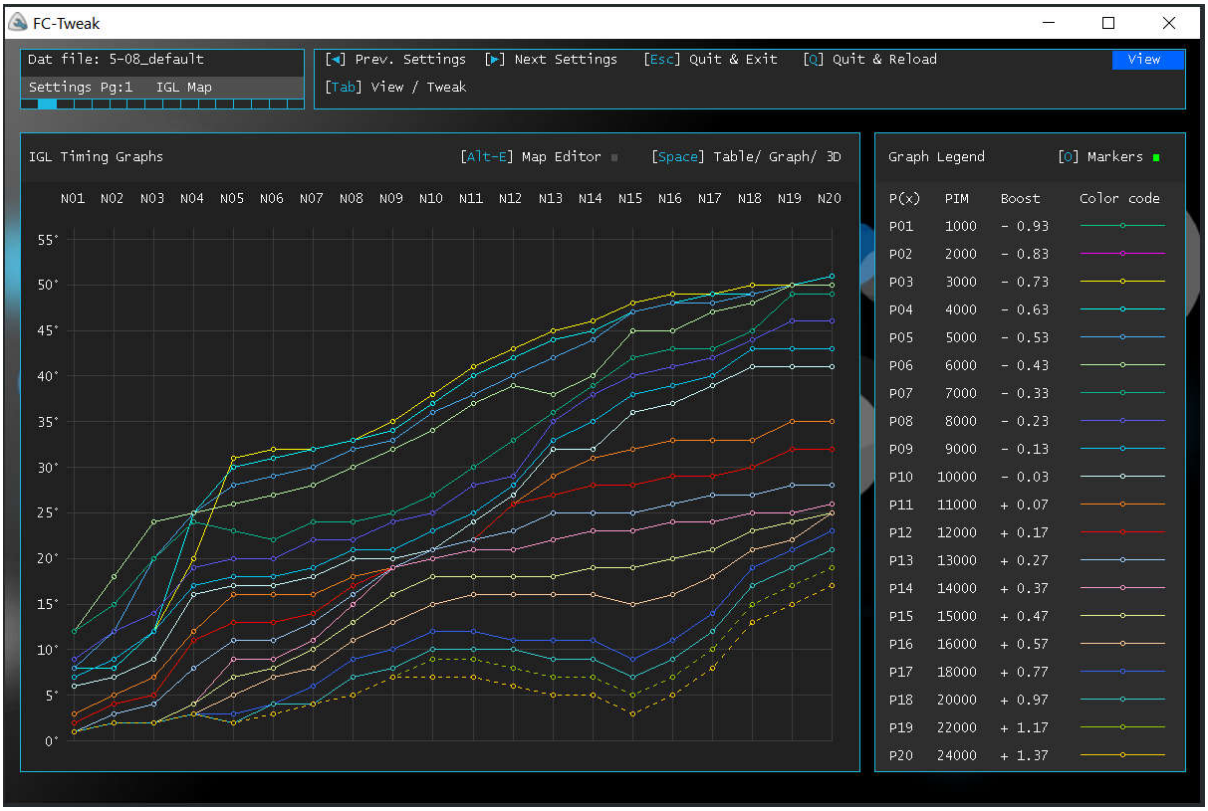
Optimize for second generation RX7 series 4 FC3S: Use this option when the PFC is wired up (using appropriate harness adapter) into an FC3S. When selecting this option, FC-Tweak will assume that the stock ignition is that of the FC3S. Intake air temperature sensor must be an FD type & boost sensor should preferably be a 3 bar Apexi type.

Enable two step launch control: (Option unlocked with USB dongle). Turns on a hidden menu with which you can program a two step launch control using only the PFC.

Settings Page 1: IGL Map

Displays IGL, the Leading ignition timing advance map. Positive values are degrees BTDC.

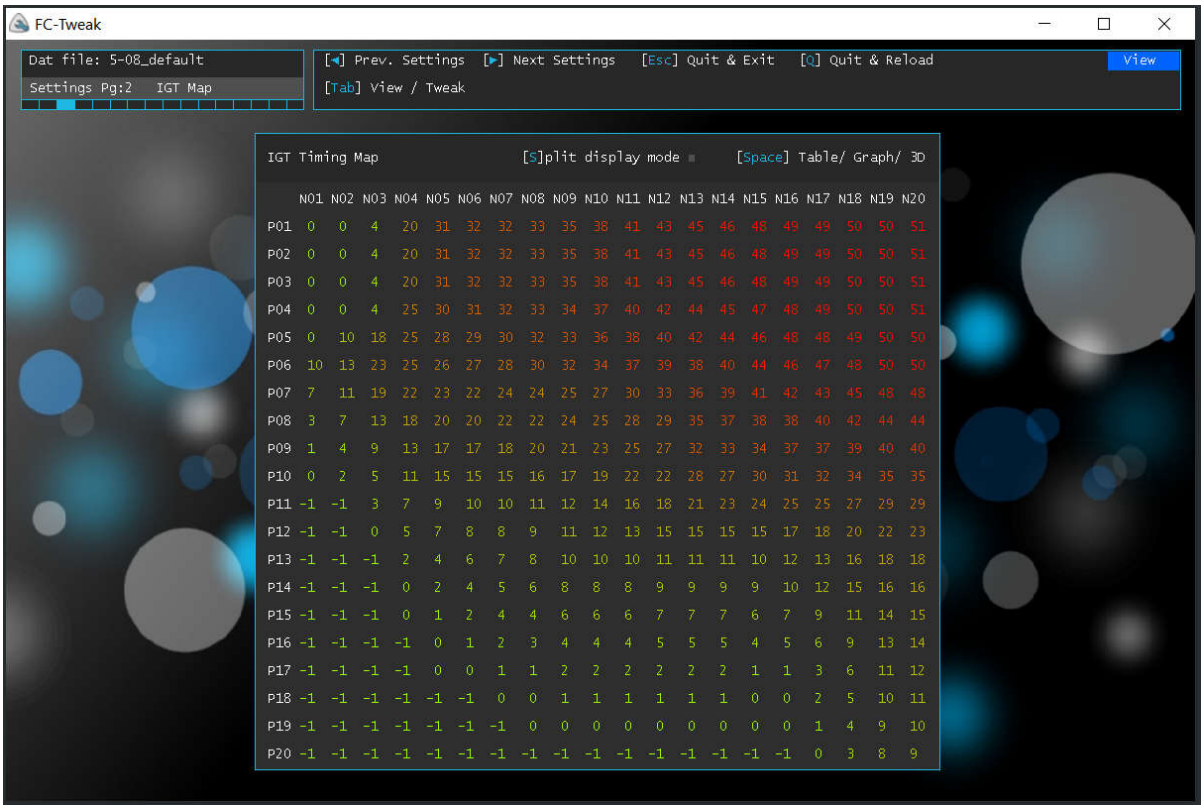




Pressing [Space] on any one of the map settings pages, will toggle between table and full screen graph mode. Pressing [O] toggles the graph markers. To the right, the graph markers status, boost rows reference values together with their respective Boost level in kg/cm^2 are shown. These map reference values are read from the same data file. Dashed graphs are for timing values that fall within the Power FC's over boost hard fuel cut region. The Pro version gives access to an additional 3D graphics map mode by pressing spacebar and can also copy the map data to clipboard by pressing [Ctrl-C], which can then be pasted in table form on other Windows apps.

Settings Page 2: IGT Map

Displays IGT; the Trailing Ignition timing advance map. Positive values are degrees BDTC.

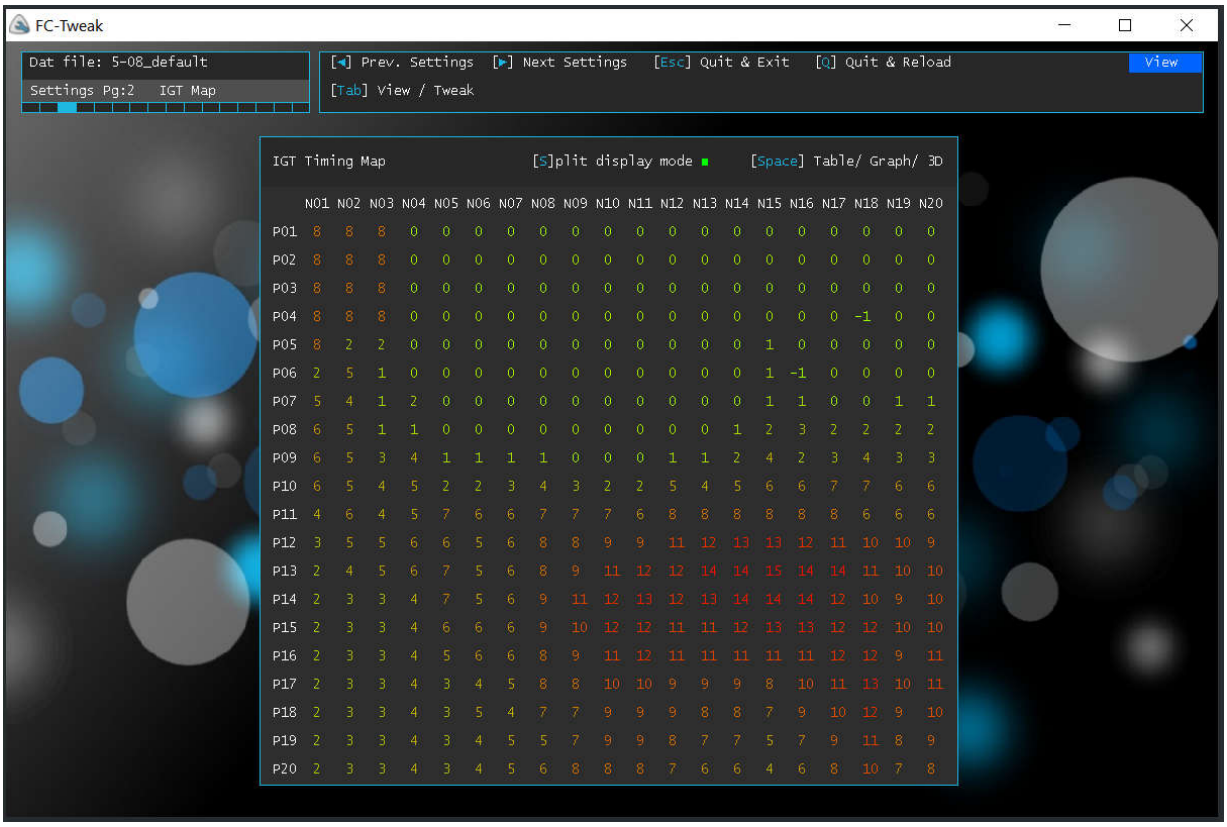


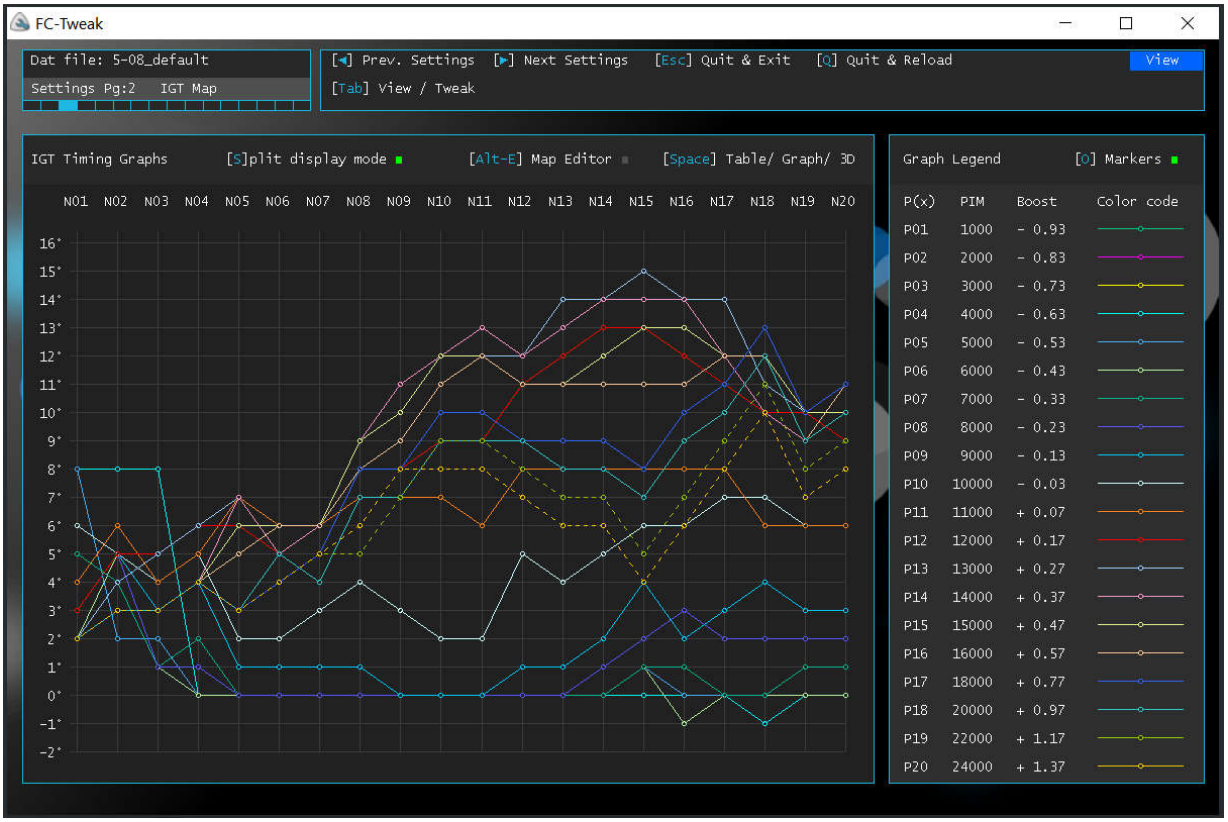
Again, your Map reference values are shown on the graph legend, together with their respective Boost level in kg/cm^2. As with the IGL plot, dashed graphs are for timing values that fall within the Power FC's fuel cut region.

It is highly recommended you switch to interactive graph mode while applying tweaks. Pro version license gives access to an additional interactive 3D graphics map mode during the tweaking process.

Settings Page 2: IGT Map in Split mode

Pressing [S] in either IGT table or IGT graph, toggles Split display mode. This shows the timing difference between IGL and IGT values and is very important for rotary engines. Positive values indicate trailing lags leading.

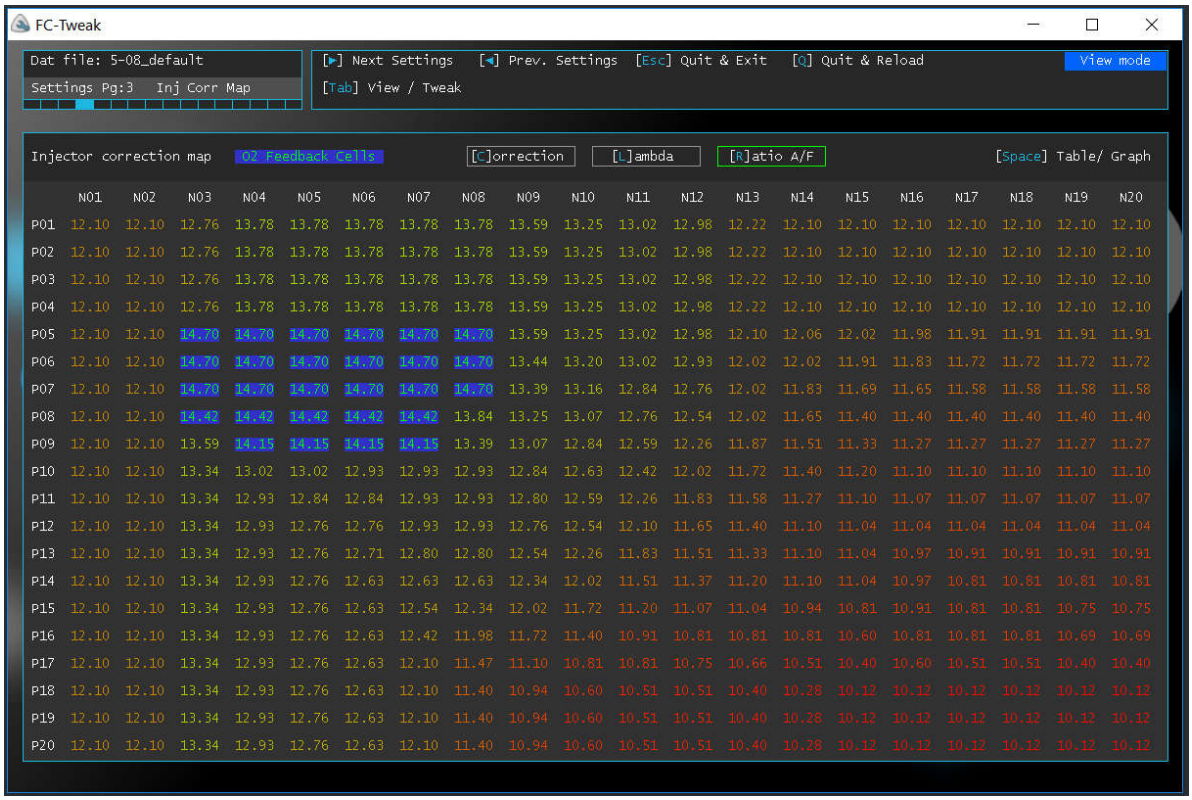




FC-Tweak will modify the split table to eliminate the chance of inter-cell errors, too high and too low values, and as per your set preference, eliminate negative split in the vacuum range.

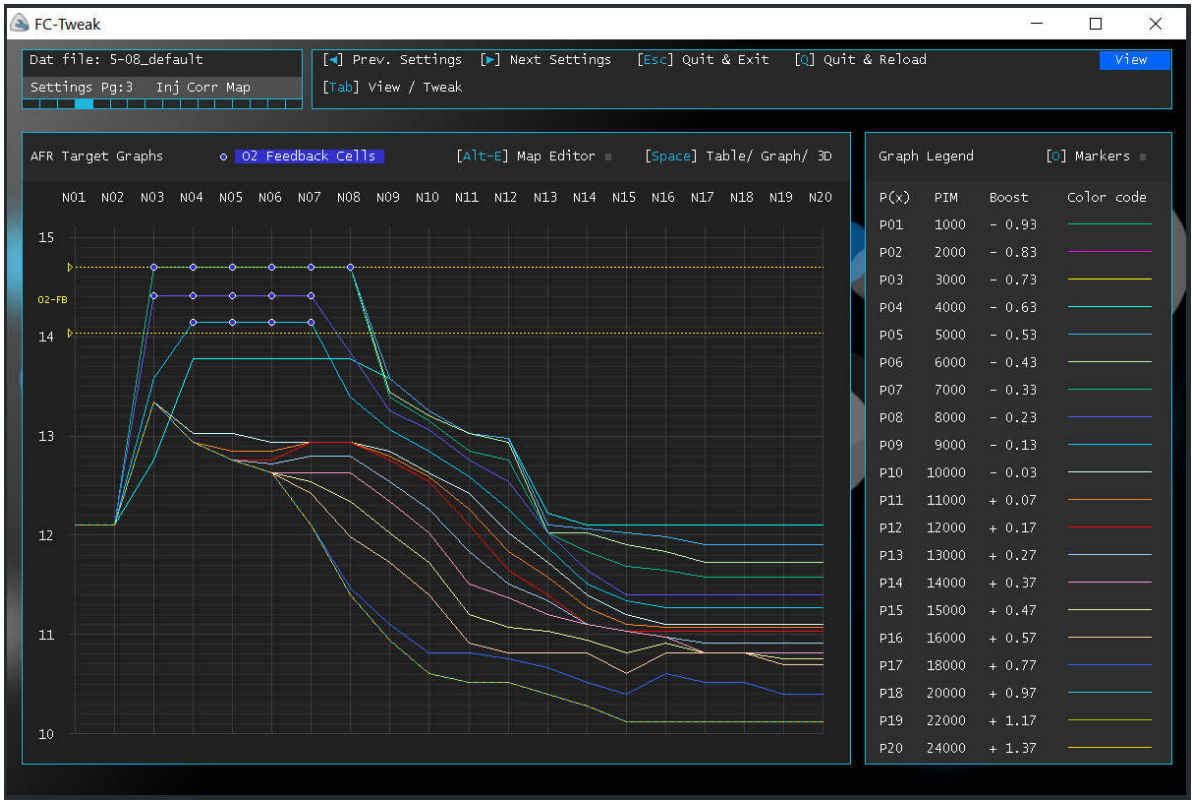
Settings Page 3: Injection Correction Map

Settings page 3 displays the Injection correction map table in one of three units: Correction factor, Lambda, or AFR. Select using [C], [L], [R] keys respectively. Again, space bar toggles between table and graph.



	N01	N02	N03	N04	N05	N06	N07	N08	N09	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19	N20
P01	12.10	12.10	12.76	13.78	13.78	13.78	13.78	13.78	13.59	13.25	13.02	12.98	12.22	12.10	12.10	12.10	12.10	12.10	12.10	12.10
P02	12.10	12.10	12.76	13.78	13.78	13.78	13.78	13.78	13.59	13.25	13.02	12.98	12.22	12.10	12.10	12.10	12.10	12.10	12.10	12.10
P03	12.10	12.10	12.76	13.78	13.78	13.78	13.78	13.78	13.59	13.25	13.02	12.98	12.22	12.10	12.10	12.10	12.10	12.10	12.10	12.10
P04	12.10	12.10	12.76	13.78	13.78	13.78	13.78	13.78	13.59	13.25	13.02	12.98	12.22	12.10	12.10	12.10	12.10	12.10	12.10	12.10
P05	12.10	12.10	14.70	14.70	14.70	14.70	14.70	14.70	13.59	13.25	13.02	12.98	12.10	12.06	12.02	11.98	11.91	11.91	11.91	11.91
P06	12.10	12.10	14.70	14.70	14.70	14.70	14.70	14.70	13.44	13.20	13.02	12.93	12.02	12.02	11.91	11.83	11.72	11.72	11.72	11.72
P07	12.10	12.10	14.70	14.70	14.70	14.70	14.70	14.70	13.39	13.16	12.84	12.76	12.02	11.83	11.69	11.65	11.58	11.58	11.58	11.58
P08	12.10	12.10	14.42	14.42	14.42	14.42	14.42	13.84	13.25	13.07	12.76	12.54	12.02	11.65	11.40	11.40	11.40	11.40	11.40	11.40
P09	12.10	12.10	13.59	14.15	14.15	14.15	14.15	13.39	13.07	12.84	12.59	12.26	11.87	11.51	11.33	11.27	11.27	11.27	11.27	11.27
P10	12.10	12.10	13.34	13.02	13.02	12.93	12.93	12.93	12.84	12.63	12.42	12.02	11.72	11.40	11.20	11.10	11.10	11.10	11.10	11.10
P11	12.10	12.10	13.34	12.93	12.84	12.84	12.93	12.93	12.80	12.59	12.26	11.83	11.58	11.27	11.10	11.07	11.07	11.07	11.07	11.07
P12	12.10	12.10	13.34	12.93	12.76	12.76	12.93	12.93	12.76	12.54	12.10	11.65	11.40	11.10	11.04	11.04	11.04	11.04	11.04	11.04
P13	12.10	12.10	13.34	12.93	12.76	12.71	12.80	12.80	12.54	12.26	11.83	11.51	11.33	11.10	11.04	10.97	10.91	10.91	10.91	10.91
P14	12.10	12.10	13.34	12.93	12.76	12.63	12.63	12.63	12.34	12.02	11.51	11.37	11.20	11.10	11.04	10.97	10.81	10.81	10.81	10.81
P15	12.10	12.10	13.34	12.93	12.76	12.63	12.54	12.34	12.02	11.72	11.20	11.07	11.04	10.94	10.81	10.91	10.81	10.81	10.75	10.75
P16	12.10	12.10	13.34	12.93	12.76	12.63	12.42	11.98	11.72	11.40	10.91	10.81	10.81	10.81	10.60	10.81	10.81	10.81	10.69	10.69
P17	12.10	12.10	13.34	12.93	12.76	12.63	12.10	11.47	11.10	10.81	10.81	10.75	10.66	10.51	10.40	10.60	10.51	10.51	10.40	10.40
P18	12.10	12.10	13.34	12.93	12.76	12.63	12.10	11.40	10.94	10.60	10.51	10.51	10.40	10.28	10.12	10.12	10.12	10.12	10.12	10.12
P19	12.10	12.10	13.34	12.93	12.76	12.63	12.10	11.40	10.94	10.60	10.51	10.51	10.40	10.28	10.12	10.12	10.12	10.12	10.12	10.12
P20	12.10	12.10	13.34	12.93	12.76	12.63	12.10	11.40	10.94	10.60	10.51	10.51	10.40	10.28	10.12	10.12	10.12	10.12	10.12	10.12

If O2 feedback control is enabled, the feedback control cells are highlighted. These should be within the cruising area of your map. The O2 feedback control limits are also shown in graph mode. FC-Tweak disables O2 feedback control if any of the feedback control cells are located in the boost area, or if the precision recalc option is enabled.



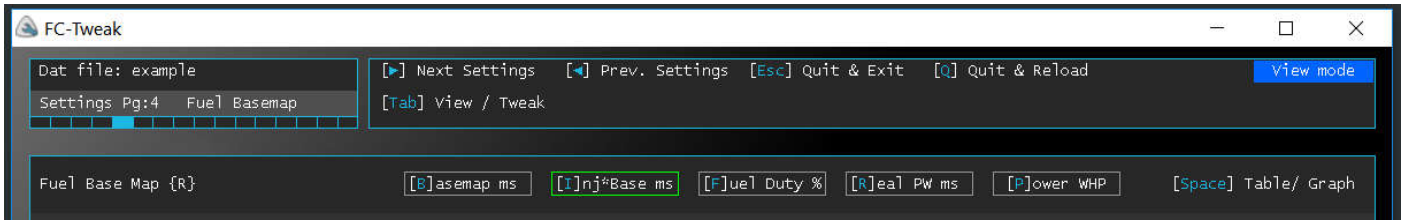
P(x)	PIM	Boost	Color code
P01	1000	- 0.93	
P02	2000	- 0.83	
P03	3000	- 0.73	
P04	4000	- 0.63	
P05	5000	- 0.53	
P06	6000	- 0.43	
P07	7000	- 0.33	
P08	8000	- 0.23	
P09	9000	- 0.13	
P10	10000	- 0.03	
P11	11000	+ 0.07	
P12	12000	+ 0.17	
P13	13000	+ 0.27	
P14	14000	+ 0.37	
P15	15000	+ 0.47	
P16	16000	+ 0.57	
P17	18000	+ 0.77	
P18	20000	+ 0.97	
P19	22000	+ 1.17	
P20	24000	+ 1.37	

If O2 feedback is not enabled, FC-Tweak will recommend recalc during the tweaking process, in which case the map will be recalculated during file export. Recalc reduces the ECU processor computational load.

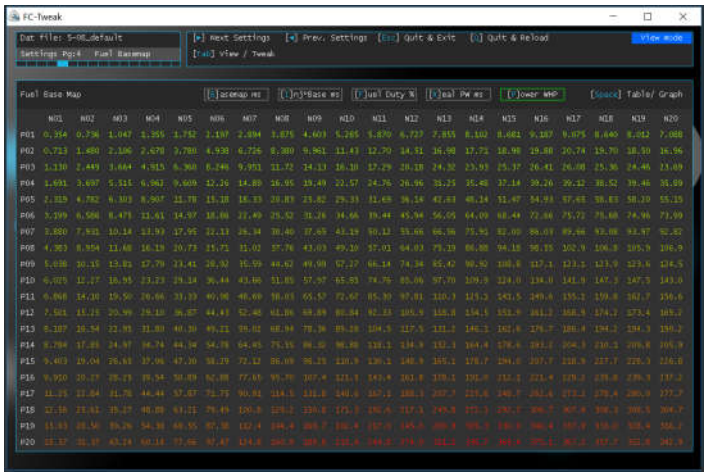
Settings Page 4: Fuel Basemap Display Options

The fuel basemap has five display modes:

- [B]asemap values (base pulse width equivalent of primary injector)
- [I]njection correction * Basemap values (corrected pulse width equivalent of primary injector)
- [F]uel duty (%) : Global/ Primary/ Secondary
- [R]eal Pulse width ms
- [P]ower (WHP)



The {R} symbol is displayed when FC-Tweak detects a Recalced map. (When its Inj. correction map is all ones)
The Power mode can also be viewed in full screen graphic mode.



Power (WHP) table mode

Power (WHP) graph mode

Basemap (ms) mode shows the raw basemap values in milliseconds for one rotor. All PFC fuel settings are equally applied to the second rotor, unless you define different front and rear primary injector scaling factors. For {R}ecalculated maps, these basemap values are equal to the values used for injector durations. Note however, that the PFC basemap values are equal to the pulse width of a single injector having the capacity of the primary injector! This gives the false impression that most pulse widths take longer than the available time per injection cycle. See 'Real Pulse width' option below.

Inj * Basemap (ms) mode shows the basemap values factored by the Injector correction table values. This is the default display mode, and shows the mapped pulse widths used by the ECU. At low loads this amount is 100% injected by the primary, while at high loads it's shared between the primary and secondary injectors. Again, the pulse widths in this table are scaled to the primary injector. Note: the PFC internally limits the minimum primary injector pulse width to 1.80ms. This makes it impossible to lean out cells whose Inj*Basemap cell value is below this limit. Keep this in mind when upgrading the primaries to higher flow rate types.

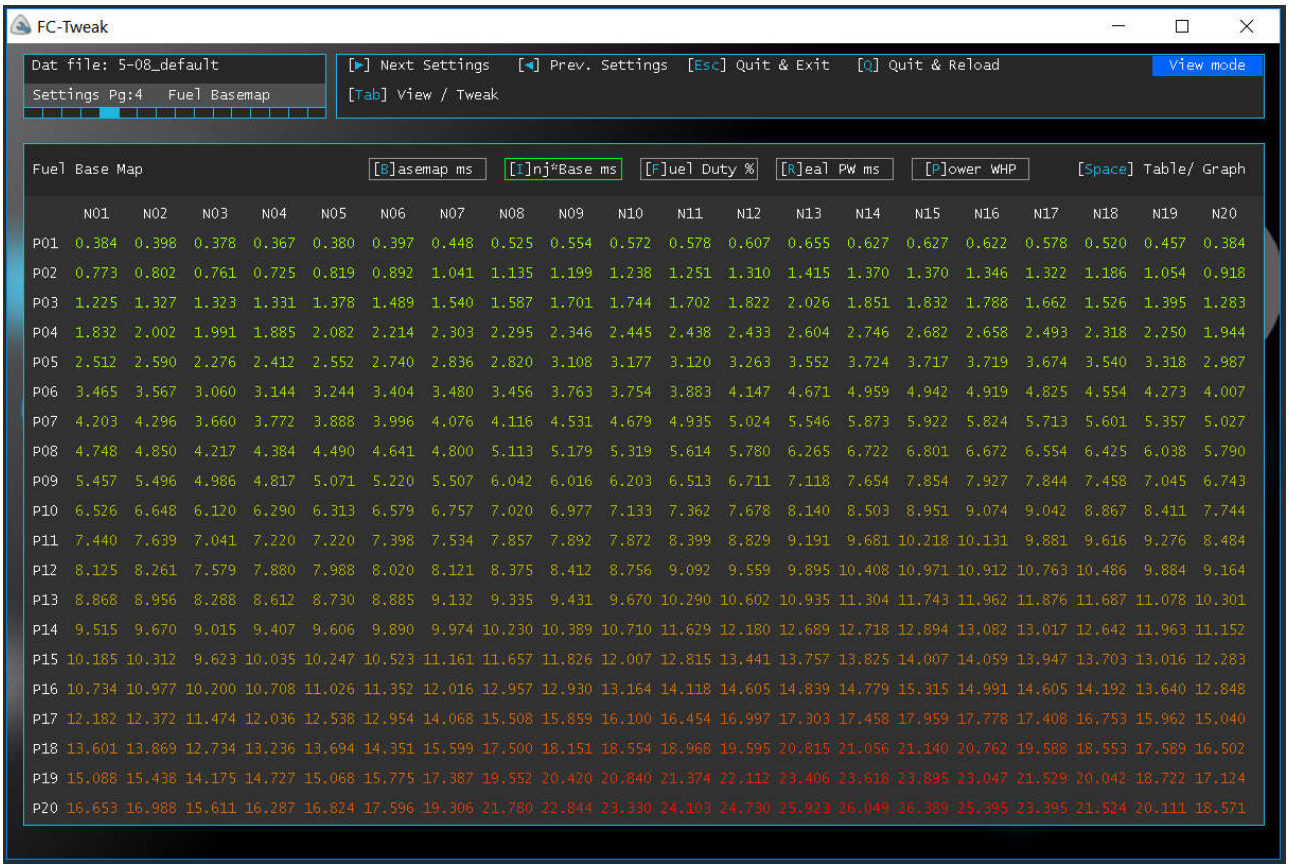
Fuel Duty (%) mode shows the injected fuel amount of each cell as a fraction of maxed out injectors' duration. Cells operating only in primary injection mode are highlighted dark blue, in order to clearly visualize the injector's transition region. Cells at 100% or over will drive the injectors continuously. Avoid operating injectors beyond 90% duty. If your map operates beyond this limit, FC-tweak will NOT lean out your map, but will just warn you to consider upgrading your injectors.

Real Pulse width (ms) mode clarifies the rather cryptic way in which the PFC shows the basemap fuel. It displays the actual on-time of your injectors. Highlighted dark blue cells drive the primary injectors only, while the rest drive both primary and secondary injectors at equal pulse widths.

Power (WHP) mode shows the estimated horse power at the wheels which can realistically be obtained from each basemap cell. Standard RX7 drivetrain losses of 16.5% are taken into account. Note that driving injectors at the wrong fuel pressure, having very rich fuel map cells or driving turbos above their nominal boost rating can lead to large discrepancies between estimated and actual power values.

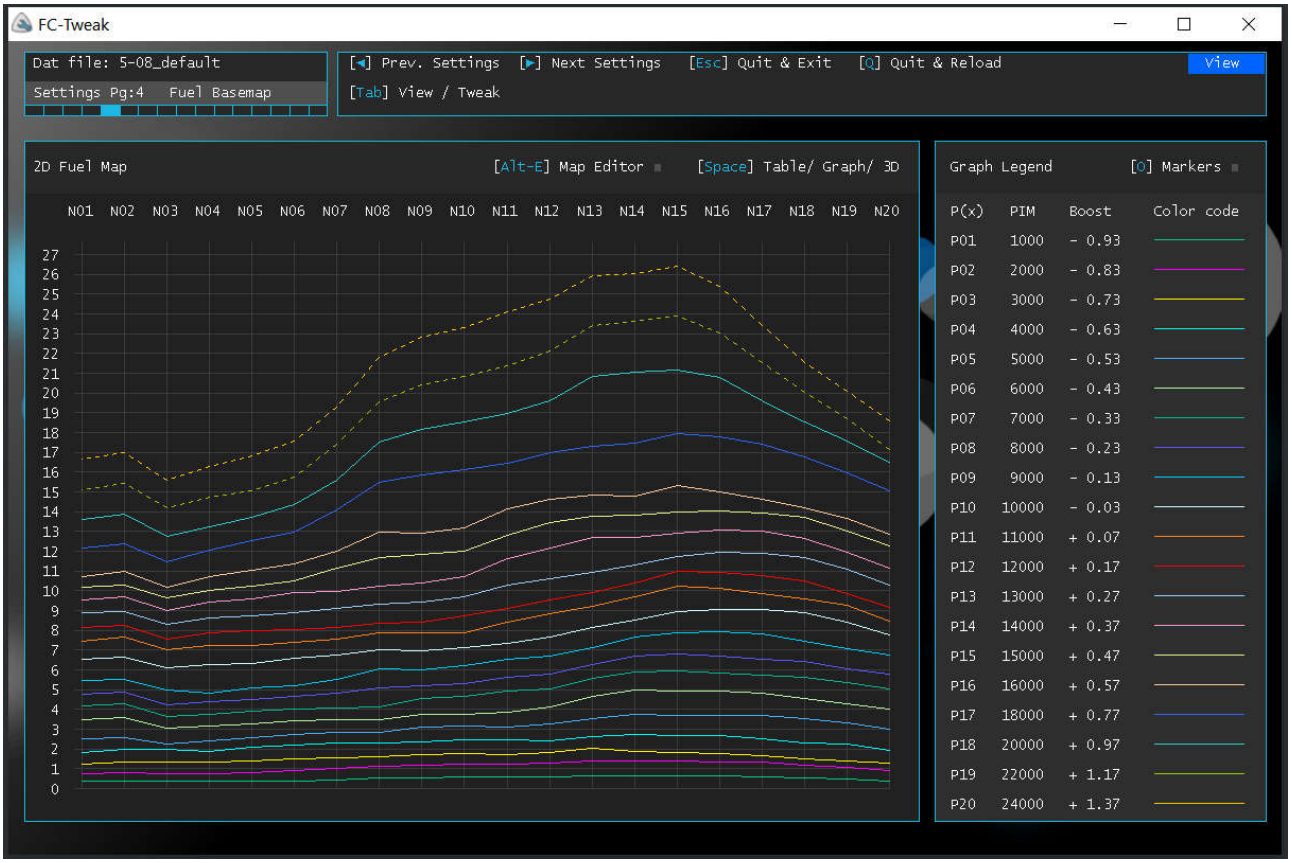
Settings Page 4: Fuel Basemap & Inj*Base

Select display mode using keys [B],[I],[F],[R] or [P]. [Space] toggles between table and full screen graph mode.



	N01	N02	N03	N04	N05	N06	N07	N08	N09	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19	N20
P01	0.384	0.398	0.378	0.367	0.380	0.397	0.448	0.525	0.554	0.572	0.578	0.607	0.655	0.627	0.627	0.622	0.578	0.520	0.457	0.384
P02	0.773	0.802	0.761	0.725	0.819	0.892	1.041	1.135	1.199	1.238	1.251	1.310	1.415	1.370	1.370	1.346	1.322	1.186	1.054	0.918
P03	1.225	1.327	1.323	1.331	1.378	1.489	1.540	1.587	1.701	1.744	1.702	1.822	2.026	1.851	1.832	1.788	1.662	1.526	1.395	1.283
P04	1.832	2.002	1.991	1.885	2.082	2.214	2.303	2.295	2.346	2.445	2.438	2.433	2.604	2.746	2.682	2.658	2.493	2.318	2.250	1.944
P05	2.512	2.590	2.276	2.412	2.552	2.740	2.836	2.820	3.108	3.177	3.120	3.263	3.552	3.724	3.717	3.719	3.674	3.540	3.318	2.987
P06	3.465	3.567	3.060	3.144	3.244	3.404	3.480	3.456	3.763	3.754	3.883	4.147	4.671	4.959	4.942	4.919	4.825	4.554	4.273	4.007
P07	4.203	4.296	3.660	3.772	3.888	3.996	4.076	4.116	4.531	4.679	4.935	5.024	5.546	5.873	5.922	5.824	5.713	5.601	5.357	5.027
P08	4.748	4.850	4.217	4.384	4.490	4.641	4.800	5.113	5.179	5.319	5.614	5.780	6.265	6.722	6.801	6.672	6.554	6.425	6.038	5.790
P09	5.457	5.496	4.986	4.817	5.071	5.220	5.507	6.042	6.016	6.203	6.513	6.711	7.118	7.654	7.854	7.927	7.844	7.458	7.045	6.743
P10	6.526	6.648	6.120	6.290	6.313	6.579	6.757	7.020	6.977	7.133	7.362	7.678	8.140	8.503	8.951	9.074	9.042	8.867	8.411	7.744
P11	7.440	7.639	7.041	7.220	7.220	7.398	7.534	7.857	7.892	7.872	8.399	8.829	9.191	9.681	10.218	10.131	9.881	9.616	9.276	8.484
P12	8.125	8.261	7.579	7.880	7.988	8.020	8.121	8.375	8.412	8.756	9.092	9.559	9.895	10.408	10.971	10.912	10.763	10.486	9.884	9.164
P13	8.868	8.956	8.288	8.612	8.730	8.885	9.132	9.335	9.431	9.670	10.290	10.602	10.935	11.304	11.743	11.962	11.876	11.687	11.078	10.301
P14	9.515	9.670	9.015	9.407	9.606	9.890	9.974	10.230	10.389	10.710	11.629	12.180	12.689	12.718	12.894	13.082	13.017	12.642	11.963	11.152
P15	10.185	10.312	9.623	10.035	10.247	10.523	11.161	11.657	11.826	12.007	12.815	13.441	13.757	13.825	14.007	14.059	13.947	13.703	13.016	12.283
P16	10.734	10.977	10.200	10.708	11.026	11.352	12.016	12.957	12.930	13.164	14.118	14.605	14.839	14.779	15.315	14.991	14.605	14.192	13.640	12.848
P17	12.182	12.372	11.474	12.036	12.538	12.954	14.068	15.508	15.859	16.100	16.454	16.997	17.303	17.458	17.959	17.778	17.408	16.753	15.962	15.040
P18	13.601	13.869	12.734	13.236	13.694	14.351	15.599	17.500	18.151	18.554	18.968	19.595	20.815	21.056	21.140	20.762	19.588	18.553	17.589	16.502
P19	15.088	15.438	14.175	14.727	15.068	15.775	17.387	19.552	20.420	20.840	21.374	22.112	23.406	23.618	23.895	23.047	21.529	20.042	18.722	17.124
P20	16.653	16.988	15.611	16.287	16.824	17.596	19.306	21.780	22.844	23.330	24.103	24.730	25.923	26.049	26.389	25.395	23.395	21.524	20.111	18.571

Note: For recalculated Base maps, Basemap (ms) and Inj x Base (ms) will be the same, since Inj=1.



Dashed curves are fuel data points that are located within the Power FC's fuel cut region. On graph mode, the transition stability rating and any unstable cells are also displayed.

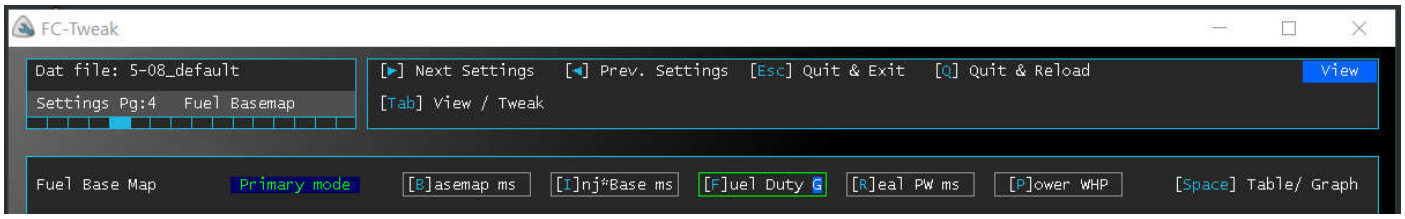
Settings Page 4: Fuel injection Duty% mode

As from version 8.0, the fuel injection duty viewing mode can display three fuel injection tables (G/P/S):

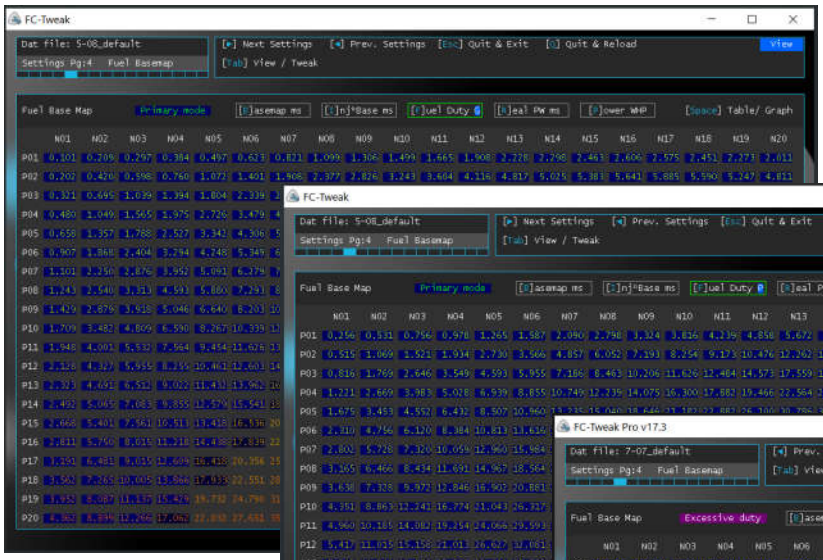
(1) (G)lobal: This is the same table as shown on the old FC-Edit software in fuel duty% table. The tabulated values are shown as a percentage of the total fuel which both injectors would be able to spray in a single combustion cycle.

(2) (P)rimary: Primary injection values show the actual injection duty for the primary injectors. This enables you to verify the primary injectors' duty at which the transition is taking place.

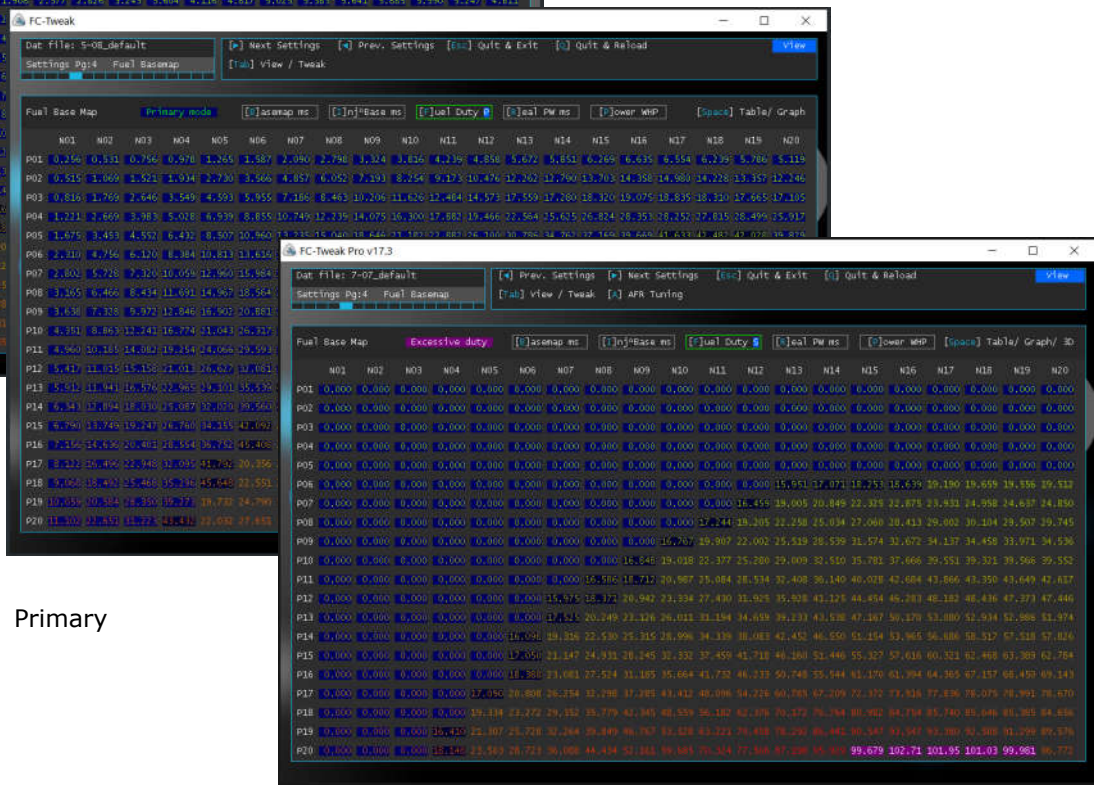
(3) (S)econdary: Secondary injection values show the actual injection duty for the secondary injectors. Note that the secondaries have a 0% duty until the transition threshold is reached.



The Fuel duty table type is highlighted inside the Fuel duty selection box, and changed to G,P, or S by pressing [F].



Global



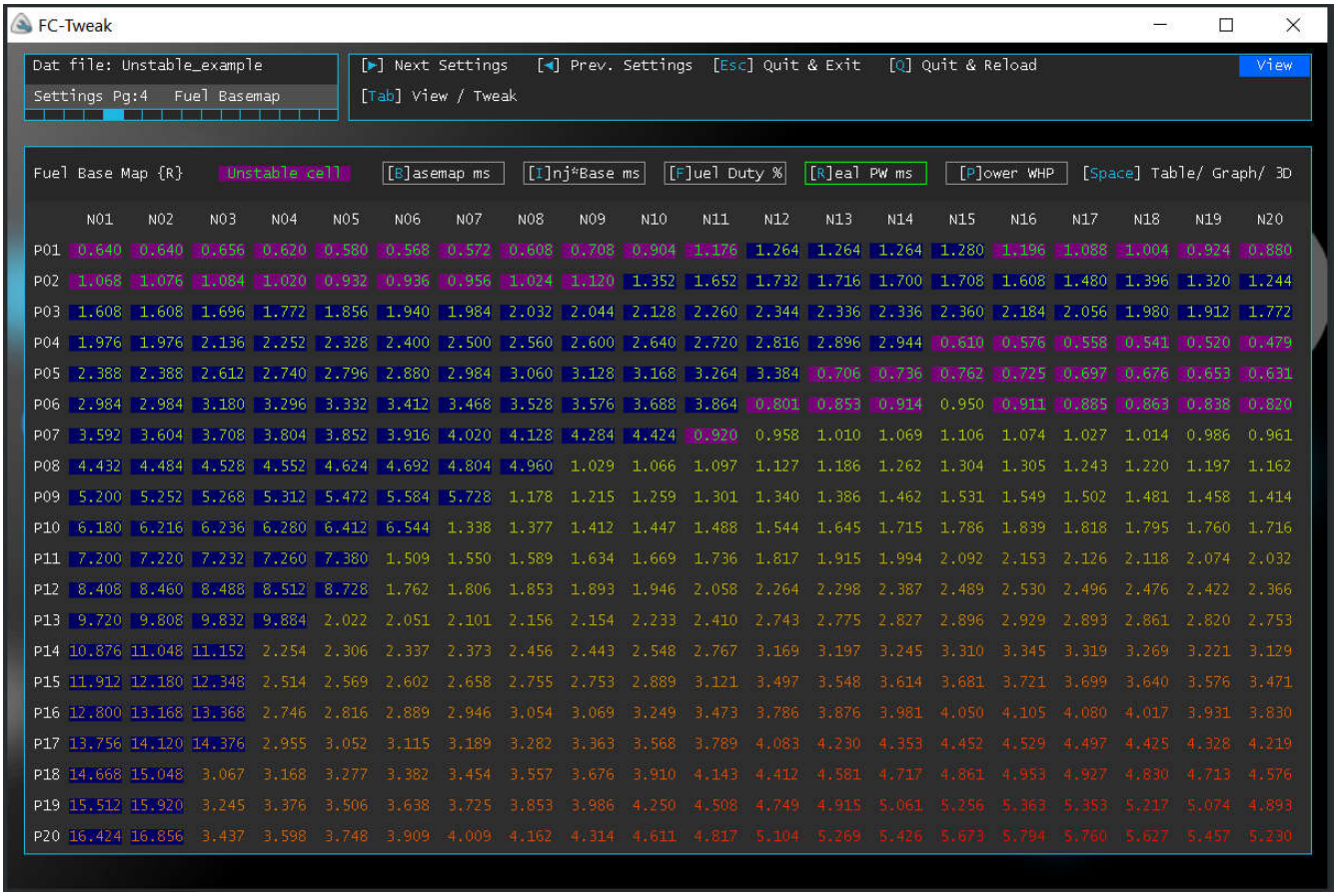
Primary

Secondary

Cells highlighted blue indicate primary mode, very dark blue indicate transition zone cells. Green-red gradient coloured cells indicate both primary and secondary working together at the same duty. Cells highlighted purple indicate an excessive injector duty, as per your injector duty warning setting value shown on settings page 7. Excessive duty usually occurs, either if the particular cell values are overly rich, or the injectors are too small. Note that FC-Tweak will NOT lean out these cells.

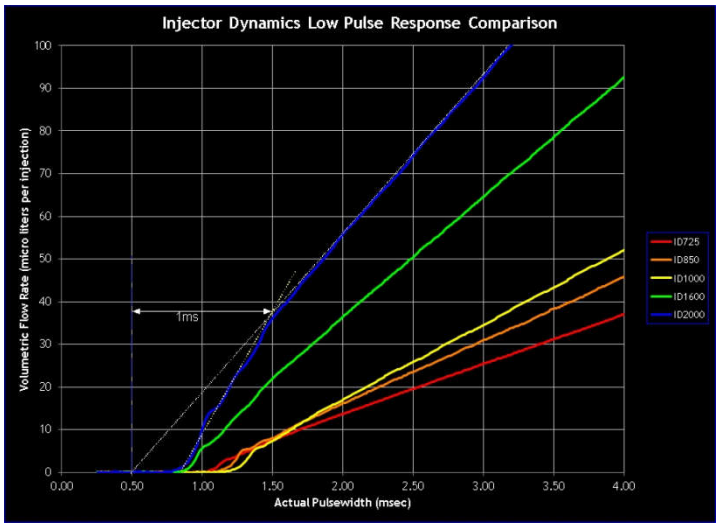
Settings Page 4: Real Pulse Width mode

To date, FC-Tweak is the only RX7 software tool which shows the actual primary and secondary injectors' pulse widths of the PFC fuel basemap. It takes into account the injectors' sizes and transition region, at which the ECU starts to share the fuel load between both primary and secondary injectors. Dark blue highlighted cells drive just the primary injectors, while the rest drive both primary and secondary injectors at approximately equal pulse widths. For example at location P05-N12, only the primary injector is being driven at 3.384ms, while at P06-N12, the ECU drives both primary and secondary injectors at 0.801ms, which in this case is marked as unstable.



	N01	N02	N03	N04	N05	N06	N07	N08	N09	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19	N20
P01	0.640	0.640	0.656	0.620	0.580	0.568	0.572	0.608	0.708	0.904	1.176	1.264	1.264	1.264	1.280	1.196	1.088	1.004	0.924	0.880
P02	1.068	1.076	1.084	1.020	0.932	0.936	0.956	1.024	1.120	1.352	1.652	1.732	1.716	1.700	1.708	1.608	1.480	1.396	1.320	1.244
P03	1.608	1.608	1.696	1.772	1.856	1.940	1.984	2.032	2.044	2.128	2.260	2.344	2.336	2.336	2.360	2.184	2.056	1.980	1.912	1.772
P04	1.976	1.976	2.136	2.252	2.328	2.400	2.500	2.560	2.600	2.640	2.720	2.816	2.896	2.944	0.610	0.576	0.558	0.541	0.520	0.479
P05	2.388	2.388	2.612	2.740	2.796	2.880	2.984	3.060	3.128	3.168	3.264	3.384	0.706	0.736	0.762	0.725	0.697	0.676	0.653	0.631
P06	2.984	2.984	3.180	3.296	3.332	3.412	3.468	3.528	3.576	3.688	3.864	0.801	0.853	0.914	0.950	0.911	0.885	0.863	0.838	0.820
P07	3.592	3.604	3.708	3.804	3.852	3.916	4.020	4.128	4.284	4.424	0.920	0.958	1.010	1.069	1.106	1.074	1.027	1.014	0.986	0.961
P08	4.432	4.484	4.528	4.552	4.624	4.692	4.804	4.960	1.029	1.066	1.097	1.127	1.186	1.262	1.304	1.305	1.243	1.220	1.197	1.162
P09	5.200	5.252	5.268	5.312	5.472	5.584	5.728	1.178	1.215	1.259	1.301	1.340	1.386	1.462	1.531	1.549	1.502	1.481	1.458	1.414
P10	6.180	6.216	6.236	6.280	6.412	6.544	1.338	1.377	1.412	1.447	1.488	1.544	1.645	1.715	1.786	1.839	1.818	1.795	1.760	1.716
P11	7.200	7.220	7.232	7.260	7.380	1.509	1.550	1.589	1.634	1.669	1.736	1.817	1.915	1.994	2.092	2.153	2.126	2.118	2.074	2.032
P12	8.408	8.460	8.488	8.512	8.728	1.762	1.806	1.853	1.893	1.946	2.058	2.264	2.298	2.387	2.489	2.530	2.496	2.476	2.422	2.366
P13	9.720	9.808	9.832	9.884	2.022	2.051	2.101	2.156	2.154	2.233	2.410	2.743	2.775	2.827	2.896	2.929	2.893	2.861	2.820	2.753
P14	10.876	11.048	11.152	2.254	2.306	2.337	2.373	2.456	2.443	2.548	2.767	3.169	3.197	3.245	3.310	3.345	3.319	3.269	3.221	3.129
P15	11.912	12.180	12.348	2.514	2.569	2.602	2.658	2.755	2.753	2.889	3.121	3.497	3.548	3.614	3.681	3.721	3.699	3.640	3.576	3.471
P16	12.800	13.168	13.368	2.746	2.816	2.889	2.946	3.054	3.069	3.249	3.473	3.786	3.876	3.981	4.050	4.105	4.080	4.017	3.931	3.830
P17	13.756	14.120	14.376	2.955	3.052	3.115	3.189	3.282	3.363	3.568	3.789	4.083	4.230	4.353	4.452	4.529	4.497	4.425	4.328	4.219
P18	14.668	15.048	3.067	3.168	3.277	3.382	3.454	3.557	3.676	3.910	4.143	4.412	4.581	4.717	4.861	4.953	4.927	4.830	4.713	4.576
P19	15.512	15.920	3.245	3.376	3.506	3.638	3.725	3.853	3.986	4.250	4.508	4.749	4.915	5.061	5.256	5.363	5.353	5.217	5.074	4.893
P20	16.424	16.856	3.437	3.598	3.748	3.909	4.009	4.162	4.314	4.611	4.817	5.104	5.269	5.426	5.673	5.794	5.760	5.627	5.457	5.230

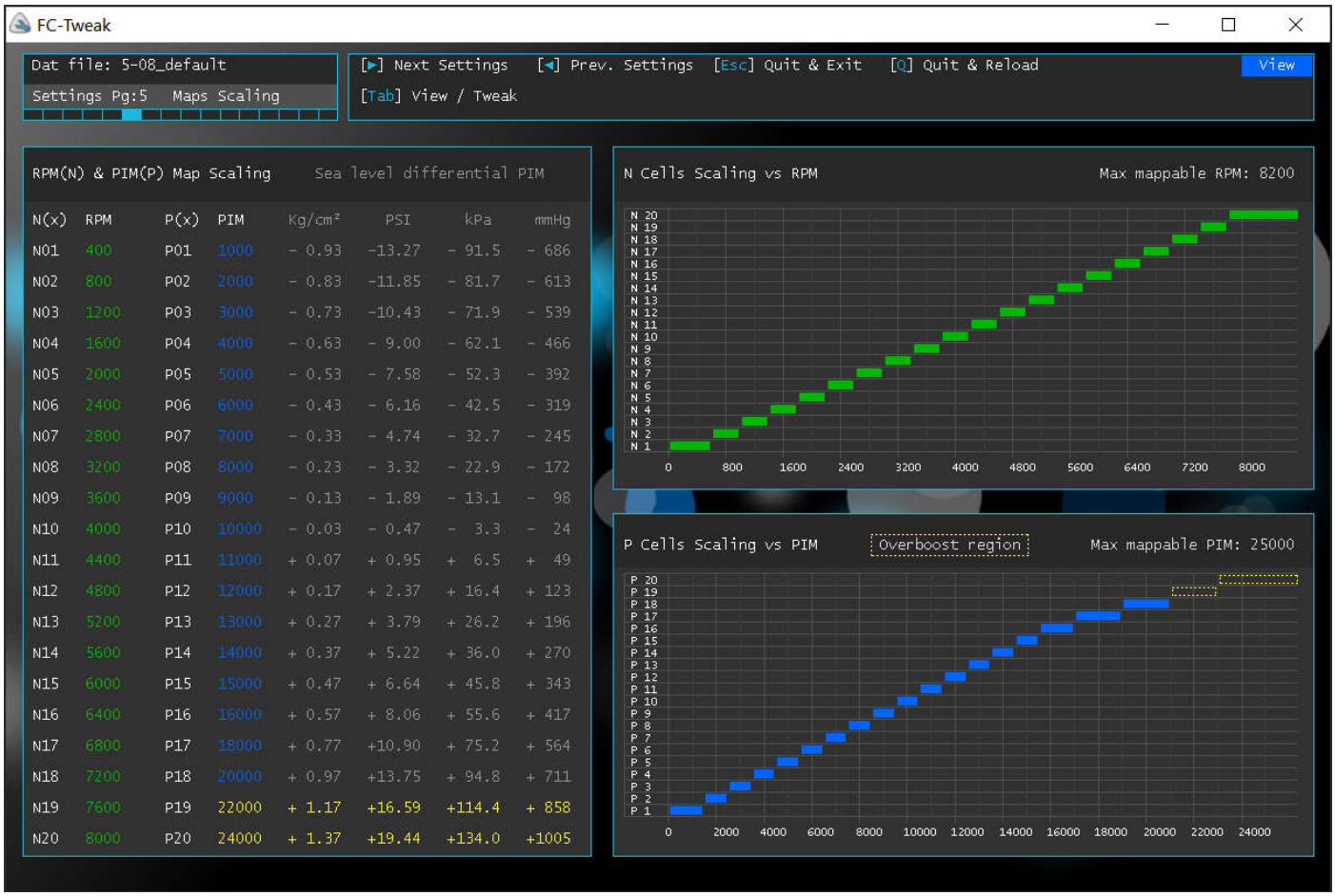
This chart mode is of utmost importance as it shows what's really going on during injector transition. Unstable cells are most commonly found in the engine brake vacuum region and in the injector transition zone. In the latter case, these eventually end up damaging the apex seals. Such cells, highlighted in purple, are the ones which are being driven in the lower non-linear/unstable region of your injectors operating curve. When an injector is driven by such short pulse widths, it will be highly unpredictable, and may not even be injecting any fuel at all. Most OEM injectors operate reliably and linearly only down to about 1.2ms or so. Most often, such cells result in very lean mixtures and the engine will sputter, stall or knock if the ECU goes through them during acceleration. The map shown above obviously has problems both within its engine brake region and within its acceleration areas.



Note that the non-linear pulse width is not included in the injector lag time specification. Here is a chart zooming on the low end characteristics of some common ID injectors. As you can see, the blue curve for the ID2000 shows an injector lag of about 0.5ms and a non-linear lower injection pulse width of about 1.0ms. The Power FC will however assume a perfectly linear injector curve, shown in dotted white. So, if for example, the ECU commands the ID2000 to open for 0.5ms, then the actual electrical pulse width sent out will be 0.5ms + 0.5ms lag time. Due to its non linearity, the injector would only deliver 10µL instead of 20µL, that is, half of the intended fuel!

If unstable cells are detected within the accelerating region of your map, FC-Tweak will correct your injector staging (Settings Pg14) so that the injector transition region is shifted to fuel cells requiring higher injector duty. This ensures that the minimum pulse width immediately after transition stays within the linear operating region for both primary and secondary injectors.

Settings Page 5: Maps scaling



This table sets the range for RPM (N) columns and PIM (P) rows in the timing and fuel cells shown on Settings Pages 1 to 4. The PIM scale here is replicated on settings pages 1-4 full screen charts for easy reference.

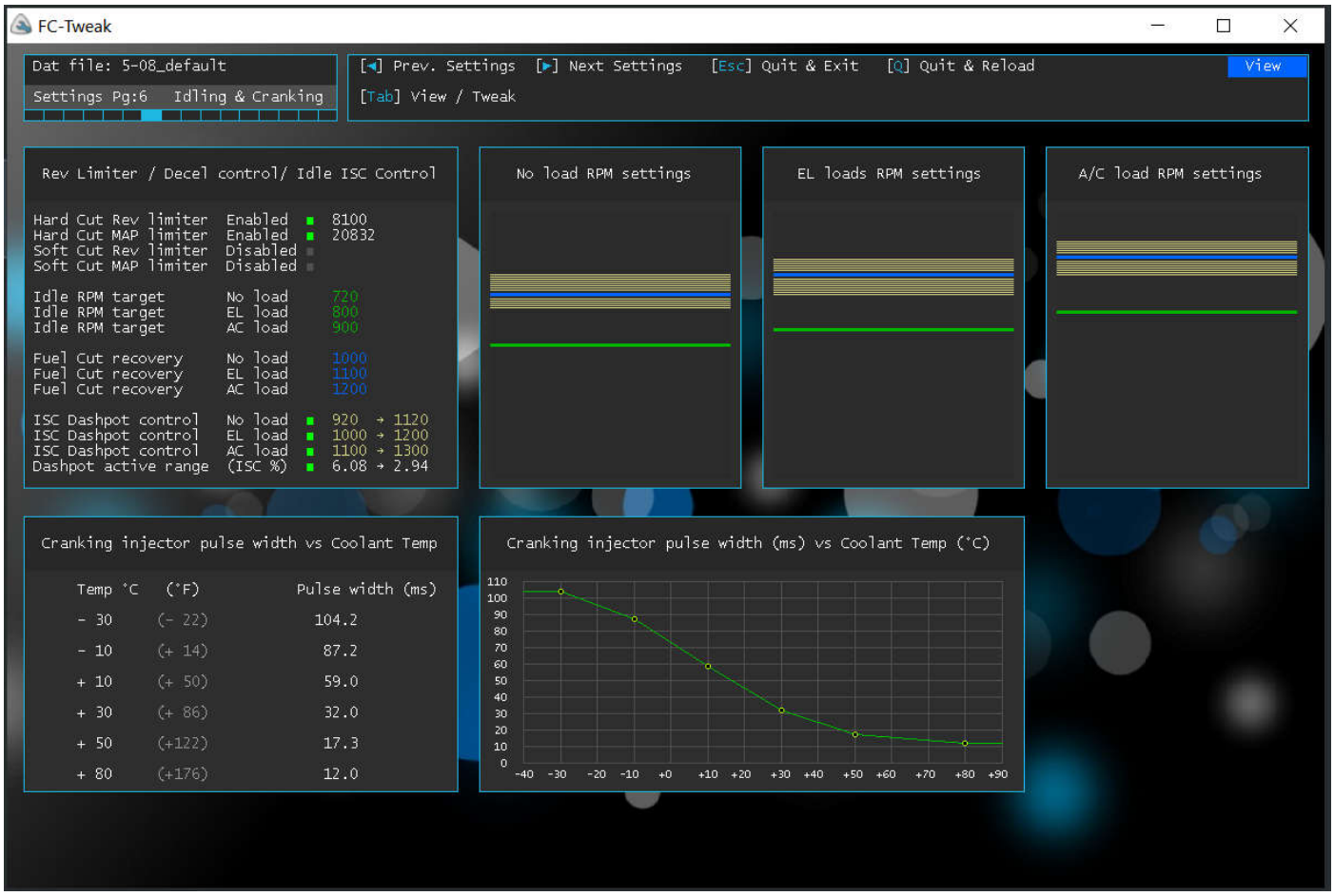
Apexi's unit for PIM is Kg/m^2 absolute pressure. However, all PFC's internal computations are based on the pressure relative to ambient pressure. For this reason, FC-Tweak includes a conversion table, converting absolute PIM pressures into relative pressures in Kg/cm^2, PSI, kPa and mmHg with reference to sea level standard atmospheric pressure (101.325kPa). Note that boost targets (defined on Settings 7) are entered in Kg/cm^2 so it is important to be able to visualize which one is your boost target PIM row. For example, if in settings page 7, you set your boost target to a relative pressure of 1kg/ cm^2, you'll immediately recognize from the conversion table that P18 will be your target PIM row, and that your turbo will be running at a target boost of ~14psi.

Table values exceeding the Power FC over-boost fuel cut protection limit (determined from your set boost target) are shown in yellow, and as dashed bars on the chart. Under normal circumstances these PIM rows will never be used. If you have more than 2 PIM rows marked within the over-boost region, you might want to re-scale your PIM ranges & maps so that you do not waste PIM rows which may be otherwise used to improve your map accuracy.

FC-Tweak also displays the maximum safely mappable RPM and PIM values. If your boost or RPM go over these limits, the PFC cannot correctly calculate either timing or fuel.

These are the limits to which the PFC can correctly extrapolate your off-the-map values. Operating beyond these limits is unsafe, and usually leads to engine failure.

Settings page 6: Idling & Cranking

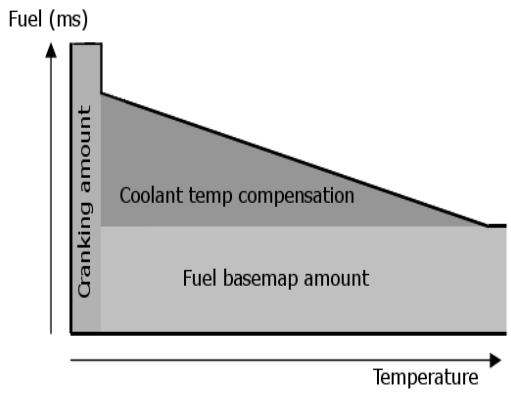


On this page you can easily visualize the status of your Power FC engine protection functions, together with the relative positions of target idle RPMs, fuel cut recovery levels and electronic dashpot control regions. Note that unlike the stock ECU, the PFC does not require the hardware dashpot unit. Status indicators turn grey for disabled, green for enabled, or red for dashpot out of range. Next to the protection status indicators, it also displays the RPM and PIM values at which the respective protection limiters are enabled.

The top three charts show idling, deceleration F/C (=DFCO disable RPM, RPM at which deceleration fuel cut off is disabled) and electronic ISC dashpot operating regions for different electrical load conditions.

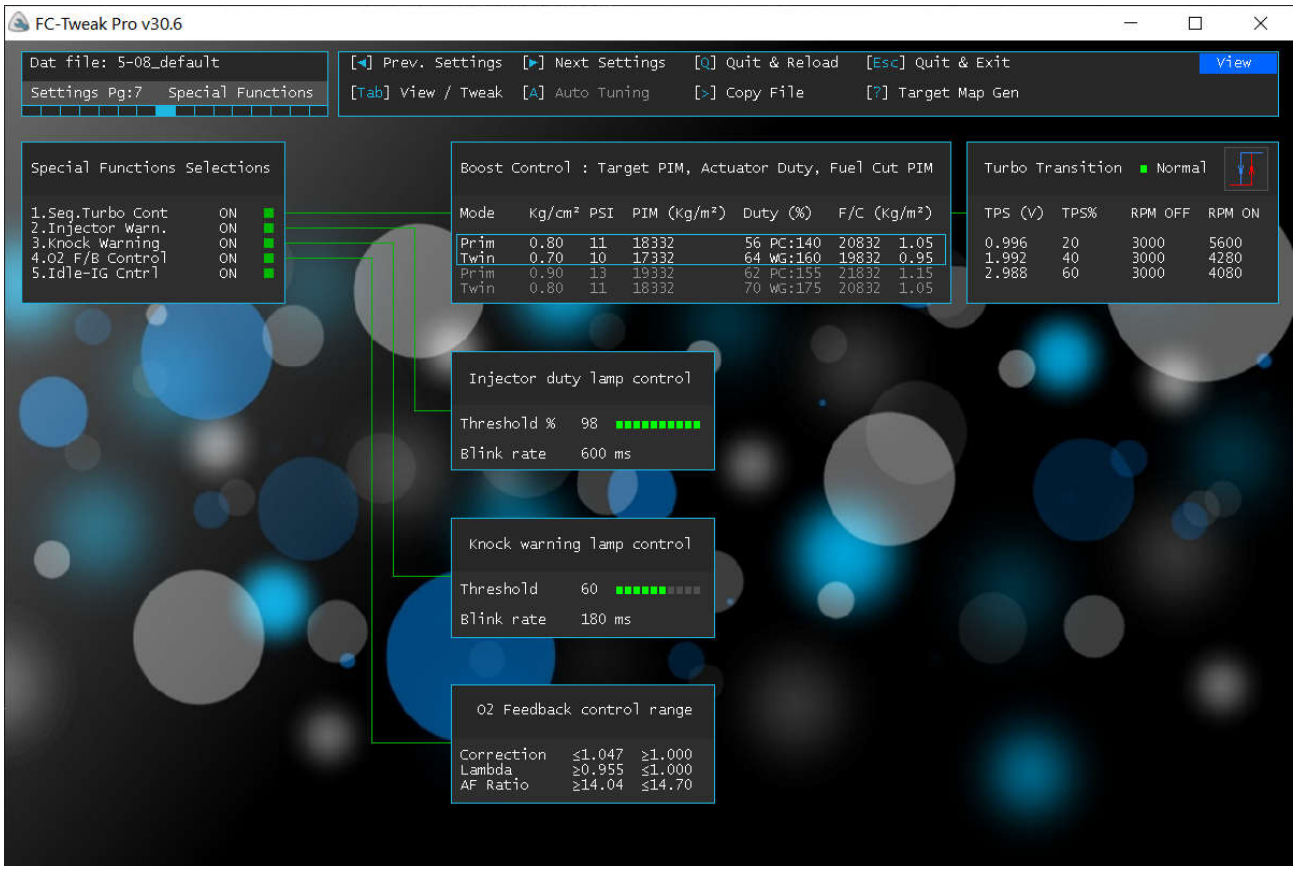
FC-Tweak can also enable hard (fuel cut) and soft (timing) limiter protections, to safeguard your engine against self destruction. It also corrects idle targets as required, and brings the fuel cut recovery points within the active dashpot range. This eliminates stalling, sticking idle & RPM bouncing or surging during deceleration. Idle control & dashpot functions will of course require the factory ISC to be still fitted & functional. If your ISC has been disabled make sure you have the hardware dashpot unit installed, as the electronic dashpot function will not work.

The lower table and graph on settings Pg6 show the Cranking injection pulse width vs. coolant temperature, which is also optimized for faster engine starting.



Here is a graphical representation of the fuel that is injected from the instant an engine is started from cold until it reaches its nominal operating temperature of 80°C (176°F). Note that only the cranking fuel amount is used until the engine starts (ex:32ms@30°C). Once it starts, the fuel amount is then determined from the main fuel basemap multiplied by the warming up compensation table (settings Pg8). A typical rotary engine requires about 30ms at 550cc/min of cranking fuel injection when cold and about 10ms when warm. For primary injectors larger than 550cc/min, the PFC will use the primary injector scaling (settings Pg14) to scale down these values automatically so as to preserve the same amount of injected starting fuel and avoid flooding the engine.

Settings page 7: Special Functions



Settings page 7 shows the programmed status of each of the PFC special functions, together with their respective settings tables. Green indicates enabled, grey disabled. The PFC controls the factory sequential turbo using the Pre-Control (PC) and Wastegate (WG) base duty values together with feedback from PIM, TPS and RPM readings in order to achieve the programmed boost targets.

Boost target relative pressure levels are shown in Kg/cm^2, PSI and absolute PIM in Kg/m^2. The over-boost fuel cut PIM values are also displayed. The PFC automatically cuts fuel if the measured boost level exceeds the boost target levels by 0.25 Kg/cm^2. The stock boost sensor will only read correctly up to about 1.2 Kg/cm^2, meaning that if your targets are above 0.95 Kg/cm^2, the PFC may not be able to protect your engine from over-boost. Note that the over-boost fuel cut function works independently of the 'Sequential Turbo control' setting. If you control boost using an external boost controller and do not wish the PFC to protect against over-boost, then you must set your PFC boost levels high enough that the respective fuel cut settings are not reached before those of the external controller. FC-Tweak verifies whether your boost targets exceed the pressure sensor's rating, and if so, adjusts them in order to safeguard both your sensor and engine. With the factory boost sensor, the ECU will read a boost of 1.2 Kg/cm^2 for any pressures in excess of that, thus mapping the fuel and ignition parameters from the wrong map row. For boost targets higher than 0.95 Kg/cm^2, an uprated boost sensor is highly recommended.

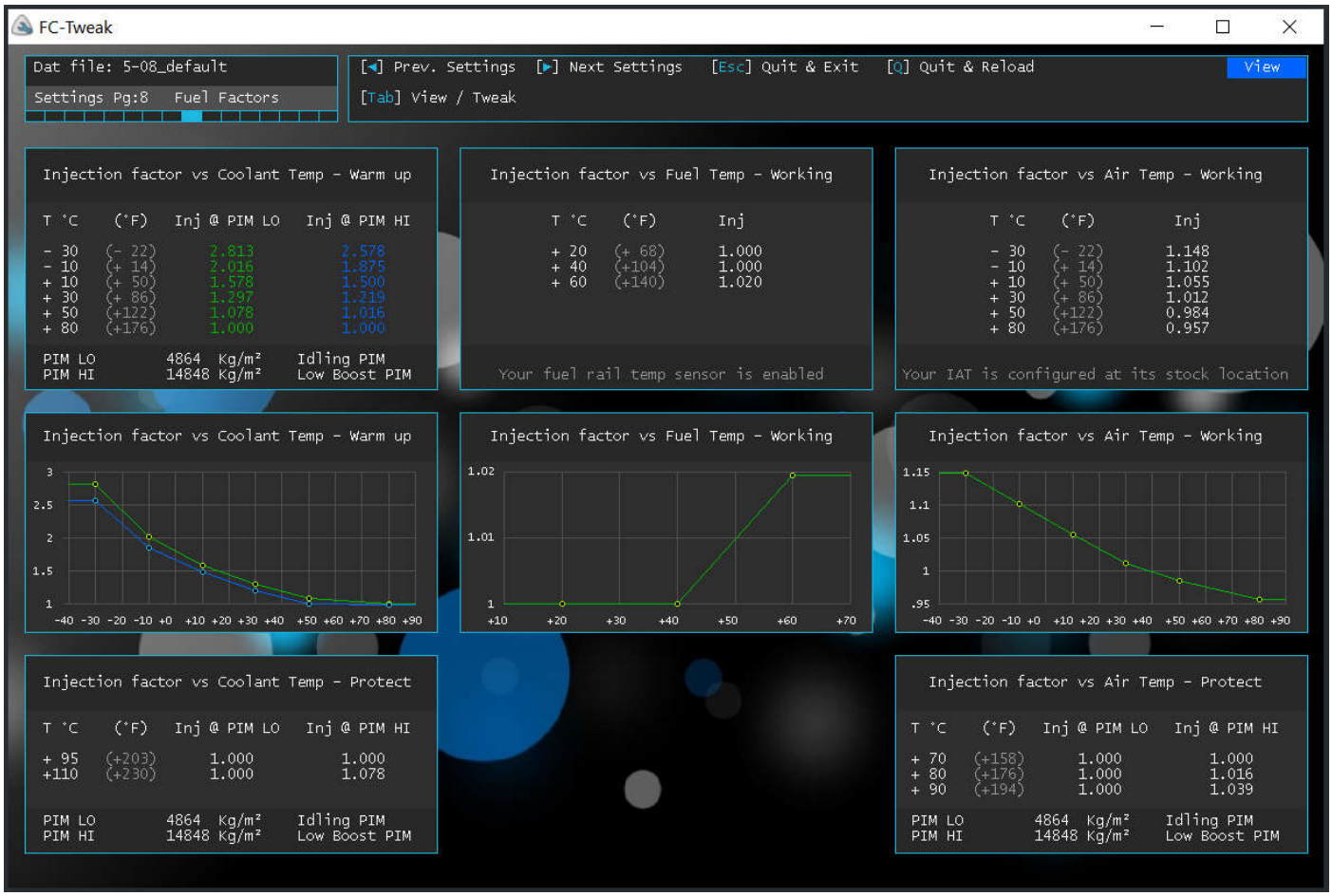
The top right table shows the turbo transition RPM thresholds at different throttle positions. Wherever you see the Schmitt symbol (red and blue arrows), it means that this is a hysteresis function with different turning on and turning off points. This table also indicated whether the twin unit is configured to work in 'normal' sequential or locked mode, behaving like a single unit. In normal sequential mode, FC-Tweak will optimize the transition settings to eliminate twin-turbo sluggishness during gear changes, by disengaging the secondary turbo earlier.

Next are the warning lamps controls for excessive injector duty and excessive knock. Their threshold settings together with their respective blink rate in milliseconds are displayed.

The lower table shows the AFR range limits in the AFR table (settings Pg3) for which the closed loop O2 feedback control will be active, if O2 feedback control is set ON. Active O2 feedback control cells are highlighted on settings page 3. If any active O2 feedback control cell lies within the boost area, FC-Tweak will recommend turning off this function. Turning off O2 feedback control will not affect drivability in anyway, and you then have the advantage of performing a 'Recalc' of your fuel basemap.

The Idle-IG control option controls an internal feedback system which fine tunes ignition timing to smooth out idling speed. FC-Tweak will recommended turning this feature on if your ISC is enabled and your PFC is controlling idling speeds.

Settings Page 8: Fuel Factors



This page groups all fuel injection correction tables into one place.

The upper left table shows Injection factor vs. Coolant temperature. It's used to enrich fuel injection during warming up time. As you can see, once the engine coolant temperature reaches 80C, there is no enrichment over the basemap values. The PIM LO and PIM HI values are categorized as Idling, low boost and high boost for clarity. The default Apexi map values set PIM LO in the idling region, and PIM HI in the low boost region. The fuel injection vs coolant temperature correction factors for PIM LO are best manually tweaked using the FC-Commander during warm-up time. FC-Tweak will only correct those values which fall outside of what is considered to be the normal required range. Too high settings in the idling PIM LO column can result in erratic idling following heat soak, as sometimes can happen when restarting the engine after being turned off for less than an hour or so. FC-Tweak will also recommend to normalize the temperature correction at 80C to 1.000 if set any differently. In such a case, after correction, it will also rescale the basemap during file export to conserve your tuned map.

The lower left table shows fuel enrichment for dangerous levels of coolant temperatures.

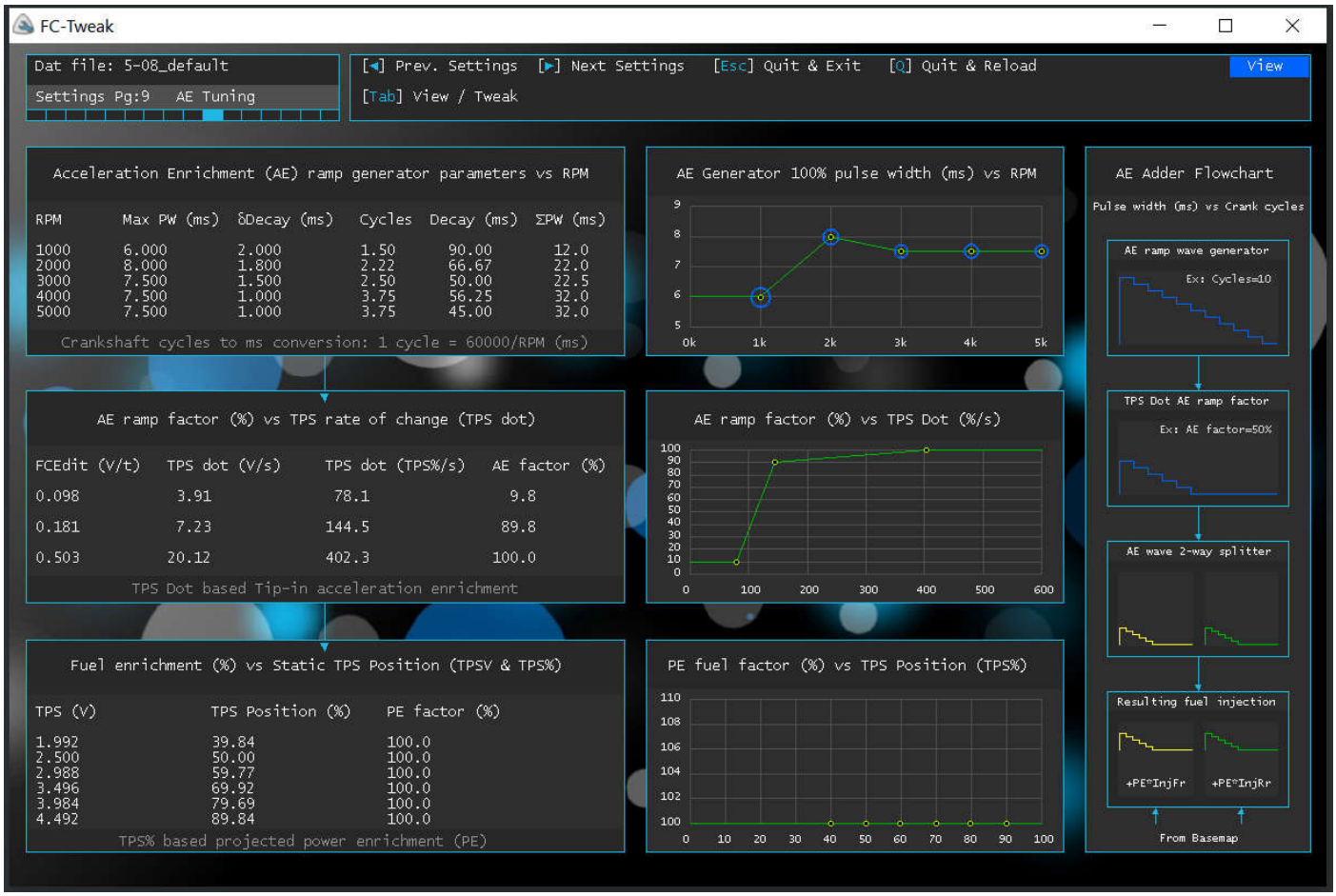
The upper right table shows Injection factor vs. Air temperature, used to compensate fuel injection for different intake air temperature (& density). Higher air temperatures result in lower air density which needs less fuel for the same A/F Ratio. FC-Tweak will optimize this table in order to hold your AFRs stable throughout the seasons.

The lower right table shows fuel enrichment for dangerous levels of air intake temperatures.

The central table shows Injection factor vs. Fuel temperature, used to compensate for changes in fuel density with its temperature. Hot gasoline is less dense than when cold, so this table must be correctly set. FC-Tweak corrects this table accordingly. Unfortunately most cars with upgraded injectors no longer have any place to mount the factory fuel temperature sensor, and so this sensor is removed. This will obviously lead to inevitable AFR errors of about 3%. FC-Tweak will reset this table to all ones, if you configure this sensor as disabled.

Charts are for the operating (working) settings, shown at the top.

Settings Page 9: Acceleration Enrichment Tuning



The function of these three tables certainly requires some clarification since no related documentation whatsoever exists in APEXI's manual. These are clearly based on Mazda's original technical paper published on March 1990. Quoting directly from Mazda:

Control over transient fuel has been improved to quicken acceleration response time during transient operation. Generally, the response lag in the initial stage of acceleration (excluding the engine's inertia moment factor) is caused by a delay in torque elevation due to a drop in the air/ fuel ratio. This drop is caused by the amount of time required by the engine's computer system to measure sudden changes to intake air volume and fuel requirements etc. during initial acceleration. In order to realize a better acceleration response, a new system has been added to the EGI system to improve fuel control. During the initial stage of acceleration, this new system first analyses ***engine RPM****, the* ***throttle opening****, and the* ***throttle opening changing rate****, then commands the fuel injectors to shoot once only a precisely calculated amount of fuel into the cylinders. This injection is given in addition to the engine's specified injection only during the initial stage of acceleration.*

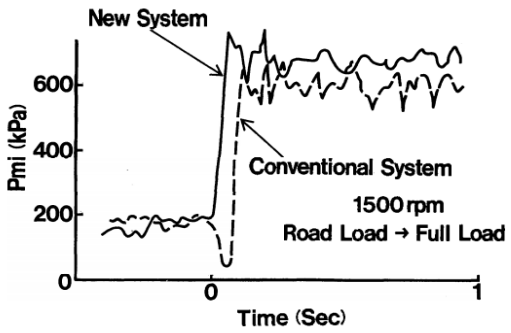


Fig.14 Variation of indicated mean effective pressure in abrupt acceleration

As shown in Fig.14, using this new system now causes the indicated mean effective pressure to be raised simultaneously with acceleration instead of first suffering a loss during the initial stage of acceleration.

These improvements to fuel control in addition to reduction in inertia moment have led to dramatically improved response times.

Note that while modern ECUs use RPM, rate of change of TPS (TPS dot) and MAP dot readings to calculate acceleration enrichment, Mazda & Apexi use RPM, TPS dot and the static TPS position to achieve the same goal. Using calculated projected power from TPS position results in faster ECU response to extra fuel needs.

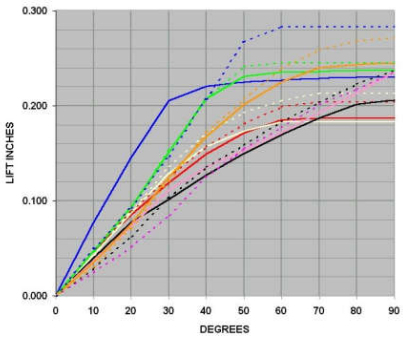
So, we see that APEXI's ECU uses these three main variables: RPM, TPS% and TPS% rate of change, in the same way described by Mazda, to provide an acceleration-enrichment (AE) function which closely emulates an accelerator diaphragm pump on old carburators. It's designed to enrich the fuel as the throttle is rapidly opened, to compensate for the sudden increase in airflow, on top of what the fuel basemap provides for steady state fuelling. To date, FC-Tweak is the only software with which you can view the proper function of these three acceleration enrichment tables including their proper units.

For those who feel more comfortable with the older carburator terminology, the above tables can be explained by the following analogies:

The top table – Acceleration enrichment generator parameters vs RPM defines the maximum volume of extra fuel injected and its duration, analogous to the capacity of accelerator diaphragm and jet size. Unlike a carburator however, you can define these parameters for different engine speeds.

The next table – AE ramp factor vs. TPS% rate of change (aka TPS dot or TPS RoC) is equivalent to the accelerator pump dynamics (usually in the form of a simple lever and spring between diaphragm and throttle. They define the leverage amplitude and stiffness on the pump's diaphragm for different rate of change of the gas pedal. Simply put, it sets the relationship between throttle motion and amount of extra fuel injected.

The lower table – Fuel projected power enrichment (PE) vs. Static TPS% position, in a way, performs the function of a carburator accelerator pump cam profile. It varies the fuel enrichment with throttle position. It's used as a fast method to predict and compensate in advance for the engine's fuel requirements. In general, it can be used to compensate for the whole system's non-linearity of airflow vs. throttle position. In practice, many system components can factor in this non-linear relation between airflow and TPS position and this table helps to compensate for that. This table is also percentage-based with numbers lower/higher than 100% subtracting/adding a percentage from/to the basemap values. Here you see various examples of carburator cam profiles plotted against throttle plate angle. The power enrichment table is thus equivalent to this cam profile plot.



Important: For the power enrichment table to function properly, you must make sure that your TPS is well calibrated. Calibration may be checked using the FC-Commander. Go to etc. menu, select Sensor/SW Check and make sure that TPS voltages VTA1 and VTA2 are within specs. Warm up the engine to 80C, and confirm that VTA1~0.4v and VTA2~1.0v. If out of spec loosen the TPS mounting bolts and re-adjust according to the service manual.

Referring to the parameters listed on FC-Tweak's Settings Page 9, in more details:

Max Pulse width indicates the 100% PW adder total for front + rear injectors, each injector gets half
Delta decay is the decrement step in (ms) which the PW function steps down per crankshaft rotation
Cycles is the duration of the decay function measured in crankshaft cycles
Decay is the total time in (ms) the PW adder function takes to drop to zero
Sigma Pulse width is the total sum of the pulse widths under the decay curve (=diaphragm volume)
Actual TPS Dot in V/s – the rate of change of TPS voltage (aka TPSV RoC)
Actual TPS Dot in %/s – the rate of change of gas pedal travel (aka TPS% RoC)
TPS Dot lower threshold – the value below which AE is inactive
AE ramp pulse width factors in %

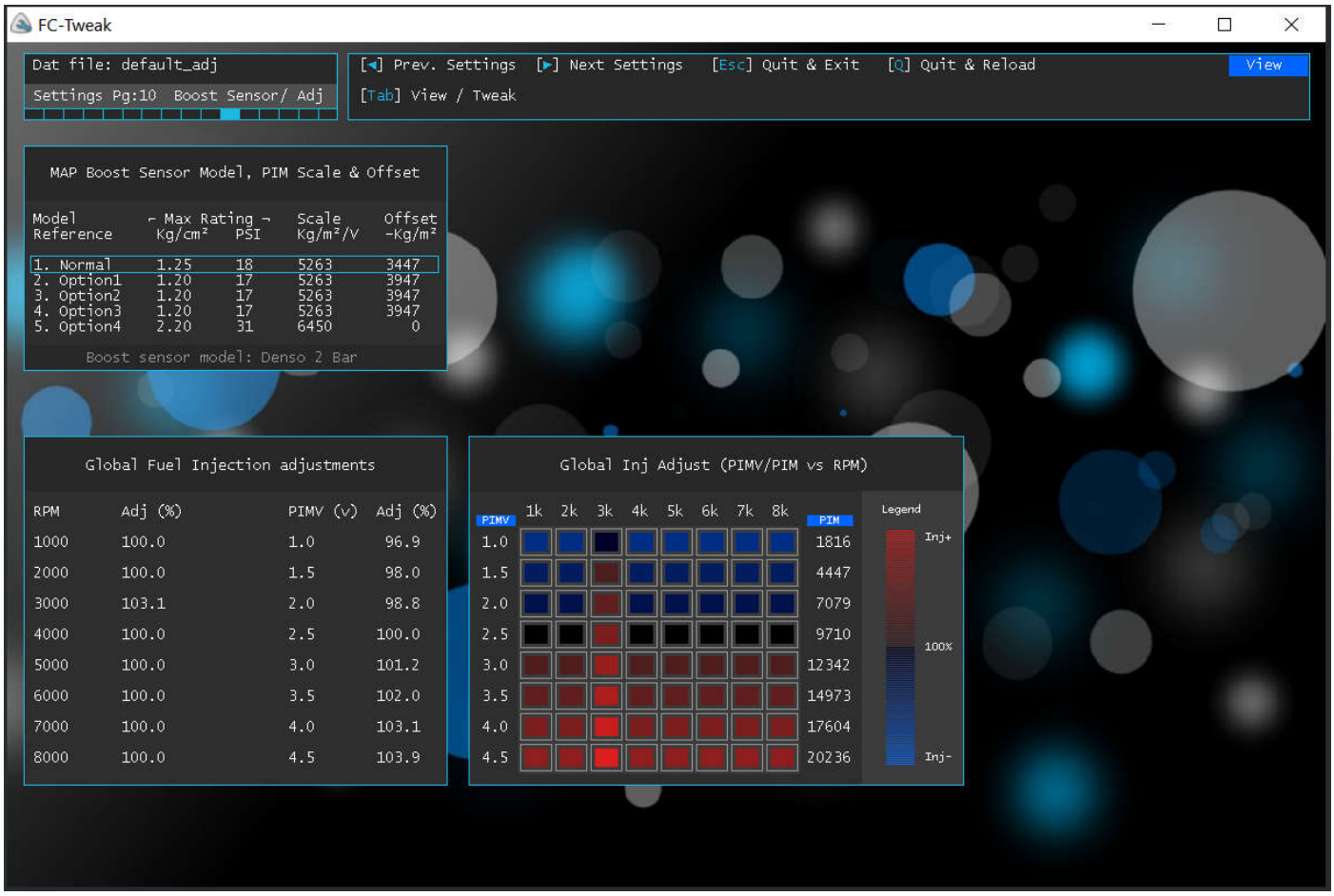
Next to each table is its respective chart. To the right is a flowchart describing the AE adder function.

A TPS Dot value of 100%/s simply means pressing the gas pedal to the floor in one second, 400%/s means pressing it to the floor in a ¼ second.

By logging AFRs and TPS Dot, one will immediately recognize the benefits of having these AE tables optimized. Your car may not show drivability problems under acceleration, but tweaking these values will most likely improve your driving experience by totally eliminating short periods (fraction of a second) of lean fuel mixture during such events.

The AE settings on the default 5.08 map are barely suitable even for the most mildly modified cars. We also find that the default PE enrichment table is set to 100% throughout, thus disabling this important feature. FC-Tweak uses the details of your car flow mods list to optimize these tables and also enable the PE function.

Settings Page 10: Boost Sensor/ Global fuel adjust



The upper table shows your boost sensor model, maximum sensor boost rating, and calibration values.

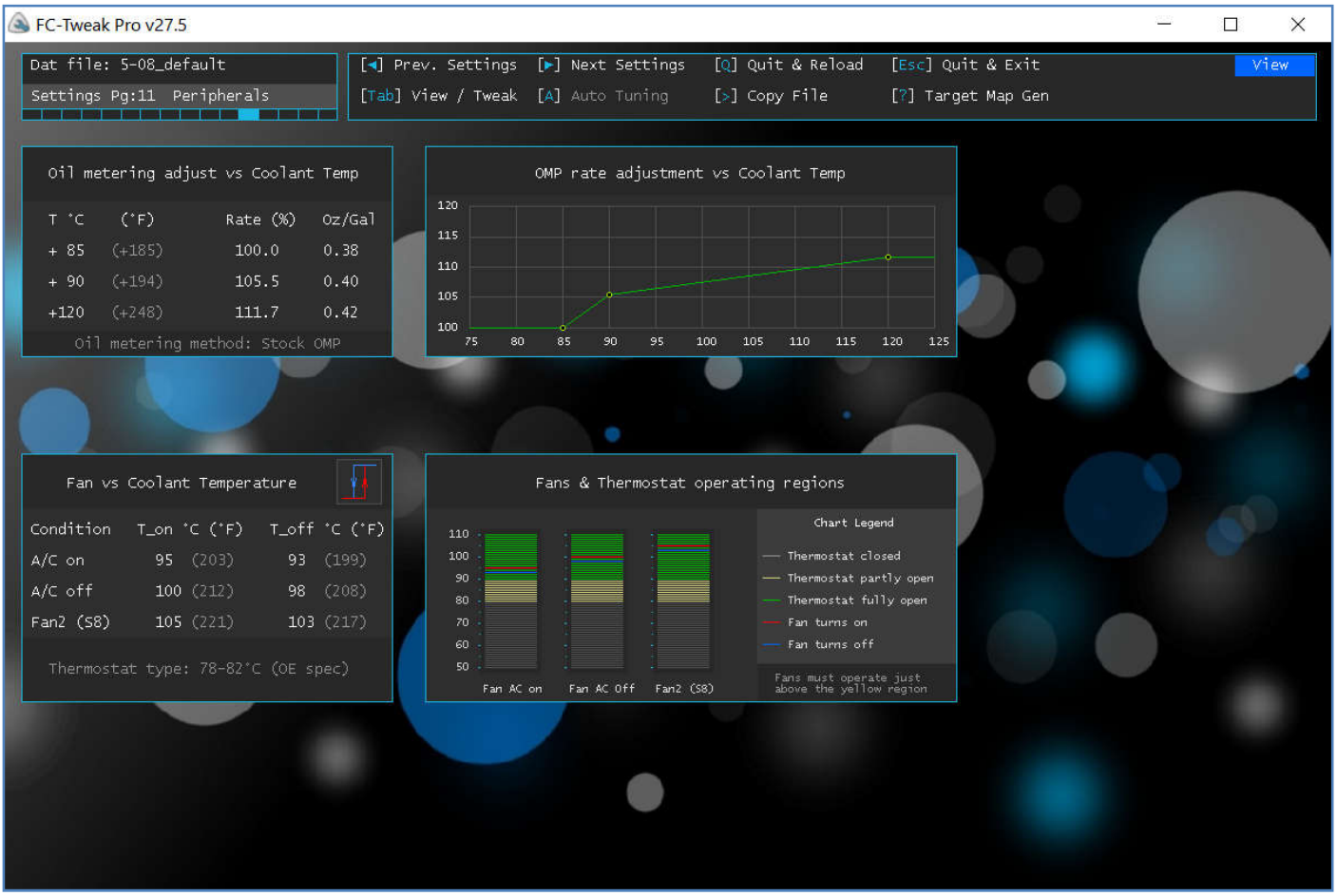
The lower table contains the global fuel enrichment factors versus RPM and PIM. The colour coded chart is an effective means of viewing the resultant fuel enrichment. Red gradient indicates cells having fuel above their base map values, whilst blue gradient indicates cells having fuel deducted from their base values. Black cells are those which remain unchanged. To its right, the chart y-axis is also labelled in absolute PIM values according to your specific boost sensor.

In the above example, the chart makes it immediately obvious that at 3000 RPM and PIMV=1 Volt, (PIM=1,816kg/m^2) no fuel enrichment is present, and that map locations at 3000 RPM, PIMV=4.5 (PIM=20,236kg/m^2) may become overly enriched. These effects would not be so obvious by just looking at the tabled values.

A note on aftermarket boost sensor compatibility

You might think that as long as the sensor can be wired up to the PFC and is properly rated for the planned boost pressure, it should be ok. Well, that turns out NOT to be the case with the PFC.
The boost sensor's offset value must be negative & big enough to enable the PFC to be calibrated correctly. Since the PFC is not equipped with an internal barometric sensor you should select a boost sensor whose offset value is higher than 700, enabling you to adjust the offset by +-50mmHg as required. Also the MAP sensor must be of the negative pressure offset type. (Refer to appendix for more detail). Some GM sensors have very small offset values of -100 or less and some have even got positive valued pressure offsets. These cannot & should not be used with the PFC. With such low or positive offset values, the PFC will not be able to be calibrated correctly, forcing PFC users to set their offset down to zero and still have relatively large errors in their boost reading. Remember that inaccurate boost readings will result in improper AFRs, timing, boost control and safety boost limits. FC-Tweak will show a warning if your aftermarket sensor is not compatible with the Power FC. In such case it is highly recommended to replace it with a compatible unit before proceeding with tuning. Refer to Appendix section for more details.

Settings Page 11: Peripherals



The upper table shows the oil metering pump (OMP) rate adjustment for different coolant temperatures. The Oz/Gallon column shows the approximate metering oil consumption per gallon (US) of fuel. To the right, the respective OMP rate vs coolant temp chart is displayed. When the coolant temperature gets higher, more oil is injected into the rotor housings in the attempt to improve apex seals' lubrication. Since oil does not burn so clean, Mazda had to make some compromise here by injecting the least possible amount of oil. FC-Tweak will optimize this table in accordance to your setup, ensuring your rotors get enough oil lubrication without leaning out your fuel mixture, and without overdoing it. If your OMP setup is configured to use 'premix' this table will be ignored. Note that 'Premix' option must only be selected when your oil metering pump is completely disabled.

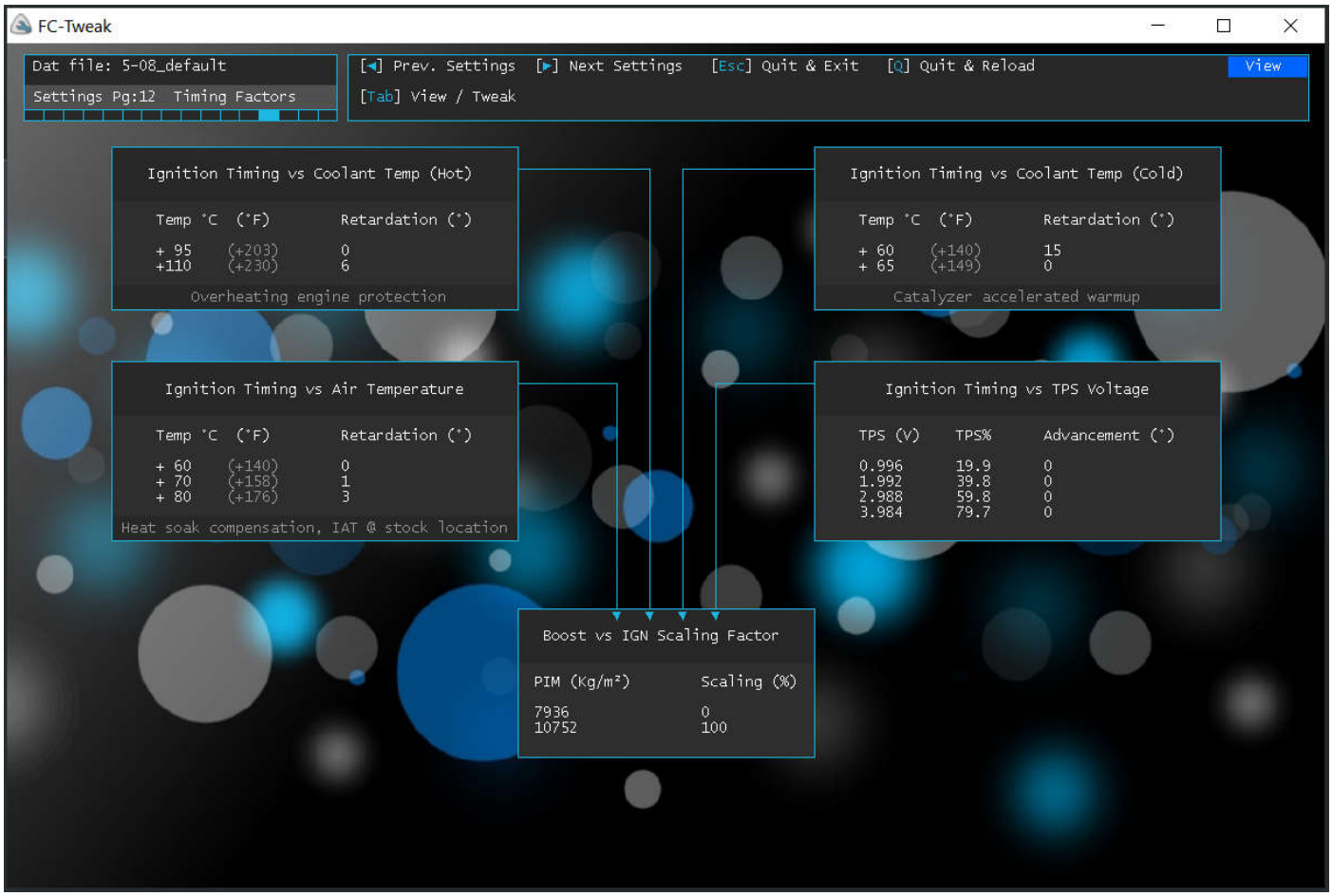
The lower table shows the temperatures at which Fan 1 turns on with either A/C on or off. FC-Tweak will optimize these settings in accordance with your thermostat type in order to improve the cooling efficiency. It simply makes no sense to have the fan start blowing when your thermostat is still not fully open or even worse, still closed. For setups configured as having a deleted thermostat (not a recommended practice), FC-Tweak will only make sure that the fan settings are not too high, and the user is free to set any lower temperatures.

Also note that Fan2 (S8) setting is only used on Series 8 RX7 (1998-2002) to control the second fan. On earlier models, the ECU can only control fan 1, exactly as with their factory ECU.

Note that both oil metering adjustments and fan speeds are optimized to perform best at your particular nominal engine operating temperature, which also depends on the thermostat type.

So, it is highly recommended to apply all tweaks on this page during the same tweaking session.

Settings Page 12: Timing factors



Settings page 12 groups all Ignition timing correction tables in one place.

Ignition timing correction vs. Coolant (Hot limit): This protects the engine by retarding timing at abnormally high coolant temperatures. Retarding the ignition timing will make less power and less heat, so it stops the engine from self destructing.

Ignition timing correction vs. Air temperature: Protects the engine by retarding timing as intake air temperatures rise due to heat soak of its intake components.

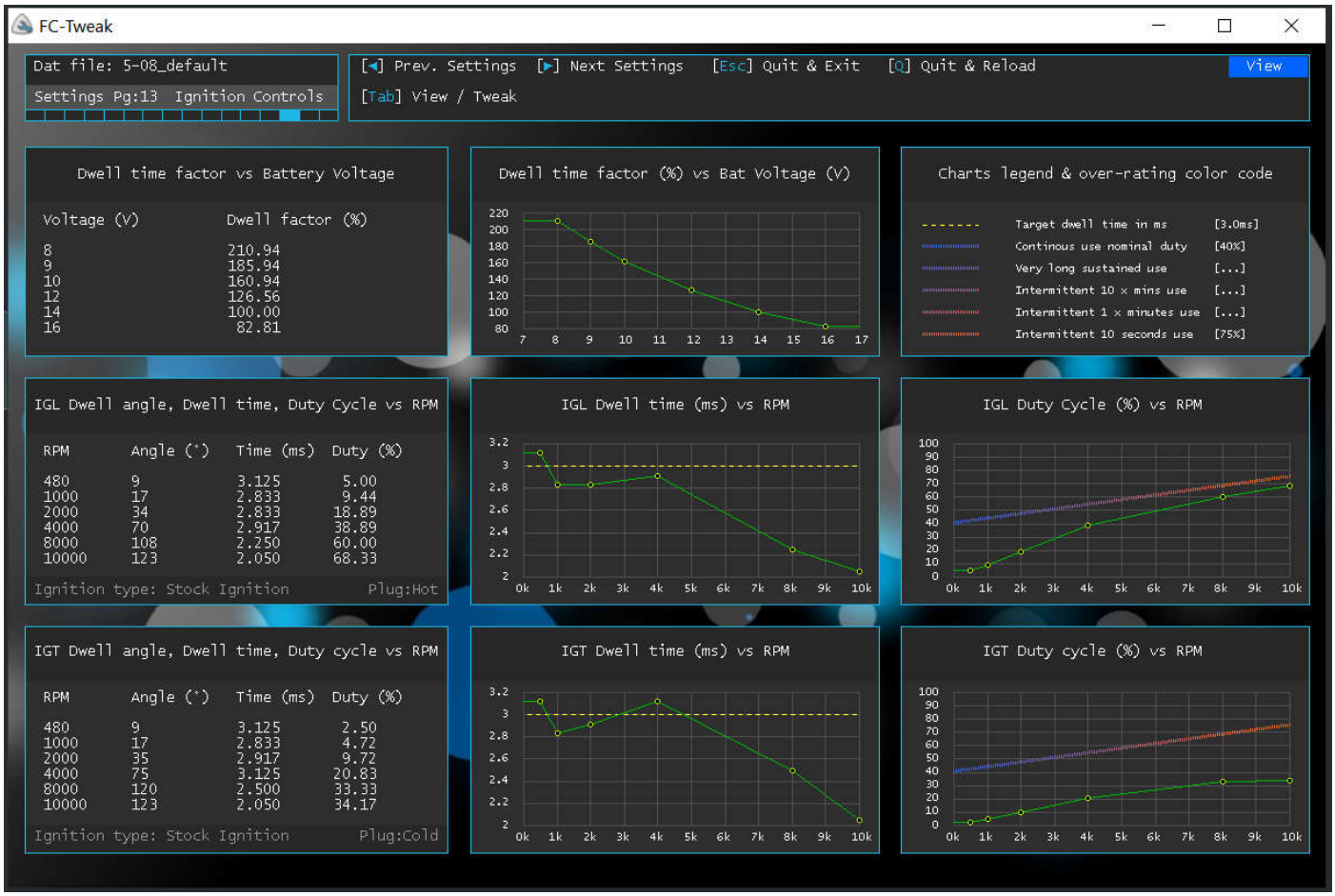
Ignition timing correction vs. Coolant (Cold limit): Retardation of the ignition angle during the first few minutes after cold start up reduces the combustion efficiency and simultaneously increases the combustion temperature or exhaust gas temperature. The hotter exhaust gas heats the catalytic converter faster. Not required for mid pipe setups.

Ignition timing correction vs. TPS Voltage: Advances the ignition timing for different amount of gas pedal travel.

All of the above mentioned timing corrections are rescaled according to the Boost vs. IGN scaling Factor table.

FC-Tweak will recommend the best settings for your particular setup.

Settings Page 13: Ignition Controls



Settings page 13 is a detailed information page showing all electronic ignition related settings in your file.

The upper table and curve shows the dwell time factor correction versus battery (/alternator) voltage. FC-Tweak will optimize this table according to the coil's manufacturer specifications. Tweaking this table will often result in better starting since the default values do not properly compensate the dwell times at low voltages.

The second and third tables show the dwell angle, dwell time and duty factor for the leading and trailing coils at various engine speeds. Note that dwell angle has got nothing to do with timing retard or advance angles, but is the coil charging duration measured in degrees of crankshaft rotation. For electronic ignitions, the most important ignition parameters are dwell time and duty factor.

The dotted yellow marker on the charts shows the nominal coil charging dwell time, at which the coil is fully charged. Any dwell values exceeding this line will not add to the spark energy but only dissipate more heat in the ignition coils.

The charts to the right show how far is your duty factor from being detrimental to the coil's lifetime. The red-blue coded line on the duty cycle charts delineates the safe operating area.

FC-Tweak will modify these parameters to optimize the spark energy while keeping it within its safe operating margin. For the stock ignition, the dwell parameters will be optimized to the values set in the stock Mazda ECU, which are by far better than those that come with the default APEXI data file. Tweaking these settings will in most cases eliminate ignition breakup at high boost and RPM, with the result of improved high end torque and power.

For other ignition types, the values will be optimized according to their manufacturer's specifications. For this reason, it's very important you choose the right ignition type in your car setup page (settings page 0).

Note: For the older FC3S (pre 1993) RX7 models using their original ignition system together with a PFC adapter harness, you may discard all tweaks on this page, since their ignition system is edge triggered and there is no benefit to be gained by optimizing these settings.

Settings Page 14: Fuel Injectors

Here you find all fuel injectors related data.

The Global Injection factor is used to scale all fuel related table entries (including the basemap) whose units are in milliseconds (not injection correction tables). A bad factor will therefore mess up a lot of things, including cranking, warming up and enrichment tables. FC-Tweak will correct the scaling factor according to your injector setup, and automatically rescale your basemap to preserve your fuel tune. The Rear to front rotor bias shows the percentage injected fuel difference between the two rotors. The status indicator turns green when the rear rotor is protected. Positive rear-front rotor bias is required for high power setups, to compensate for LIM design & turbo heat radiating mostly on its front runners. This would otherwise lead to the rear rotor running leaner than the front one increasing its probability of failure. FC-Tweak implements adequate fuel bias if required.

The next four Injector Lag Adjustment entries represent the additional electrical lag for each injector. This should include the additional lag introduced due to the voltage drop of the wiring harness and that of the driver chip within the ECU. Preferably, it must NOT be used as a way to compensate for the difference between the nominal lag of the stock and of the new injectors (as shown on the FC-Commander manual). Note that APEXI has included the electrical lag for stock injectors (marked by a green symbol ☺) in the respective Lag vs Voltage tables.

Next is the injector lag calibration data for both primary and secondary injectors. This is the correct place to enter your new injectors' lag vs. voltage specs, as supplied by the manufacturer. FC-Tweak will display a warning message if it detects non-stock size injectors (marked by a purple symbol ☺) which still use the factory injectors lag calibration values, however it cannot correct these values since they are specific to each specific brand. In such a case, the relevant calibration data table to be updated is also outlined in yellow. See above example.

Injector overlap is the time measured in crankshaft cycles during which the secondary injector increases its duty to take over part of the injection task, while decreasing that of the primaries. Larger injectors usually require longer overlap durations to avoid instabilities during this transition.

The table 'Other calculated data' shows the effective primary injectors flow rate and the total (electrical + mechanical) lag of each injector after applying the global Injector Lag adjustments. This makes it easier to cross check whether the parameters actually match your hardware. An estimate of the wheel horse power at which the injectors max out, and the maximum power mapped by the fuel basemap (prior to fuel cut) are also displayed.

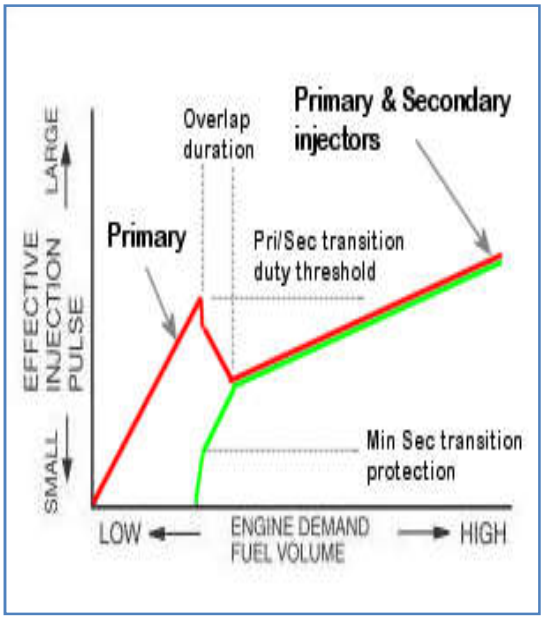
FC-Tweak will correct any anomalies in injector scaling, optimize the electrical lag time values and the overlap duration for smoother operation.

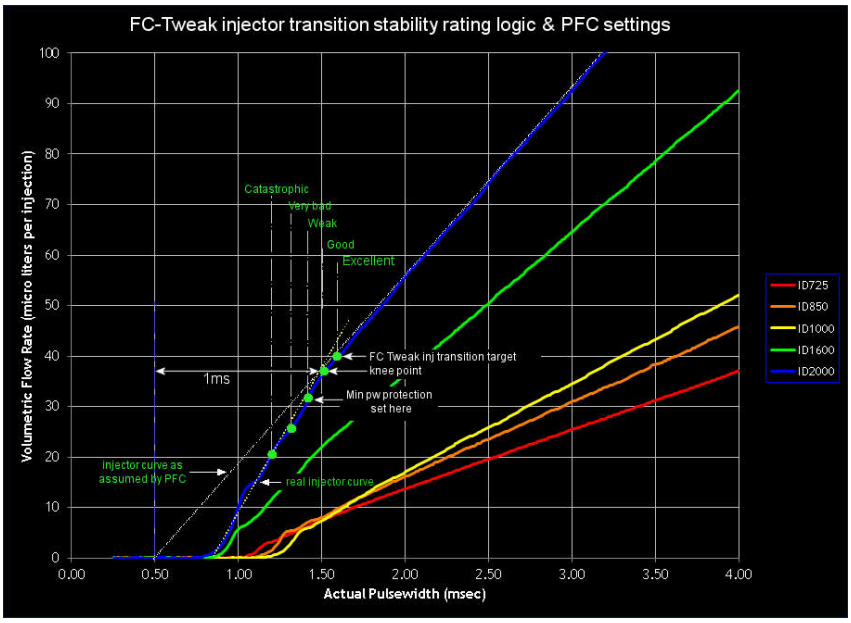
Note on injector staging settings

FC-Tweak calculates the best transition duty threshold, best overlap duration and best minimum secondary transition protection point based on your injectors combo and fuel map. It makes sure that the secondary injectors never operate in the dangerous non linear flow region during transition, and enables the Power FC's internal transition zone protection by setting the proper value for the minimum secondary pulse width. These two features are extremely important especially when large secondary injectors are used in combination with much smaller primaries. The secondary injector transition pulse width at 8000RPM, which gives the worst case scenario, is calculated from your fuel map and displayed in the calculated data table. Pulse widths lower than the injector linear zone value, usually spell big trouble, and often lead to engine failure over a period of time. This software will totally ensure such things never happen.

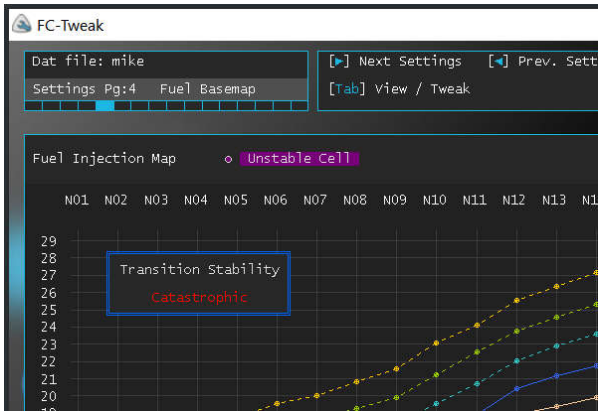
As with most other tweaking functions, this software does not rely on internally stored tables, but works out the optimal values from first principles using the map data and your own mods list. The below charts show the real flow rate vs pulse-width graphs for ID injectors. Other brands have very similar properties.

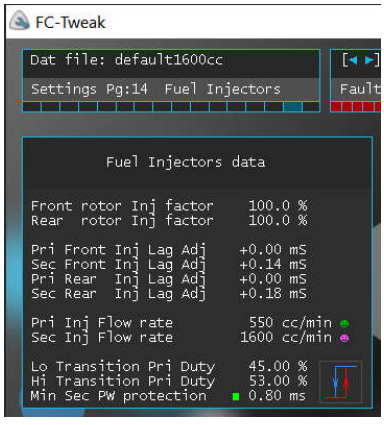
The knee point is defined as the location at which the linear injector curve assumed by the PFC and the real injector curve take separate paths and start to deviate considerably from each other for the lower pulsewidths. The blue curve below the knee point is the non linear operating zone and you do not want your ECU to utilize that part. The software will scan all your fuel cells and then sets the transition point to the location marked 'Excellent', just above the knee point. The point marked 'weak' just below the knee point is used to set your PFC transition protection. If at any point, the ECU is instructed to turn on the secondary injectors at pulse widths less then this point, the Power FC will use this value instead. This stops the ECU from potentially destroying your engine. Setting the protection pulse width to very small values such as 0.1ms, will effectively disable this internal protection, and gives permission to the ECU to use the non linear region!





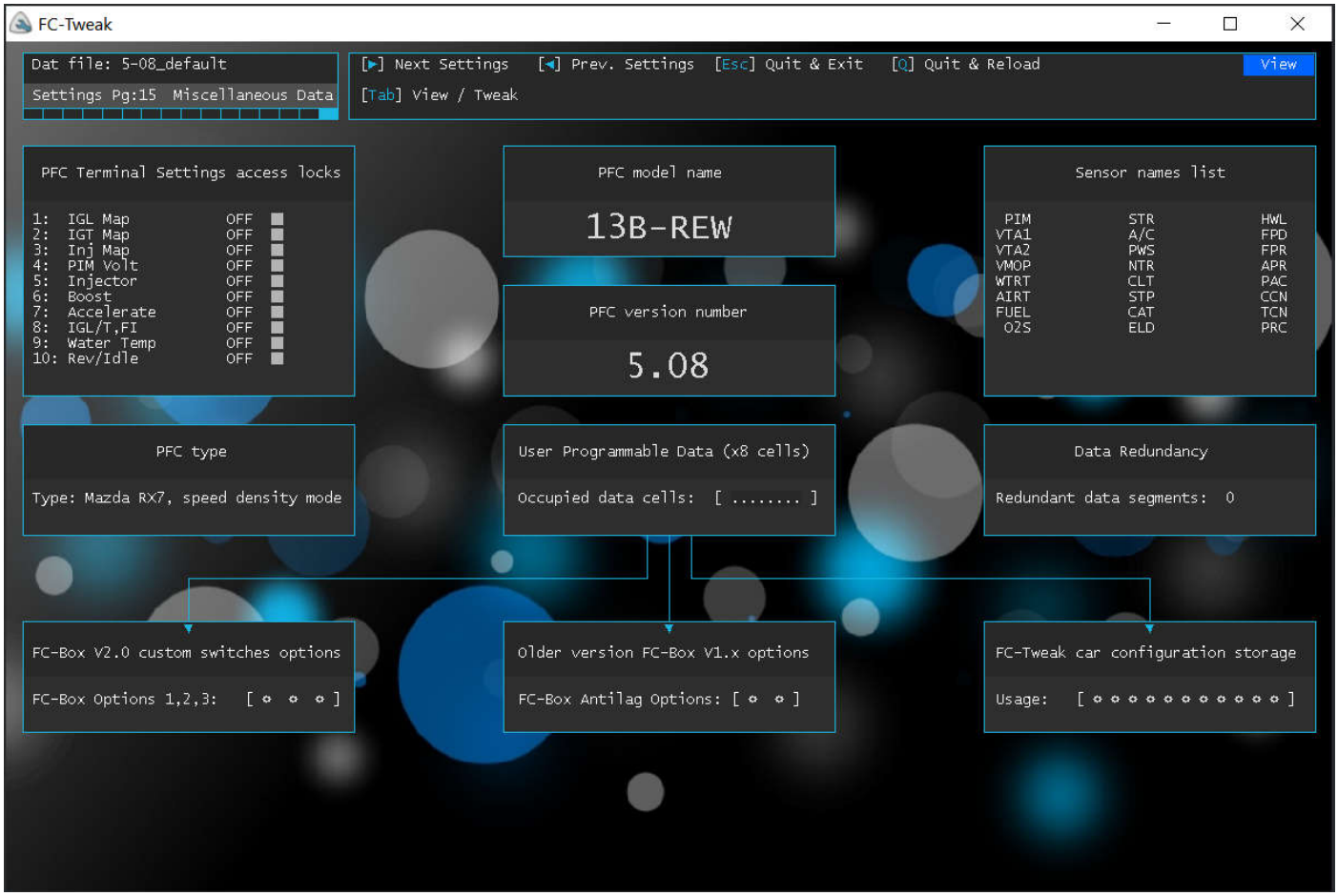
Upon scanning your file, you can immediately check out the transition stability rating of your map by viewing the fuel map. Your fuel map's stability will be rated according to the above operating points, and classified as excellent, good, weak, very bad or catastrophic. FC-Tweak will move your transition point to the 'excellent' target.





An indicator for the minimum secondary pulse-width protection status is shown on settings page 14. Grey signifies disabled, green enabled, and red is off-range (may interfere with transition operation).

Settings Page 15: Miscellaneous Data



Settings page 15 shows various internal data:

PFC Terminal settings access locks: Shows editing locks for FC-commander users.

PFC version name: Power FC hardware version. Name usually relates to engine model.

PFC version number: A serial number for the PFC revision.

Sensor names list: List of names as will be shown on the FC-Commander.

PFC type: Internally used by PFC to determine which APEXI ECU hardware & sensors are being used.

Data Redundancy: Shows number of junk content segments in your file which FC-Tweak will cleanup.

User programmable data: An 8 byte location used by Black FC-Box, Beige FC-Box and FC-Tweak.

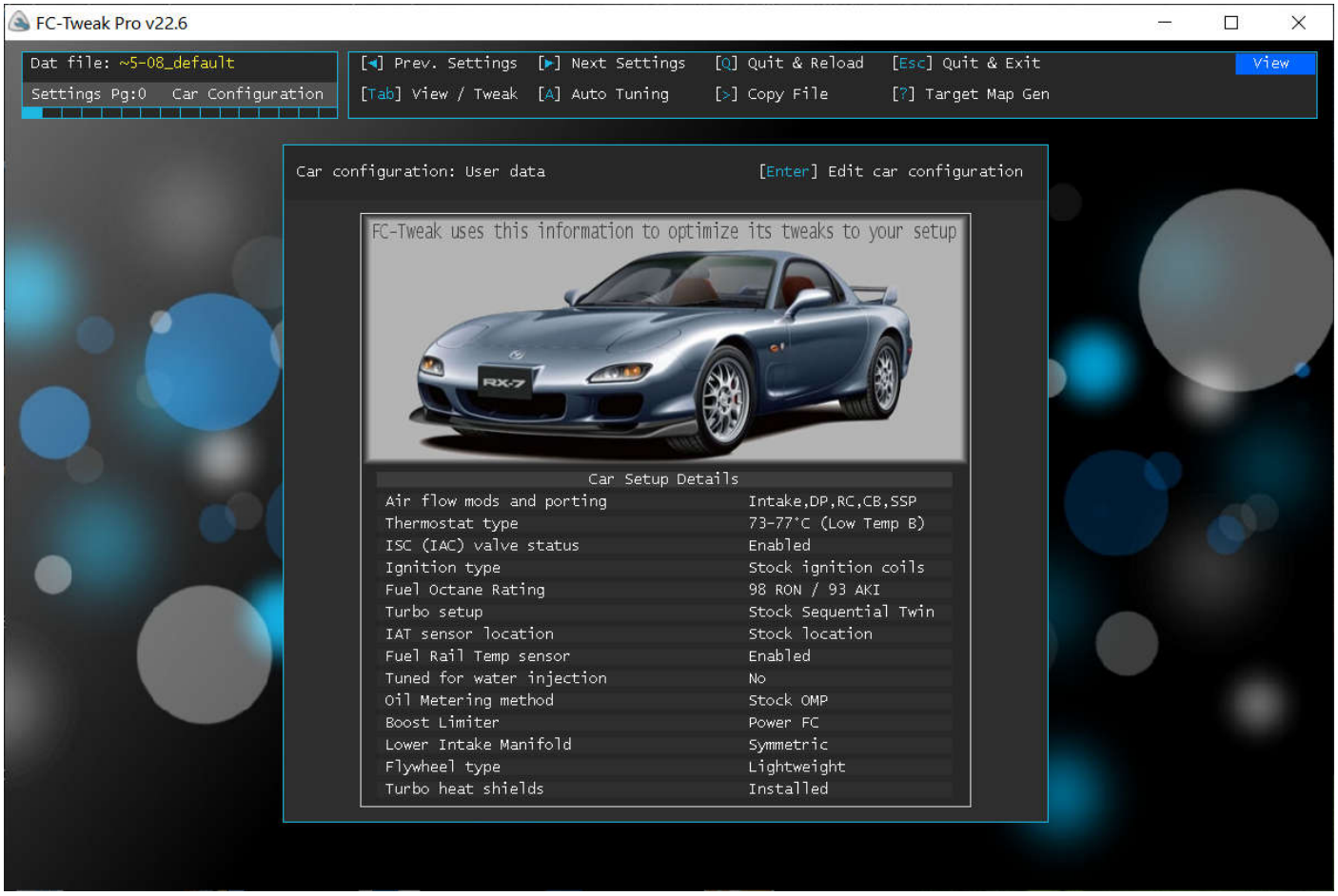
FC-Box V2.0 switches options is data used to control the external switch ports of the Black FC-Box.

FC-Box V1.0 options contains data used by older FC-Boxes for anti-lag control (always delete these).

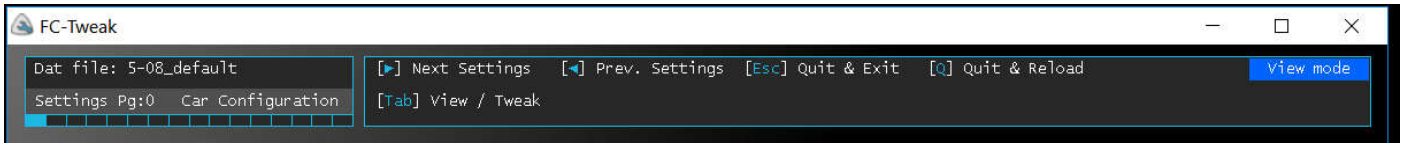
FC-Tweak car config settings contain your car config details from Pg0.

Reading the mods list of other cars

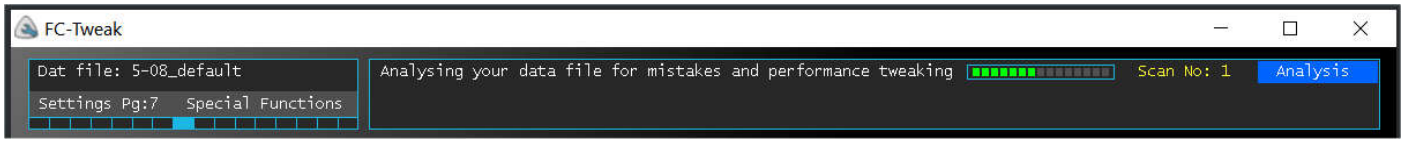
When anybody uploads the file from your ECU into his own FC-Tweak, all the mods you've edited in your car config screen will be displayed under the heading Car Configuration: User data



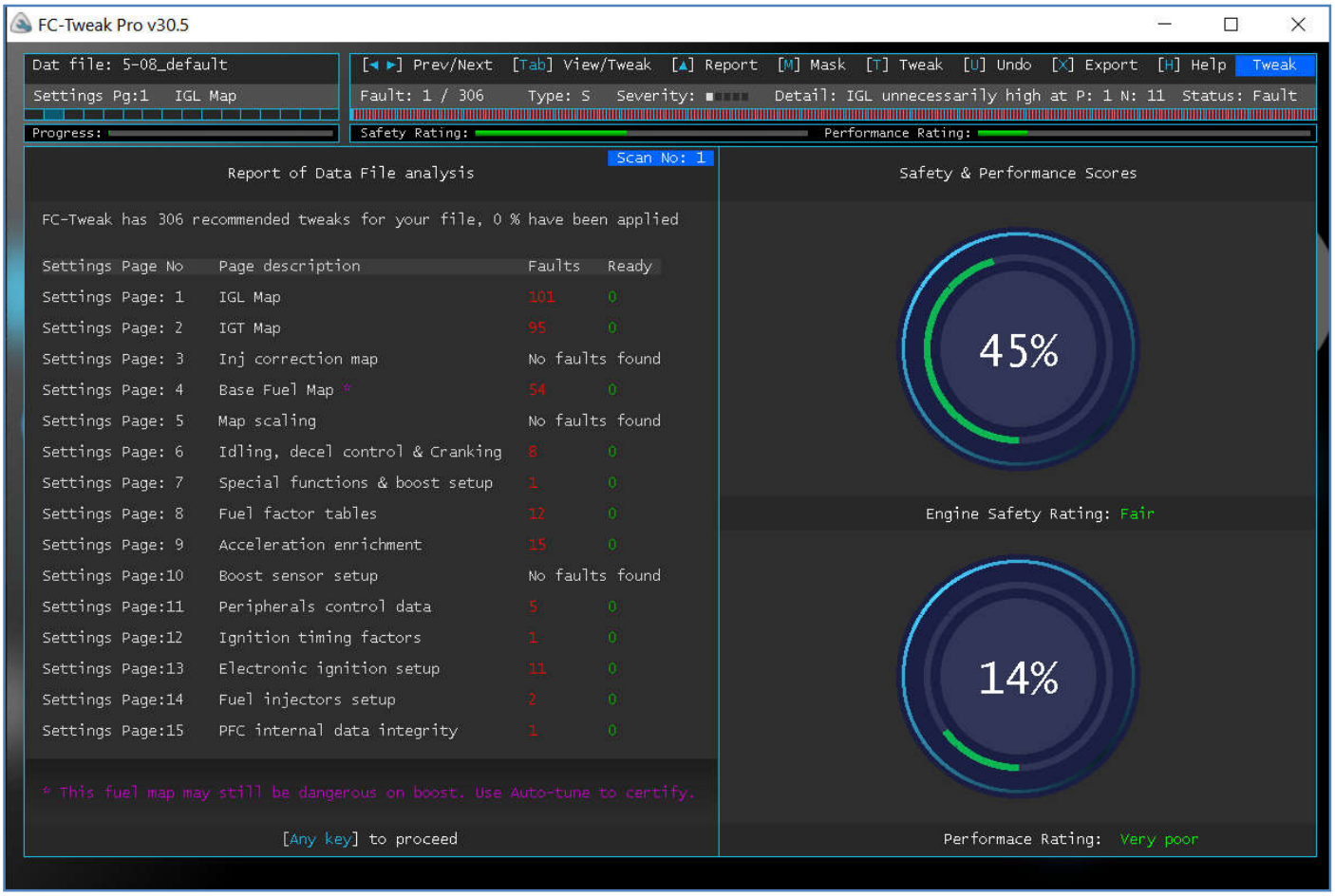
Starting Data file analysis & applying tweaks



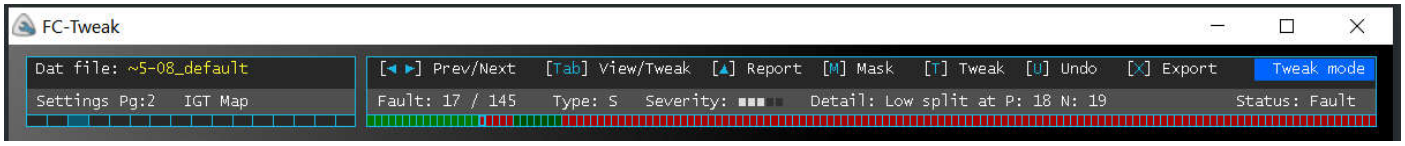
From any page in View mode, press [Tab] to start data file analysis. A green progress bar will be displayed.



In a few seconds, FC-Tweak will display a short report of all faults found in your file. Below are the results from Apexi's Default 5.08 data file..... with over 300 errors it's far from perfect, but Apexi never said it was!



You are now in Tweak mode, from where you can scroll through the error bars (using left and right arrow keys), and decide whether to [T] tweak, [M] mask/unmask or to [U] undo a tweak. FC-Tweak keeps all changed values in memory, so any selected tweak can be undone at any stage during the tweaking session. A progress bar, safety and performance bar, get updated in real time as you implement each recommended tweak.

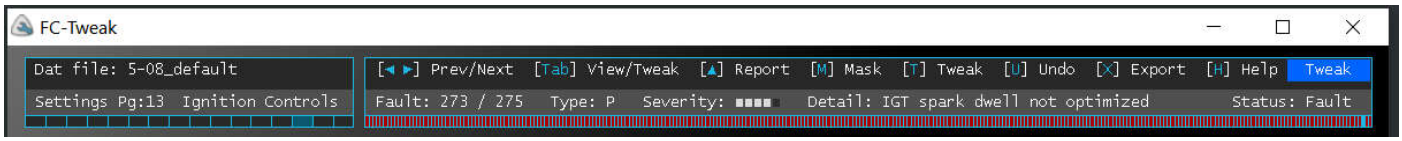


Each individual cell status in the error bar is colour coded as follows:

Red: Fault present. Note: 'Faults' include both engine safety, Type: S and performance, Type: P related issues.
Green: Tweaked/corrected cell
Dark green: Masked (use this only if for any valid reason you do not want to tweak the particular data)

Toggling between View and Tweak mode

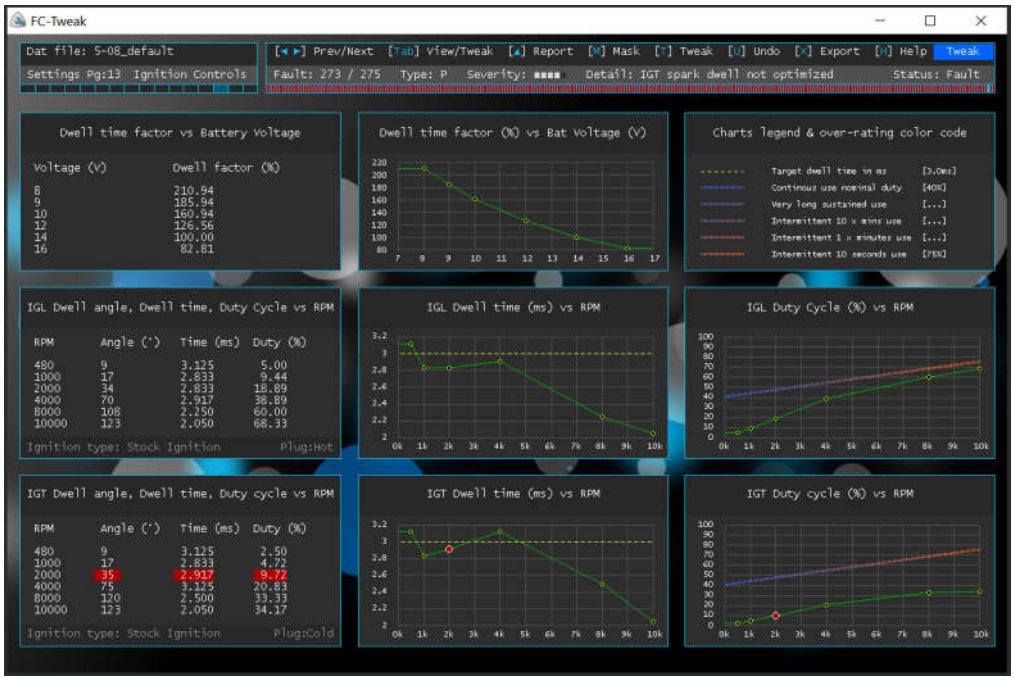
Toggling between the two modes is done by pressing [Tab]. When toggling from Tweak mode to View mode, you will be taken to the settings page in which your currently selected error is located.



In the above example, it will take you to settings page 13 (Ignition controls), where FC-Tweak found a bad IGT dwell time setting on error 273.

Tweak Detail Information

In Tweak mode all relevant information on the fault found will be displayed in 3 ways:



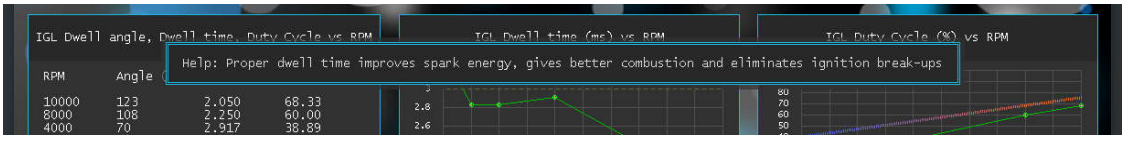
(1) A short summary in the status bar area will give the fault sequential number, for example: Fault Number: 273/275. Fault type: S for safety tweak, P for performance tweak, a 5 bar fault severity level bargraph meter and a more specific detailed description, ex: 'IGT spark dwell not optimized'

(2) Highlighted table entries show the actual data to be changed, in this case the IGT dwell angle at 2000RPM. Once corrected by pressing [T], cells are highlighted green, and status changed from 'Fault' to 'Ready'.

(3) Auto-updating tables and graphs reflect the tweaked value before & after the tweak has been applied.

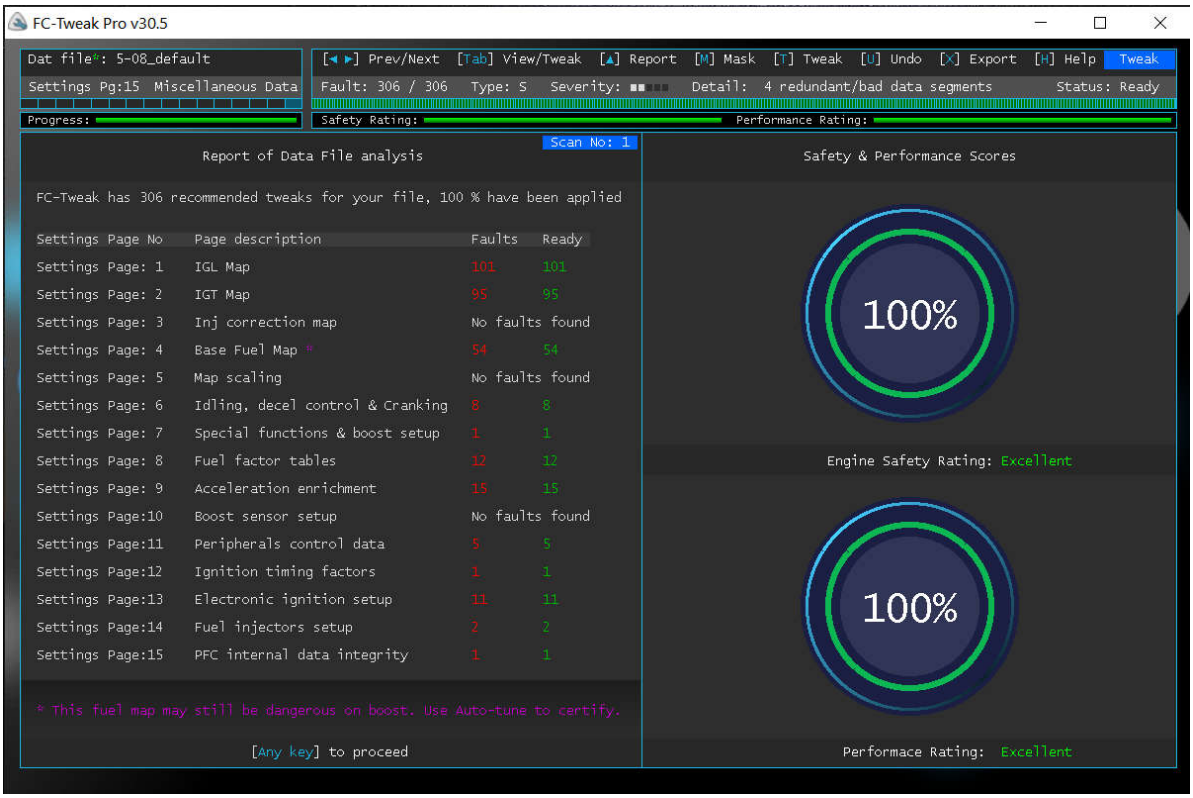
Getting further help/ information pop-up on a particular tweak

Further help and technical information can be called up for each recommended tweak by pressing [H]

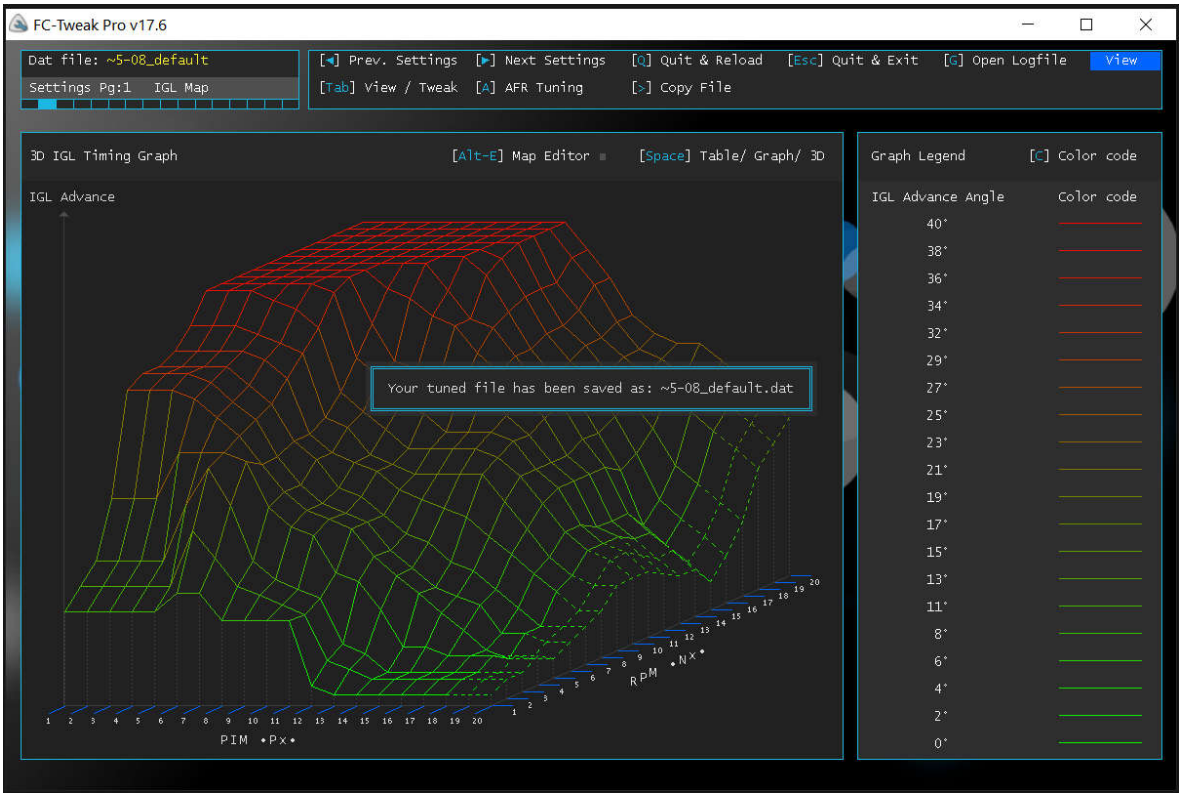


Exporting your Tweaked data file

At any point in time, pressing the [up] arrow key will show all details of your file tweaking process and the resulting overall safety & performance ratings. The below screenshot shows that we have tweaked all errors and are now ready to export the new data file. You can export your file at any stage in the tweaking process, and continue later.



Pressing [X] from Tweak mode will export your tweaked file in *.dat format, ready to be loaded by PFC-Connect. The saved file will be automatically loaded in View mode so that you can view or re-scan your new file.



The filename for the Tweaked file will always be the same as the original with a tilde symbol (~) prefix. All tweaked filenames are printed in yellow. If required press [>] to copy your tuned file from the default DATFILES folder onto a pen drive.

Consecutive analysis scan runs

Sometimes, badly or partially tuned maps will require more than one scan to converge the maps to their best values. To check whether your map requires any further tweaking, after exporting the file, just press [Tab] again. This will run a new analysis on the exported file. The scan number is shown next to the progress bar and also in the summary report.

If more errors are found a new error bar will be generated, and you have to [T]weak the errors in the same way you did on pass 1. Once ready, press [X] again, to export the new tweaked file. A new tweaked file will overwrite the first pass tweaked file. Repeat the sequence [Tab]> [T]weak> e[X]port, until no more scan runs are required.

When the file analysis finds no more problems in your exported file, you'll see the following message:

At this point the saved file is ready to be uploaded to the PFC. FC-Tweak will switch into View mode, where you can either

(a) Copy the tweaked file [>] to a pen drive so you can load it on your tuning laptop
(b) scroll between the settings pages to view all your new data file contents
(c) press [Q] to load another data file to tweak, or
(d) press [Esc] to exit the program.

Note that tweaking all settings for 100% safety & performance does NOT magically make an un-tuned fuel map safe on boost!! The ONLY way to make sure the map is safe under all driving conditions is to perform a full map AFR tuning using the Pro version's auto-tune function.

Automated macro tweaks

One of the most important characteristics of FC-Tweak is the total control given to the user as to which tweaks would be applied to the data file. So what are automated macro tweaks? These are tweaks which are authorized by the user to be performed by FC-Tweak's powerful computational engine, which would otherwise be too complicated and time consuming to confirm each single change in the usual manner. Such tweaks usually modify whole maps and related settings following the instructions set by the user in the program preferences. The following list gives detailed information about these automated tweaking functions:

- **Basemap Recalc (changes 800 data points)**
  Enabled from the program preferences settings
  If O2 sensor is disabled it sets injector correction map to all 1, and auto-recalculates the basemap.
  Recalculated maps are written to file upon file Export

- **FC-Tweak config data (changes 1 data entry)**
  Writes the car setup configuration details to your data file, and enables FC-Tweak users to share data

- **Soft-cut engine rev and boost limiters (changes >78 data entries)**
  Soft cut engine rev and boost limiters are enabled from program preferences settings
  It backs-off ignition timing before the engine goes beyond RPM or MAP soft-cut limits.
  When the soft rev limiter tweak is enabled, the last column N20 on both IGL and IGT maps is modified
  When the soft MAP limiter tweak is enabled, one or more rows on both IGL and IGT maps are modified

- **O2 sensor offset calibration with Map recalibration option (changes 1204 data entries)**
  Calibration is enabled from program preferences settings and recalibration mode from settings pg10
  Used to correct boost sensor reading of files which have been previously tuned with bad offset
  When calibration tweak is confirmed your fuel, IGT, IGL maps are recalibrated and boost targets revised
  All changes are performed during file export

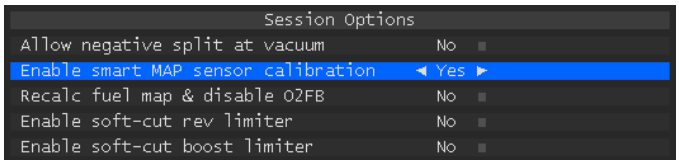
- **Changes to the front inj scaling or water temp correction at 80C (changes 400 data entries)**
  FC-Tweak can even correct the worse mistakes. Bad primary injector scaling parameter which unless corrected will mess up many PFC functions, including the correct functionality of cranking and most fuel adjustment tables. Once you accept to tweak this scaling parameter, your basemap will be auto-recalibrated to preserve your tune and all functions will be restored. Same applies to water temp correction at final warming up temperature. The new revised basemap will be written upon file export.

Boost sensor offset calibration utility

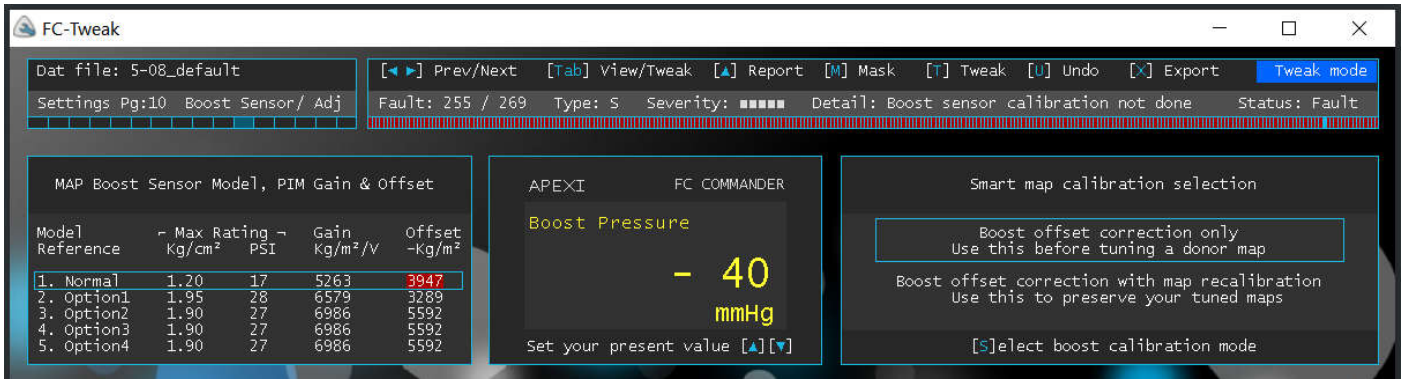
FC-Tweak has a built-in boost sensor calibration mode capable of eliminating the offset error of your boost reading. Even two identical brand new stock sensors will have a different offset value. Boost sensor calibration should preferably be done before tuning your maps. The boost calibration utility is able to automatically remap fuel and timing maps, and target boost settings to preserve your tune after zeroing the boost offset. Keep in mind that at an offset of -73mmHg the PFC will be wrongly reading its map data from one P-row lower, thus driving your engine at higher advance and leaner fuel!! Boost sensor calibration is a very important step, as failure to do this will not only show wrong boost readings on your PFC commander, but also shift all boost related settings, such as turbo transition points, timing and fuel maps. The stock ECU has got an internal barometric pressure sensor to perform this task automatically. Unfortunately, the PFC has no such feature, so you will need to manually deduct your sensor offset from the offset table. To do this, you just need an FC commander & FC-Tweak. Whether you are calibrating a new donor map or one which has been already tuned with a bad offset, the procedure is very easy:

With your data file loaded into the PFC, turn car key to 'ON' position, and use the FC Commander to monitor Boost With engine still off, take note of your vacuum pressure, for example -40 mmHg

On FC-Tweak, load your data file.
On settings page 0, select Session Options menu and set 'Enable smart MAP sensor calibration' to <Yes>



Press [Tab] to run file analysis, and scroll through the errors until you are on screen 10:



Using the up/down arrow keys set the boost pressure to the value you had with engine off.

If you are either:

(a) tweaking a donor map coming from a PFC with zero boost offset error, or
(b) have an offset error less than -20mmHg (ex. -13mmHg), or
(c) after replacing the boost sensor with a new type (having manually entered its correct gain & offset), then leave the Smart map calibration selection on 'Boost offset correction only'.

If you are performing boost offset calibration on a map which has already been perfectly tuned to your own car with the same boost sensor and just the wrong offset, given it's a PFC compatible sensor, press [S] to toggle the selection to the second option: 'Boost offset correction with map recalibration'. This mode will zero out your boost offset, while preserving your tune. **Never use this second selection for anything else or you may end up with bad fuel and timing maps!**

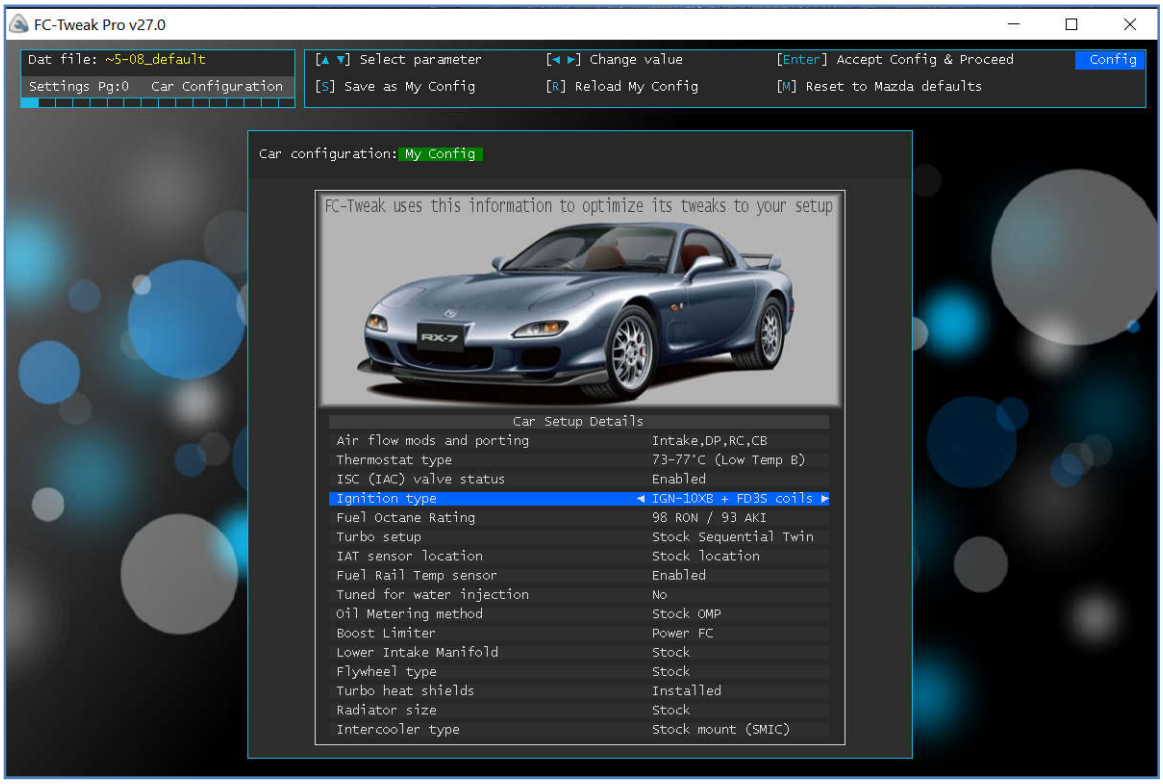
Finally, press [T] and FC-Tweak will automatically correct your sensor offset value. Press [X] to Export your new file. Once you upload the new tweaked data file, your FC-commander will read zero at atmospheric pressure, and all your boost related tables will be correct!

Note: It's normal for the reading to vary a few mmHg depending on daily weather conditions.

WARNING: If your present vacuum reading is higher than 50mmHg, the chances are that you have either an incompatible boost sensor (see Appendix section), or totally wrong sensor settings, in which case you will need to obtain the manufacturers datasheet and check that the scale and offset values are not far off. Performing an offset calibration in these cases should not be done. Correcting these large offsets will most likely need a total map retune.

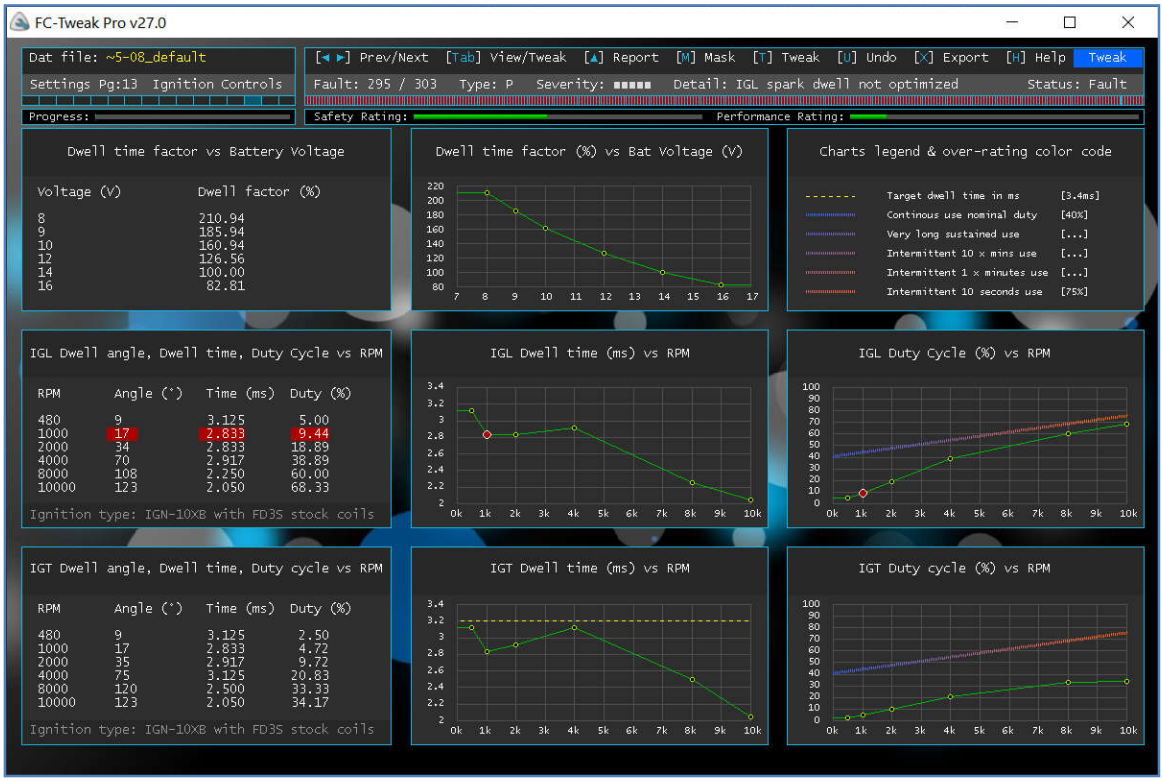
Reconfiguring a data file for a different car setup

FC-Tweak allows you to easily and safely convert one data file from a car setup to another. Here I shall take a simple example of how one can handle an electronic ignition upgrade using FC-Tweak. In this example, the car setup will change from one using the stock ignition system to one using the uprated FD-IGN10XB module.



- Load the existing setup data file
- From Settings Pg:0, change the Ignition type from Stock Ignition to IGN-10XB + FD3S coils

- Press [Enter] to confirm the new settings and [Tab] to start data analysis
- Tweak all errors found on Settings page 13

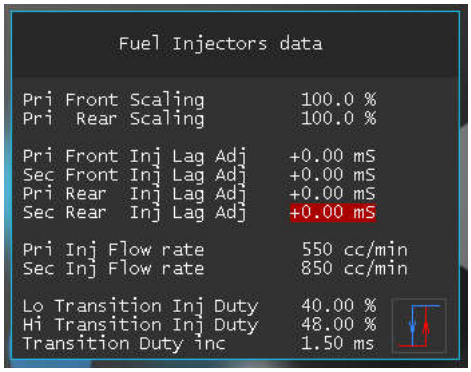


- Press [X] to Export your new data file
- Finally use PFC-Connect to 'Write All' the new file to your PFC

Notes about error masking (ignoring a recommended tweak)

As already mentioned, applying a tweak is performed by simply pressing [T] and move to the next error cell. One is also free to ignore a recommended tweak (mask it) by pressing [M]. However, some complications may arise if you ignore a tweak which is forming part of a data table which you have started tweaking.

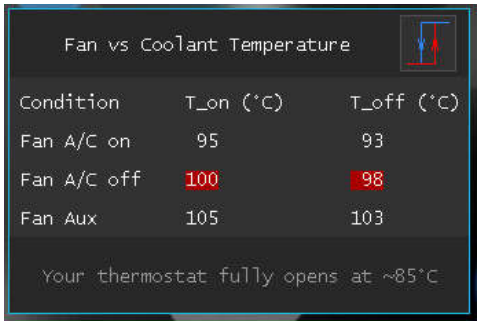
Masking errors in tables with independent parameters



This is an example of a table containing independent parameters. Such tables are recognized by the fact that they have a single column of data and do not represent a graph.

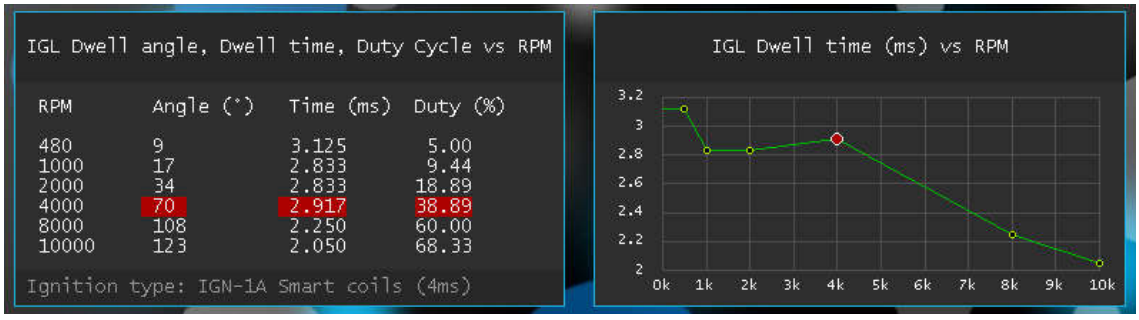
In these cases, modifying any of the table parameters will affect only that particular entry, since the ECU will not do any averaging calculations to its neighbouring cells or link it to another parameter.

This means there is nothing wrong with tweaking one value and ignoring another in the same table (if you have any valid reason to do so).



The Fan switching table is another example of totally independent parameters. Even if it shows two columns of numerical data, the two columns have a fixed relation, meaning they are based on a single entry. That's why they get highlighted together. If you change one, both values will change. So, again we see that this table cannot be represented as a graph, and one is free to change the highlighted values of this row and ignore the tweak recommendations for the next.

Masking errors in tables with related parameters 



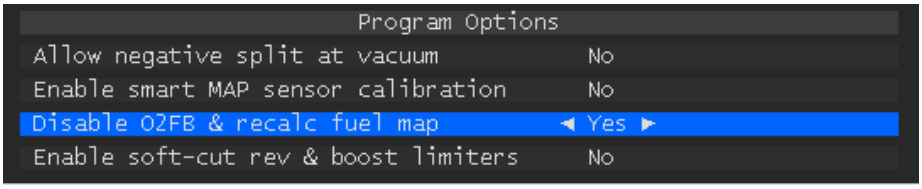
Tables with related parameters usually contain two or more data columns, and can be represented as a graph. The dwell table is one such example. Note that dwell angle, dwell time and duty are highlighted together, which means that all highlighted numbers are in fact different representation of the same data entry. So, actually this is a simple two column table of Dwell (angle/time/duty) vs. RPM.

From the graph we see that each number is only valid for a specific RPM, and that the ECU is interpolating the curve between the cell values to estimate dwell times which are not present in your table. For example we see that at 7000RPM the ECU will use a dwell time of ~2.4ms. If we change the dwell value at 8000RPM, the ECU will then also calculate a new value for 7000RPM. So, unless you know exactly what you're doing, it is highly advisable to refrain from ignoring any recommended tweak once you start tweaking such tables. If you are not sure which type of table you are dealing with, then it's best to either tweak it all, or mask it all.

Precise Fuel Basemap Re-Calc

FC-Tweak gives the option to re-calculate your fuel basemap, so that your injection correction map is all ones. This option considerably reduces the computational load on the PFC processor.

If your map already has O2 feedback disabled, FC-Tweak will recommend to recalc during the tweaking session. On the other hand, if your map has presently got O2 feedback enabled, you will need to manually activate this feature, by setting 'Disable O2FB & recalc fuel map' to 'Yes' in the program options on settings screen 0, followed by a tweaking session. This will turn off O2FB and automatically perform recalc when saving the tweaked file.



FC-Tweak's Re-calc function is far more accurate than the old FC-Edit. For comparison, these are the error margins you get from FC-Tweak's Re-calc on Apexi's 5.08 default map:

	N01	N02	N03	N04	N05	N06	N07	N08	N09	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19	N20
P01	0.000	0.002	-0.002	0.001	0.000	-0.001	0.000	-0.001	-0.002	0.000	-0.002	0.001	0.002	0.001	0.001	0.002	0.002	0.000	-0.001	0.000
P02	-0.001	-0.002	-0.001	-0.001	0.001	0.000	-0.001	0.001	0.001	0.002	0.001	-0.002	0.001	0.002	0.002	0.002	-0.002	-0.002	0.002	0.002
P03	-0.001	0.001	0.001	0.001	-0.002	-0.001	0.000	0.001	-0.001	0.000	0.002	-0.002	0.002	0.001	0.000	0.000	-0.002	-0.002	0.001	0.001
P04	0.000	0.002	0.001	-0.001	-0.002	-0.002	0.001	0.001	-0.002	-0.001	0.002	-0.001	0.000	-0.002	0.002	0.002	-0.001	-0.002	-0.002	0.000
P05	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.002	0.000	-0.001	-0.001	0.001	-0.002	0.000	-0.002	0.001
P06	-0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.002	-0.002	0.001	0.001	0.001	0.001	0.002	0.001	-0.001	0.002	-0.001	0.001
P07	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000	-0.002	-0.001	-0.002	0.000	-0.001	-0.001	-0.001	0.001
P08	0.000	-0.002	-0.001	0.000	0.002	-0.001	0.000	-0.001	0.001	0.001	0.002	0.000	-0.001	0.002	-0.001	0.000	-0.002	-0.001	-0.002	0.002
P09	-0.001	0.000	-0.002	-0.001	0.001	0.000	0.001	-0.002	-0.001	0.001	-0.001	0.001	-0.002	-0.002	-0.002	0.001	0.000	-0.002	-0.001	0.001
P10	0.002	0.000	0.000	0.002	-0.001	0.001	-0.001	0.000	-0.001	-0.001	-0.002	0.002	0.000	0.001	0.001	-0.002	-0.002	0.001	0.001	0.000
P11	0.000	0.001	-0.001	0.000	0.000	0.002	0.002	-0.001	0.000	0.000	0.001	-0.001	0.001	-0.001	-0.002	0.001	-0.001	0.000	0.000	0.000
P12	-0.001	-0.001	0.001	0.000	0.000	0.000	-0.001	0.001	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.000	0.001	-0.002	0.000	0.000
P13	0.000	0.000	0.000	0.000	0.002	-0.001	0.000	0.002	0.001	0.002	0.002	-0.002	0.001	0.000	0.001	0.002	0.000	0.001	-0.002	-0.001
P14	0.001	0.002	0.001	0.001	-0.002	-0.002	-0.002	-0.002	-0.001	0.002	-0.001	0.000	-0.001	-0.002	0.002	0.002	-0.001	0.002	0.002	0.000
P15	-0.001	0.000	0.001	0.001	0.001	0.001	-0.001	-0.001	-0.002	0.001	0.001	-0.001	-0.001	-0.001	0.001	0.001	0.001	0.002	0.000	0.001
P16	0.002	-0.001	0.000	0.000	-0.002	0.000	0.000	-0.001	0.002	0.000	0.002	-0.001	0.001	0.001	0.001	0.001	-0.001	0.000	0.000	0.000
P17	0.002	0.000	-0.002	0.000	-0.002	-0.002	0.000	0.000	0.001	0.000	-0.002	-0.001	0.001	0.002	0.001	-0.002	0.000	-0.001	-0.002	0.000
P18	-0.001	-0.001	0.002	0.000	0.002	0.001	0.001	0.000	0.001	0.002	0.000	0.001	0.001	0.000	0.000	0.002	0.000	-0.002	-0.001	-0.002
P19	0.000	0.002	0.001	0.001	0.000	0.001	0.001	-0.001	0.000	0.000	-0.002	0.000	-0.002	0.002	0.001	0.001	-0.002	-0.002	0.002	0.000
P20	-0.001	0.000	0.001	0.001	0.000	0.000	0.002	0.000	0.000	0.002	0.001	-0.002	0.001	-0.001	-0.001	0.001	0.001	0.000	0.001	0.001

..... and these are the error margins using FC-Edit's Re-calc on the same file:

	N01	N02	N03	N04	N05	N06	N07	N08	N09	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19	N20
P01	0.000	0.002	-0.002	0.001	0.000	-0.001	0.000	-0.001	-0.002	0.000	0.002	0.001	0.002	0.001	0.001	0.002	0.002	0.000	-0.001	0.000
P02	-0.001	-0.002	-0.001	-0.001	0.001	0.000	-0.001	0.001	0.001	-0.002	0.001	-0.002	0.001	0.002	0.002	0.002	-0.002	-0.002	0.002	0.002
P03	-0.001	0.001	0.001	0.001	-0.002	-0.001	0.000	0.001	-0.001	0.000	0.002	-0.002	-0.002	0.001	0.000	0.000	0.002	0.002	0.001	0.001
P04	0.000	0.002	0.001	-0.001	-0.002	-0.002	0.001	0.001	-0.002	-0.001	0.002	-0.001	0.000	-0.002	0.002	0.002	-0.001	0.002	0.002	0.000
P05	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.002	0.000	-0.001	-0.001	0.001	-0.002	0.000	-0.002	0.001
P06	-0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.002	-0.002	0.001	0.001	0.001	0.001	-0.002	0.001	-0.001	0.002	-0.001	0.001
P07	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	-0.003	0.001	0.000	0.002	-0.001	0.002	0.000	0.003	0.003	0.003	0.001
P08	0.000	0.002	0.003	0.004	0.002	0.003	0.004	0.003	-0.003	0.001	-0.002	0.000	0.003	0.002	-0.001	0.000	-0.002	-0.001	-0.002	0.002
P09	-0.001	0.000	-0.002	-0.001	0.001	0.000	0.001	0.003	-0.001	0.001	-0.001	-0.003	-0.002	-0.002	0.002	0.001	0.000	0.002	0.003	0.001
P10	0.002	0.000	0.004	0.002	-0.001	0.001	0.003	0.004	0.003	-0.001	0.002	0.002	0.000	0.001	0.005	-0.002	-0.002	-0.003	0.001	0.000
P11	0.000	0.001	0.003	0.004	0.004	0.002	0.002	0.003	-0.004	0.000	-0.003	-0.001	0.005	0.003	-0.002	-0.003	-0.001	0.000	0.000	0.000
P12	-0.001	0.003	0.001	0.000	-0.004	-0.004	0.003	0.001	-0.004	0.000	0.000	0.001	0.001	0.000	0.001	0.000	0.001	-0.002	0.000	0.000
P13	0.000	0.000	0.004	0.000	-0.002	-0.001	-0.004	-0.003	0.001	-0.003	-0.002	-0.002	0.001	-0.004	0.001	0.002	0.004	0.001	0.002	0.003
P14	0.001	0.002	0.005	0.001	-0.002	-0.002	-0.002	-0.002	-0.005	0.002	-0.005	0.000	0.007	-0.002	-0.002	0.002	-0.005	-0.002	-0.003	-0.004
P15	0.003	0.000	0.005	0.001	-0.003	0.001	0.003	-0.005	0.002	0.001	0.005	-0.001	-0.001	0.004	-0.003	0.005	-0.003	-0.003	-0.004	-0.003
P16	0.002	0.003	0.004	0.004	-0.002	0.000	0.004	0.007	0.002	0.000	0.002	-0.005	-0.003	-0.003	0.005	-0.003	-0.005	-0.004	0.000	0.000
P17	0.002	0.000	0.006	0.004	-0.006	-0.002	0.000	-0.004	-0.003	-0.004	-0.006	-0.001	0.001	-0.006	-0.003	0.002	-0.004	-0.005	-0.002	0.000
P18	0.003	0.003	0.006	0.004	-0.002	-0.003	0.001	0.000	0.005	0.006	-0.004	-0.007	0.001	0.004	0.000	-0.002	0.000	-0.002	-0.001	-0.002
P19	0.004	0.002	0.005	0.005	-0.004	0.001	0.001	-0.001	0.004	0.004	-0.006	-0.008	-0.002	0.006	-0.003	-0.003	-0.002	-0.002	-0.002	0.000
P20	0.003	0.004	0.005	0.005	-0.004	0.000	0.002	0.000	0.004	0.006	-0.007	-0.006	-0.003	0.007	-0.001	-0.003	-0.003	-0.004	-0.003	-0.003

Max error margin for FC-Tweak Re-calc = ±.002
Max error margin for FC-Edit's Re-calc = ±.008

FC-Tweak precise basemap recalc is thus 4 times more accurate than FC-Edit's.

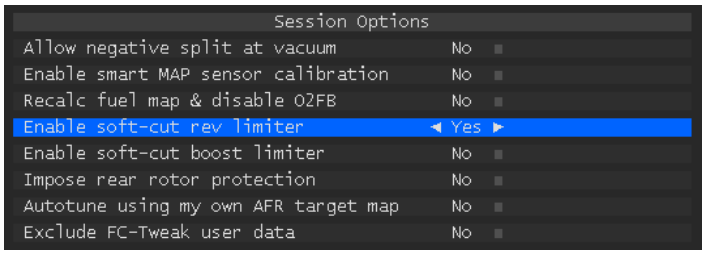
Activating soft-cut rev & boost limiters

FC-Tweak can add a second level of engine protection as it approaches its redline or boost cut limit. As with Mazda's original ECU, the Power FC comes pre-programmed with only two hard-fuel cut protections: one for redline and one for over boost protection. On modern ECUs, hard cuts are generally only set as an emergency RPM or boost cut in case the soft cuts don't have the required effect. FC-Tweak makes the Power FC behave like newer ECUs by adding soft cut limiters through software. So what is the difference between soft and hard cut limiters?

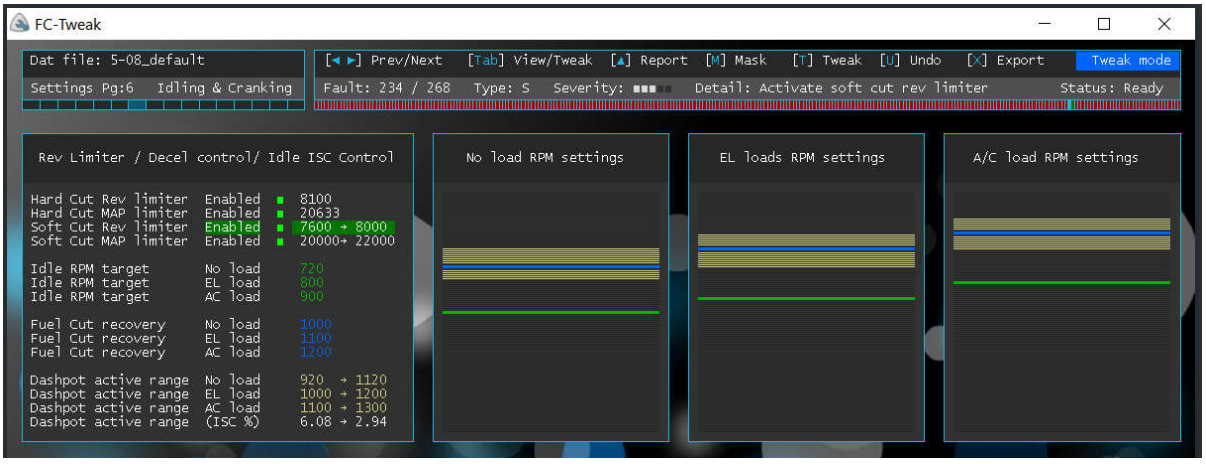
Hard-cut limiters completely cut fuel to the engine. This type of limiter activates abruptly at the set RPM and bounces off of it if throttle is still applied. The bouncing occurs because the limiter will cut off fuel at the set RPM, but will restore full fuel flow as soon as the RPM drops below the set limit. If the driver is still at WOT when the RPM drops, the RPM will then soon raise again to the limit, cycling the engine between the two extreme power conditions, violently jerking the car in the process. Although it offers quite a scary experience, this system works fine as long as the fuel injectors do not leak any fuel when shut off. Leaking injectors or high boost instability during such power cycling can however destroy the engine.

On the other hand, a soft-cut rev limiter is a type of limiter that gradually retards the ignition timing. With a soft-cut rev limiter, the ECU will start to retard ignition timing before the preset hard cut limit, until it slowly reaches a point at which the engine power is not enough to increase the RPM any further and stabilizes there. This totally eliminates the hard limiter power cycling, together with its accompanying violent jerks and risks. Even in the remote case of RPM climbing up further, the hard-cut limit will be reached at a much lower engine power, which minimizes the risk of damage should the injectors not close completely. Same applies to the soft-cut boost limiter.

Once you've tuned your car to the desired target boost settings, you are ready to set the soft-cut limits. In order to activate the soft cut limiters, the Session Option 'Enable soft-cut rev limiter' and/or 'Enable soft-cut boost limiter' must be enabled on settings screen 0.



After scanning your file, apply the soft limiters tweaks on settings page 6, which will enable the soft rev and/or the boost limiter functions to gradually back off ignition timing within the RPM or PIM ranges highlighted in green. Both IGL and IGT ignition timing maps will be modified to achieve these two limiter functions.

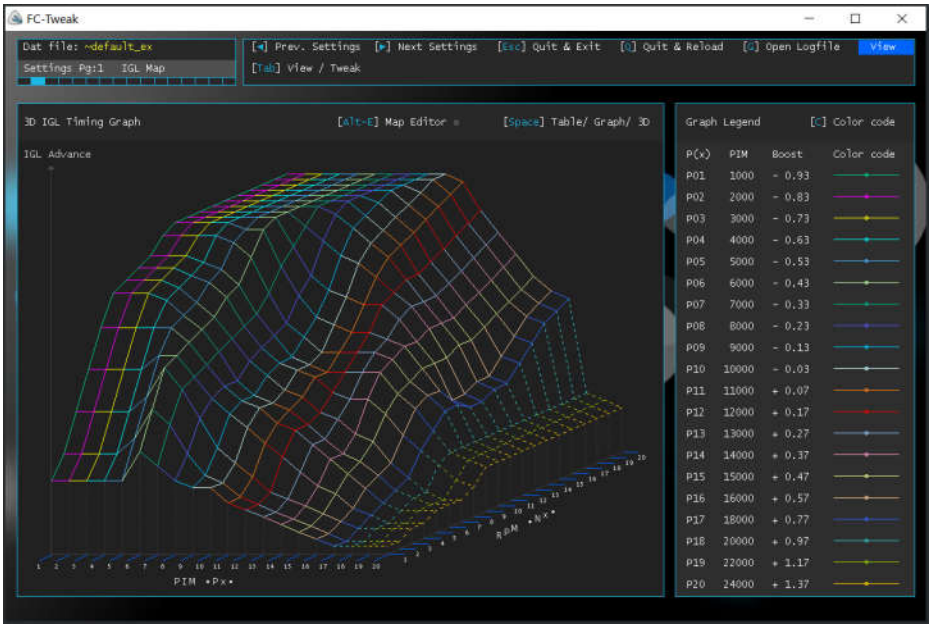


In this example, the soft cut rev limiter will start reducing engine power at 7600RPM until it has applied the maximum ignition retardation at 8000RPM. The maximum retardation will remain in action for any engine speeds above 8000RPM. If for some reason, like a slipping clutch, or free revving, the soft limiter does not slow the engine enough to limit its speed, the hard fuel cut will come into action at 8100RPM. For this reason, it's important you never disable the hard-cut rev limiter.

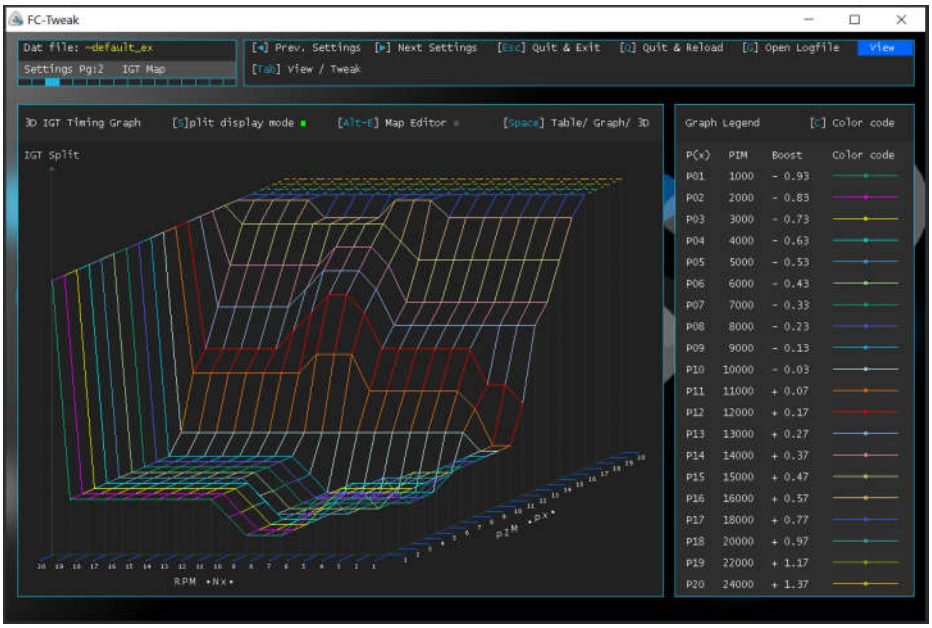
Activating soft-cut boost limiter

Similarly, the soft-cut boost limiter will start to gradually reduce engine power when boost exceeds your target boost level, being 20000Kg/m^2 in the above example, before the hard-cut boost limit is reached at 20633 Kg/m^2. Again, whether or not you opt to enable the soft-cut limiter, never ever run your engine with a disabled hard-cut MAP (boost) limiter. If you choose an external boost controller as your primary boost limiter, the hard-cut limit will display 'External' and its PIM value is set at the extremity of your map limit, so that it still safeguards your ECU from going off the map just in case your boost limiter fails.

The soft limiter functions are implemented by creating a boundary timing protection into your timing maps. Below is a screen shot of the IGL map when the soft-boost limiter is applied to a 5.08 default map, with a boost target of 0.70 kg/cm^2. The soft boost function can be clearly seen by the dashed cyan ramp down of IGL timing between P17 & P18.



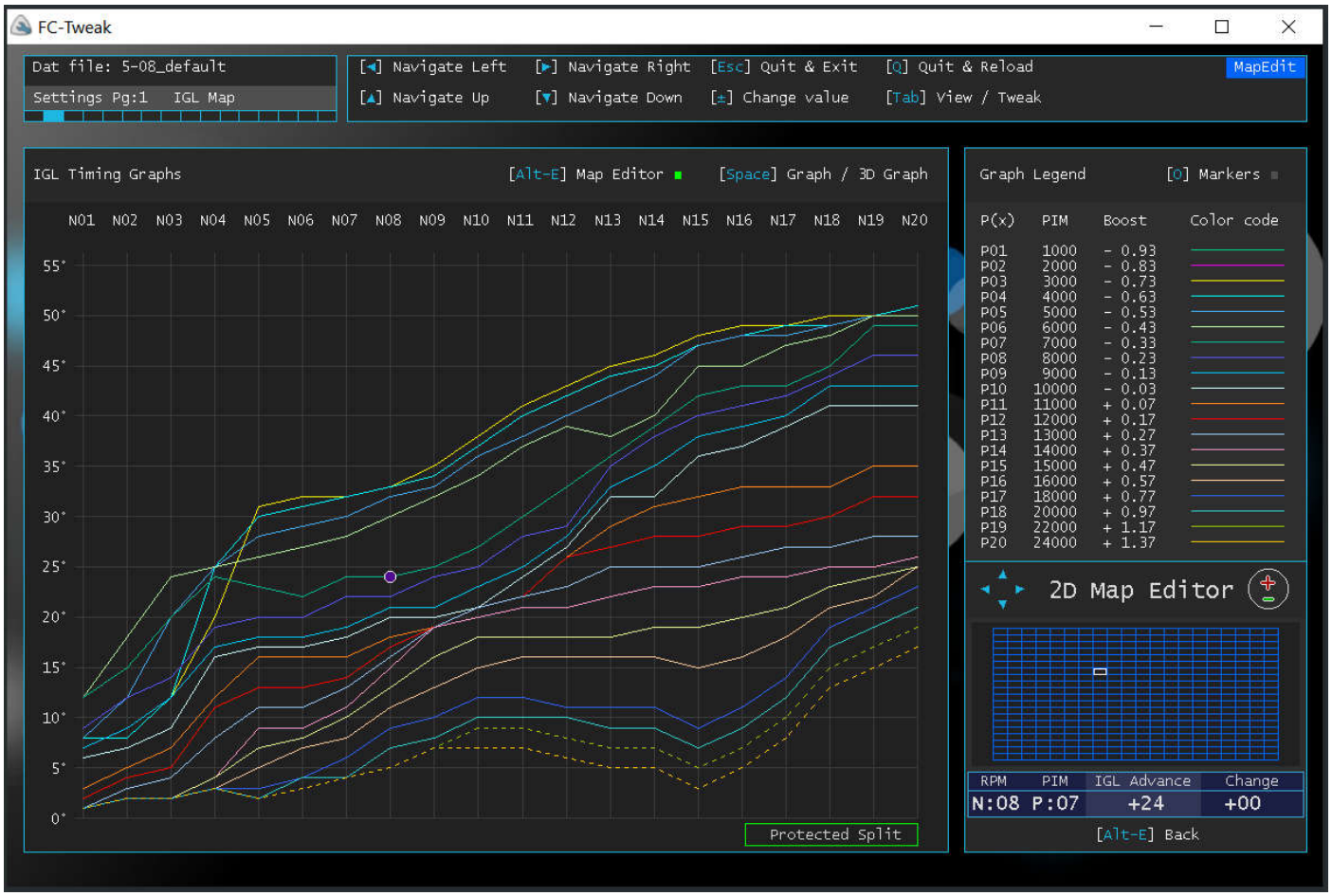
The soft limiters also create a timing protection zone within the IGT split map. Below is a 3D map showing how the split map is modified when both RPM and boost soft limiters are enabled. The soft limiters are immediately made obvious by the presence of the two boundary walls.



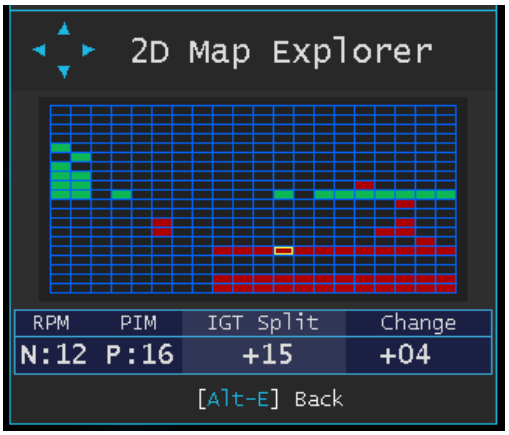
Note: It is highly recommended to enable the soft boost protection tweak only once you decide on your maximum boost level. If you have not yet made up your mind about the final boost target, do NOT enable soft-cut boost limiter before you have finished tuning your car. No harm is done but you won't be able to set a higher boost than your present target value. Also, if you want to be able to increase your target boost some day in the future, keep a copy of your map just before you enable the soft-cut limiters. Later on, you may then enable the soft-cut limiters with higher target setting starting from the saved map.

Explorer Mode

Apart from View and Tweak mode, one can switch to Explorer mode when viewing any of the graphs. Pressing the key combination [Alt-E] will toggle the Explorer mode function.



The Explorer function adds a new window at the bottom right corner of all graph modes. With Map Explorer one can navigate around the 2D map using the cursor keys and read the cell value of that particular cell location. A small grid map helps you visualize the position of the target cell within the map. The table underneath this grid map displays the RPM column and PIM row numbers, value of the map parameter, and any change that occurs during the tweaking process.



Red cells within the small grid map are those which have had their value increased, while green one are those which had their value decreased during tweaking. Map Explorer will display cell values for IGL, IGT, IGT split, BasexInj, and Power, depending on which graph it is activated.

In the above example, we can see that for this particular map, FC-Tweak has increased split for cell N:12 P:16 by 4 from its original value, and has set it at 15 degrees.

Pressing [Alt-E] turns off Explorer mode, and returns back to View mode.
Note: Explorer mode turns into a full manual Map Editor when upgrading to a Pro license. See page 54.

FAQ – Frequently asked questions

Q: FC-Tweak recommends over 300 changes to my file. Should I be alarmed, scrap my tune and start over with another map?

A: It's not unusual for the first diagnostic run to recommend so many changes, and you shouldn't be alarmed. A file with just 5 errors may be more damaging than one having 200, it all depends on the particular errors found. For this reason, the Tweak mode status bar incorporates a 5-bar severity meter for each error found, and states whether the tweak improves engine safety or performance. Two bar meters also show the overall safety & performance levels, as you go along with the tweaking process. You can call for an additional technical help pop-up by pressing [H]. The summary report, called at any time by pressing the up arrow key, also gives an overall rating of your file for engine safety and performance.

Q: I just got the car from my tuner, it works fine and has no particular problems. Why should I even bother with FC-Tweak?

A: FC-Tweak can make many changes which will result in better driveability, better acceleration, safer running, improved turbo behaviour, and other things which are not usually tackled during a tuning session. Also, there are various parameters whose detrimental side effects become obvious only after a couple of thousands of kilometres of driving, or only upon particular conditions. As long as your tuner is not himself using FC-Tweak, or has not used a map which he's been optimising for a long time, it is highly improbable that he had the time or patience to go through all your settings, since this process would be too time consuming. Damage to apex seals does not always happen by a single high knock event, but most often is the cumulative result of frequent small knocks or excessive heat. Lack of proper oil injection, wrong fan-trigger temperatures, bad injector staging settings, uncalibrated sensors, incorrect heat soak timing compensations, insufficient acceleration enrichment.... all these settings can slowly but surely take their toll on your engine longevity. From my own experience, a well tuned stock rotary engine managed by APEXI's PFC, running consistently at about 350WHP, should be able to clock well over 100,000km before needing its first rebuild. For the cost of an AST, FC-Tweak is surely an affordable insurance.

Q: Will FC-Tweak modify my tuned maps?

A: We all know how time consuming or expensive is to achieve a proper tune, and so, FC-Tweak gives priority to preserve your tune. It avoids at all costs leaning out a fuel cell or advancing timing. Modifications to your fuel and timing maps are performed with engine safety as priority, and are limited to richening up obvious lean cells, increasing split if found dangerously low, and backing off timing at the map extremes for soft limiters if the option to do so is enabled. Most of the performance benefits you get with tweaking your file come from tweaks made to other table settings and not from fuel & timing changes. On the other hand, if you own a Pro license, you'll be able to directly edit your maps and also have FC-Tweak auto-tune your fuel map against logged data.

Q: Will FC-Tweak increase power?

A: FC-Tweak does clean up obvious fuel (power) dips, but will not try to modify your maps to obtain more power. However, tweaking electronic ignition dwell parameters usually results in total elimination of ignition breakup, thus resulting in higher torque and power at high engine speeds. The default APEXI dwell settings are known to intentionally cripple the engine when used with Mazda's factory coils. The default values are so much off, that some FDs have problems exceeding 6000RPM under load! Results will be clearly seen upon Dyno testing. Other tweaks to turbo settings, especially to the stock sequential system will effectively make your car reach its top speed earlier, and more fun to drive. If you need to optimize power by tuning the fuel basemap AFRs using real logged data, then you'll need the Pro version.

Q: Shall I use FC-Tweak before or after tuning my car?

A: FC-Tweak can be used both before and after tuning your car, however using it before tuning gives more benefits. For the best results, you should start by configuring FC-Tweak to your car setup and perform the tweaking process on a donor map of your choice (Apexi's basemaps v5.08 or v7.07 are fine to start with). Try to avoid getting donor maps from other cars since most users do not even calibrate their boost sensors, and a mismatch with your sensor calibration will result in totally offset maps, making them useless and dangerous.
Once you load the tweaked map to your PFC, the next very important step is to perform the Boost sensor offset calibration (see pg39), and then you may proceed to fuel map tuning. Street tuning is now a completely automated process using the Pro version auto-tune function.

On the other hand, if tuning has already been done, you can simply execute FC-Tweak and run through the tweaking process until no further tweaks are recommended. If you've already finished tuning with the wrong boost offset, FC-Tweak is also able to zero out any boost offset error while recalibrating all maps to preserve your tune.

Q: I would like to have FC-Tweak operational on more than one computer/ or my PID changed due to hardware changes on my pc. Do I have to pay for each copy?

A: No, there's no need. In such cases, we can offer a hardware dongle license key. See page 84.

Q: Is it safe to confirm all recommended tweaks?

A: Usually it is, but you should do this responsibly, not just pressing [T] like crazy until you're done with the whole lot. Unless you enter the wrong car configuration settings, FC-Tweak's recommendations are very safe to apply. However you are given full control to apply, reject or leave to a later stage, any recommended tweak. Your car may have mods which only you know about, for which you might decide against particular tweaks. If you have any doubts regarding any particular settings, you can either press [H] for further tweak information, e-mail us for help, or simply leave your current setting.

Q: FC-Tweak highlighted some of my fuel map cells as 'Unstable cell', what does that mean?

A: An unstable cell is one which will drive either your primary or secondary or both injectors below their linear operating range, nominally about 1.2ms. When this happens, the real amount of fuel sprayed by the injector is no longer directly proportional to the pulse width signal, and the injector may not be spraying any fuel at all. Unstable cells are most commonly found in two distinct areas of the fuel map: (a) at very low vacuum in the engine brake region and (b) within the injector transition region. More detail on page 20 of this manual.

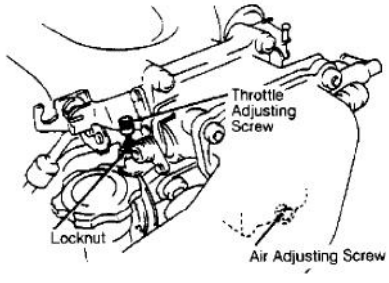
Q: Following tweaking of my file, my acceleration is much better, but I can still log very short lean events in some areas of my map when under acceleration. Why didn't FC-Tweak correct this issue?

A: FC-Tweak optimizes its acceleration enrichment settings according to your air flow setup making an approximate prediction of your engine's volumetric efficiency. You can boost your acceleration enrichment settings by selecting the next available air flow mod from the car setup screen, but do not go any further than one stage up. If this does not help, then the chances are that the fault is within the basemap tune. Use the full screen basemap graph to see if there is any correlation between the lean accelerating area and the shape of your graph. FC-Tweak will also enable the predictive power enrichment table which further improves acceleration response under load. With the Pro version you can also perform auto-tune to eliminate overly rich or lean areas.

Q: FC-Tweak has increased my fan trigger temperatures. I thought lower settings will keep my engine cooler, so why have they been increased?

A: When your trigger temperature settings are set so low that your fans turn on before your thermostat has fully opened, your fans will be wasting a lot of energy to do nothing, since little or no coolant will be flowing through the radiator. This will result in higher engine and alternator temperatures, and higher fuel consumption. It can also lead to continuous cycling of your thermostat, thus reducing its lifetime. FC-Tweak will increase these fan settings to make sure that coolant is flowing through the radiator before the fans are turned on. If you want the Power FC to turn the fans on at a lower temperature in an efficient way, you must first replace your thermostat with a lower opening temperature type.

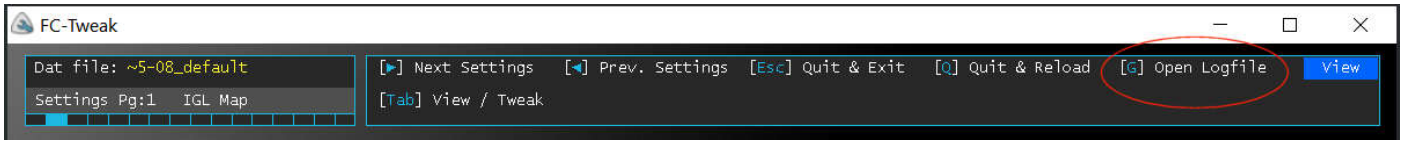
Q: My car idles poorly and/or hunts idle but FC-Tweak did not help. What could be wrong?



A: In most cases, FC-Tweak will successfully correct idling problems. In remote cases however, some hardware settings need to be performed if software tweaking is not enough. The PFC controls idle by introducing extra air through the ISCV. In addition to this, there is a throttle adjusting screw (TAS) and an air adjusting setting (AAS) screw just underneath the throttle elbow which sets the base air amount. Wrong setting of these screws can result in the ISC operating beyond its normal operating window, in which case the PFC will no longer be in control of the idle mixture. Setting the AAS at one turn from fully closed, and the TAS at ¼ turn from just touching, usually brings back the PFC in control. In most cases setting the AAS solves most PFC idling problems. Ideally you should use PFC-Connect's Real time monitor function and turn the AAS so that parameter ISCV which is your ISC actuator position, reads between 15% and 35% at idle. Also, check that your TPS1 voltage reads 0.4v±0.1v, and TPS2 is about 1.0v with throttle in fully closed position and the engine warmed up at operating temperature. If adjusting the AAS does not work, you'll need to perform an ISC recalibration. See appendix pg86.

Session Log file FC-Tweak PRO

This feature is only available on the Pro version aimed mainly for professional and dyno tuners. All tweaks enabled during a session are logged into a text file Logfile.txt stored into your FC-Tweak folder.



A tweaking session starts at the moment you load a data file, and ends when you either quit or reload another client's file. Consecutive analysis on the same data file will be appended to the same log file, so the log file will contain all tweaks which have been applied from start to finish of the tuning process. It is updated at the time you export your tweaked data file.

Once you export a tweaked file, the '[G] Open Logfile' option will appear on the top right corner of the View mode window. Pressing [G] will open the logfile in Windows Notepad from which it may be renamed or printed out for your (or your customer's) records.

Note that FC-Tweak will always use the filename Logfile.txt, as to avoid cluttering your hard disk with unnecessary log files. So if you do not rename it or print it, the file will be overwritten on the next tweaking session.

Logfile.txt - Notepad

File Edit Format View Help

```
============================================================
FC-Tweak Automated logfile for data file: 5-08_default.dat

Tweaked on: 10-28-2019  19:00:31
============================================================

Car configuration details


Flow mods & porting:     Intake,DP,RC,CB
Primary Injectors type:  550 cc/min
Secondary Injectors:     850 cc/min
Boost sensor type:       Stock unit
Thermostat opening temp: 75øC
ISC (IAC) valve status:  Enabled
Ignition type:           Stock ignition coils
Fuel Octane Rating:      95 RON / 91 AKI
Turbo setup:             Stock Sequential Twin
IAT sensor location:     Stock location
Fuel Rail Temp sensor:   Enabled
Water Injection System:  No
Oil metering method:     Stock OMP
Boost Limiter:           Power FC


================================
Tweaks applied on scan number: 1
================================

=======
IGT Map
=======

(1) Increased split at P: 16 N: 9 for better engine safety
(2) Increased split at P: 16 N: 10 for better engine safety
(3) Increased split at P: 16 N: 11 for better engine safety
(4) Increased split at P: 16 N: 12 for better engine safety
(5) Increased split at P: 16 N: 13 for better engine safety


============
Fuel Basemap
============

(1) Corrected Unstable injection at P: 1 N: 1
(2) Corrected Unstable injection at P: 1 N: 2
(3) Corrected Unstable injection at P: 1 N: 3


==============================
Special functions & boost setup
==============================

(1) Corrected Twin mode disangaging RPM too low
(2) Corrected Twin mode disangaging RPM too low
(3) Corrected Twin mode disangaging RPM too low


================================================
Total number of applied tweaks on this scan: 11
================================================
```

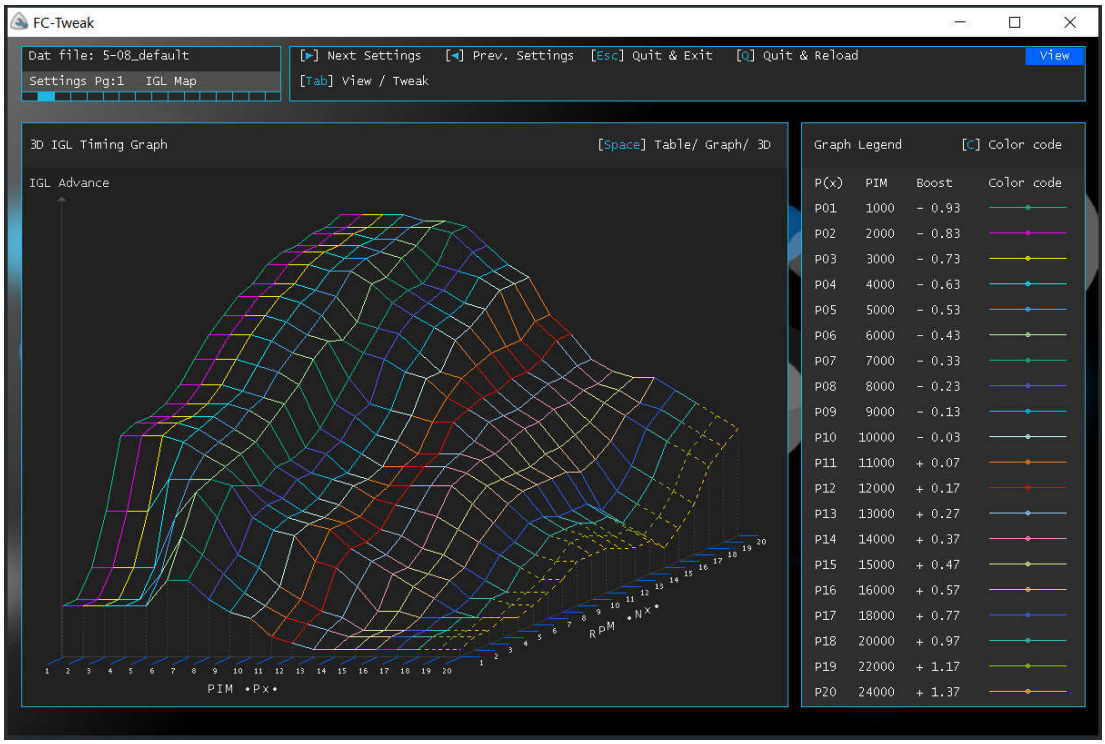
As shown in this log file sample, the file contains:

- The original data file name
- Date and time of tweaking session
- Car configuration setup details
- Fuel injectors information
- Boost sensor type
- The scan number
- Settings page heading of tweaks location
- Description of corrected fault
- Number of corrections per settings page
- Total number of applied tweaks for each scan

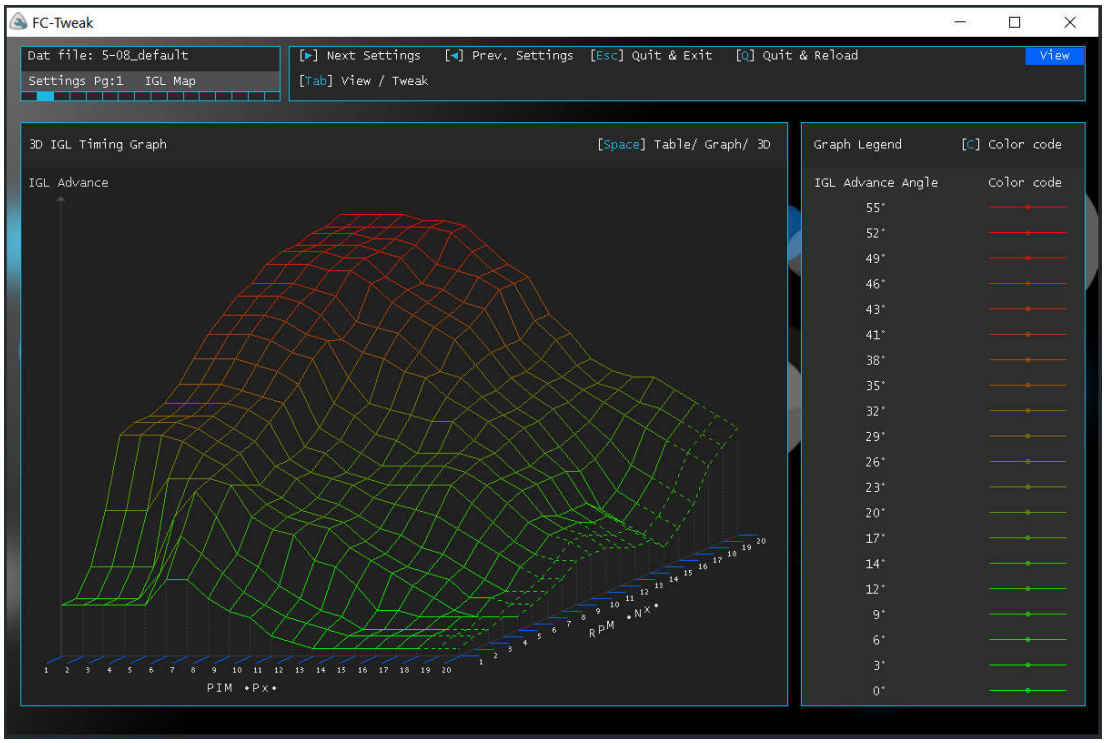
Also, any automated macro tweaks (refer to manual pg38) which may have taken place during file export, are shown preceded with a double asterisk **.

3D Graphs: IGL FC-Tweak PRO

While FC-Tweak's 2D graphs already give RX7 users a great advantage over the standard numeric table format, the new interactive 3D graphs take the visualization of the actual ECU data to a whole new level.



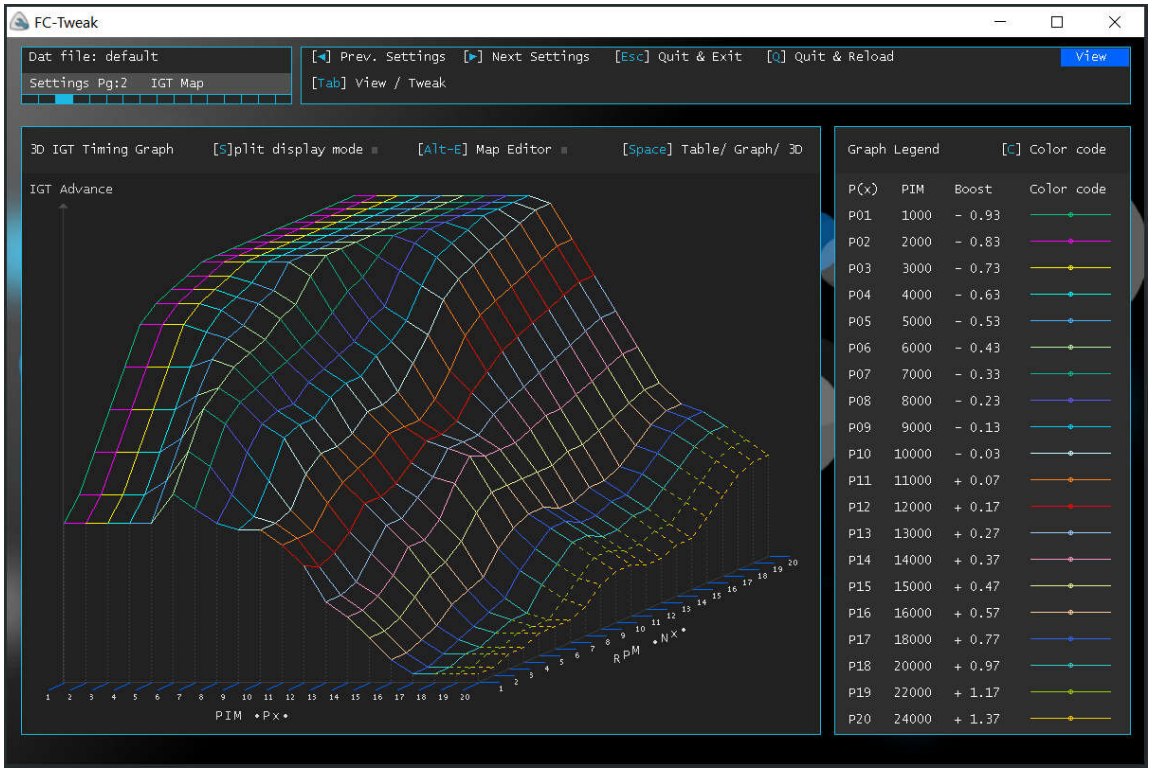
This graph renders the IGL timing map in 3D. This rendering makes the interpolation paths followed by the ECU immediately clear. The Power FC does not only interpolate map data along individual PIM curves, but also across them, and 3D plotting is the only way to visualize these PIM-to-PIM curve interpolations. Unlike 2D charts, this enables you to spot sharp drops which may be present at a link between two PIM curves. 3D graphs can be color coded in two modes: (a) PIM (same as 2D charts) and (b) Contour Z value. Pressing [C] switches between the two modes.



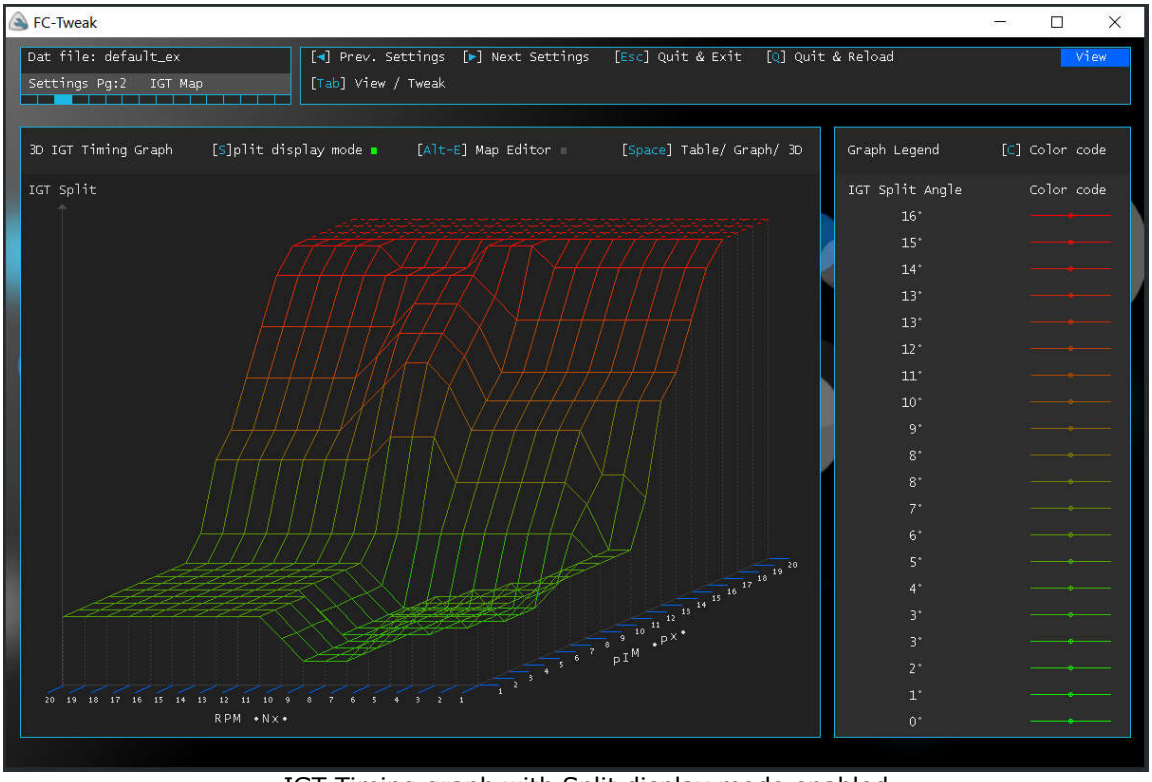
IGL graph in timing contour color coding

3D Graphs: IGT FC-Tweak PRO

This graph renders the IGT timing map in 3D. Some RX7 tuners do not give as much importance to the trailing map, and simply set the split levels with no regards to the resulting smoothness of the resulting trailing map values. 3D rendering makes any resulting sharp changes in IGT immediately clear. Unlike 2D charts, this enables you to spot sharp drops which may be present at a link between two PIM curves, due to a drastic step change in split levels. As with IGL, the PIM curve color coding can be switched between PIM coded, and timing contour coded.



All 3D curves are interactive, meaning that they are updated in real time during the tweaking process. As in 2D graphs, the target cell being tweaked is shown by a red circle. They are also auto-scaling so that they always take up the full graphic screen for best resolution.

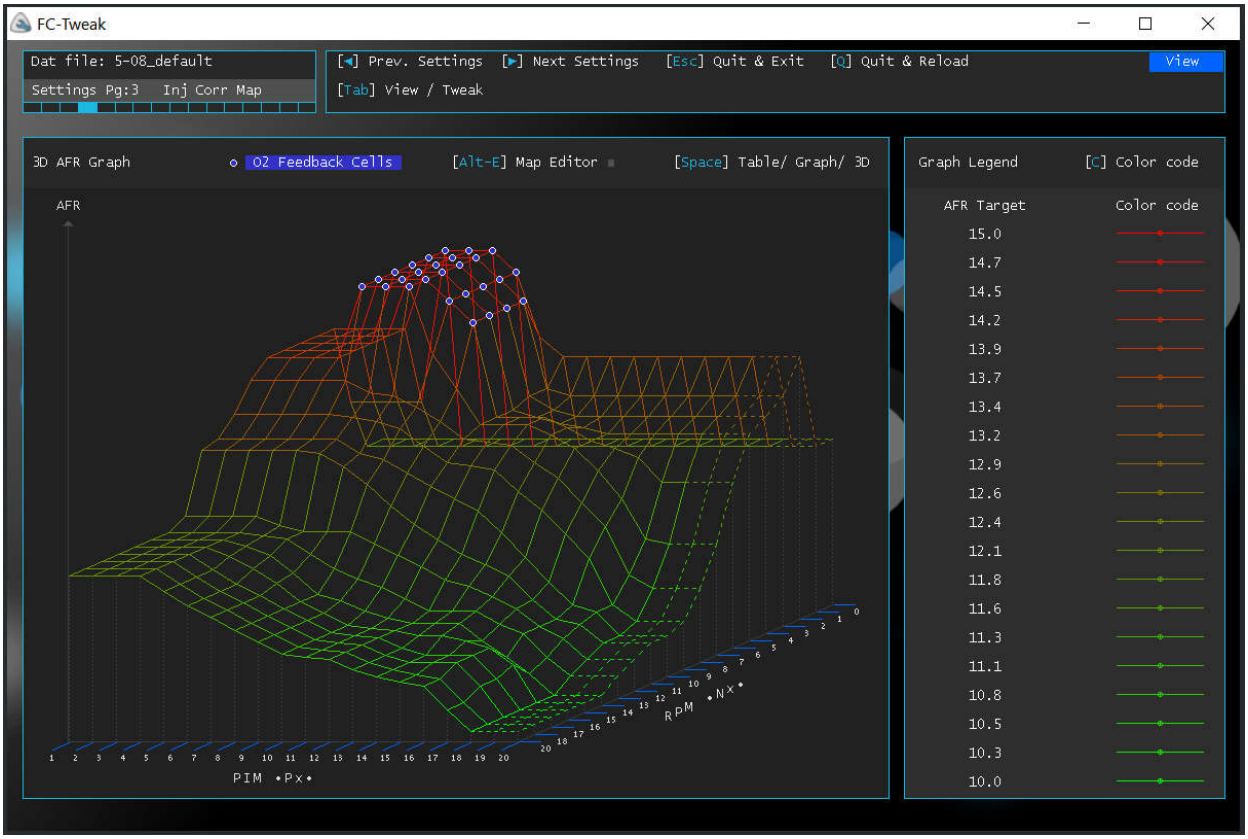


IGT Timing graph with Split display mode enabled

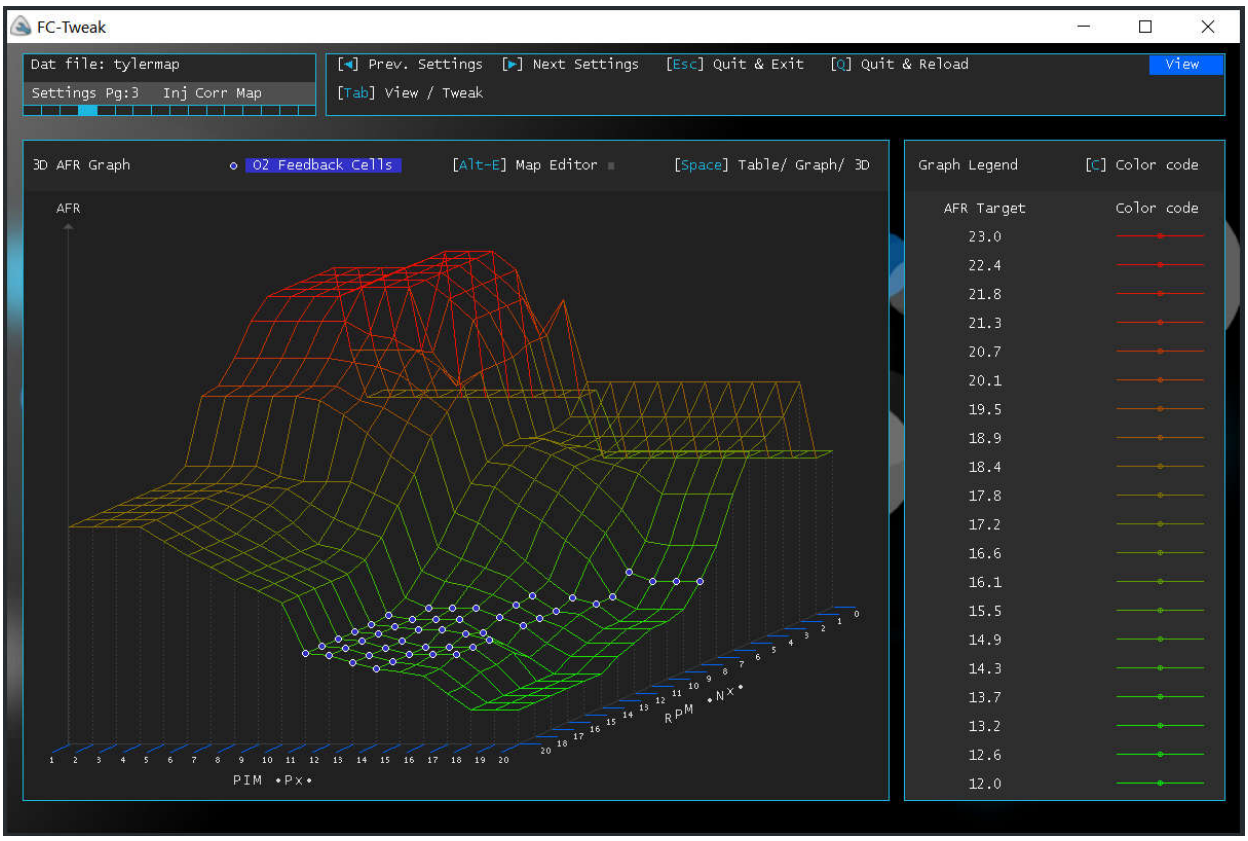
As with the 2D graphs, a dashed mesh indicates map regions beyond the over boost fuel cut, which depends on the boost settings in the particular data file.

3D Graphs: AFR FC-Tweak PRO

This graph renders the AFR map in 3D. It also highlights in blue circles the active O2 feedback control cells within the map. Any O2 feedback cell located within the boost area will be immediately visible.



The below map comes straight from a tuner shop who forgot to turn off the O2 feedback control, after manually leaning some boost cells. 3D viewing of the AFR target map makes the fault immediately visible.

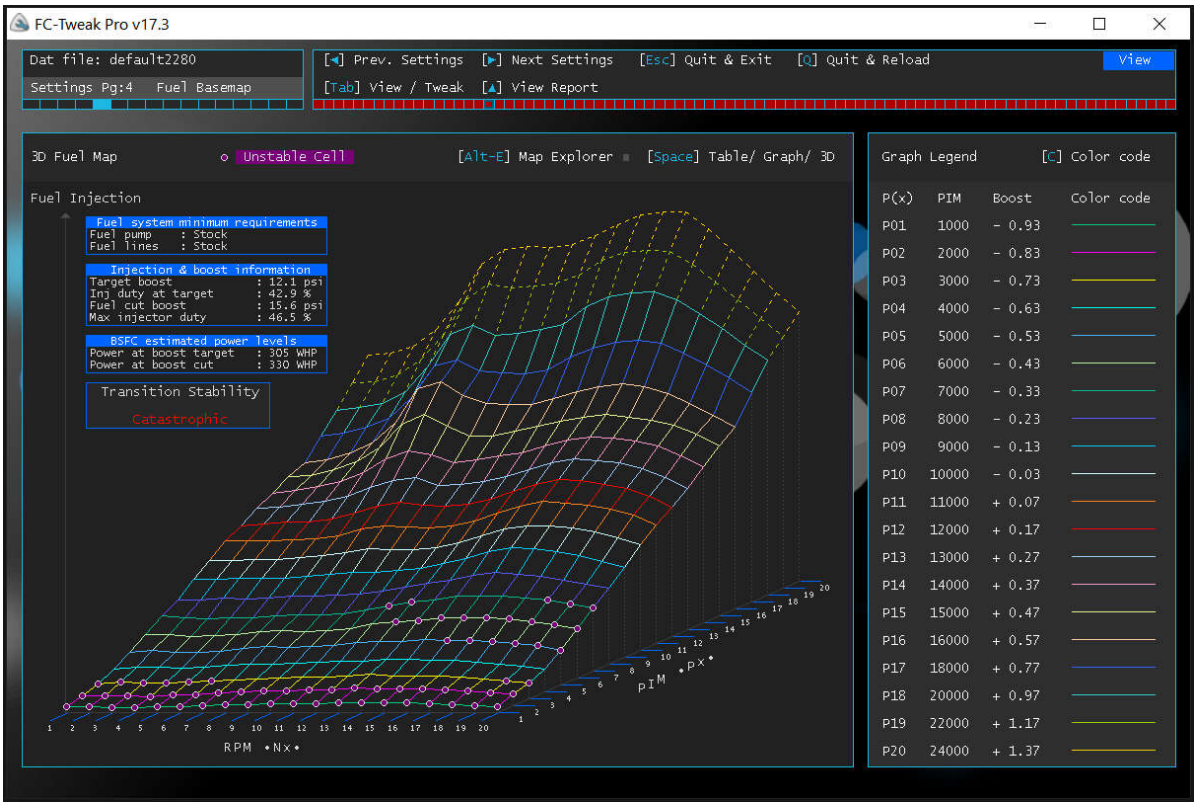


FC-Tweak always rotates the 3D graphs for best visibility, so always refer to the axis values.

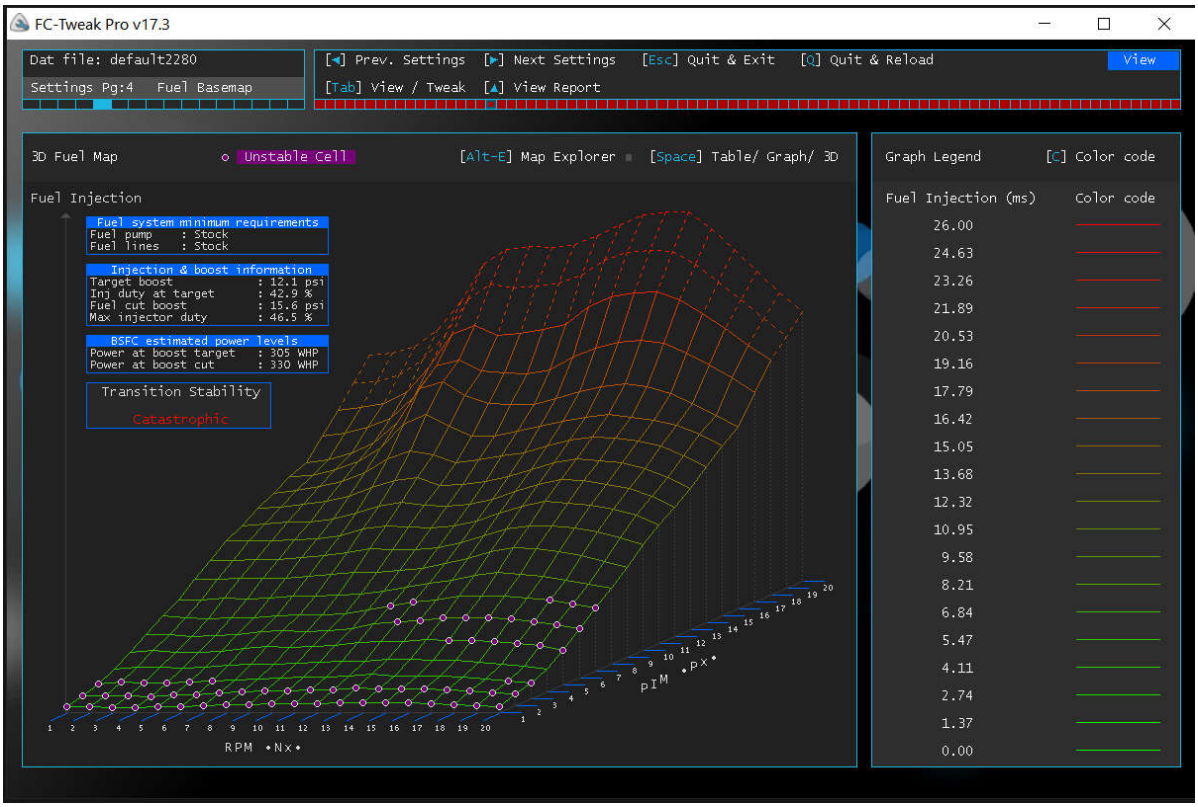
3D Fuel graph & fuel system requirements FC-Tweak PRO

This map shows the Base x Inj basemap in 3D. In general, the smoother the resulting map, the smoother will be the engine power across both load range, and RPM range. Dashed curves are above the hard fuel cut threshold.

If the Power FC is configured as the default boost limiter, then all relevant fuel system requirements, boost and injector duty limits at the target boost and boost cut limits are displayed. When the stock fuel components are not adequate, the exact fuel pump minimum specs and required fuel lines diameter will be displayed.

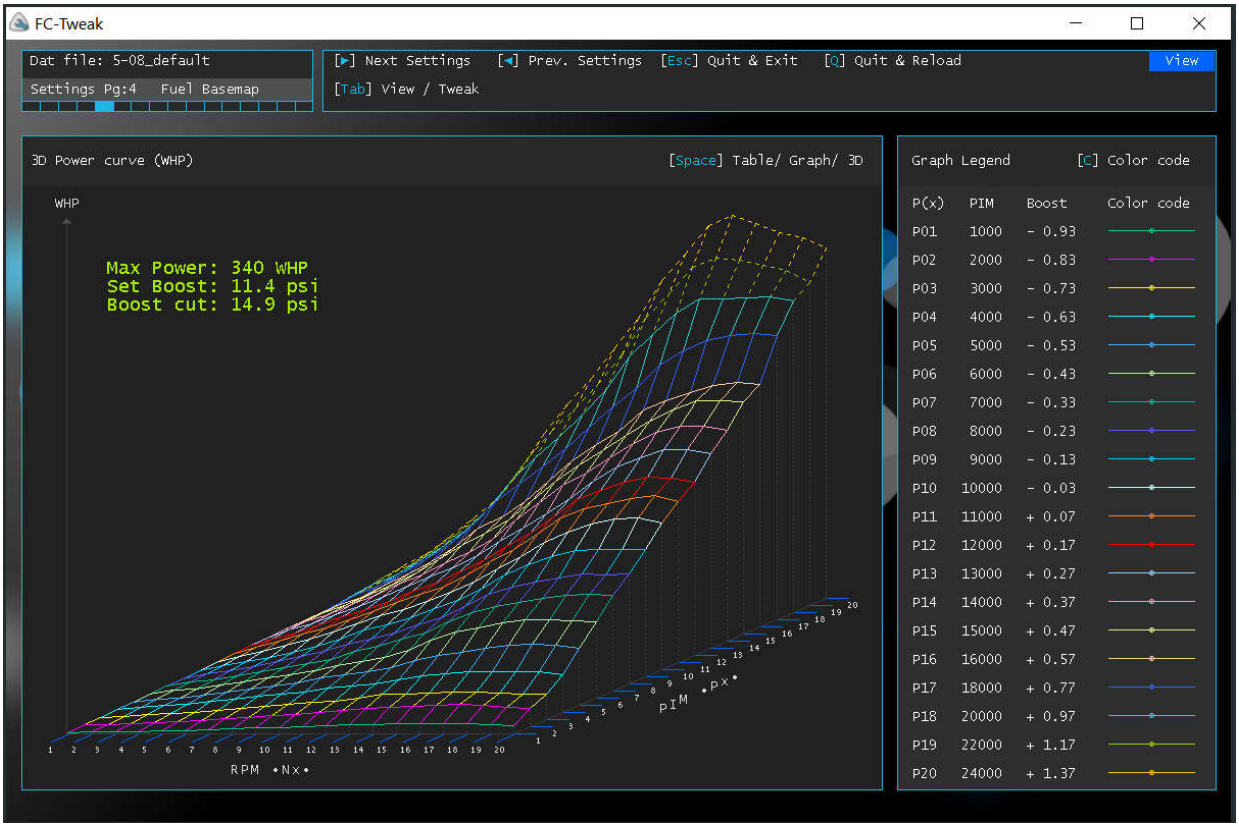


Below is the fuel contour color coded map. The transition stability rating and any unstable cells are also shown.

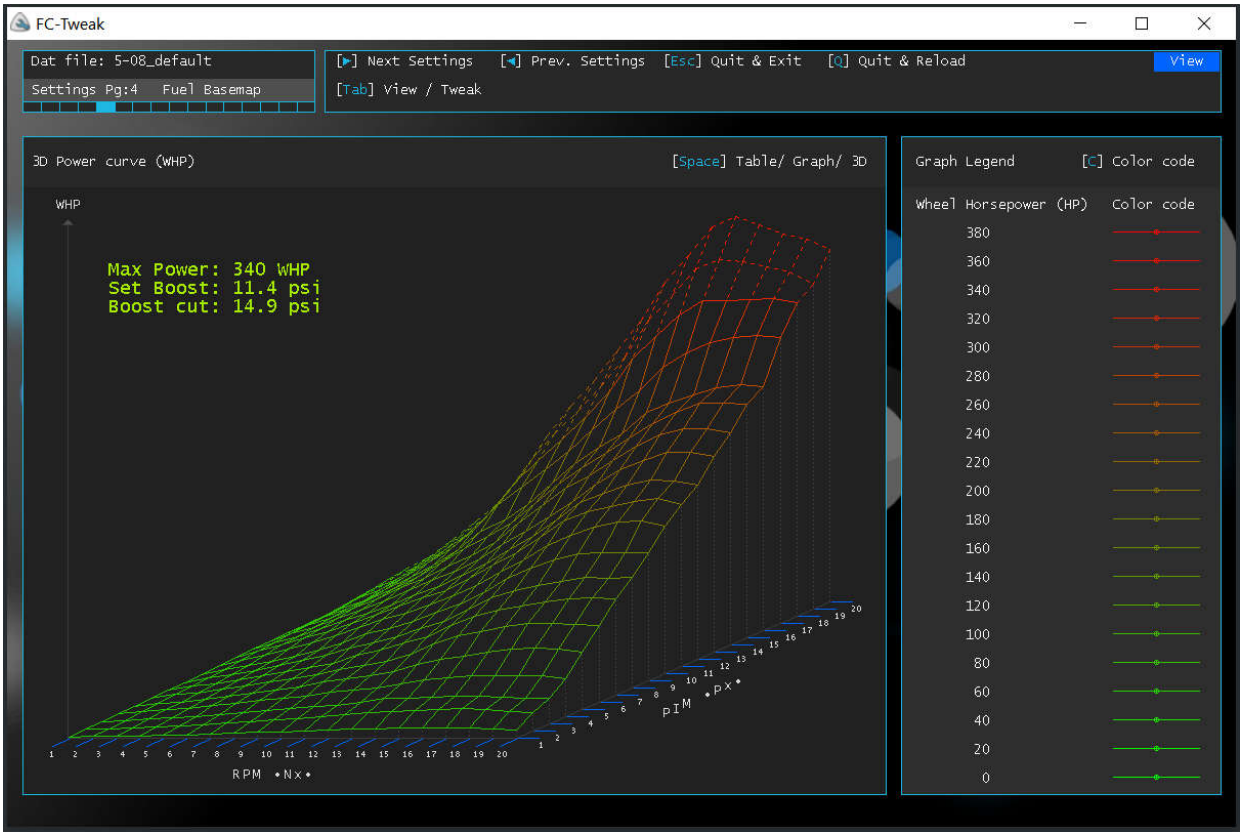


3D Power graph FC-Tweak PRO

FC-Tweak computes the maximum wheel horse power attainable from each map cell, taking into account the RX7 transmission losses. This curve will immediately make obvious any power dips or other instabilities resulting from your fuel map. If the Power FC is configured as sequential boost controller & limiter, then the maximum predicted wheel HP before boost cut, set PFC target boost and hard boost cut limit are displayed.



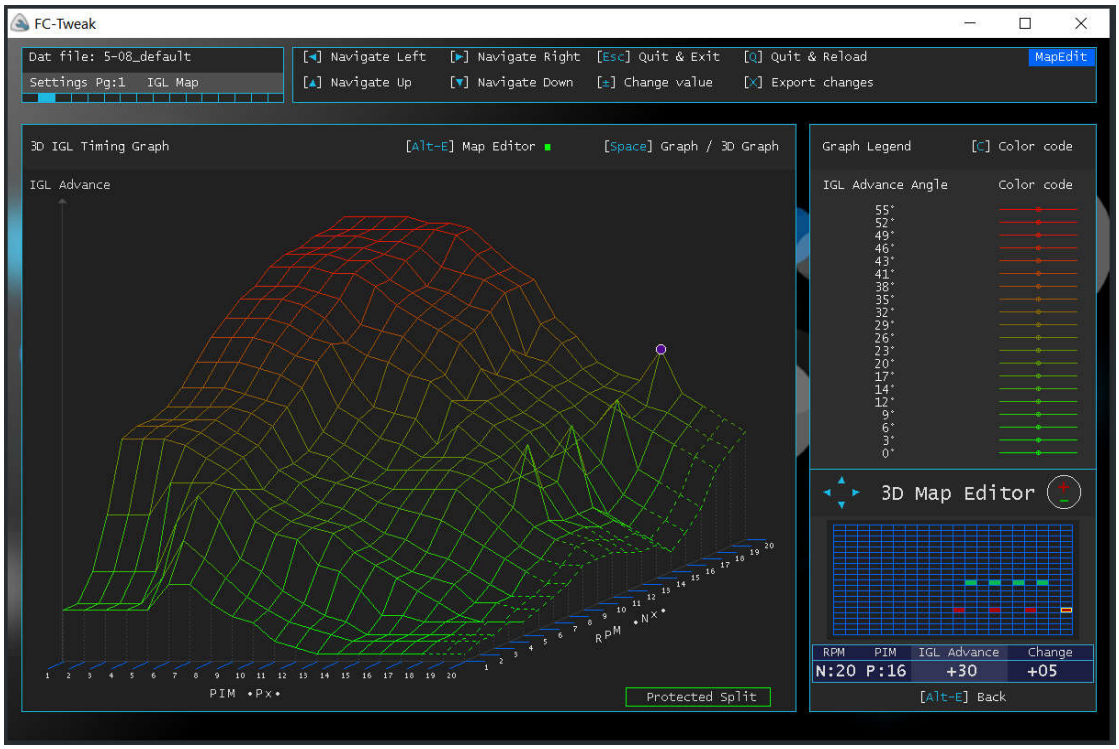
Below is the same graph color coded for wheel horse power. Dashed curves go beyond the Power FC hard boost cut limit.



Map Editor FC-Tweak PRO

With Map Editor, FC-Tweak becomes the only software you'll ever need for both tuning and tweaking your maps. This manual map editor is the first professional direct-to-file 2D/3D map editor made available for RX7 Apexi PFCs, and will eliminate the need for Excel to be used in order to graphically modify maps. Unlike Excel (which no longer offers this function on its latest versions), the frustrating task of picking up a cell on a graph and dragging it to a new value is now much easier, more accurate and faster to perform, especially when it comes to overlapping sections of the graphs. It also protects your split values from changing when editing IGL. During map editing, you may switch between 2D and 3D map views as required by pressing spacebar.

The Map Editor function gives those owners willing to tune their own maps, full control over the timing and fuel map values. Map Editor will protect the user from inadvertently changing values on maps other than the ones working on. The map mode being protected is printed on the lower right corner of the main graph, for example, in the example shown below, Split values are being protected while editing IGL timing graphs.



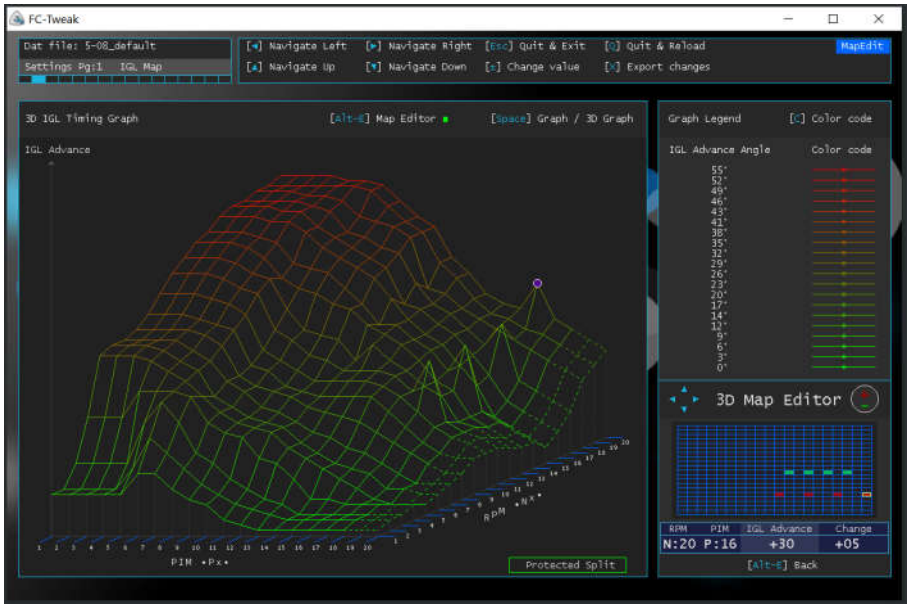
Using Map Editor FC-Tweak PRO

The Map Editor on FC-Tweak Pro is accessed by pressing the key combination [Alt-E] from any graph, and then one simply uses the cursor keys to navigate around. The Map Editor window comes up at the lower right corner. The ± sign indicates you can now increase or decrease any cell value at will by simply pressing either [+] or [-]. The target cell will be highlighted on both the full screen 2D/ 3D chart and on the smaller explorer grid map simultaneously, as shown in the examples below. On the explorer grid map, cells manually increased in value turn red, while those decreased in value turn green. Use Map Editor responsibly.

Editing IGL Map

IGL Map cell values can be altered in steps of one degree advance or retard. Retard those cells which give high knock despite having the correct AFRs.

If you just use Excel or FC-Edit to make changes to IGL, then you will end up messing up the split timing. FC-Tweak will preserve the split timing when making changes to IGL. The table value 'Change' displays the difference between the modified and original map value in degrees for the targeted cell. Pressing [Space] will toggle between 2D and 3D map editing modes.



Editing IGT/ IGT Split Map

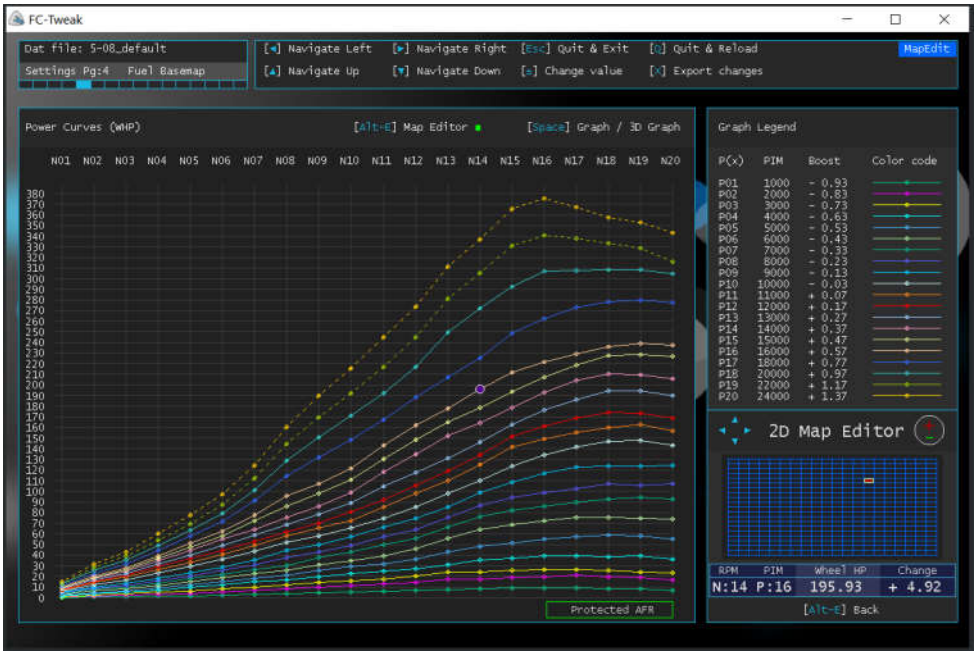
IGT map can be edited while viewing either IGT or IGT Split curves. The chosen mode depends on whether Split display mode is enabled or not. You can switch between the two modes during editing by pressing [S]. In both modes, the value shown is for split angle, which is what matters most.

Editing AFR Map (aka Inj correction map)

Editing AFR gets handy when you want to move cells into or out of the O2 feedback control region. If you try to do this with any other utility or with the Commander, you end up changing the amount of fuel (Base x Inj) that the ECU injects. FC-Tweak will let you edit the AFR (Inj correction) table, while preserving your fuel (Base x Inj) map. 'Change' is displayed as AFR difference between the new and original value.

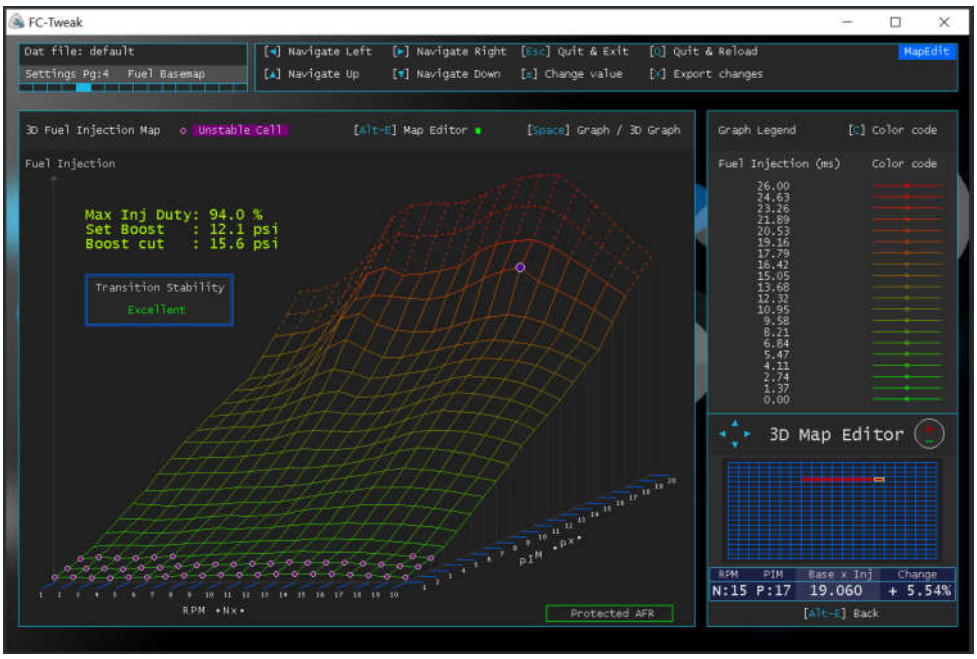
Editing Wheel HP map

Editing Wheel HP which indirectly edits the fuel map, enables you to alter cells which show a dip on the power curve. Do not overdo it. Changing a cell by +10whp does not necessarily mean that you will gain 10whp. It's important to understand that FC-Tweak calculates power with the assumption that each cell is operating at optimal AFR. Injecting further fuel will usually result in an overly rich fuel mixture, and have the opposite effect on power. However, used carefully to modify cells which are visually dipped (or even sharply bumped up) on the power curve, will usually result in a measurable increase in power. 'Change' is in wheel HP.

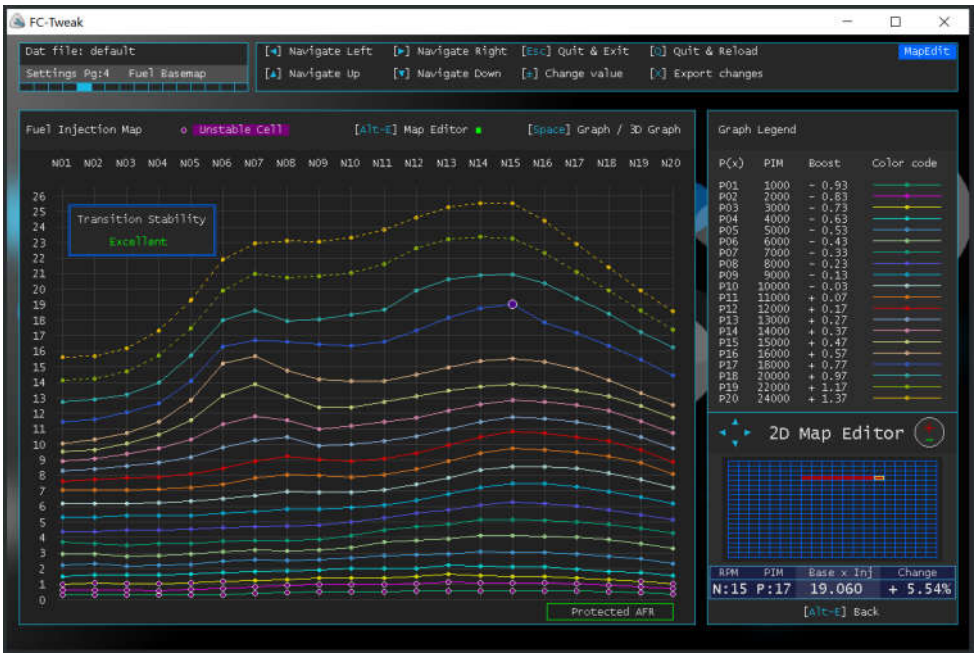


Editing Base x Inj

Editing Base x Inj, will let you tune the fuel map directly, without altering the Inj correction table. This is the map you need to modify based on your logged values to approach the desired AFR targets. Manual editing is always required to approximate the fuel amount for those cells for which there is not enough data logged. 'Change' is shown as a percentage increase in fuel over the original cell value.



Pressing [Space] toggles between 2D and 3D editing modes.



Tips & Tricks for Map Editor

Hidden key functions: [Alt +] and [Alt -]: Change cell value in large steps. Then use ± to make the fine changes.

[Delete]: Restore original value

[Alt-arrow left] and [Alt-arrow right]: Scroll between IGL/ IGT/ AFR/ Fuel maps within Explorer, without having to go back to view mode.

If you need to switch over between Map Editor and File Scan modes, you first have to either discard [Q] or save [X] your changes.

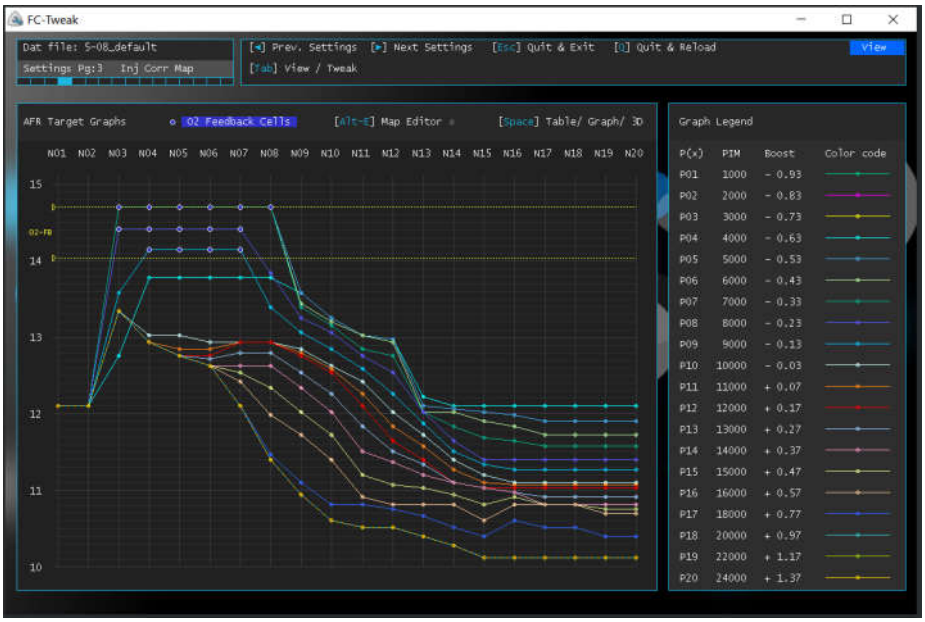
Once ready from manual editing, press [X] to export the modified file ready to be uploaded to the PFC.
You may also run a scan on the exported file so that FC-Tweak smoothes out your manual changes.

Example using Map Editor FC-Tweak PRO

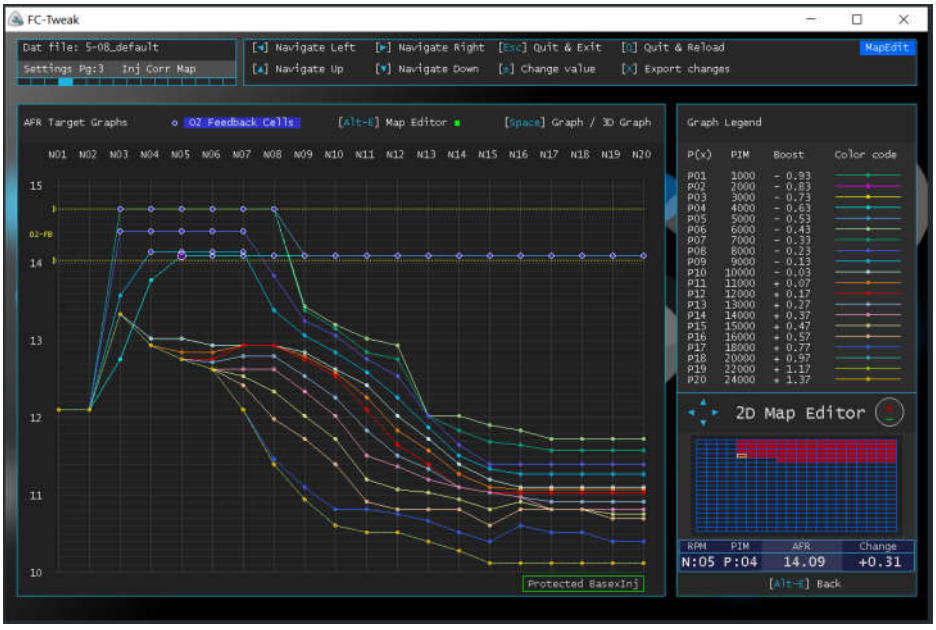
In this example we shall modify a map file so that its cruising cells operate under O2 feedback control, thus optimizing emissions and fuel economy. In this situation we need to alter the AFR (inj correction) table *without* leaning out the tuned fuel map.

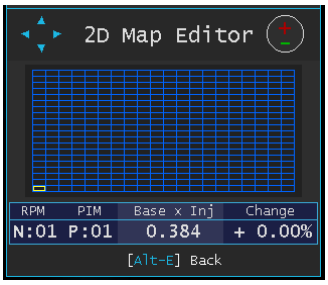
Using Map Edit function, all we need is to select the AFR map, and drag the cruising cells until they are located within the O2-Feedback region, enclosed by the two yellow markers, and finally export the file. FC-Tweak will automatically protect the base x inj values during the whole process, so that the fuel map remains untouched.

This is the map before editing.



And this is after just about a minute of manual editing.... all cruising cells are now within the O2 feedback control zone.



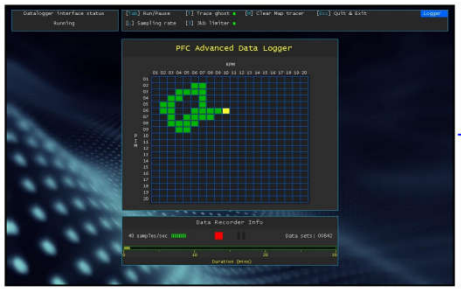


Verifying on the Base x Inj map editor window for any changes, we see that FC-Tweak has successfully preserved all fuel cells during the whole process.

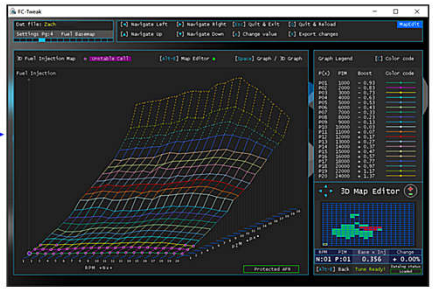
Pressing [X] exports the file ready to send to the PFC.

FC-Tweak Pro has the ability to tune and certify your fuel and timing maps based upon logged data captured by PFC-Connect, the logging software which is distributed with the DL-340XB interface. From now on, tuning your Power FC maps will be as easy as going for a drive. All you need is to log a 30 minute drive. The more cells you populate, and the greater the number of samples per cell, the faster you'll be able to finish the job. However auto tune is not only about speed. Accuracy and reliability are top priority.

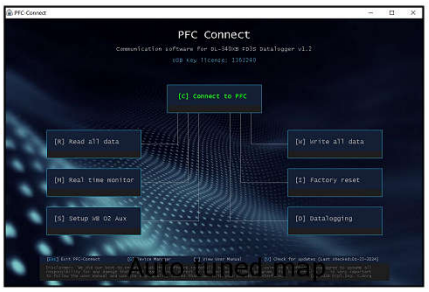
Auto-tune for RX7 Apexi Power FC



Log driving session with PFC-Connect



FC-Tweak Auto-tune



Send auto-tuned file to PFC with PFC-Connect

The procedure is very simple: A driving session is logged by PFC-Connect. The Log session file is imported into FC-Tweak and the automated map tuner will instantly generate a tuned fuel map, and export the new tuned settings file in *.dat file format, ready to be uploaded into the Power FC.

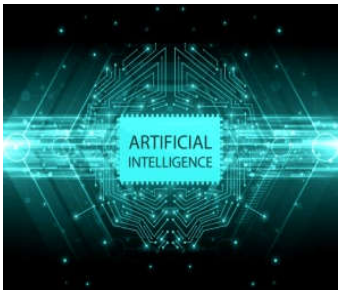
Auto-tune is performed over 3 consecutive steps, which FC-Tweak will guide you through:

1. Automatic generation of custom AFR target map with user preferences
2. Loading & viewing of session log file data
3. Automated map tuner page which also includes advanced manual data manipulation tools

What's so special about Auto-tune?

The program auto-tunes the fuel map so that it matches the target AFRs to within ±1%. Optionally, it can also correct the timing map to eliminate high knock. However, unlike the conventional ways of fuel tuning, Auto-tune does not blindly apply correction factors to all logged cell locations. Most logged data is simply not good for processing. That's why a map tuned without applying special data filtering and verifying logged data integrity & quality, will most often at best result in overly rich zones, and at worst in a dangerous map.

Upon loading the log file, Auto-tune will first analyse it for data quality and sampling speed. If all is fine it proceeds to discard those cells in which it detects O2 feedback control or deceleration fuel cut. It also cancels the effect of any acceleration enrichment factors and compensates for the inherent exhaust gas delay time, which is the time it takes for an exhaust air 'packet' to travel from the combustion chamber to the wideband O2 sensor. In fact most logged raw wideband data is time shifted, and does not really belong to the cells on which it is logged. Auto-tune's DDS algorithm allocates each logged value into the cell it really belongs to.



Finally, after applying all mentioned validations, it selects only those cells which have at least 10 clean samples, and uses their cell average as a representation of the actual AFR for that particular cell on which it eventually applies its corrective actions.

FC-Tweak's auto tuning module now includes an AI engine, which learns about your engine from each tuning session, and performs look ahead tuning, thus preparing cells for which no logging data is yet available, for example higher boost cells which may be still very lean. AI therefore eliminates all chances of running lean during the tuning session even if you start off from a lean map. All these features are what make auto-tune the most efficient and reliable tuning tool for your FD.

Activating Auto-tune FC-Tweak PRO

Start FC-Tweak and import your driving session file from PFC-Connect DATFILES folder. If PFC-Connect resides in FC-Tweak folder, than there is no need to import it as the logfile will be visible in the files list. Both dat (map file) and txt (log file) will be copied simultaneously into FC-Tweak's DATFILES folder. Once imported, such files are color coded blue in FC-Tweak's file manager, indicating that they can be auto-tuned.

*Note: If FC-Tweak is not located on the same computer which you use for logging, then make sure you transfer both *.dat & *.txt files (having the same name) onto the pen drive you import from.*

Press **[A] – Auto Tuning** from the main menu. This will start a simple 3 step procedure.

STEP 1/3: Target AFR map generation

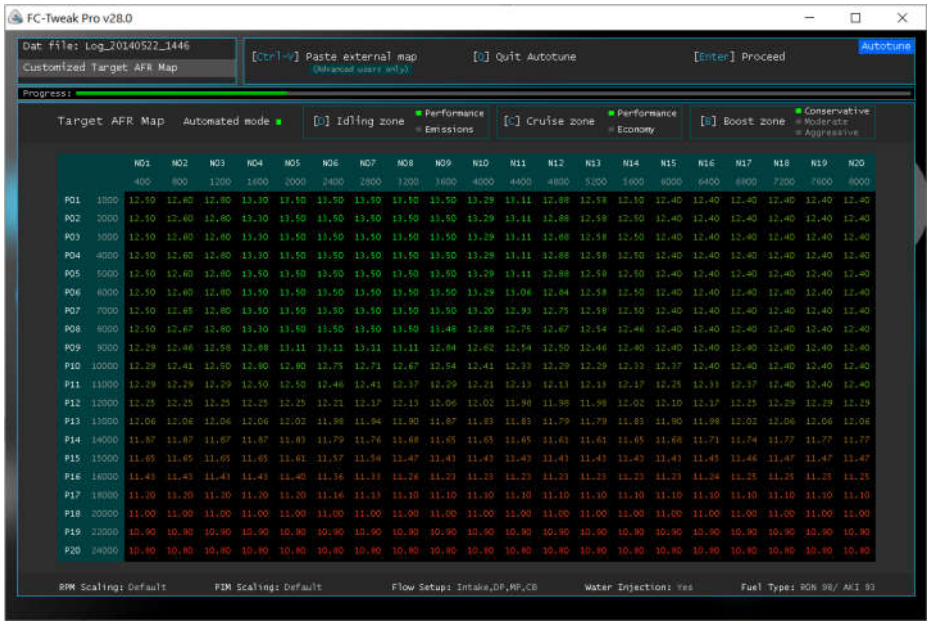
FC-Tweak will first compute the best target AFR map for your setup, and give you the option to modify the general characteristics for idling, cruising and boost zones. It supports any PIM & RPM map ranges, and eliminates the chances of users utilizing very aggressive AFR targets meant for other rotary applications or fuels.

Pressing [D] lets you select between an idling zone tuned for best performance or best emissions. Emissions option will reduce the irritating exhaust stink on setups with no air pump.

Pressing [C] lets you select between a cruise zone tuned for performance, or one which is tuned for economy. *Performance* tunes the map for best torque even under cruising conditions, while *Economy* will be closer to stoich. *Economy* will not aim for super economic AFRs of over 14.7, but still enables one to run some cruise cells under O2 feedback if the function is enabled, and if equipped with one, tries to keep your catalyzer in a healthy state.

Pressing [B] selects between conservative, moderate and aggressive boost zone.

The main difference between these user preferences is the amount by which the fuel mixture is enriched with increasing boost levels. Conservative is best used for applications in which engine reliability is top priority, for example for sustained high boost driving in which the engine operates for long durations at high power. Moderate gives further power always at the expense of slightly higher EGTs, but still very safe for all kinds of street driving. Aggressive goes even higher in power, and is only enabled for RON 98 fuel or water injection setups. If the car has no fuel temperature sensor or no turbo heat shield, or still with the factory intercooler, boost zone preference will be forced to conservative. Note that running an aggressive tune for long sustained boost track sessions can harm the engine but is still safe for spirited street driving. Of course the overall aggressiveness will also depend on your timing maps.



Pressing [Enter] will proceed to step 2/3.

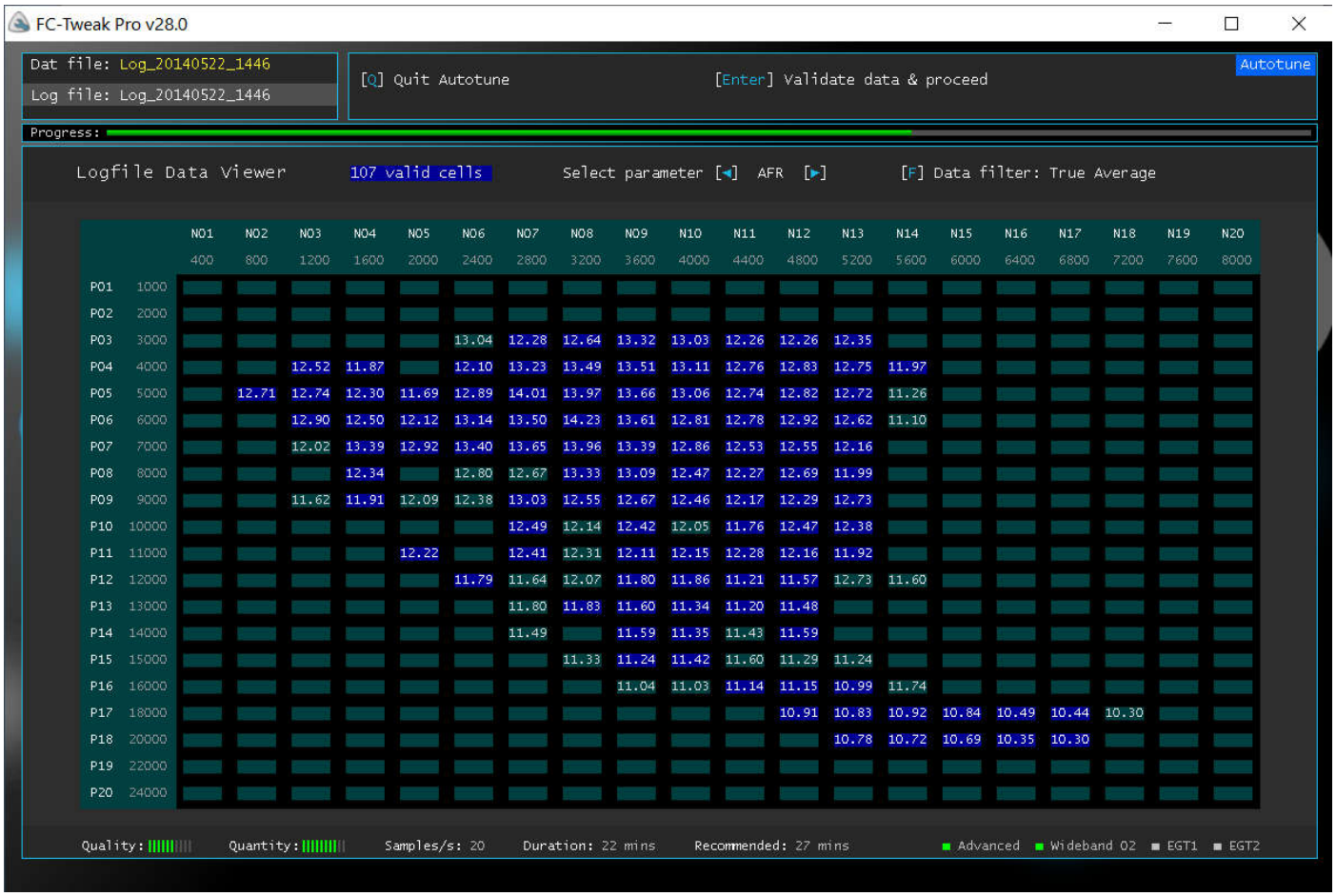
At the bottom of the page, the following information is also shown:

RPM & PIM scaling: 'Default' is displayed when the map scale is the same as Apexi default. If your map uses modified scaling factors, 'Modified' will be displayed, and the target map will be automatically rescaled.

Flow setup, water injection, and fuel type information are also displayed as defined on your car setup configuration page 0. The AFR target map generator will take all these into account to generate the appropriate fuel targets.

STEP 2/3: Start Logfile data viewing, data filtering and validation

Once the AFR target map has been confirmed, the log file is automatically loaded and all wideband O2 and knock data will be displayed. You can select to view between AFR, Real knocks or Num parameters, and also choose whether to have data filtering view on or off. FC-Tweak uses special filtering techniques to show true peak and average values, and discard invalid data. A dynamic data shifting algorithm (DDS) compensates for time lag of AFR data. Note that these are only viewer's selections, and won't change the outcome of auto-tune in any way. So, unlike the old & obsolete method of copying and pasting different tables from Mapwatch into a spreadsheet, it's now virtually impossible to make a mistake.



		N01	N02	N03	N04	N05	N06	N07	N08	N09	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19	N20
		400	800	1200	1600	2000	2400	2800	3200	3600	4000	4400	4800	5200	5600	6000	6400	6800	7200	7600	8000
P01	1000																				
P02	2000																				
P03	3000						13.04	12.28	12.64	13.32	13.03	12.26	12.26	12.35							
P04	4000			12.52	11.87		12.10	13.23	13.49	13.51	13.11	12.76	12.83	12.75	11.97						
P05	5000		12.71	12.74	12.30	11.69	12.89	14.01	13.97	13.66	13.06	12.74	12.82	12.72	11.26						
P06	6000			12.90	12.50	12.12	13.14	13.50	14.23	13.61	12.81	12.78	12.92	12.62	11.10						
P07	7000			12.02	13.39	12.92	13.40	13.65	13.96	13.39	12.86	12.53	12.55	12.16							
P08	8000				12.34		12.80	12.67	13.33	13.09	12.47	12.27	12.69	11.99							
P09	9000			11.62	11.91	12.09	12.38	13.03	12.55	12.67	12.46	12.17	12.29	12.73							
P10	10000							12.49	12.14	12.42	12.05	11.76	12.47	12.38							
P11	11000					12.22		12.41	12.31	12.11	12.15	12.28	12.16	11.92							
P12	12000						11.79	11.64	12.07	11.80	11.86	11.21	11.57	12.73	11.60						
P13	13000							11.80	11.83	11.60	11.34	11.20	11.48								
P14	14000							11.49		11.59	11.35	11.43	11.59								
P15	15000								11.33	11.24	11.42	11.60	11.29	11.24							
P16	16000									11.04	11.03	11.14	11.15	10.99	11.74						
P17	18000												10.91	10.83	10.92	10.84	10.49	10.44	10.30		
P18	20000													10.78	10.72	10.69	10.35	10.30			
P19	22000																				
P20	24000																				

While displaying logged AFRs, the blue highlighted cells are the ones which will be used by auto-tune for further processing. The rest will be discarded, either because the number of clean samples for those cells is less than 10, or because most of the data in those cells is not reliable.

While displaying max knock, any cells with true knock levels exceeding the knock threshold defined in your dat file will be highlighted in red. If you see all max knock readings at zero, or all highlighted red, it probably means that your knock sensor is faulty, & should be replaced before proceeding with tuning.

If high knock cells have been logged, Auto-tune will prompt for permission to modify the relevant timing cell into IGL map (preserving IGT split) on its warnings dashboard screen.

At the bottom line of the log viewer, you have very valuable data about your log file, including a data quality and quantity bar graphs. You must keep the number of packets to the absolute minimum so as not to slow down the logging process with unnecessary data, otherwise data quality will suffer. 'Advanced' and 'Aux' data packets are the only ones you need. If these settings are correct, and quality is consistently low, check that no background tasks, such as antivirus software is slowing down your logging software. Refer to pages 71,72 for more help.

Duration shows the length of the logging session in minutes. FC-Tweak will also recommend the best logging session duration based on your sampling speed.

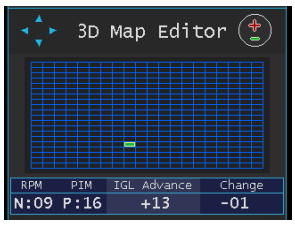
Pressing [Enter] will proceed to the final step 3/3 which will generate your new map.

STEP 3/3: Launch the automated fuel map tuner & Export new mapfile

At this stage a clean version of your data log file is in memory.
Press **[A] – Auto-tune** to start the automated fuel map tuner in normal mode.

By default, 'normal' mode will not process the idling region (which will appear greyed out) since most owners prefer to manually tune this area for smoothest operation, rather than by AFR. Three other advanced map zoning methods may be used, which will be described shortly. Artificial intelligence (AI) feature defaults to 'On', and can be manually disabled by pressing [Home].

Auto-tune will instantly generate the new tuned map and display both old and new curves on the same chart. Any map cells exceeding an error of ±1% from the target AFR will be automatically corrected, and their changes marked on the lower right Map Editor's grid map. The tuned fuel map is much better than anyone can ever achieve using the conventional & very time consuming procedure of manually tuning the map with Excel and Mapwatch data. Below is an example of an auto-tuned fuel map. Auto-tuned cells are marked on the grid map with a dot. Red cells in the grid map editor window are those cells which were automatically enriched in fuel, while those marked green are the ones leaned out. Logged cells already within ±1% of their target AFR are only marked with a white dot. AI look-ahead & curve smoothing tuned cells are marked in solid color.



IGL Map: To view the changes that Auto-tune has done to your timing map (if any), scroll to Settings Page1: IGL chart using Alt-(arrow left) and view the Map Editor window for any changes. In the above example, Auto-tune has backed off 1 degree from IGL cell N09 P16 due to a high knock event found in the data log file.

FC-Tweak will only perform any changes to the IGL map if you enable the option on the warnings dashboard screen, which will come up if high knocks are detected.

Exporting auto-tuned map file

Once the new map is displayed, you can simply proceed to e**[X]**port the file. Auto-tuned files have an added '+' prefix and are automatically given an extension -Auto. If you need to manually manipulate any tuned cells, you must do this before exporting the file (see page 65). Once all boost rows have been auto-tuned, that is, after finishing with all auto-tune sessions, one may also run a final scanning/tweaking session over the final file in order to further smooth out any drastic corrections. Do not scan files with FC-Tweak between auto-tune sessions, as this can undo ongoing corrections.
Unless starting from a very lean or very rich map, one should be able to finalize fuel and timing tuning in about three driving sessions, making it possible to tune the car on a single day! Once a good AFR tune score (>90%) is achieved in the boost zone, auto-tune will mark your map as certified.

1. Start the auto tuning process with a tweaked file for best results.
2. If still equipped with air pump, turn key to off position & disconnect its electrical connector before logging.
3. Using the FC-Commander or advanced manual editing, turn off O2 feedback for logging sessions.
4. Take off the mechanical dashpot*. This reduces redundant deceleration logged data.
5. Do not be tempted to fit a wideband O2 sensor at the stock O2 sensors bung, use lower end of downpipe.
6. Make sure wideband O2 sensor bung is not welded on the lower half of the pipe cross section.
7. Use the shielded cables supplied with your DL-340XB interface to connect WB O2 analogue port to DL Box
8. Correctly select, calibrate and save your Wideband O2 kit model using PFC-Connect before logging.
9. Always wait for engine coolant temperature to reach at least 80C before initiating logging.
10. Do not drag along with tuning sessions over weeks so ambient temps will remain stable throughout.
11. Log for about 15 to 30 minutes per session. Best if you let PFC-Connect timeout & save logging by itself.
12. Keep gear-shifting to a minimum.

*Note that unlike the stock ECU, the PFC is equipped with an electronic dashpot control emulated through the ISC, so unless your car is equipped with a lightweight flywheel, or has its ISC deleted, the PFC does not need the mechanical dashpot at all & you may take it off permanently.

Keeping track of multiple auto-tune sessions

Keeping track of multiple sessions is very important, but also very easy to accomplish.

Note that PFC-Connect conveniently pairs the settings file (*.dat) and log file (*.txt) with the same filename each time a new log file is saved.

The logged file names all have format: Log_YYYYMMDD_HHMM

YYYY is the year, MM the month, DD the date, HH are hours and MM are minutes

This pair of files gets automatically loaded into FC-Tweak whenever you import a dat file from PFC-Connect's DATFILES folder. There is no way one can ever tune a file with the wrong log file.

FC-Tweak will keep the same date codes in the auto-tuned exported filenames.

All autotuned files start with a '+' sign in front of their filename, and are color coded orange when displayed in FC-Tweak's file manager.

So, for example, imported file Log_20141114_1630.dat ,
will be auto-tuned and saved as +Log_20141114_1630-Auto.dat

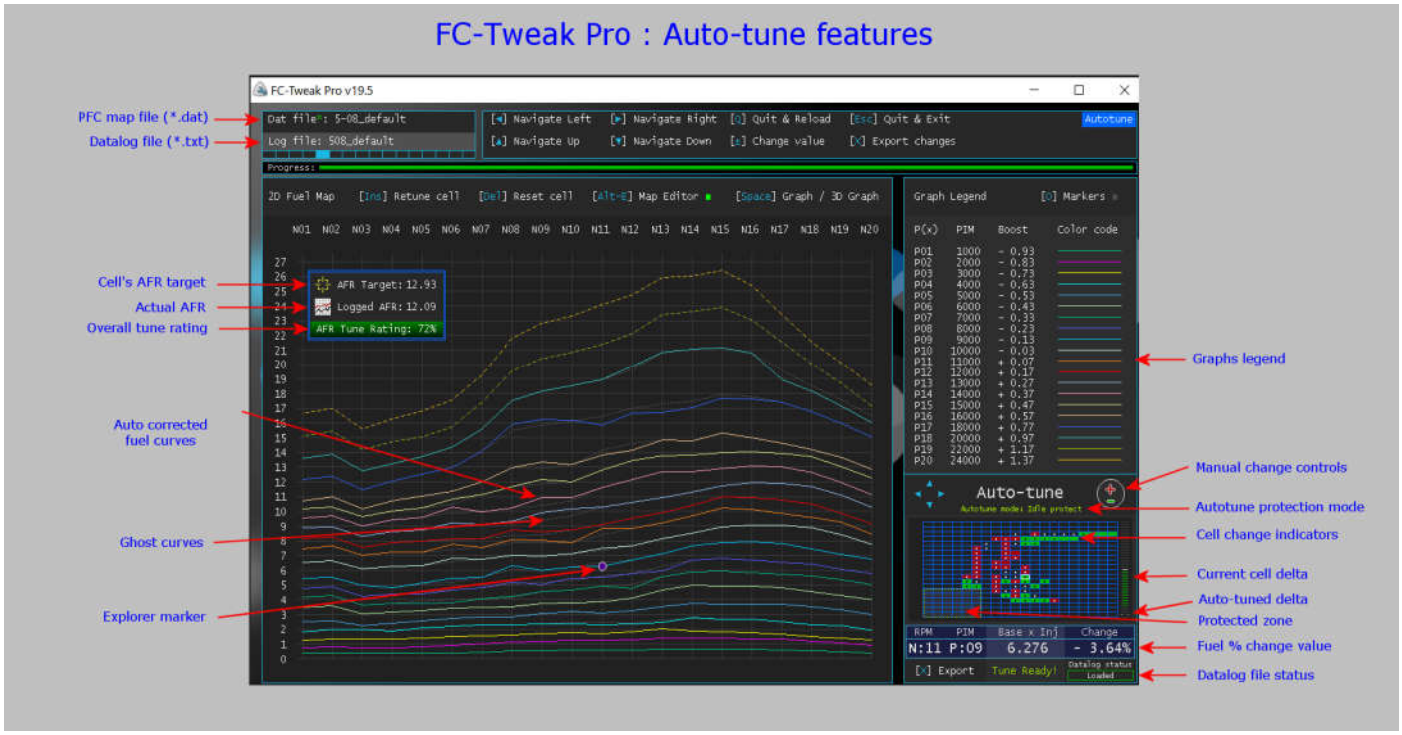
If PFC-Connect & FC-Tweak are to be used on the same computer, copy all PFC-Connect files into FC-Tweak folder, so that they share the same DATFILES folder, so that you won't even have to import the files as these will be immediately visible on FC-Tweak's file manager.

Auto-tune features FC-Tweak PRO

While packed with features for the most demanding users, Auto-tune is the most easy to use software tool to automate AFR tuning on an RX7.

Auto-tune starts up with its default functional settings set in a way so that the beginner can simply import the log file, auto-tune the fuel map, and press [X] to export the tuned file. Can't be any easier!

The more experienced users can also adjust auto-tuning max delta, select protection zones, customize their own AFR target map and also manually refine and smooth out fuel cells in graphic mode. Note that as from version v26.0 map smoothing is also performed automatically.



PFC map file: Filename of dat file (aka settings file or map file) used during logging session.
Datalog file: Filename of log file acquired during logging session. These two files must have the same name!

Cell's AFR target: shows the target AFR value for the selected cell.
Auto-tune will tune your fuel basemap cells to bring them exactly on target.

Actual AFR: This is the filtered and averaged logged AFR obtained from your log file, for that particular cell.

Overall AFR tune rating: Indicates how close all logged cells are to their final target AFRs. Above 90% means it's mostly done.

Auto corrected fuel curves: Once auto-tuned, all curves will be instantly updated to their corrected values.

Ghost curves: These are plotted in light grey, and show the original curves.

Explorer marker: You can move around all curves to view and edit any cells position, manually refining the curves if required.

Graphs legend: Shows color coding for PIM curves.

Manual controls: Control keys used to manually apply changes in addition to those modified by auto-tune.

Auto-tune mode: Select from (Normal) Idle zone protection [A], No idle protection [Alt-A], Boost zone only [Alt-B], Cruise only [Alt-C]

Cell change indicator: Solid color indicates manual or AI changes, dotted for auto tuned: green for leaned out cells and red for enriched cells

Current cell delta: Indicates total percentage change (auto-tune + manual)

Auto-tuned delta: Indicates applied auto-tune percentage change

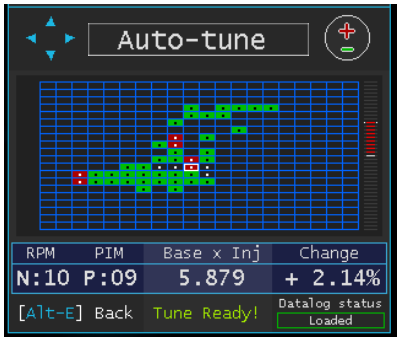
Protected zone: Shading indicates protected zone, auto-tune will not apply any changes to this zone. You can still manually edit this area.

Fuel percentage change: Change applied to selected cell in percent.

Data log file status: Shows 'Loaded' when filtered valid log data is in memory

Manipulating individual auto-tuned cells FC-Tweak PRO

The most demanding experienced users may still want to manipulate some of the tuned cell values or neighbouring ones, in order to achieve their desired level of perfection and map smoothness. While FC-Tweak's AI does the heavy lifting, such manual manipulations are particularly useful to modify cells for which not enough data has been logged, in which case the user can easily visually estimate their correct value based on neighbouring tuned cells. When the message 'Tune Ready!' appears, one may further increase; decrease; reset a cell value to its original value; or restore the auto-tuned value of any particular cell, using the following keys:

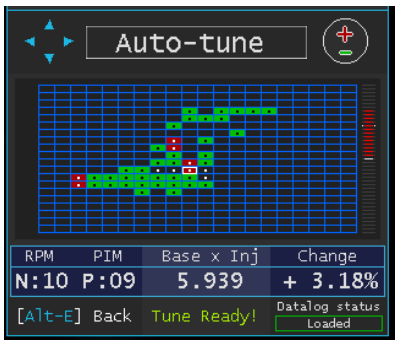


[+] Manually increase cell value
[-] Manually decrease cell value
[Del] Reset tuned cell to its original value
[Ins] Restore cell to its auto-tuned value

To assist in this process, a bar graph is displayed next to the auto-tune grid map, showing the sign and magnitude of the change done to each particular cell. Positive changes are shown in red bars, negative in green. Here we see that auto-tune has enriched cell N10 P09 by +2.14%.

The white bar shows 0% change with respect to the original cell value.

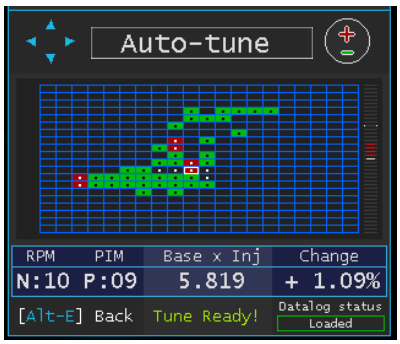
The 2 small white dots next to the upper bar, show the auto-tuned cell value.



Here the auto-tuned cell N10 P09, has been manually increased over and above its auto-tuned value by pressing **[+]**. The white dots stay there for reference, to remind you of the value computed by auto-tune.

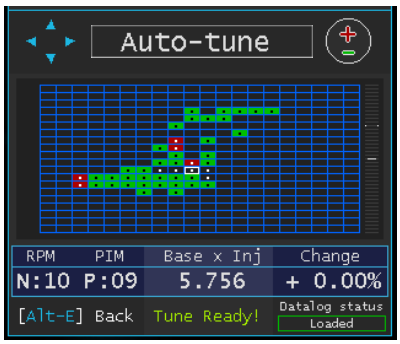
Whenever you manually alter the value of an auto-tuned cell, it is highly advisable to remain close to the tuned value (marked by the two small dots), and definitely not alter the sign of the recommended change.

← Not recommended: auto-tuned change is +ve, manual change is –ve.



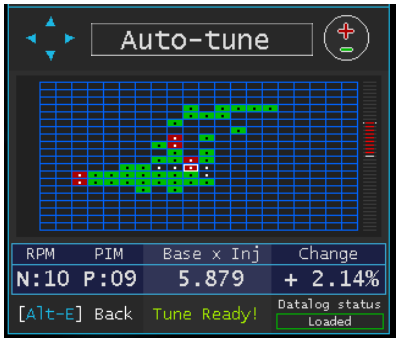
Here the auto-tuned cell N10 P09, has been manually decreased by pressing **[-]**. The white dots stay there for reference, to remind you of the value computed by auto-tune.

Those of you who used to perform this task with Excel, would know how frustrating it was to lose track of either the original cell value or the tuned value, once a cell is manually changed. FC-Tweak keeps all these values in memory and displays them simultaneously on the bar graph. By pressing either [Del] or [Ins] you can instantly recover either the original cell value or the auto-tuned value respectively.



Here the auto-tuned cell has been reset to its original cell value by pressing **[Del]**. Change indicates zero percent.

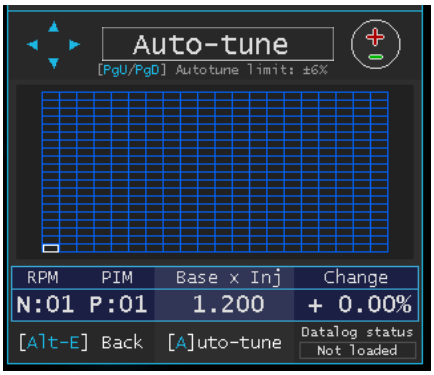
Note that the grid cell is no longer highlighted in red, but is still marked with a white dot, indicating that a valid auto-tuning log data is available for that cell.



Here the cell is retuned by pressing **[Ins]**, and recovers its auto-tuned value.

Advanced Auto-tune options

Setting auto-tune's max delta

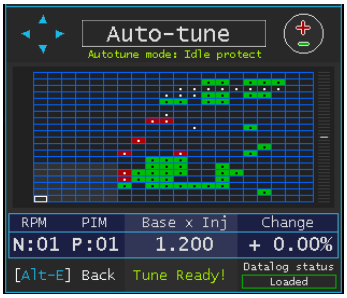


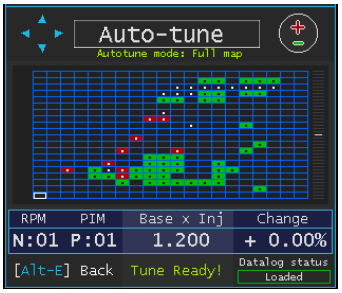
By changing max delta, the user can manually restrict the maximum correction change which can be applied by Auto-tune. That is, if any map cell is leaner or richer than this amount, auto-tune will limit its correction to this delta value. By default, this limit is set to 'Auto'. This option helps to maintain smooth changes and not lump large corrections onto a single cell on a single session. The lower this value is, the better the final result, since the required correction is then distributed over a group of cells. However, if you're starting from a very lean or rich map, modifying the map at low max delta values per driving session may become time consuming, and so, you can also increase this limit up to ±15% per session. When 'auto' is selected, FC-Tweak will apply the best max delta for your log file, from ±5% to ±15%. Manually set limits are shown above the grid map and can be changed by pressing [Page Up] or [Page Down] respectively, before executing Auto-tune.

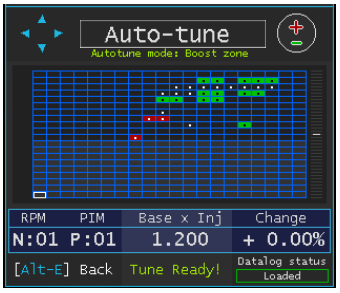
Selecting Auto-tune mode

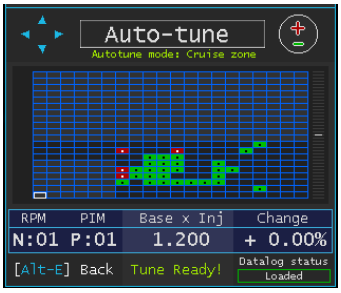
FC-Tweak offers 5 auto-tuning modes:

- Idle protection mode (default mode), launched by pressing [A]
- Full map mode, launched by pressing [Alt-A]
- Boost zone mode, launched by pressing [Alt-B]
- Cruise zone mode, launched by pressing [Alt-C]
- Idle zone mode, launched by pressing [Alt-D]









Forcing auto-tune on all cells

By default Auto-tune will exclude the idling zone from automated tuning, since most owners prefer to tune this zone for engine smoothness rather than by targeting to particular AFRs.

By pressing the key combination [Alt-A] instead of [A], you can override this idle zone protection, and force auto-tune on all map cells for which logged data has been gathered.

Always make sure that your air pump electrical plug is disconnected during logging and O2 feedback is disabled.

Auto-tune mode: 'Full map', is displayed on top of the grid map as soon as auto-tune is launched.

Restricting auto-tune to boost or cruising zone

Sometimes it is desirable to perform auto-tune only on the boost area, leaving idling and cruizing map zones untouched. Pressing [Alt-B] will restrict auto-tuning to the boost zone.

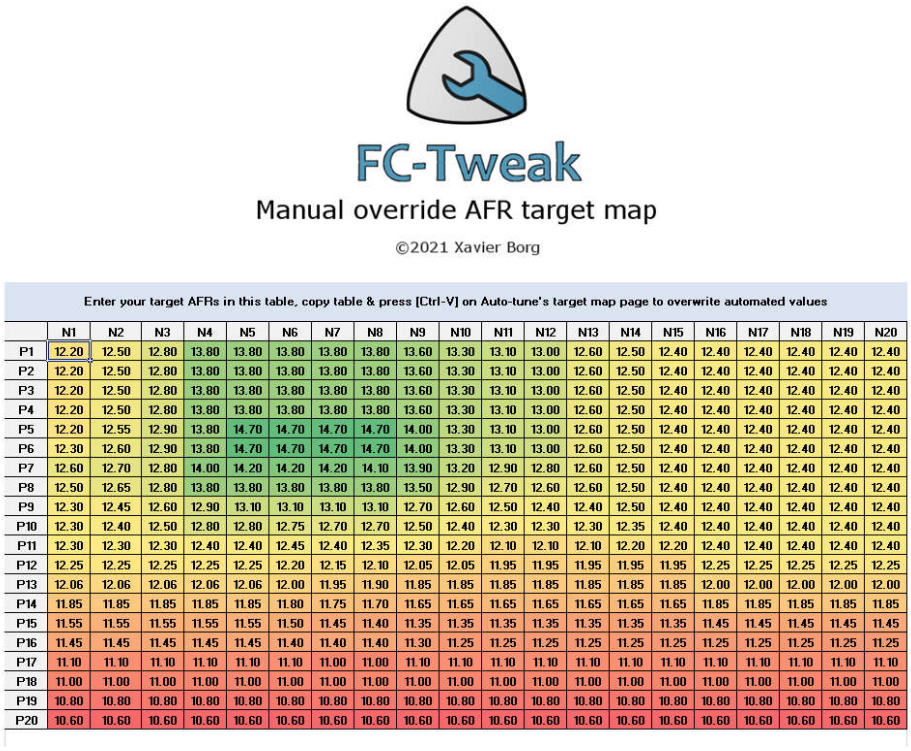
Alternatively, one may wish to leave idling and boost map zone untouched, and tune the cruising zone. Pressing [Alt-C] will restrict auto-tuning to the cruising zone. [Alt-D] will restrict auto-tuning to the idling zone.

Auto-tune mode zone is displayed on top of the grid map as soon as auto-tune is launched in any of these modes. Protected zones are greyed out and outlined in a dotted line.

Note: If FC-Tweak determines that your logged AFR data range is not good enough to discriminate between true and false lean cells created during fuel cut events, it will abort auto-tune. To avoid this, make sure that your Aux Wideband readings include the range 10:1 to 18:1.

User defined AFR target maps

If for some particular reason, you prefer to use some of your own dedicated target maps instead of the one recommended by the automated generator, you can paste this directly from clipboard into auto-tune's target map generator screen by pressing [Ctrl-V].



FC-Tweak

Manual override AFR target map

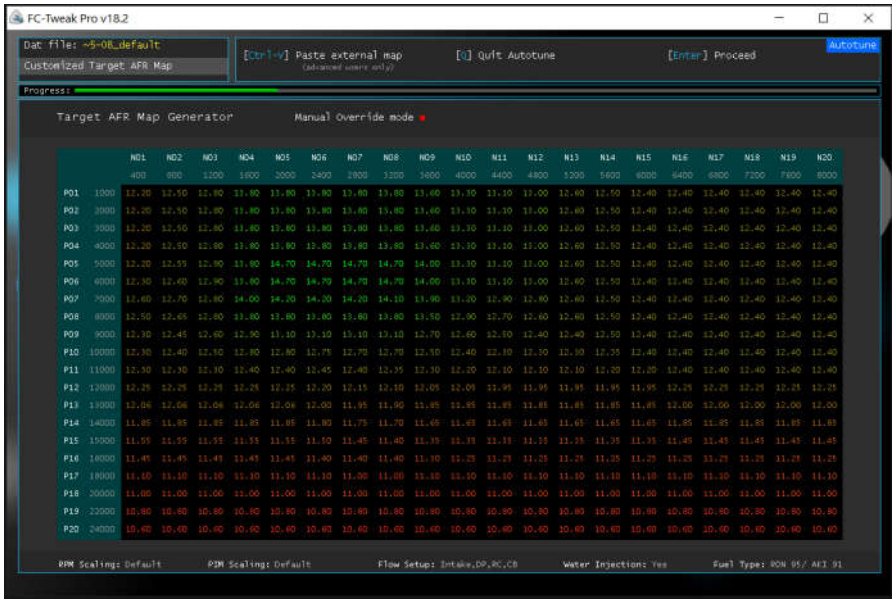
©2021 Xavier Borg

Enter your target AFRs in this table, copy table & press [Ctrl-V] on Auto-tune's target map page to overwrite automated values

	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19	N20
P1	12.20	12.50	12.80	13.80	13.80	13.80	13.80	13.80	13.60	13.30	13.10	13.00	12.60	12.50	12.40	12.40	12.40	12.40	12.40	12.40
P2	12.20	12.50	12.80	13.80	13.80	13.80	13.80	13.80	13.60	13.30	13.10	13.00	12.60	12.50	12.40	12.40	12.40	12.40	12.40	12.40
P3	12.20	12.50	12.80	13.80	13.80	13.80	13.80	13.80	13.60	13.30	13.10	13.00	12.60	12.50	12.40	12.40	12.40	12.40	12.40	12.40
P4	12.20	12.50	12.80	13.80	13.80	13.80	13.80	13.80	13.60	13.30	13.10	13.00	12.60	12.50	12.40	12.40	12.40	12.40	12.40	12.40
P5	12.20	12.55	12.90	13.80	14.70	14.70	14.70	14.70	14.00	13.30	13.10	13.00	12.60	12.50	12.40	12.40	12.40	12.40	12.40	12.40
P6	12.30	12.60	12.90	13.80	14.70	14.70	14.70	14.70	14.00	13.30	13.10	13.00	12.60	12.50	12.40	12.40	12.40	12.40	12.40	12.40
P7	12.60	12.70	12.80	14.00	14.20	14.20	14.20	14.10	13.90	13.20	12.90	12.80	12.60	12.50	12.40	12.40	12.40	12.40	12.40	12.40
P8	12.50	12.65	12.80	13.80	13.80	13.80	13.80	13.80	13.50	12.90	12.70	12.60	12.60	12.50	12.40	12.40	12.40	12.40	12.40	12.40
P9	12.30	12.45	12.60	12.90	13.10	13.10	13.10	13.10	12.70	12.60	12.50	12.40	12.40	12.50	12.40	12.40	12.40	12.40	12.40	12.40
P10	12.30	12.40	12.50	12.80	12.80	12.75	12.70	12.70	12.50	12.40	12.30	12.30	12.30	12.35	12.40	12.40	12.40	12.40	12.40	12.40
P11	12.30	12.30	12.30	12.40	12.40	12.45	12.40	12.35	12.30	12.20	12.10	12.10	12.10	12.20	12.20	12.40	12.40	12.40	12.40	12.40
P12	12.25	12.25	12.25	12.25	12.25	12.20	12.15	12.10	12.05	12.05	11.95	11.95	11.95	11.95	11.95	12.25	12.25	12.25	12.25	12.25
P13	12.06	12.06	12.06	12.06	12.06	12.00	11.95	11.90	11.85	11.85	11.85	11.85	11.85	11.85	11.85	12.00	12.00	12.00	12.00	12.00
P14	11.85	11.85	11.85	11.85	11.85	11.80	11.75	11.70	11.65	11.65	11.65	11.65	11.65	11.65	11.65	11.85	11.85	11.85	11.85	11.85
P15	11.55	11.55	11.55	11.55	11.55	11.50	11.45	11.40	11.35	11.35	11.35	11.35	11.35	11.35	11.35	11.45	11.45	11.45	11.45	11.45
P16	11.45	11.45	11.45	11.45	11.45	11.40	11.40	11.40	11.30	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25
P17	11.10	11.10	11.10	11.10	11.10	11.10	11.00	11.00	11.10	11.10	11.10	11.10	11.10	11.10	11.10	11.10	11.10	11.10	11.10	11.10
P18	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
P19	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80
P20	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.60

To edit your own target maps, use the excel sheet provided, which you may find in FC-Tweak's folder, filename: User_target_01.xlsx, also directly accessible from the opening screen by pressing [E]. If you wish, you can even make multiple copies with different filenames and store individual maps for different setups.

To load the table contents into auto-tune, open the spreadsheet and select & copy the whole table using [Ctrl-C], then go to Auto-tune's map generator page, and simply press [Ctrl-V] to paste. 'Manual Override mode' will be displayed and Auto-tune will use these values as its target AFRs. The table will remain in memory until the user quits auto-tune or loads a new settings file. If you wish, you can also set it as your default target table from the Session Options menu so that you won't need to copy & paste it in each time.



Note, you can grab a copy to clipboard of any automated map by pressing [Ctrl-C] from the standalone automated map generator screen, accessed by [?] from View mode.

Important Information for Data Logging

Your final tune will be as reliable as the logged data. If the data entered is inaccurate, the results will be too, no matter how sophisticated your sensor is. Whether you are manually tuning your fuel maps, or utilizing FC-Tweak's Auto-tune function, bad logged data can result in engine damage instead of a better map. Unreliable readings will also make it hard or impossible to get the AFR's to converge on target.

Below are some rules of thumb for a successful data logging session.

Wideband sensor location & orientation

Never fit a wideband O2 sensor at the stock O2 sensor bung. It's too close to the exhaust and will damage your sensor in a very short time due to extreme overheating. The lower end of the downpipe, or the inlet side of the catalytic converter (or midpipe) is fine. A heatsink is also required if temperatures are in excess of 500°C. The orientation of the welded bung is very important. Locating the sensor in the lower half of the pipe cross section (between 3 o'clock and 9 o'clock) results in condensation & accumulation of residues in the sensor, which can also damage it in a short time. Always weld the bung on the upper half, so that gravity helps to keep the sensor clean.

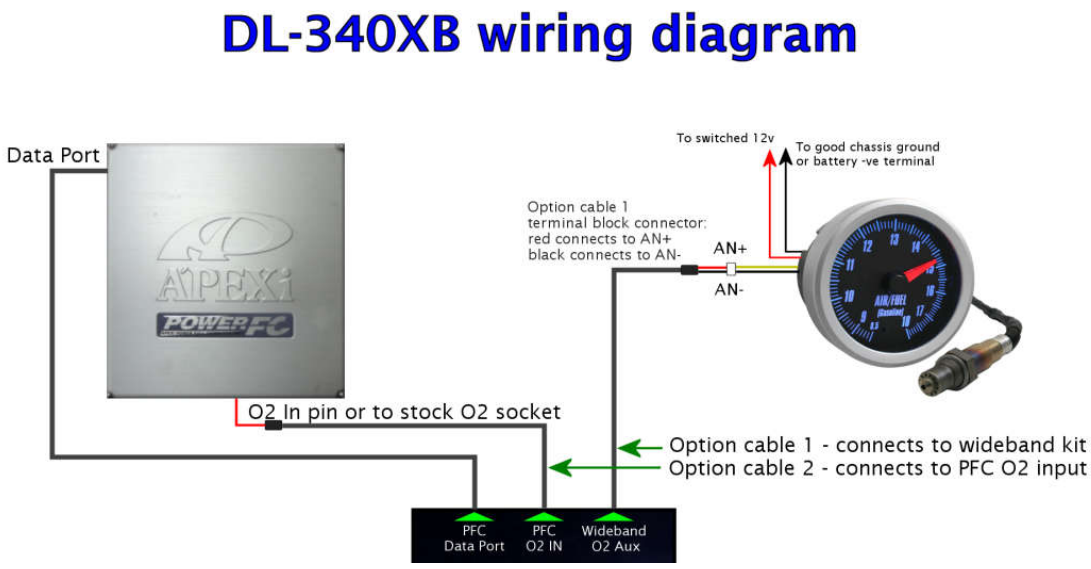
Wideband O2 sensor calibration

Most wideband O2 sensors have a way to force auto-calibration. It is highly recommended you follow the user manual and perform a free air calibration before fitting the sensor to the exhaust bung.

Wideband O2 module connections

Always use the option cables supplied with DL-340XB. These are high quality shielded cables which guarantee noise free signal transmission from your EUGO kit to the PFC.

Connect the red terminal of option cable 1 to (0-5v) AN+ on your UEGO kit, and the black terminal on the option cable 1 to AN-. Some UEGO kits use ground instead of AN-, in which case you should run an extra wire from the UEGO grounding location to the black terminal on Option 1 cable. Finally connect option cable 2 to the PFC O2 input as described on the interface manual. NEVER bypass the interface by connecting AN+ directly to the PFC O2 pin, as this will damage the ECU.



PFC Connect Aux port setup & calibration

Wideband O2 Auxiliary port setup

On this page you can configure any wideband O2 sensor kit to be used with the DL-340XB interface box. Once set, you will be able to view and log in real time the exact AFR values.

Selecting your UEGO module

There is no need to enter any equation or voltage to AFR conversion tables, since PFC-Connect has a built in library of most commonly used wideband modules. If you do not see your model listed, contact us and we'll include your model in the list. Select your model using the left / right arrow keys.

Trimming the ground offset

The central dot matrix font display shows both the analogue voltage and the calculated AFR for the selected model number. Any small AFR discrepancy due to ground offset can be corrected using the up / down arrow keys.

To trim the AFR offset, start the engine and leave it idling. Compare the displayed value with that shown on your UEGO digital meter. Press arrow up/down until the AFR readings match exactly. Do not perform this calibration with engine off, with AFRs>18, or analogue voltage above 4.5v. Ideally the analogue voltage during ground offset live calibration should be in the range of 1 V to 4.5 V.

Re-confirm that the model name is correct, and press [S] to save settings.

From thereon, the saved model & ground offset will be your default whenever you start the program.

Key functions reference guide

FC-Tweak is controlled using various keyboard keys. Some keys are active only in specific modes. At all times, the program displays the functional keys in each mode inside square brackets at the top of each page, so there is no need to remember them. For fast reference, here is a full list of active keys available in each mode. The Mode is highlighted in blue at the upper right corner of settings pages. This list includes hidden key functions (marked * under function description).

Mode: Opening page (File manager)

Key	Function	Comment
Cursors	Navigate through PFC filenames	Filenames are color coded.
Page Up/Down	*Scroll up/ down through filenames	Page scroll, enabled for large number of dat files
Enter	Select and load PFC file	Must be a valid RX7 file
Delete	Deletes file from directory	Asks for confirmation before deletion
H	Opens revision history log page	Shows most recent revision history changes
E	Edit AFR Target map spreadsheet	Used by advanced users to override automated target maps
Esc	Exit FC-Tweak	Stores your current program settings & exits
I	Import dat files from other locations or drives	Copies a dat file (and its log file) into DATFILES folder
V	View PDF manual in external window	Opens manual in your default PDF reader
R	Send registration enquiry by email	Only enabled for unregistered version – requires Outlook
U	Remote software upgrade	Checks for new versions on FC-Tweak online server
Alt-U	*Remote software upgrade (alternative method)	Same as above, use only if you have problems with [U]
Alt-T	*License transfer update	E-mail us new laptop shareware PID before transfer
Alt- Enter	*Toggles between 5 screen display modes	For mini LCD screens, or user visual preference

Mode: Config

Key	Function	Comment
Cursor up/down	Navigate through mods list & program options	Active on settings page 0
Cursor left/right	Select from pre defined mods for current selection	Note: tweaked files will contain their own User Config
S	Save current mod list as 'My Config'	My config mods list will be your default list
R	Reload 'My config' mods list	
M	Reload mods list for a stock RX7 FD3S car setup	
Enter	Accept current mods and proceed to tweaking session	The 'Modified config' will be saved within the tweaked file

Mode: View

Key	Function	Comment
Tab	Start file scan and enter Tweak mode	Toggles between View and Tweak modes after scan
Cursor Left/Right	Navigate through Settings pages	
Esc	Exit FC-Tweak	Stores your current program settings & exits
>	Copy or 'save as' a PFC file to any folder or drives	Used to copy a tuned file to a pen drive or networked drive
Q	Quit working on PFC file and go to file manager	All session changes are lost if no file export is done
Cursor up	View full scan report and PFC file ratings	Active only after file scan is done
G	Opens log file of enabled tweaks in Windows Notepad	Only enabled after file export in Pro version
Spacebar	Toggles between table mode / 2D / 3D graph modes	Active on settings pgs1-4. 3D only available in Pro
Alt-E	Enters or exits Mapedit or Explorer mode	Mapedit only available in Pro version
A	Shortcut to enter AFR tuning & start log based Auto-tune	Pro version only
S	Split mode – toggles between IGT and IGT split	Active in settings page 2 (IGT map)
O	Toggle graph markers	Active in 2D graph mode on settings pgs 1-4
C	Toggles 3D graph color code, PIM or gradient	Available only in Pro version
Ctrl-C	*Copy any displayed map data to clipboard	Can be pasted into Excel and other Windows apps
Alt-Print Screen	*Copy FC-Tweak screenshot to clipboard	Can be pasted into emails and any Windows apps
?	Calls stand alone AFR target map generator	Press 'shift'+'/'. Pro version only.
Alt-X	*Clone file to a different PFC version from set page 0	Changes file PFC version signature ex. from 7.07 to 5.08

Mode: Tweak

Key	Function	Comment
Tab	Toggles between View and Tweak modes	
Cursor Left/Right	Navigate through detected faults bar	
Cursor up	View scan report and rates PFC file	File rating changes in real time with enabled tweaks
M	Mask error – to ignore a recommended tweak	Takes off red mark from selected fault
T	Let FC-Tweak optimize/tweak the selected fault	Action can be undone any time during the session
U	Undo tweak – returns value to its original	Undo can be done at any time before exporting file
X	Export tweaked file in PFC *.dat format	Tweaked file will have a ~ prefix added to its name
H	Show additional help for recommended tweak	Use if in doubt on any recommended tweak
Alt-E	Enters or exits Mapedit or Explorer mode	Mapedit only available in Pro version
Cursor Up/Down	Set boost value shown on Commander	Active in settings pg10 with smart boost calibration
S	Select boost recalibration method	Active in settings pg10 with smart boost calibration
Any key	Exits from Data file analysis report page	Active on analysis report page only
Alt-Print Screen	*Copy FC-Tweak screenshot to clipboard	Can be pasted into emails and any Windows apps
Alt-X	*Clone file to a different PFC version from set page 0	Changes file PFC version signature ex. from 7.07 to 5.08

Key functions reference guide

Mode: Map Edit

Key	Function	Comment
Alt-E	Toggles Map Edit On/Off	Active only on graphic screens setting pgs 1-4
Cursor keys	Navigate in all directions within graphs	Displays extra grid map on lower right corner
Esc	Exit FC-Tweak	Stores your current program settings & exits
Q	Quit working on PFC file and go to file manager	All session changes are lost if no file export is done
C	Toggles 3D graph color code, PIM or gradient	Available only in Pro version
+	Increase cell value	Pro version only
-	Decrease cell value	Pro version only
Alt +	*Increase cell value – fast mode	Increases cell value by larger amount – Pro only
Alt -	*Decrease cell value – fast mode	Decreases cell value by larger amount – Pro only
Delete	Resets cell to its original value	Pro version only
Insert	Restores cell to auto-tuned value	Recover auto-tuned value after manual editing – Pro
Alt – Left	*Go to previous settings page graph (1-4)	Scrolls between graphs within Map edit mode
Alt – Right	*Go to next settings page graph (1-4)	Scrolls between graphs within Map edit mode
X	Exports changes done in Mapedit / Auto-tune	Save all changes, or press Q to discard all – Pro only
Ctrl-C	*Copy displayed map data to clipboard	Can be pasted into Excel and other Windows apps
Alt-Print Screen	*Copy FC-Tweak screenshot to clipboard	Can be pasted into emails and any Windows apps

Mode: Autotune

Key	Function	Comment
B	Select boost target AFR preference	Select from conservative, moderate, aggressive (WI only)
C	Select cruise target AFR preference	Select from performance, economy
D	Select idling zone target AFR preference	Select from performance, emissions.
Ctrl-V	Paste an external AFR target table into autotune	Use provided excel sheet (option for advanced users)
L	Load log file	Loads DL-340XB log files *.txt
Q	Quits logfile viewer	Aborts autotune
Enter	Validate log data and proceed to map auto tuner	Asks for permission to tweak timing if high knocks present
A	Start Auto-tune in default idle protect mode	Starts map auto tuner using loaded log & AFR target map
Alt-A /-B /-C /-D	Restrict Auto-tune zone to: full map/boost/cruise/idle	Selective zoning for auto tuning
Home key	Toggle artificial intelligence feature	Enable/ disable AI before autotuning
Cursor keys	Navigate in all directions within graphs	Displays extra grid map on lower right corner
X	Exports changes done in Mapedit / Auto-tune	Save all changes, or press Q to discard all
+	Increase cell value	Pro version only
-	Decrease cell value	Pro version only
Page Up	Increase Auto-tune max delta value (graph 4 only)	Pro version – default is 'auto', set before autotuning
Page Down	Decrease Auto-tune max delta value (graph 4 only)	Pro version – default is 'auto', set before autotuning
Alt +	*Increase cell value – fast mode	Increases cell value by larger amount
Alt -	*Decrease cell value – fast mode	Decreases cell value by larger amount
Delete	Resets cell to its original value	Reverts to value it had before auto tuning
Insert	Restores cell to auto-tuned value	Recover auto-tuned value after manual editing
K	Toggles knock based timing correction in autotune	Option shown on warnings dashboard screen
Alt – Left	*Go to previous settings page graph (1-4)	Scrolls between graphs within Map edit mode
Alt – Right	*Go to next settings page graph (1-4)	Scrolls between graphs within Map edit mode
Alt – Up	*Ignore warnings dashboard fatal fault & force proceed	Not recommended. Use only if you know what you're doing!
K	Toggle autotune based on knock	Enabled in warnings dashboard if knock cells are found
Esc	Quit and exit	Asks to confirm exit if changes have been done

Mode: MapGen

Key	Function	Comment
Ctrl-C	Copies AFR target map into clip board	For use with external apps
G	Calls true AFR Inj map REGEN function	Regenerates AFR Inj map, use once auto-tuning is all done.
Enter	Back to main menu	Exists Mapgen mode

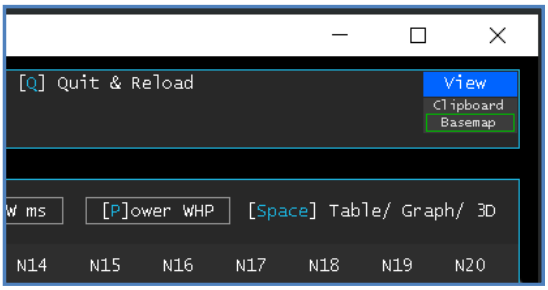
Clipboard functions

FC-Tweak can paste tables and graphics to clipboard, for use with other external applications, such as spreadsheets, email programs, word processors and graphic utilities.

Pasting map data to clipboard

Pressing [Ctrl-C] from any map settings page will paste the numeric values in table format to clipboard. Using this function, the following map data can be transferred to other apps:

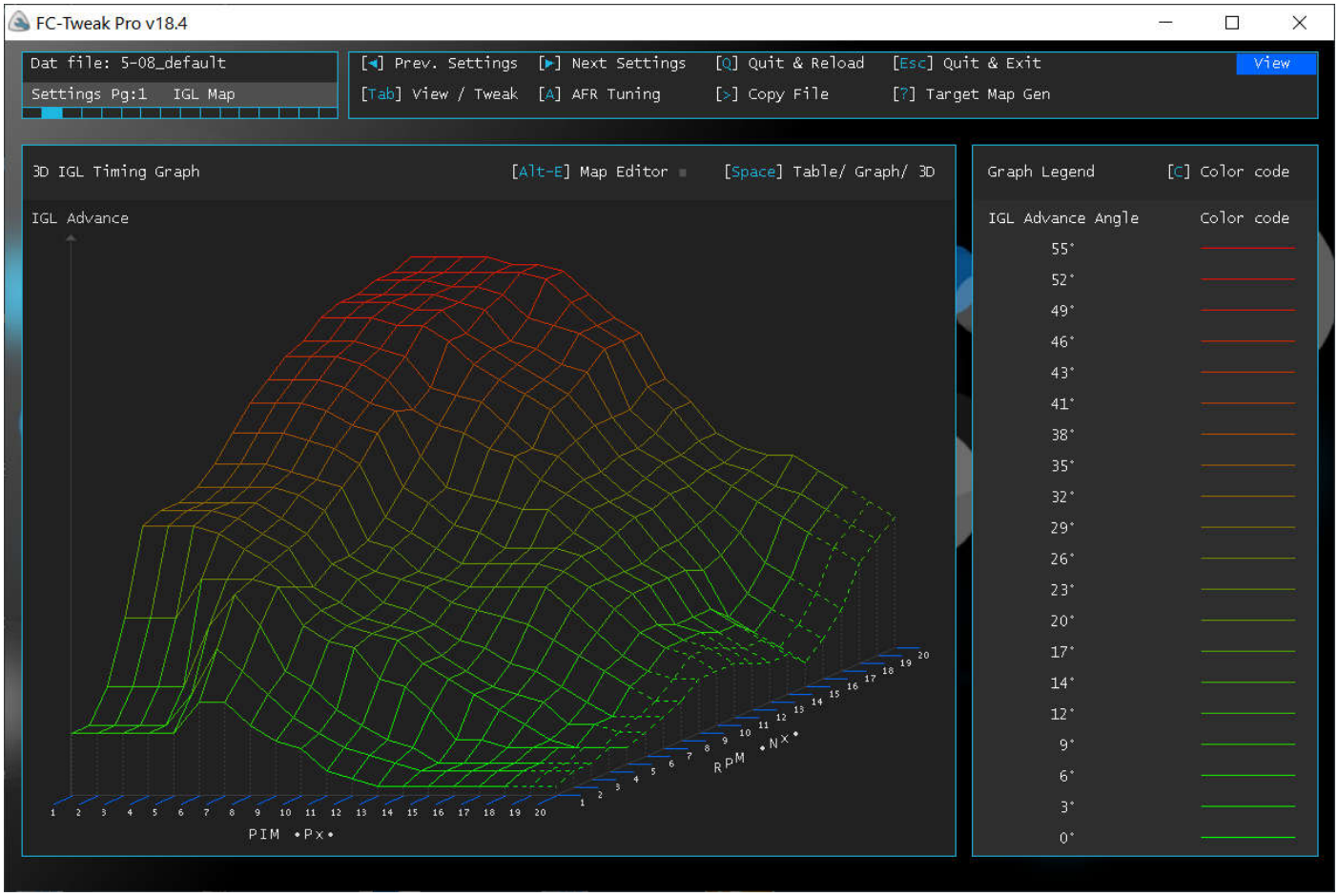
- IGL map
- IGT map
- IGT Split map
- Inj correction map
- Lambda map
- AFR map
- Base map
- Base x Inj Map
- Power Map
- Automated AFR target maps



This enables one to paste (using Ctrl-V) the map table data in Excel spreadsheets and other applications which can tabulate data. Clipboard contents are shown at the top right corner, underneath the mode selection. Note that clipboard contents are cleared when you quit FC-Tweak.

Pasting graphic screenshots to clipboard

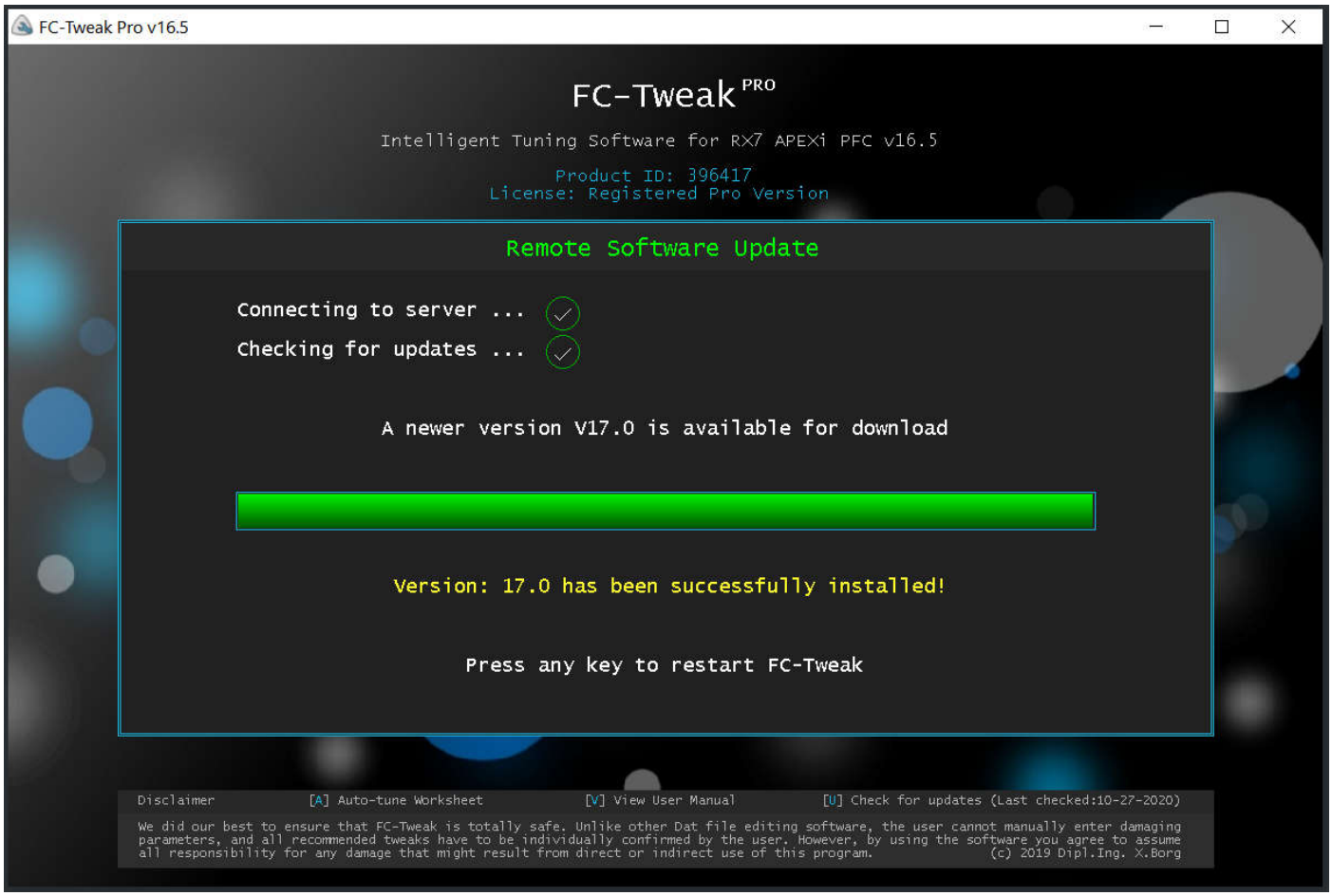
Pressing [Alt-Print Screen] from any page will paste a graphic screenshot of FC-Tweak's window to clipboard. This is very useful when you want to email a screenshot of any FC-Tweak page without have to use any external graphic snipping tool to exclude your desktop background.



The above screenshot has been pasted in this document using this function.

Remote Software Updates

You can manually check for to newer software versions, and upgrade your software free of charge from FC-Tweak's opening screen by simply pressing [U]. FC-Tweak will also automatically remind you every two months.



The date you've last checked for updates is also shown.

Once launched, this function will connect with FC-Tweak's server, and if any newer version is found it will automatically update and restart FC-Tweak.

An internet connection must obviously be available for this function.

The user manual does not get automatically updated, but the latest revision can always be downloaded from:

https://tinyurl.com/FCTweakManual

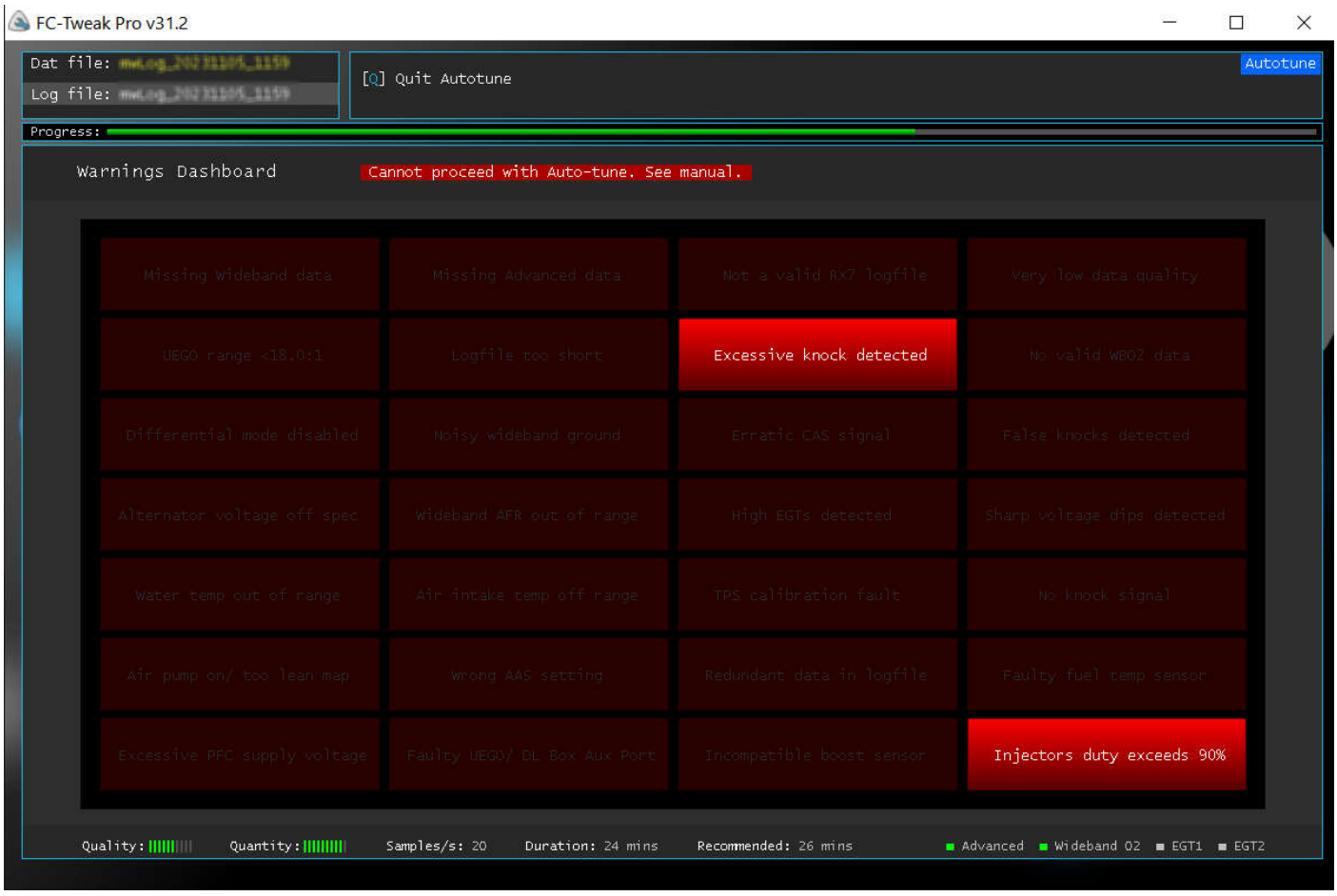
Important: All our files are tested clean from any virus or malware. However, Windows Defender treats all executables as zero reputation files and tends to block or delete them during remote updates. This may leave you with an unregistered version after download. In order to avoid this from ever happening it is recommended to set the following:

Click on Windows Start > Settings> Update and Security> Windows Security> App & Browser control > Reputation based protection settings > Turn off Potentially unwanted app blocking

Click on Windows Start > Settings > Update & Security > Windows Security > Virus & threat protection settings > Manage settings > Exclusions, select Add or remove exclusions > Add an exclusion> select FC-Tweak folder

Warnings Dashboard

FC-Tweak tests the quality & integrity of your log file, and many of your car's important sensors and other related hardware in the background, as to make sure that the data captured during a logging session is reliable. These tests are performed each time you load and validate a new logging session file. The task runs in the background. If anything wrong is found, auto-tune will open the Warnings Dashboard screen, highlighting all faults found. If no problems are found, FC-Tweak will not display the dashboard screen and will proceed straight to the final auto tuning step. Although in most cases, it won't stop you from proceeding with auto-tune, the resulting tune may not be optimal if you still choose to ignore and go ahead. It's highly recommended to correct the problem before proceeding with tuning. If any faults found are deemed to be too dangerous to continue with tuning, FC-Tweak will inform you and exit auto-tune.



List of hardware faults on warnings dashboard

Warning	Description	Comment / solution
Not a valid RX7 logfile	Checks whether the loaded logfile is corrupt and whether it has a valid RX7 signature.	Make sure you load the correct log file.
Logfile too short	Logfile duration too short to perform a full map tune.	Log session duration should ideally be between 20 to 30 minutes.
Alternator voltage off spec	Checks whether alternator output voltage is within factory specs: 14.7v cold, down to 14.0v hot. FC-Tweak warns if found off specs. Off spec alternators may damage the PFC!! Do not ignore this warning!	Some aftermarket 'upgraded' units use cheap out of spec regulators. A 'booster diode' and/or the correct pulley sizes usually correct this problem, but faulty alternators need to be repaired or replaced.
Sharp voltage dips	Small batteries, especially relocated ones may result in sharp ECU voltage dips when inductive loads such as fans, water injection pump, etc... turn on. FC-Tweak warns if such sharp dips are detected.	This affects the stability of your tune. A larger battery, heavier gauge (gauge 0) battery cables routed to the original battery post or a good quality universal car stabilizer (low ESR capacitor pack) corrects this problem.
Erratic CAS signal	The Crank Angle sensor provides the heartbeat for your PFC. Missing pulses on this sensor can damage the engine.	Sensor itself is quite robust. Look for dented timing wheel, and correct wheel to sensor clearance.
No knock signal	FC-Tweak warns if it detects a dead sensor. Auto-tune uses this sensor to back off timing, if option is enabled.	Check wiring harness, clean connector or replace sensor.
Water Temp out of range	The PFC uses this sensor to control fuel injection factors. Tuning with a bad water temp sensor is not recommended. Also, one must wait for the engine to reach normal operating temperature (80°C) before starting a log session. If necessary let it idle at stand still until it reaches 90°C before starting the log session.	Always warm up engine before starting a log file, and replace sensor if faulty. No valid cells will be found unless engine has warmed up. Also, never tune or drive a car with a faulty or bypassed thermostat. If your coolant temperature cannot reach over 75C, engine oil will accumulate moisture, and engine will suffer from carbon build up since the PFC will be stuck in warm up enrichment mode.
Air intake temp out of range	The PFC uses this sensor to control fuel injection factors. Tuning with a bad intake air sensor is not recommended.	Check wiring harness and replace sensor (located underneath UIM) if necessary.
TPS calibration fault	The PFC uses this sensor to read the throttle angle. It needs to be correctly calibrated for the PFC to enter idling control mode and FC-Tweak warns if it's out of calibration.	Loosen the TPS bolts and turn until TPS voltage (VTA1)=0.4v with warm engine (80°C) idling and gas pedal released. Also make sure that the thermowax fast idle cam separates from the throttle body warm up idle post. Refer to FSM.
Wideband AFR out of range	FC-Tweak will detect bad wiring configuration Make sure the correct WBO2 kit model has been selected on PFC-Connect	Make sure UEGO kit is connected according to DL-340XB wiring diagram.
UEGO range <18.0:1	FC-Tweak warns of improper AFR range from your UEGO. Mixed driving tuning requires modules able to read AFRs of at least 18:1, ideally up to 20:1.	All modules presently on the market meet this requirement. Also make sure that your fuel cut recovery settings (F/C no load, FC EL, FC AC) are not set above 2000RPM otherwise this error will also come up.
No valid WBO2 data	No valid AFR data found at all.	Check logging hardware and log again for over 20 minutes, making sure air pump is unplugged and coolant temperature is over 75C.

False knocks detected	An unusual number of false knocks detected.	Check for faulty bearings, noisy belt driven accessories, and other mechanical parts which may contribute to high background noise.
Excessive knock detected	Autotune warns of real knocks present in your log file. It will give you the option to autocorrect timing for the offending cells. Press [K] to toggle auto correction of timing map based on knock.	Do not run an overly advanced timing map while tuning AFRs. Timing advancement or dyno-tuning for peak power should only be attempted once AFRs are tuned.
Air pump on/ too lean map	Very lean cells are found in your log file. This could be either because you forgot to unplug the air pump, or you started with a very lean map.	Make sure to disconnect the air pump. If air pump is not enabled, you may still proceed with autotune, which will enrich the lean cells, however it's always recommended to start with a rich map rather than a lean one.
Wrong AAS setting	The air adjustment screw (AAS) located underneath the throttle body elbow needs to be manually calibrated so that the ISC (with which the PFC controls idling and dashpot functions) can function within its normal operating range.	Refer to pg47 for AAS calibration procedure. Make sure to auto-tune your idle AFRs first, or it may be impossible to calibrate. Wrong setting of the AAS will usually result in idle bouncing/ hunting or stalling upon deceleration. Refer to appendix pg86 if tuning a new map or if manual AAS calibration fails.
Faulty fuel temp sensor	Fuel temperature sensor is either defective or disconnected. Without sensor, fuel injection can be as much as 4% off.	If car is equipped with sensor, replace/ check harness. If sensor has been deleted, make sure you configure the sensor as deleted on the Car Config page, so auto-tune will take the necessary precautions and let you proceed with tuning.
Excessive PFC supply voltage	Dangerously high supply voltage reaching the PFC. Alarm threshold is >15.5v The PFC is at a great risk of being damaged, and is not able to correctly scale fuel injection at these voltages.	Check side connector on the alternator is fully inserted, and alternator voltage never exceeds 15v. If problem persists, stop using your car & immediately repair or replace the alternator.
Faulty UEGO	Unreliable AFR data is being received at the Aux input port of the interface box. Probably caused by a hardware fault within your UEGO module.	Check WBO2 sensor and wiring from the UEGO module to the interface box. It's highly likely that faulty hardware will need to be replaced. Auto-tune will be terminated so as to avoid tuning with bad AFR data.
O2 feedback enabled!	Log session was done with O2 feedback enabled. Not allowed during logging.	Turn off O2 feedback function using either the FC-Commander or by editing the setting on your map file. Auto-tune will abort tuning. If you never intend to use O2 feedback, it's highly recommended to perform a fuel map unification (aka basemap recalc) using the advanced file editor.
Injectors duty exceeds 90%	Some cells need to be enriched beyond the maximum recommended injector duty in order to reach the target AFR. Autotune will abort in order to protect the PFC injector driver chip and your engine.	This can happen for various reasons, ex: Faulty or ageing fuel pump or related relays, Injectors which are not big enough, Partially clogged injectors, or fuel filters or even a malfunctioning WBO2 sensor.

True AFR Inj map Regenerate function

Did you ever regret the moment you recalc'd your Inj map, or hate the fact that the AFR values on your present Inj map are far from the actual values and thus of no use?

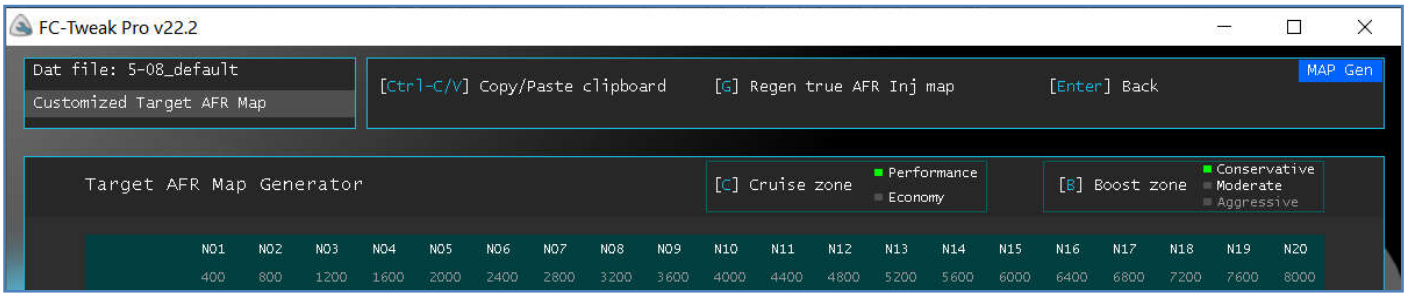
FC-Tweak now includes a 'Regen' function to rebuild your Inj AFR table so it reflects the actual AFRs used while auto-tuning your map. Of course it only makes sense to Regen a map once it has been fully autotuned!

Although it is common practice to simply recalc and effectively get rid of what is normally a useless Inj table, the Regen function will bring back features and functions which are impossible with a recalc'd map.

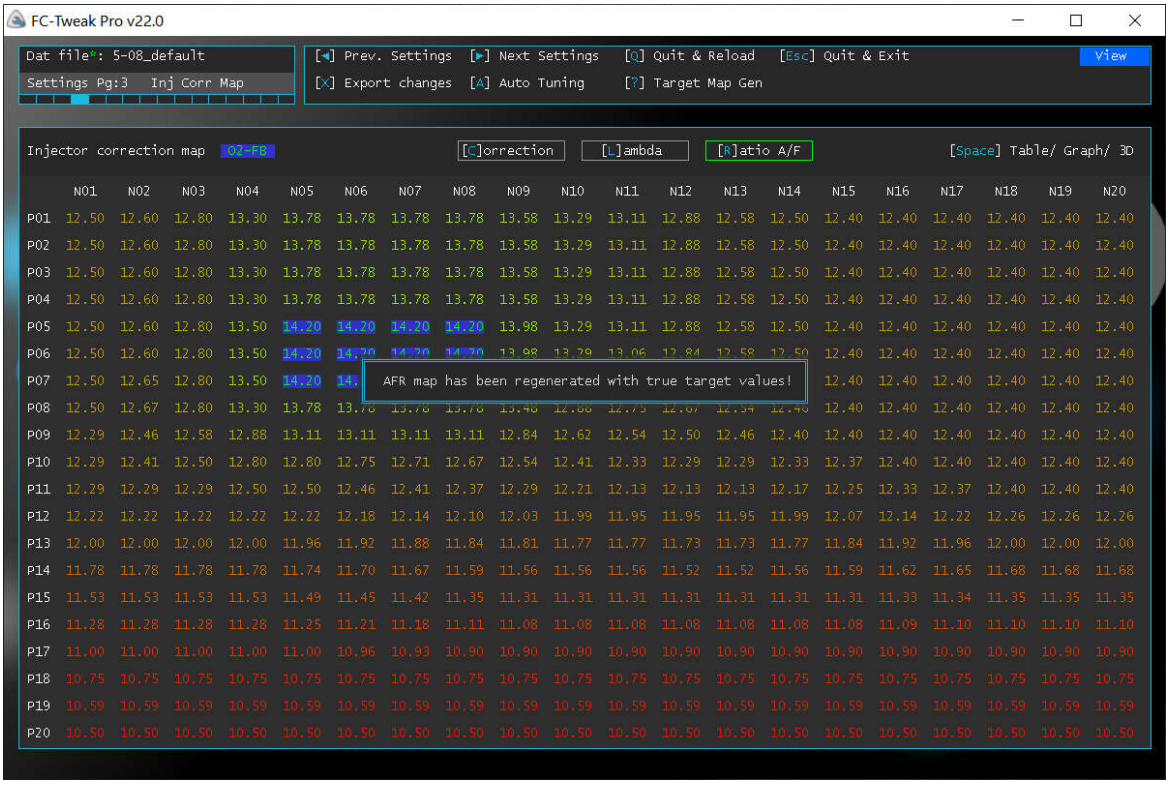
One obvious advantage is that you will be able to enable the PFC O2 feedback control and save on fuel economy.

The second advantage, is that, like on modern ECUs, you will be able to directly edit your Inj AFR map without ever having to re-perform any tuning sessions to confirm AFRs. The Inj map editor becomes a powerful WYSIWYG (what you see is what you get) map editor. Meaning that if you edit an Inj cell's AFR value from 11.0 to 11.5, then an AFR of 11.5:1 is what you'll then actually read while driving.

The Regen function can be called by pressing [?] from the main menu to bring up the Target map generator. Make sure your cruise & boost zone options are the same as the ones you had during auto-tune, and press [G]. You can use it on any map, whether or not it's been recalc'd. Advanced users can use Ctrl-V to paste custom AFR maps.



FC-Tweak will regenerate your Inj map with the real AFRs, and will also modify the basemap so that all cells have their Base x Inj values preserved, thus perfectly preserving your tune. Following map regeneration, you will be taken to settings pg 3 where you'll see your new true AFR Inj map. O2 feedback function will also be reactivated.



And finally, pressing [X] will save your regenerated file with file prefix '~RG-'.
The original file will not be modified.

FC-Tweak active features for different versions

FC-Tweak is available as free shareware, full registered version, registered Pro and USB dongle version.

The shareware version is a comprehensive and organized viewer of all data contained in the PFC Data file. All maps can be viewed in 2D graphic format making it easier to visually spot timing and fuel map anomalies. It has a fully functional data analysis module, and is able to scan and analyse your file and give a short error summary. This version does not expire, but has restrictions imposed on details of errors found, has no tweaking ability and no file export.

The registered standard version activates all tweak mode capabilities (refer to list on page 5). This version has got all tweaking functions enabled and will load, tweak and export your new data file, ready to be uploaded to the Power FC. It literally takes away all dangerous guesswork from FC-Edit or the FC Commander. A must have for all Power FC owners!

The registered Pro version is aimed at the more professional user/ tuner, who wants to make sure the engine is running safe AFRs throughout the whole map. This version is in fact being used by several professional tuners and dedicated RX7 owners worldwide. Apart from all the standard version functions, it also unlocks several powerful functions, such as an active 3D graphic charting and map editing module, implementation of rev and boost soft cut limiters, automated fuel map tuning using logged wideband O2 data, predictive AI tuning, boost sensor calibration tool, engine diagnostic warnings dashboard and lots more.

Features list	Shareware	Registered Standard	Registered Pro	Pro Dongle activation
Customize, load, modify and save car configuration	✓	✓	✓	✓
Load and view all RX7 dat file maps & settings tables	✓	✓	✓	✓
Scan file and rate for safety & performance	✓	✓	✓	✓
Fault report summary screen	✓	✓	✓	✓
Real pulse width & wheel hp tables	✓	✓	✓	✓
2D graphs for IGL, IGT, IGT Split, AFR, Fuel, Power	✓	✓	✓	✓
Highlights O2 feedback, unstable injection and over boost cells	✓	✓	✓	✓
No software expiry date	✓	✓	✓	✓
Can activate hard and soft cut RPM & boost limiters		✓	✓	✓
Individual fault/ tweak detail		✓	✓	✓
Severity rating for each individual tweak		✓	✓	✓
Computes Injector transition for any injector size combination		✓	✓	✓
Injector transition stability rating displayed on all fuel maps		✓	✓	✓
Help/info pop up for each individual tweak		✓	✓	✓
Displays O2 feedback control limits on Inj correction map		✓	✓	✓
Boost sensor offset calibration		✓	✓	✓
Tweak mode (see list on pg5)– corrects all selected problems		✓	✓	✓
Interactive 2D map tweaking		✓	✓	✓
Map Explorer (navigation within 2D graphs)		✓	✓	✓
Export tweaked file to FC-Edit / PFC-Connect format		✓	✓	✓
Clone (convert) PFC files from/to different PFC versions		✓	✓	✓
Free lifetime remote software updates		✓	✓	✓
Manual Map Edit mode in 2D and 3D for all maps			✓	✓
3D graphs for IGL, IGT, IGT split, AFR, Fuel and Power			✓	✓
Dual color mapping (PIM / contour value)			✓	✓
Interactive 3D map tweaking			✓	✓
Copy edited maps to clipboard for use with external apps			✓	✓
On screen display for expected WHP and real max inj duty			✓	✓
Printable log file output for tweaking sessions			✓	✓
Log viewer – loads Datalog files & tabulates measurements			✓	✓
Rates logfiles for data quality, speed & detects wrong UEGO wiring			✓	✓
Auto tuning of fuel map based on real logged wideband O2 data			✓	✓
Advanced auto-tune fuel map data manipulation			✓	✓
Computes fuel pump & fuel lines minimum requirements			✓	✓
Automated AFR target map generator			✓	✓
Ability to import user defined AFR target maps (for advanced users)			✓	✓
Warnings dashboard tests various car sensors using logged data file			✓	✓
Detects & warns of misbehaving/ degrading alternators during auto-tune			✓	✓
Artificial intelligence enables look ahead predictive log based tuning			✓	✓
Filters real logged knock readings from stubborn false knocks			✓	✓
Inj AFR map regeneration function – generates true AFR target inj map			✓	✓
Activates PFC two step launch control for drag racing setups				✓
Includes dealer's option Excel tools which can be called from FC-Tweak				✓
Can be used on multiple laptops without need for individual registration				✓
Price	Free	USD 150	+ USD 70	+USD 30

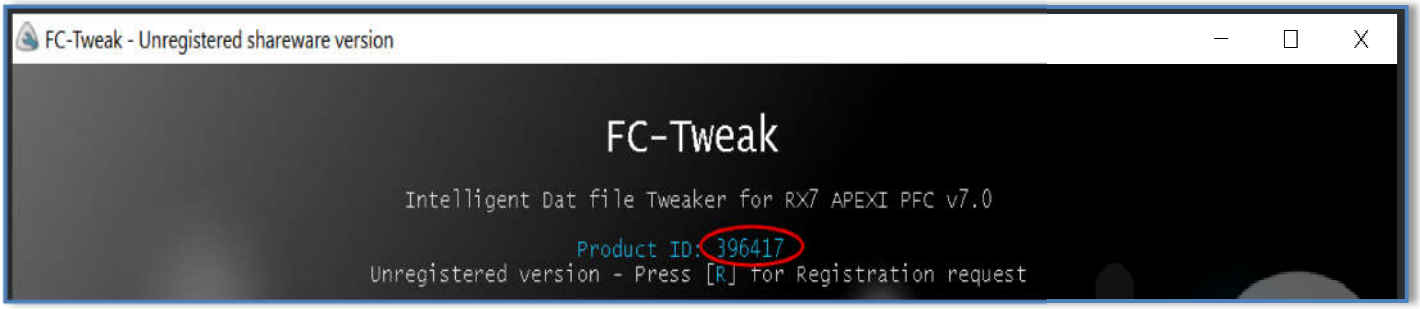
Registering for Fully Licensed or Pro Version

In order to register for the standard full version, or the Pro version, you must first install the shareware version on the same PC on which you intend to run the licensed version. The licensed version will only run on one PC, it has no expiry, and includes free lifetime software updates.

Click the below link to download your shareware copy now
https://tinyurl.com/getFCT

Once downloaded, select the option: Open with Windows Explorer (default), and simply drag and drop the FC-Tweak folder to your main local disk.

When the shareware version is run for the first time, a unique Product ID will be assigned to your program. This is shown at the top of the file manager screen as shown below:



To obtain the full registered version or registered Pro version, you may either send an e-mail to: ingxborg@gmail.com, stating your product ID number as shown on the same PC on which you intend to use the full version. Alternatively, just press [R] on the opening screen, which will send an automated e-mail request. Purchasing information will be sent to you by e-mail, and a download link will be sent to you upon confirmation.

If you already own a registered copy of FC-Tweak, you may also upgrade the license to PRO at any later date by simply paying their price difference.

PFC-Connect USB key activation for FC-Tweak Pro

You can activate FC-Tweak Pro version on your PFC-Connect USB key, so that you can use both software packages on any of your computers without the need to register multiple product IDs. It is also the best choice for those who frequently perform hardware changes to their laptop, since such changes will deactivate the normal product ID license versions. Features:

- License key hard coded on chip, no problems with PID changes.
- Built-in fast memory can also run FC-Tweak directly from key.
- 16 GB of memory space can hold all your PFC files.
- Access to specialized features

The activation option for DL-340XB owners costs just $30.

Notes for Dealer key option

The official USB hardware license key (dongle) unlocks FC-Tweak Pro version on unlimited number of computers without the need to register multiple product IDs. Features:

- Robust metal casing.
- License key hard coded on chip.
- Built-in fast memory can also run FC-Tweak directly from key.
- 16 GB of memory space can hold all your PFC files.
- Gives access to specialized features

You can either run FC-Tweak directly from the dongle, or copy its whole FC-Tweak folder to any of your laptops and run from the local disk. FC-Tweak Pro will be activated on all your laptops as long as the dongle is present on any USB port.

Usage:

(1) You can either copy the whole folder from the USB key to your hard disk so that FC-Tweak will reside on your hard disk. In this case, the key will only be used to unlock FC-Tweak, and all files will reside on your computer(s).

(2) Or you can run FC-Tweak directly from the USB key, as a stand-alone tool. In such a case, all files, including all your customer's map files will reside on the key. This will leave no trace of FC-Tweak on the host computer, and one may even run FC-Tweak from the key on the customer's own computer without installing anything.

Creating a desktop icon:

Having a desktop icon gives fast access to start up FC-Tweak Pro.

For usage (1), click on the Windows search button, type 'file explorer' and click on File explorer App.
Double click on 'Local disk C:' folder and click on FC-Tweak folder. Then right click on the application file 'FC-Tweak' and select 'Send to->Desktop (create shortcut)'.

For usage (2), you first need to make sure that your computer always assigns the same drive letter whenever the USB key is inserted. So first, right click on the Windows start button, select 'Disk management', right click on FC-Tweak pen drive, select 'Change drive letter & paths', press 'Change' and assign letter 'T'. Avoid choosing letters A-F, as these are commonly auto-assigned by Windows. Finally, open file explorer and go into T:\FC-Tweak folder. Right click on the application file 'FC-Tweak' and select 'Send to->Desktop (create shortcut)'.

Setting for best graphic appearance

On some computers, especially those with a customized screen scaling factor, FC-Tweak graphics may appear out of focus. If you see that FC-Tweak's graphics are not perfect, proceed with the following.

For both (1) or (2), right click on the desktop icon, select 'Properties' and 'Compatibility', select Change high dpi settings, then select 'Override high DPI scaling behaviour. Scaling performed by -> Application' and hit OK, apply,OK.

Warning: In order to avoid data losses or any hardware damage, always select 'Safely remove hardware and eject media' from Windows taskbar before pulling out the USB key.

Other special features

Programmable two-step launch control for drag racing setups

Launch control is designed to produce the maximum amount of power and traction for a vehicle to accelerate from standstill as quickly as possible. It's used to assist drivers of both street and racing cars. While the "control" part of its name has a safety aspect, the emphasis is on the "launch" and the resulting zero-to-sixty mph times. As the name suggests, a two-step rev limiter locks the engine speed at two points: one being the conventional redline and the other set at a particular engine speed where your combined car setup makes its best launch, effectively delivering the optimal power to the road from standstill. This function is commonly achieved using aftermarket hardware add-ons, but FC-Tweak incorporates this function within the PFC file with no additional wiring or hardware requirements. Note that this option is only available on the USB dongle version.

As you know, it takes time for the engine to ramp up its speed due to rotational inertia, and further time is required to spool up the turbos. On the other hand, your engine cannot be redlining for a perfect launch, as you'll end up having unnecessary wheel spin and total loss of traction. Without proper launch control you will be doing an unintentional burnout at the starting line, while your opponent equipped with launch control would be already half way down the track by the time your tires grip the track.

There is a sweet spot in the engine's rev band combined with clutch & tire characteristics at which you get the most amount of effective acceleration, and that's where the first launch limiter is set. The moment the car is launched, there is no further role for the first limiter and the engine can rev past this limit until it hits the second limiter at redline.

Most aftermarket add-on units which are mainly aimed for use with piston engines, tend to favour the ignition cut method that supplies unburnt fuel to the exhaust manifold. This method was also used on earlier Apexi Pro units which have been discontinued long time ago. The pops and bangs are much wilder than the retarded timing method, but the stresses in play are something to be very worried about especially on RX7s. Exhaust manifolds and turbos are simply not designed to handle such amounts of repetitive stress and get permanently damaged in a relatively short time.

On the contrary, the control method used by FC-Tweak's two step launch control is by retarding ignition timing just enough to serve the purpose. In this case, the ignition happens midway during the power stroke close to zero degrees timing, which leads to most of the igniting combustion mixture to exit the exhaust while keeping the effective work done by the engine to a minimum. Not an ideal solution as far as fuel efficiency is concerned, nonetheless it's the safest way to go in order to prolong the life of the engine, turbo and exhaust components. Most importantly it serves the main purpose of holding a stable and controlled launch RPM while pre spooling the turbo before releasing the clutch pedal.

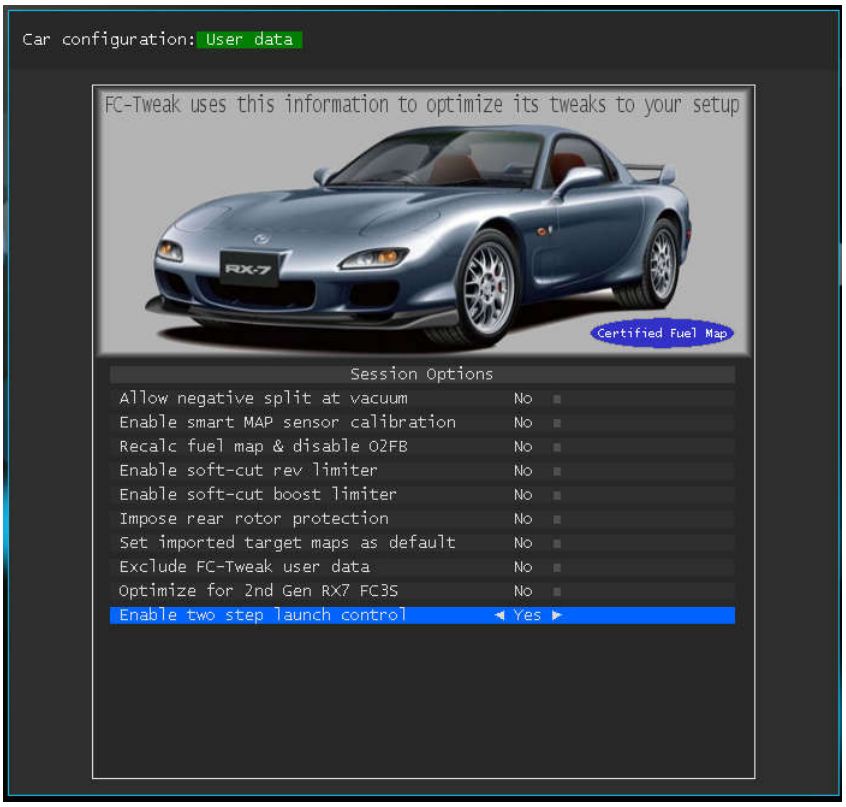
Although FC-Tweak's two step launch control is by far safer, it still generates a considerable amount of heat and it should be used responsibly, and only for those moments needed to do its job. Water injection is also recommended. Holding the engine at the launching RPM for prolonged periods of time, just for the fun of it, may eventually result in expensive damage. Catalytic converters should obviously not be used for such setups.

Setting up two-step launch control on the PFC

To help you with setting the correct launch parameters, it's a good idea to turn the FC-Commander into map tracer mode, and take note of the trace which the ECU takes when stepping down on the gas pedal at standstill. This is very helpful to select the correct launch parameters which will be described shortly.

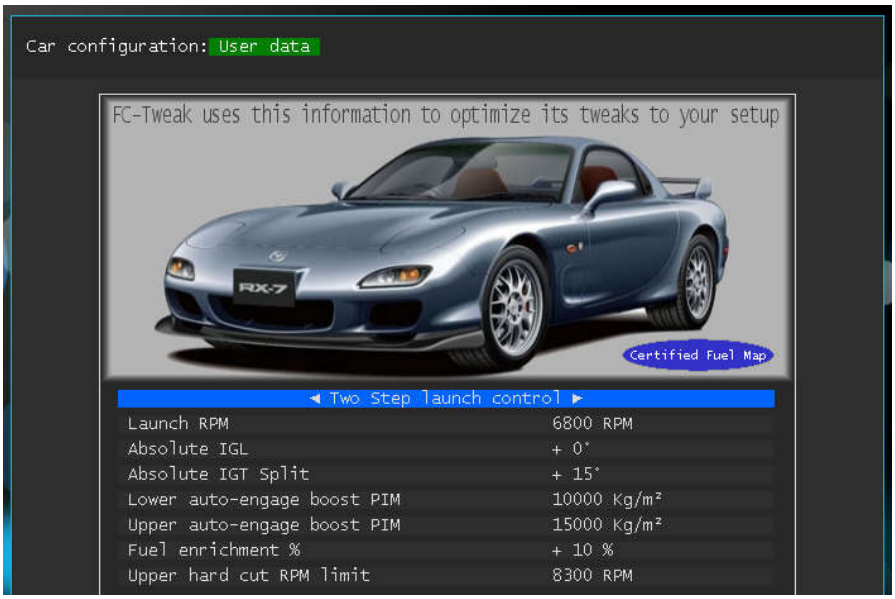
Before setting up the launch control, you should make sure that your map is fully tuned and ideally certified by auto-tune. Certified maps are clearly marked on FC-Tweak once loaded.

Enable the two-step launch control feature from the Session Options menu. This tells FC-Tweak that you intend to set up launch control, and will give you access to its settings menu.



Then scroll up to the Session Options bar and click on the right cursor arrow key to access the Two step launch control settings menu.

Two step launch control settings menu



Setting these parameters correctly and with some practice, you will be able to master consistent and powerful launches. As with all launch control systems, some trial and error will be necessary until you get the best result. Note that the PFC has no external switching hardware for it to go into launch mode on demand, so this method will auto-engage launch control whenever a very specific zone of your map is being used. Luckily, the correct engagement map zone for launch control is not commonly used during normal driving, so it makes it possible to be embedded into the same map used for street driving with virtually no false engagements.

Launch control parameters

Launch RPM: This defines the RPM at which the engine will hold its speed whenever the gas pedal is floored and the car has no external load. This speed should be set high enough to avoid false triggering during normal driving and also close to the RPM at which the engine gives the best acceleration from standstill without excessive loss of wheel traction. This usually ranges between 5000RPM and 6800RPM depending on car setup.

Absolute IGL: This defines the absolute retarded ignition timing which will stop the engine from revving past the launch RPM. The smaller the number the less advance, so the combustion energy will be diverted away from the engine to the exhaust. FC-Tweak will also create a 400RPM buffer zone approaching the launch RPM in which it will smoothly ramp IGL, IGT and fuel from their normal map values to those defined here.

Absolute IGT split: Defines the timing split angle to be used while sustaining the launch RPM. Use high values in the region 12 to 15.

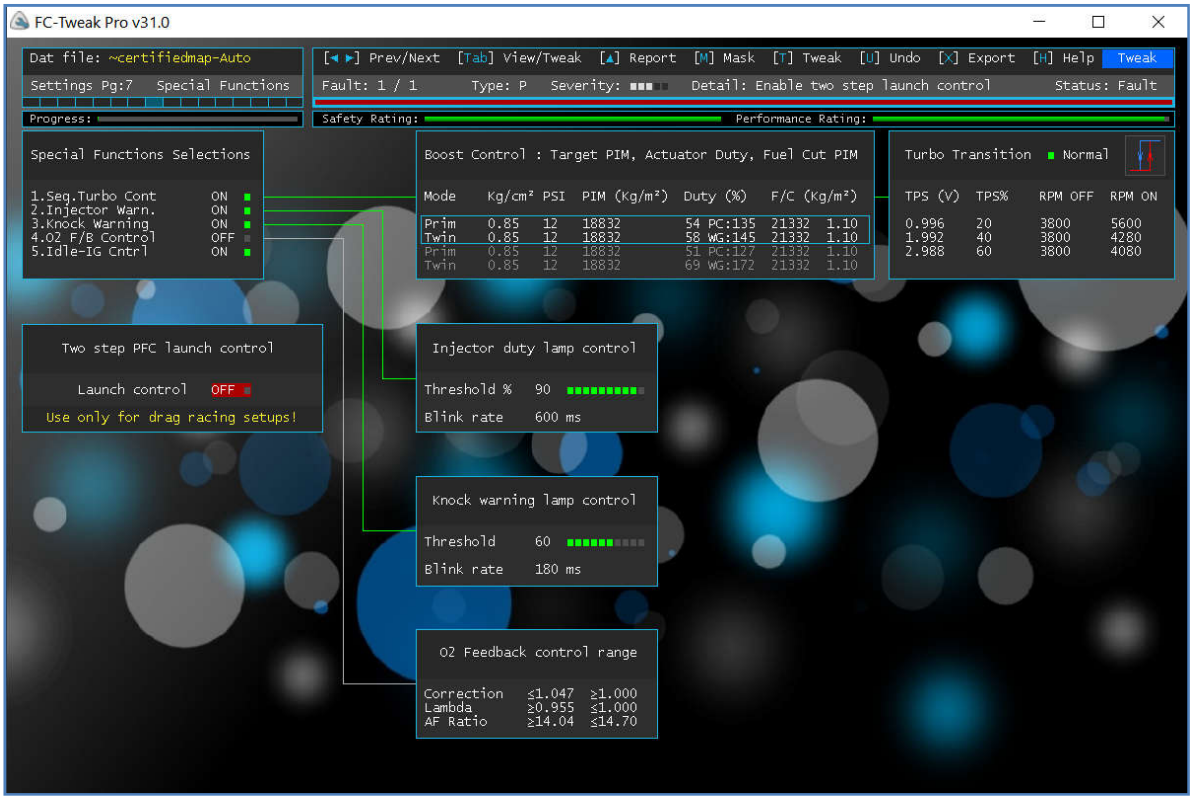
Lower & Upper auto-engage boost PIM: These will define the auto-engage capture zone of the launch control. For example if the launch control RPM is set at 6800RPM, lower PIM=10000 and upper PIM=15000, the launch control will be engaged whenever the PFC hits map zone P10-P15, N17 (on a default map reference table). It will stay in that zone until the drivetrain is engaged, forcing the ECU to 'slide back and away' from this map zone. The map tracer Commander screen can be of great help in selecting this zone. Make sure that when the gas pedal is floored with clutch disengaged, as you would do during a launch, the map tracer always hits the selected zone. If this zone is missed, the launch control will not be triggered and the engine will instead hit the redline limiter.

Fuel Enrichment: The amount of fuel added while being held at the launch RPM. A setting of +10% is a good starting point.

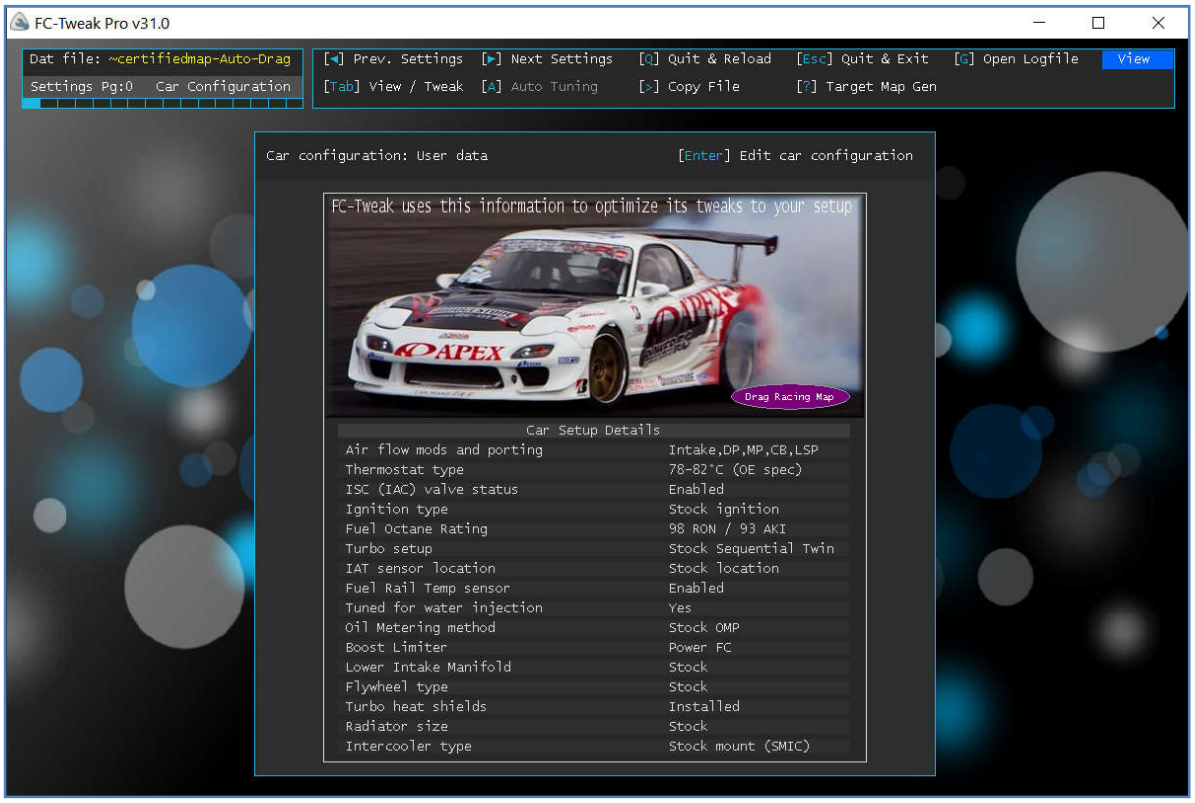
Upper hard cut RPM limit: Change this to your desired red line fuel cut. In addition to this you can also enable the soft cut rev limiter from the Session Options menu for a softer ignition controlled approach to red line.

Launch control activation

After programming the correct parameters, press [Enter] and [Tab] to start a file scan.



Scroll to settings page 7, and press [T] to turn on the launch control option, followed by [X] to export your new file.

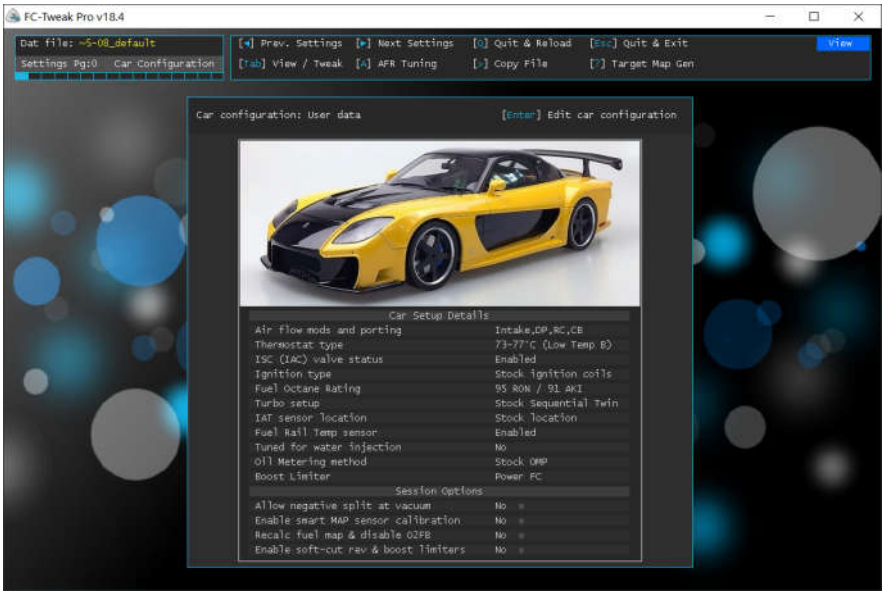


The generated map file will have name extension -Drag.dat and will be marked as a drag racing map when loaded on FC-Tweak. Note that drag racing maps cannot have their launch parameters changed a second time, so to try out a different set of launch settings you should always start from the original tuned map. The launch settings parameters used in the previous session are automatically stored in FC-Tweak upon exit.

Personalize car config picture

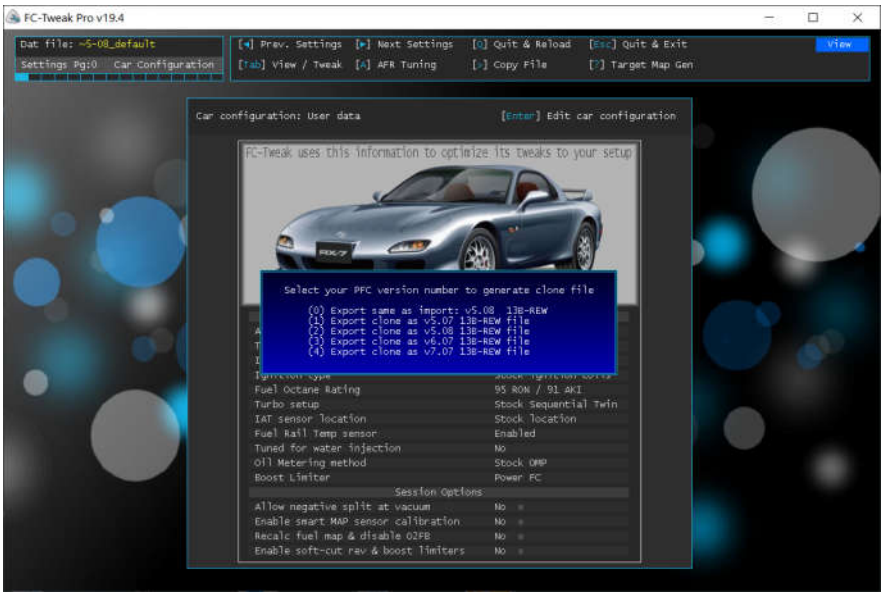
You can personalize FC-Tweak's car config screen photo by simply copying your desired photo into FC-Tweak's folder.

The file must be named 'mycar.jpg' and have an exact resolution of 547 x 226 pixels.



PFC file version cloning

The PFC will refuse to load a file if it does not match its internal hardware version, even if both versions are in fact compatible. For example, one might prefer to start from a map originating from a v7.07 ECU and load it in his own v5.08 ECU. FC-Tweak's file version cloning feature makes it possible to transfer PFC files between different versions. Just load the file you want to convert, press [Alt-X] from Settings page 0, and choose the destination ECU version from the list.



Note: Portions of this document make direct reference to hardware & software from the below mentioned companies:

APPENDIX

How to re-initialize the PFC to recalibrate ISC data to a new starting map

Warning

Place your car in a well ventilated area, since this procedure demands leaving the car idling for some time.

Whenever you start tuning using a completely new map, it is highly recommended to perform this procedure to make sure the ISC data in your PFC is correct. Skipping this procedure may result in sticking or bouncing idle which cannot be corrected by simple adjustments of the throttle body settings. Ideally you should perform this before proceeding with autotune.

This procedure will erase all existing PFC data (not just the map file), and recalibrate the ISC valve data to your new map for a stable idle.

Step 1: Resetting the PFC
Turn key on (engine off)
Set the FC-Commander on its main menu
Select Etc -> All Data Init -> Yes -> Next, to confirm initialization
Turn key off wait for 3 seconds and turn it back on

Your PFC has now been reset to factory conditions and is ready to calibrate its ISC (idle speed control) data, but first you need to load your new file.

Step 2: Loading the new file
Make sure your interface module is connected to the PFC
Turn key on, engine off and set the FC-Commander on its main menu
Connect DL-340XB USB cable to laptop
Run PFC-Connect and 'Write All' selecting the new file
Close PFC-Connect

Step 3: Reprogramming ISC memory
Using FC-Commander from its main menu, set:
Monitor -> 4 channel, and using its arrow keys, select Eng Rev, WtrTemp, Boost, BatVolt
Press Next button to enable monitoring
Make sure the boost value is very close to zero, example 0.01kg/cm2 or -5mmHg
If you see a value greater than -10mmHg you need to calibrate your boost sensor data with FC-Tweak's 'Boost offset correction only' calibration mode & upload the corrected file to PFC before proceeding.

If boost reading is fine, it's now time to start up the engine. During the following procedure it is normal for idle to be unstable or erratic, but the PFC should be able to complete the whole procedure without stalling, so do NOT be tempted to 'help' the engine by pressing on the gas pedal. In fact, it is very important not to touch the gas pedal during the whole procedure. It's also important not to press the brake pedal as this affects the electrical load.

Check that all electrical loads such as lights, rear window defroster, any sound systems and A/C are all off.
Make sure WtrTemp is lower than 50C and start up engine

Check that BatV goes above 13.7v with engine idling

Leave it idling until WtrTemp reaches 80C
By this time, the engine should stabilize at your preset 'Idle AE' (no load) RPM setting

Turn main headlights on for 5 minutes
During this time engine should stabilize at your preset 'Idle E/L' (electrical loads on) RPM setting

Turn A/C on for 5 minutes (if A/C has been deleted, skip this part)
During this time engine should stabilize at your preset 'Idle A/C' (A/C on) RPM setting

The PFC has now completed the ISC programming process and has stored the data in memory so that it can idle perfectly under any load conditions.
Turn off engine. Your car should now be able to start and idle perfectly under any condition.
Proceed with FC-Tweak's auto tune to get your fuel map tuned.

APPENDIX

Choosing your aftermarket boost (MAP) sensor

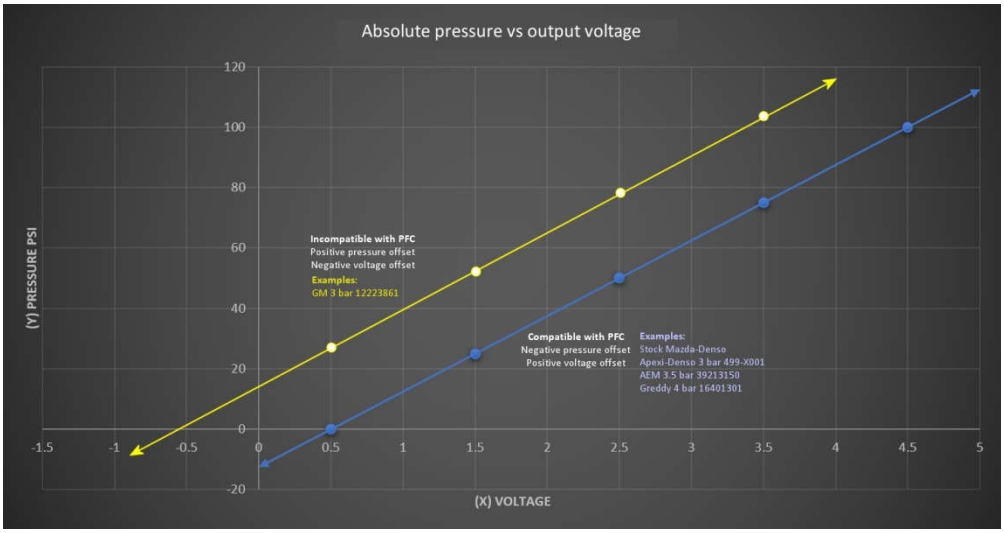
Unfortunately there seems to be a common misconception amongst most RX7 owners and tuners, that as long as the MAP sensor can be wired up to the PFC and is properly rated for the planned boost pressure, it should be ok. Well, that turns out NOT to be the case with the PFC.

There are basically 3 important things to look check before purchasing an aftermarket boost sensor:

- Make sure it is compatible with PFC (do not assume it is compatible just because other RX7 owners are using it!)
- Make sure its offset value is big enough to allow the PFC to compensate for barometric pressure variations
- Select the proper boost range for your application. Go for the smallest boost rating which adequately covers your maximum boost. Going for higher ratings will only serve to reduce the boost pressure accuracy on the PFC.

Checking sensor compatibility with PFC

Of course you would want to know this before actually purchasing. Never rely on what the vendor or even other RX7 owners say about a particular sensor, do your own homework and decide for yourself. I will show you 2 easy ways to do this. The easiest ways to know whether or not an aftermarket boost sensor is compatible with the PFC is to look either at its graph, or at its sensor voltage equation given by the manufacturer. If you can't get either of these, do not purchase.



On the PFC you cannot flip the sign of the offset value (which is a negative pressure offset), meaning that boost sensor selection is restricted to those models having a negative pressure offset (or a positive voltage offset). In layman terms, the chosen sensor should give a positive voltage reading even at absolute vacuum, as in the blue colored graph shown above.

As shown in the above chart, GM 3 bar model 12223861 has a negative voltage offset (the place where the yellow graph touches the X-axis), so no matter what values you put in the map sensor settings on the PFC, it can NEVER read correctly across the band. One can play around with scale and offset to make it read correctly at one particular pressure, but the readings will be wrong everywhere else.

Alternatively, if the manufacturer does not give a graph, it should at least give an equation for its output voltage characteristics, in the form Vout = xxxP (+/-) yyy
If the sign in such equation is (-) it means it's a negative voltage offset type, and cannot be used with the PFC.
For example GM3 bar equation is 0.0162P - 0.0179, which is clearly incompatible!

Checking its offset value

The boost sensor's pressure offset value must also be big enough to enable the PFC to be calibrated correctly. Since the PFC is not equipped with an internal barometric sensor you should select a boost sensor whose negative offset is higher 700, enabling you to adjust the offset by +-50mmHg as required for your particular ground elevation. For example both Apexi's 3 bar and Mazda's stock sensor offset values are in excess of 3000, so one can either increase or decrease the offset as required, practically without limit. To check this offset value, convert the manufacturer's voltage equation to the form: P= xxxV – Offset

Choosing your aftermarket boost (MAP) sensor (continued)

Map sensor table indicating PFC compatibility

PFC scale & offset values calculated from manufacturer's specs or real measurements

Brand	Pressure Rating (Bar)	Part no.	Compatibility	PFC Scale	PFC –ve Offset
AEM	2.0	30-2130-30	Yes	5234	2618
AEM	3.5	30-2130-50	Yes	8749	4375
AEM	5.0	30-2130-75	Yes	13148	6574
AEM	7.0	30-2130-7	Yes	17577	8789
Apexi Denso	3.0	499-X001	Yes	6579	3300
Denso	2.0	100798-2131	Yes	5303	3734
Denso	3.0	DPS-310-2000A	Yes	6579	3300
GM	3.0	1222-3861	No (>~5% error @ offset=0)	6400	<0
HKS	3.0	4299-RA008	Yes	10194	5093
LINK	3.0	MAP3L	No (~5% error @ offset=0)	6417	<0
Mazda Denso	2.0	N3A1(F1)-18-211	Yes	5303	3734

If your MAP sensor is not listed here, let us know its part number so that we can verify its compatibility and add it to this list.

GLOSSARY

[A]

Absolute Pressure: is the pressure as measured relative to absolute vacuum. Atmospheric Pressure is 101Kpa/ 1Bar/ 14.7 psi.
Access: The process of reading the internal maps and settings data stored within the POWER FC.
Actuator: Using either electrical or air pressure inputs, an actuator uses the signal to create a physical motion.
Advance: The action of changing ignition timing to make the spark occur earlier in the combustion cycle, opposite of Retard.
Air Fuel mixture: The combination of air and atomized fuel injected into the engine as a fuel mixture.
Air Fuel Ratio(AFR): The Air/Fuel Ratio is the proportion of Air versus Fuel in the combustion chamber. A richer A/FR will have a lower number (ex: 10.5:1) while a leaner A/FR will have a higher number (ex: 15.0:1).
Atmospheric Pressure: The pressure exerted by the earth's atmosphere on the earth's surface at any given time. Atmospheric Pressure at Sea Level is 101.3Kpa/ 1 Bar/ 14.7 psi.
Auto-tuning: Refers to FC-Tweak's unique AI process of generating a tuned fuel map by using real data logged during a driving session.

[B]

Base Fuel Map: The setting map on D-Jetro systems that allow for ideal air fuel ratios. Since D-Jetro does not measure air volume, it is based off of engine RPM and manifold pressure. Fuel injection times are calculated based on values from this map.
Base Fuel Pressure: Fuel pressure measured within the fuel line before being increased to compensate for engine load. It can be measured by connecting a jumper across F/P and GND terminal on the diagnostic connector and turn key on, with engine off.
Boost Control Kit: A kit developed for use with the POWER FC to control single turbo boost pressure electronically through the POWER FC. Note that Power FC does NOT need this to control the stock twin turbos. When using this boost control kit, which is basically an actuator, no external boost controller is necessary. It lacks control flexibility compared to external stand alone EBCs.

[C]

Cell: An individual unit inside a map that contains data.
Combustion Chamber: The space within the engine between rotor & housing on the spark plug side.
Combustion Speed: The speed at which the air fuel mixture ignites and combusts by means of the spark plug.
COM Port: One of the communications ports on older PCs used to communicate with external devices. A serial to USB converter is required to interface serial port connections to newer computers.
Compression Rate: The rate of comparison between the volume within the combustion chamber at BDC vs. TDC.
Crank Angle Sensor: A Crank-Angle sensor measures the angular position of the crankshaft and sends that information to the ECU in order to calculate engine RPM and crank angle position.
Cycle: One whole pattern of a repetitive sequence of events.

[D]

D-Jetro: A type of ECU controlled fuel injection using a pressure sensor installed on the intake manifold, engine RPM, and an open loop control Basic Fuel Injection Maps, also referred to as speed density mode.
Diagnostic Connector: A factory ECU port in which various operations of the vehicle can be checked for proper operation and problems can be diagnosed using the proper tools. FD3S diagnostic port is located in the engine bay close to the main fuse box.
Displacement volume: The total volume of air that the rotor sweeps across during its combustion cycle.
Duty Control: Controlling the time averaged amplitude by changing the on:off time ratio of an electrical signal. Injectors are controlled in this way.
Duty Cycle: A measurement of a solenoid valve's (or fuel injector) time spent ON relative to the time it takes for the solenoid valve to cycle ON then OFF. Duty cycle is measured in percentage of a whole cycle.
Duty Time: The amount of time a fuel injector is switched on and fuel is sprayed, usually measured in milliseconds.

[E]

ECU: Engine Control Unit which controls most of the engine related electronic systems on a vehicle. The PFC is an ECU.
Electrical Load (E/L): Reference to all hardware that uses considerable electrical current (headlights, fans, A/C) and therefore higher load on the alternator. Higher load on the alternator results in higher load on the engine, and the ECU will need to compensate for it so as not to affect driveability.
Engine Code: The designation, or name, given to an engine by its manufacturer, example 13B-REW
Exhaust back pressure (reverse pressure): Any pressure impeding the flow of exhaust gas in an exhaust system, mostly due to flow restrictions within the catalytic converter. For turbocharged applications, there is an additional back pressure caused by the turbo.
Exhaust Gas Temperature (EGT): is the measured temperature of an engine's exhaust gases usually measured about 3-5 inches from the exhaust port, pre turbo. Temperatures >950°C in rotary engines are to be avoided.

[F]

FC Commander: A simple handheld plug-in editing device that can also be used to monitor up to 8 channels of information from the POWER FC. Earlier types had a green backlight LCD display, while newer ones have a yellow OLED display.

FC Edit: A third party software which allows one to communicate, edit and log data from the PFC via an interface box. There are several interface boxes readily available on the market.
FC PRO: An official APEXi software that allows POWER FC complete setting/tuning using FC Pro interface box.
Feedback loop: is a control loop that uses output data to modify the input of that same source generating the data. Example O2 feedback loop is used to modify fuel injection quantity to keep AFRs at stoich during cruising.
Fuel Cut: is the act of completely stopping fuel flow into the engine. There are 3 modes of "fuel cuts" in the PFC: High RPM Fuel Cut (Rev Limiter), Overboost Fuel Cut, and deceleration Fuel Cut.
Fuel Pump Capacity: The fuel rate a fuel pump can move through its system.
Fuel Pressure: The pressure of fuel required so that the injectors may spray an exact predefine amount of fuel. Stock fuel pressure is 38psi.
Fuel Pressure Regulator: A spring loaded device in series with the fuel line necessary to keep fuel pressure seen across the injector constant at any boost pressure.
Fuel Rail: A manifold used to supply multiple fuel injectors with an equal volume of fuel at an equal pressure.

[H]

Hysteresis: The gap between switching ON and OFF threshold points of a control device necessary to avoid oscillations.

[I]

Idling speed: The engine speed to which an engine reverts to at closed throttle. For performance engines, idling speed should be set between 800 – 1000RPM depending on several other factors.
Idle Self Learning: The PFC has the ability to learn the throttle position and engine behaviour in order to improve stability at target idle RPM's. The TPS & AAS must be correctly set for this function to work properly.
Idling Ignition Timing Control: A PFC feature to hold a stable idle by advancing the ignition timing when the idling falls, and retarding timing when the idling rises. This function is combined with the ISCV control.
IGL: Ignition timing for the leading spark plugs
IGT: Ignition timing for the trailing spark plugs
Interpolation: The process to create "missing data" based on neighbouring data. The POWER FC continuously interpolates data from several settings tables and maps.
Initialize: Resetting the PFC to factory conditions. By initializing your Power FC, all settings & maps will revert back the original program as installed by APEXi. Be sure to back up your data before reinitializing.
Injector (Inj): A duty controlled solenoid managed by the ECU to inject precise fuel quantities into the engine.
Injector capacity: The amount of fuel sprayed by an injector per minute, measured in cc/min.
Injector Lag Time: The measurement of time between the instant when the injector is commanded by the ECU to open, and the instant when the injector actually opens and injects fuel. Typically larger injectors are slower and have higher lag time.
ISCV(Idle Speed Control Valve/ISC): ECU controlled air that bypasses the throttle valve for a more stable idle.

[K]

Knocking: This occurs when combustion of some of the air fuel mixture in the cylinder does not result from propagation of the flame front ignited by the spark plug, but when one or more pockets of air/fuel mixture explode outside the envelope of the normal combustion front.
Knock level: The FC-Commander has a knock level display that uses the factory knock sensor. This display shows the vibration in the cylinder block created by knocking. The PFC takes no action on this value and offers no protection against high knock levels. The knock level displayed is for reference only and can report a high percentage of false knocks. False knocks can increase when, for example, race clutches are used, or exhaust components are not properly mounted.

[L]

L-Jetro: an MAF type ECU that calculates how much fuel to inject according to air volume data from the Airflow Meter.
Ld(Leading): There are 2 spark plugs for each rotor on rotary engines. The bottom plugs ignite first thus gaining the term "leading".
Lean: A state where there is less fuel than your target A/F Ratio requires.
Linear solenoid: An electromechanical valve whose motion is proportional to the current applied to a magnetized coil.
Load: Resistance an engine must overcome. Example: High alternator loads like, A/C, driving up a slope will all increase mechanical load on an engine.
Logging: The process of recording data from various sensors to playback/ analyze at a later time for tuning purposes.
Low temperature Thermostat: A thermostat installed for the purpose of lowering the operating temperature by opening earlier allowing coolant to pass through coolers earlier lowering the temperature. Typically these will operate around 6c degrees cooler than an OEM thermostat. The opening temperature must still be enough for the engine to reach 80C after warming up, otherwise the PFC will be stuck in its cold start fuel enrichment mode.

[M]

MAP (Manifold Absolute Pressure): Absolute pressure at the intake manifold relative to absolute zero vacuum pressure.
MBT (Minimum advance Best for Torque): The ideal ignition timing to produce maximum torque for a given load and engine RPM. Applying this value for every stage would be extremely efficient and minimize load on the engine while driving.

[O]

O2(Oxygen) Sensor (narrow band): Measures oxygen content in exhaust gas and produces 0 – 1v voltage to the ECU, with a sharp change over from 0v to 1v at an AFR of 14.7:1. This voltage is used to determine the feedback for better fuel economy and combustion.

Overshoot: A condition in which a control system exceeds its intended target. It's used mainly to describe the behaviour of boost control systems.

[P]

PIM: Originally Pim, refers to the absolute pressure measured at the intake manifold.
Pressure Sensor: It is an electronic sensor which converts intake air pressure into an analogue 0-5v voltage. Pressure Sensors are used in D-Jetro fuel management systems and boost pressure measuring devices.

[R]

Relative Pressure: is the measured pressure relative to atmospheric pressure as a starting point. With atmospheric pressure of 1 bar being the reference point, relative pressure at sea level would be zero 0 bar, while absolute pressure would be 1 bar. A 3 bar (absolute) MAP sensor will therefore be able to measure up to 2 bar (relative) boost.
Retardation: Adjusting the ignition spark to occur later. It is the opposite of advancement.
Rich: A state where there is more fuel than set in your target AFR map.
RS232C: A standard communications interface approved EIA for serial devices.

[S]

Sampling Time: The time measured in milliseconds which the logging device takes to read a whole data set. A sampling time of 100ms means that a data line is read once every 100ms.
Sampling Rate: Is the inverse of sampling time. The longer the sampling time, the lower is the sampling rate. A sampling time of 50ms means that data is being captured at a sampling rate of 20 samples/ second.
Self Learning: A built-in function of the POWER FC that uses TPS and RPM data history to give stable idling.
Sequential Turbo: A system using two turbochargers which spool in sequence rather than at the same time. The goal is to lessen low end turbo lag associated with large turbochargers, while still providing good high end power.
Solenoid Valve: A solenoid valve is an electromechanical valve which converts an electronic signal into physical movement using an electromagnet, or solenoid.
Spark Plugs: An electrical electrode that ignites spark to the air fuel mixture within the pressurized combustion chamber. Due to a 100-150°C operating temperature difference, when upgrading spark plugs heat range, be careful of rough idling and plug fouling with colder plugs.
Speed density mode: A type of ECU controlled fuel injection using a pressure sensor installed on the intake manifold, engine RPM, and an open loop control Basic Fuel Injection Maps, also referred to as D-Jetro. Alternatively, an ECU can use air flow metering (MAF) instead of MAP sensor to measure load, also referred to as L-Jetro.
Split timing: Is the difference in timing angle between the trailing and leading spark. The split map is extremely effective in eliminating knocking/detonation.
Stoichiometric A/F: The amount of air divided by the amount of fuel drawn into an engine which is chemically correct to burn all carbon and hydrogen in the fuel leaving only carbon-dioxide and water leaving no oxygen.

[T]

Target AFR: This is the ideal air/fuel ratio for each cell as set in the AFR target map.
Thermostat: A temperature activated device which is used to control the flow of water and/or oil from the engine to its coolers. The Thermostat allows for quicker building of temperatures for improved drivability, by bypassing the radiator until the engine reaches operating temperature.
Throttle Position Sensor (TPS): The Throttle Position Sensor measures throttle angle at the throttle-body and sends this information to the ECU for better control of fuel injection.
Tr (Trailing): There are 2 spark plugs per rotor on rotary engines. The top spark plugs ignite after the Leading plugs thus gaining the term "trailing." This IGT map setting is extremely effective in eliminating knocking/detonation.
Tweaking: Refers to FC-Tweak's unique process of analyzing all PFC data, search, correct & optimize all settings which may lead to engine damage or loss of performance.

[V]

Volume Efficiency
A term used to describe the amount of intake charge drawn into the combustion chamber during the intake stroke versus the amount it the combustion chamber was completely filled.

[W]

Wideband O2 module (WBO2): Measures oxygen content in exhaust gas and produces a linear analogue 0 – 5v voltage which is fed to a data logging device. This voltage is converter to AFR readings and used to tune the engine so that each fuel cell can be precisely tuned to its target AFR.

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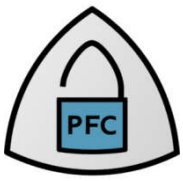

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