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Any goods returned for any other reason other than manufacture error will incur a 10% re-stocking fee.

Introduction

What is an interceptor?

Haltech has been in the aftermarket ECU business for over a decade offering fully programmable replacement ECUs that completely replace an engine's factory ECU or carburettor system. Haltech's ECUs are high quality programmable ECUs that can be setup to run any engine at optimal tune. For many years, this has been the preferred method of achieving consistent accurate tuning in a modified engine. In recent times however, modern car manufacturers have been consolidating the many electronic boxes that were previously independent systems into a single electronic box, or at least a much reduced number of electronic boxes that have much higher control complexity. Not only have engine electronics increased in complexity, but the modern ECU also controls much more than just the engine, with control now extending to automatic transmission control, instrumentation control and much more. Although Haltech has added many advanced control features to satisfy increased requirements, it is impossible for Haltech to keep up with the many new features being added to the vast models of vehicles being released each year.

Haltech continues to support these vehicles by recommending the install of full replacement ECUs in a piggyback arrangement. This is achieved by leaving the stock ECU in place to control all functions that are not related to engine performance, and using the Haltech to control features that affect engine performance. This approach is very effective, and allows a high degree of engine control to tune the engine for optimal performance. In many cases however, the Haltech ECU is running the engine exactly the same as the still present factory ECU except at large throttle openings. Haltech tuners must still tune the difficult areas of light load, idle and cold start that the original ECU did so well.

Haltech recognized a need to add a product to a car that retains the factory ECU for everything it does so well, but adds the ability to tune the factory ECU in areas where performance gains may be made. The Haltech Interceptor is Haltech's response to this need.

The Haltech Interceptor is an electronic box that is designed to read and/or intercept factory ECU signals in order to control the factory ECU to deliver desired tuning settings. The interceptor is fully programmable, so it can be used to adjust only the engine load/rpm areas where the factory ECU is less than optimal in its tune. This then leaves the factory ECU to continue to control the areas of the map that it does so well like cold start, idle etc.

Why does the factory ECU need to be retuned?

All factory ECUs control the amount of fuel injected into an engine, as well as the ignition timing of the engine. In addition, many factory ECUs also control features like turbo boost pressure, variable cam timing, and many other modern engine features that affect engine performance. Car manufacturers do not set out to deliberately detune the engine, but there are often many requirements aside from engine performance that the tuner of the factory ECU must meet. Most of these requirements are to the detriment of engine performance:

- Emissions targets.
- Durability under worst-case conditions (high ambient temps with poor car maintenance).
- Minimization of warranty claims.
- Need to provide lower engine performance in lower priced models.

Even if the factory ECU does tune the engine optimally for performance, it is unlikely that the standard factory ECU will run the engine optimally if the engine receives performance modifications.

Haltech recognizes that many performance car enthusiasts prefer to gain increased engine performance rather than retain worst-case safety tunes. Other enthusiasts prefer to take this further to perform mechanical engine modifications aimed at increasing engine performance and then require the ECU to be tuned to optimize the modifications.

The Haltech interceptor is designed to offer the cheapest and most effective way of achieving retuning of the factory ECU to meet the requirements of the modern performance car enthusiast.

How does the Haltech Interceptor Work?

All factory ECUs will have a sensor used to calculate engine load, and a sensor used to track engine position.

The engine load sensor (in order of highest to lowest preference) is usually an airflow meter (AFM), a manifold absolute pressure (MAP) sensor, or a throttle position sensor (TPS). Some engines may have all of these sensors, but the lower preference sensors are used for diagnostics or transient fuel calculations, and have no effect on the calculated engine load. These sensors usually output 0 – 5V analogue voltage or a frequency voltage signal that the factory ECU uses to calculate engine load. This engine load is then used to calculate how much fuel to inject into the engine.

Fuel Control

When installing the Haltech Interceptor, the signal wire from the engine load sensor to the ECU is cut and rewired so that the sensor signal output goes into the Haltech Interceptor. The Haltech Interceptor then produces a new signal that is connected to the ECU input for the sensor. The interceptor can now make changes to the load signal of the engine so that the factory ECU thinks that the engine load is different to what it actually is.

The factory ECU has tables inside its memory that are used to calculate the required injection time to achieve the desired fuel mixture at various engine load and RPM sites. By altering the engine load signal, the interceptor can alter the position in the tables that the factory ECU is using to calculate the injection time. Generally it is possible to enrich the fuel mixtures by increasing the engine load signal, and to lean the fuel mixtures by reducing the engine load signal.

Inside the Haltech Interceptor is a memory that retains its data even when the interceptor is turned off. Within this memory is a table of percentages that are mapped against engine RPM and engine load. The interceptor calculates the engine RPM and load, and then extrapolates a percentage out of the table that it can apply to the input load signal to produce an output signal altered by this percentage. The tuner of the Haltech Interceptor can tune the percentage tables to output an altered signal that results in the factory ECU thinking the engine load is different to the actual engine load and changing its injection time to achieve the desire fuel mixture ratio across various engine load and RPM.

Ignition Control

The engine position sensor is usually a Hall effect or Reluctor type sensor that is fitted to detect teeth, slots, or magnets on the crankshaft or camshaft of the engine. The factory ECU uses the signal produced by this sensor to calculate engine speed and position, and using this information, it can generate pulses that result in a spark at the desired ignition advance angle.

When installing the Haltech Interceptor, the signal wire from the engine position sensor to the ECU is cut and rewired so that the sensor signal output goes into the Haltech Interceptor. The Haltech Interceptor than produces a new signal that is connected to the ECU input for the sensor. The Haltech Interceptor can then alter the phasing of this signal to advance or delay the signal on its output relative to the true engine position. The result of this is that the factory ECU thinks the engine is in a slightly altered position to the actual position, and therefore it will produce its ignition spark advance output at a similarly altered position.

The Haltech Interceptor contains another table that works in a similar fashion to the table used for altering the engine load sensor described above. The tuner edits this table to provide ignition corrections over various engine load and RPM sites. The interceptor alters the engine position signal by the amount it extrapolates from the table. In this way the tuner can optimally tune the engine to the desired ignition timing.

By intercepting the engine load and position sensors, the Haltech Interceptor can accurately control the factory ECU to deliver the optimal ignition time and fuel mixtures for all engine load and RPM conditions.

In addition to fuel and ignition tuning, there may be other engine signals that can be used to alter engine performance. The Haltech Interceptor has been designed to allow the control of many engine components for optimal performance such as turbo boost pressure and variable cam timing. Additionally, the Haltech Interceptor can be used to override factory protection features like speed limiters and boost limiters.

The Haltech Interceptor is designed to work in perfect unison with the complex factory ECUs on modern cars. It works as a package to provide control of all performance parameters, as well as defeat unwanted protection features of the factory ECU.

Fitting and Tuning a Haltech Interceptor

Fitting a Haltech Interceptor

From the outset, the Haltech Interceptor was designed to be simple and quick to fit and tune. To this end, Haltech has adopted an approach where all currently supported vehicle types can be fitted and started by simply wiring the interceptor using a vehicle specific wiring diagram, and then loading the Haltech Interceptor with a vehicle specific default map. The engine can then be started and should run as it had previously, as Haltech default maps apply no corrections. The engine is now ready for tuning.

Haltech provides a "Haltech Interceptor Software Tools" CD that contains the Haltech Interceptor programming software along with default maps for all currently supported vehicles. Additionally, the CD contains a folder with PDF wiring diagrams for all currently supported vehicles. The wiring diagrams can be printed from any computer with Adobe Acrobat Reader installed and access to a printer. The use of the Haltech Interceptor programming software to load the default map is detailed in later sections of the manual.

The complexity of the wiring varies from vehicle to vehicle, but the minimum complexity consists of wiring to the following factory ECU loom wires:

- Splice to +12V Power
- Splice to Signal Ground (low current, low noise)
- Splice to Power Ground (high current)
- Cut engine load signal and connect to each side
- Cut engine position signal and connect to each side

Additionally, many vehicles have additional signals that must be connected:

- Cut MAP sensor signal and connect to each side (to defeat over boost fuel cut)
- Cut boost control solenoid signal and connect to each side (to enable boost control)
- Cut road speed signal and connect to each side (to defeat speed limiter)

For most vehicles the Haltech Interceptor can be installed by cutting or splicing just 5-10 wires of the factory ECU loom. An experienced installer should be able to install a Haltech Interceptor and be ready to tune in 30-60 minutes.

Tuning a Haltech Interceptor

Tuning a Haltech Interceptor is quite different to tuning a standalone ECU. Although the theories for tuning remain the same in terms of tuning each load point for desired fuel mixture and ignition timing, the response of the factory ECU to Haltech Interceptor changes can be quite different. This section sets out to detail the recommended methods and potential issues that should be considered when tuning an interceptor. This section considers basic tuning theories and methods as assumed knowledge.

Basic Fuel Tuning

The Haltech Interceptor stores corrections in its internal tables as percentages. The actual percentage change applied is a percentage of the signal level. Therefore +100% corrections will double the signal level (not increase it to the maximum), and –100% will reduce the signal level to zero. This gives very high-resolution correction. The actual response of the factory ECU to these corrections is dependent on two main factors: the load sensor type and the factory ECU maps.

MAP and TPS type load sensors will generally give a signal level range from the minimum level to the maximum level at any RPM site. An AFM signal will give the highest signal at the engines max power (high RPM) and the lowest signal at the engine minimum power (low RPM). The result of this is that a smaller signal range is used at any RPM site for the range from minimum load to maximum load. Therefore, when applying corrections to an AFM load sensed factory ECU, small changes (<5%) can make a large difference to fuel mixtures. In contrast, MAP and TPS load sensed factory ECUs often require larger percentage changes (>10%) to get a measurable change in the fuel mixtures.

In addition to the load sensor type affecting the sensitivity, the fuel tables within the factory ECU can also affect the sensitivity. The actual sensitivity is dependant on the fuel mixture variation with load of the factory ECU. Some ECUs tend to enrich the mixture quite aggressively when the load is detected above a normal level as a safety response. Unfortunately the results can be quite non-linear, and sometimes some trial and error is required. Because the Haltech Interceptor has a very high resolution of fuel control with variable load and RPM sites, the desired fuel mixture curves can be achieved with some tuning time.

Closed Loop Mode

Most factory ECUs use closed loop control of injection times at light loads. This means that the actual injection times are calculated after monitoring the exhaust mixtures with the O2 sensor. This is generally only done at light loads (cruising, idle) with a stoichiometric fuel mixture.

During closed loop mode, the factory ECU only uses the engine load sensor for the base injection time, and it then applies corrections to this time to get the mixture to stoichiometric. The impact of this on the Haltech Interceptor is that the factory ECU will tune around any fuel corrections made whilst in closed loop mode as it attempts to get back to stoichiometric fuel mixtures. If large corrections are made in the Haltech Interceptor fuel tables during the factory ECU closed loop mode, the factory ECU could generate a fault code if the closed loop corrections it must do fall outside of its normal expected range. It is recommended that fuel corrections done in closed loop mode should only be done to bring the tune closer to stoichiometric fuel mixtures. This may even be necessary if mechanical modifications have been

made, resulting in the factory ECU base maps being well away from the required stoichiometric fuel mixture. Modifications that would likely cause this are: larger injectors, higher fuel pressure, modified cams etc.

Basic Ignition Tuning

Haltech Interceptor ignition tuning is quite consistent in its response across all vehicle applications. The units in the internal tables are in degrees that are then added to the ignition timing generated by the factory ECU ignition tables. It is important to realise that the ignition tables are a correction, and not the actual ignition timing being run. The factory ECU should be quite close to the desired ignition timing on an unmodified car, but performance gains can be made if tuning for higher quality fuels or the factory ECU tune is very conservative. If the engine is modified, large power gains may be possible. As always, it is important to monitor for any pinging that may occur with too much ignition advance.

Unlike fuel corrections, ignition corrections can generally be made at any load and RPM site, as there is no closed loop control of ignition timing. Often the factory ECU can be very conservative at light loads, and noticeable gains in throttle response can be achieved with additional ignition advance in these areas.

Knock Control

Many factory ECUs employ knock control to prevent engine damage due to pinging. Generally the factory ECU will monitor pinging using the knock sensor and retard ignition timing to get rid of it. The problem with this for the Haltech Interceptor is that in the quest for more power, a tuner may advance the ignition timing, but this may cause pinging. The factory ECU then retards the timing to get rid of the pinging, and the result is that the power curve becomes inconsistent and makes no more power. Haltech recommends that before applying advance, the tuner should retard the ignition timing to see if power is lost. If power is lost, then the advance can be gradually added until max power is reached. It is recommended that the tuner run the minimum advance that achieves the performance requirements. Haltech has found on several cars that maximum power was achieved with ignition retarded from the factory ignition curves, as the factory ECU was tuned to run on the verge of knock control all the time. Therefore more power was made by pulling the ignition advance back to a level that would prevent knock control operation and still make good power.

Diagnostic Scan Tools

Haltech strongly recommends the use of diagnostic scan tools to aid in the tuning of the Haltech Interceptor. Some of the issues mentioned above can be easily diagnosed and worked around with knowledge of the correction factors and modes of the factory ECU. The following parameters can be very useful whilst tuning a Haltech Interceptor:

- **Fuel Mode** – Often a parameter is available that indicates if the ECU is in closed loop mode or open loop mode. This aids in preventing factory ECU errors resulting from applying inappropriate corrections whilst in closed loop mode
- **Long Term Fuel Trim** – Often factory ECUs monitor the closed loop control corrections, and if they average away from 0%, a long term fuel correction is added to enable the closed loop to work with a base injection time that is close to correct. This is to allow the system to maintain correct operation as mechanical parts wear and affect the fuel mixtures. Sometimes mechanical modifications can change the long-term fuel correction significantly (larger injectors), and this could cause fault conditions. If the tuner monitors the long term fuel correction, they can tune to minimize this value to prevent any ECU fault conditions
- **Ignition Timing** – This parameter is useful to give the tuner the ability to know the actual ignition timing being run. Note that the actual ignition timing is this value added to the interceptor correction value.
- **Knock Control Retard** – This parameter indicates if the factory ECU is retarding ignition in response to detection of pinging. It is recommended that the tuner adjust the tune so that pinging does not occur in normal circumstances in order to get a consistent power curve.

There are many generic scan tools available now that support a wide range of vehicles. It may be necessary to research into the best scan tool to suit the vehicles that are dealt with most commonly.

Haltech Interceptor Software

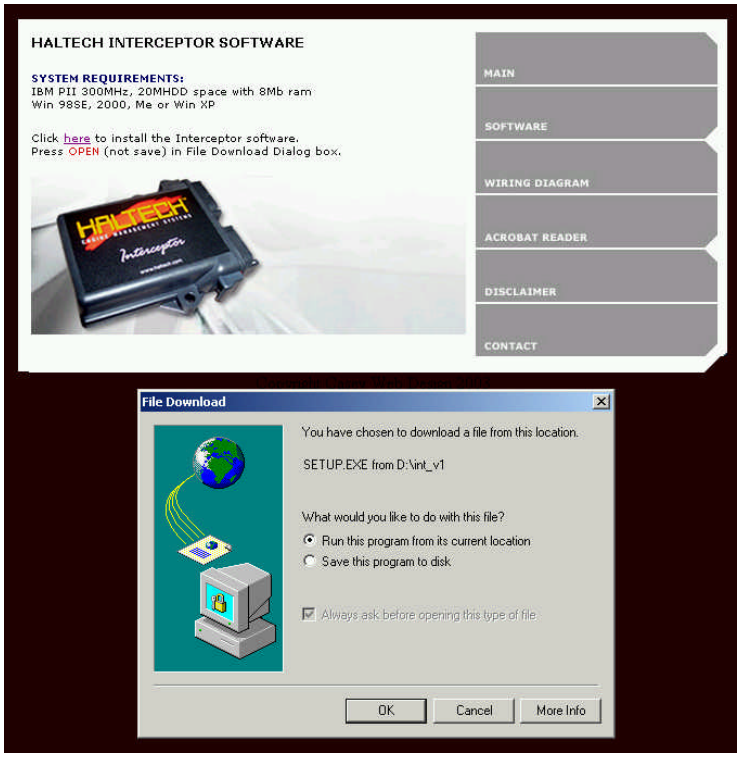
"A quick guide"

This guide is not a full software manual. It is intended to get the tuner up and tuning quickly. Once the basics of the software operation are known, further details can found in the online help built into the software.

Installation

To install the software insert the Haltech Interceptor CD into the computer. The CD should start automatically. After agreeing to the disclaimer you will be presented with the following screen:

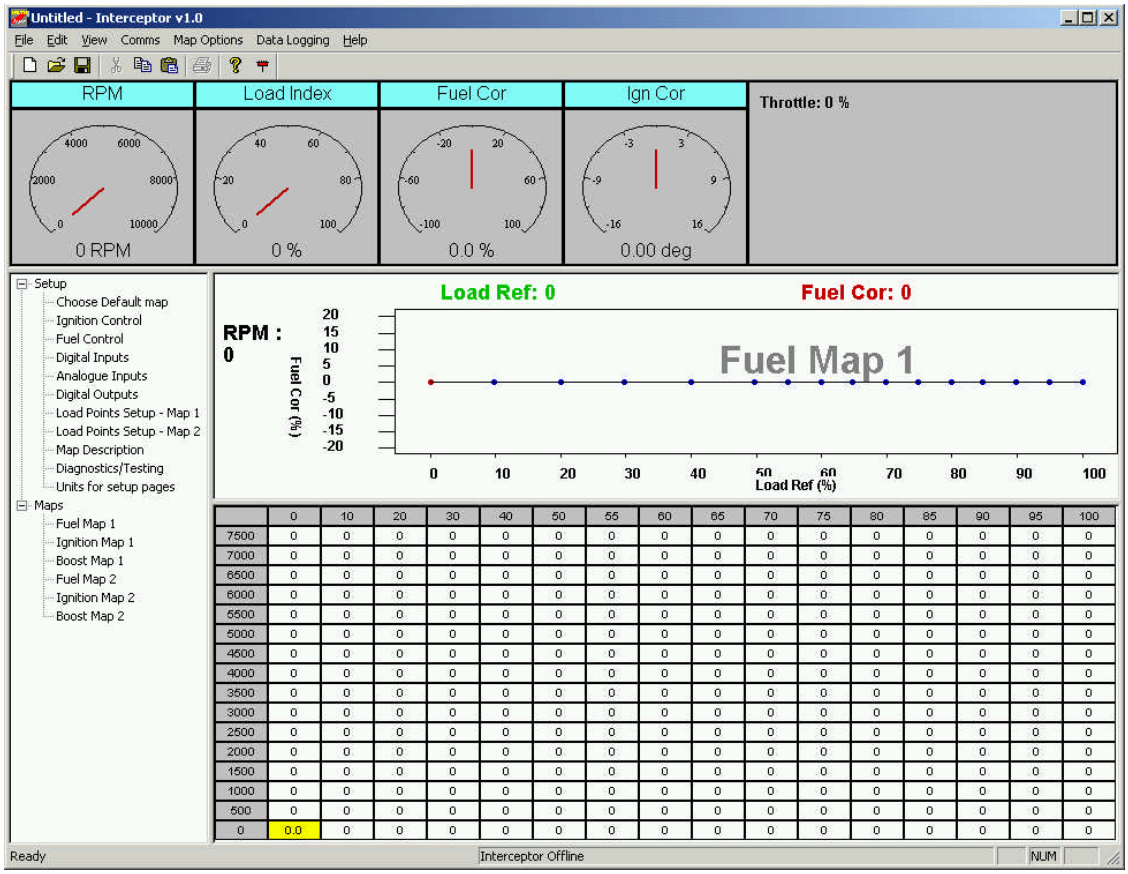
To start the software installation click on the software tab, and this will present the following screen. To start the process of installing the software, select “Run this program from its current location” and click OK.



This will start the install shield and the user can just follow the prompts to install the software. Once the software installation is complete the user will see the following icon on the desktop:

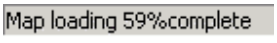
Starting the Software and going online

To start the software, double click on the Haltech Interceptor Programmer Icon. This will display the following screen:



To bring the Haltech Interceptor online the user must first ensure the interceptor has power and the communications cable is connected. Once these two have been checked the user can click on the communications cable icon on the tool bar at the top of the screen:

When this is clicked the map in the Haltech Interceptor is transferred to the front end. The status of this is outlined in the status bar at the bottom of the screen:



Once the map load is complete the message on the Status bar will show "Interceptor Connected". If there is a communications disruption the Status bar will display "Interceptor Disconnected".

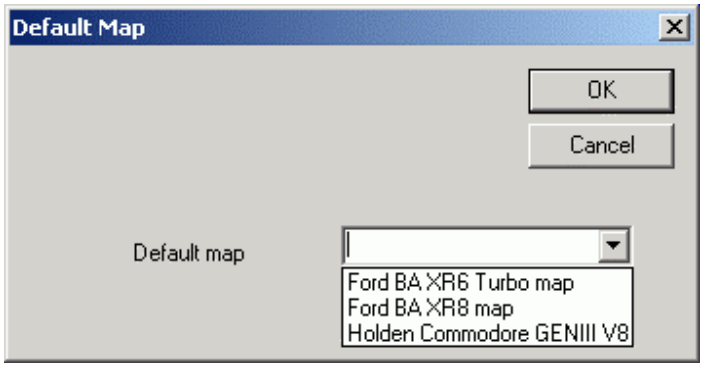
The front-end software uses Com Port1 as the default communications port. Should there be a need to select another com port, for example if the computer has no RS232 port and a virtual USB RS232 port is being used, then the user can select the desired Com Port in the *Comms->Comms Setup* menu. This needs to be done when the Haltech Interceptor is offline.

If the user needs to reset the Haltech Interceptor, for example after a setup change, the user can select *Comms->Reset ECU*. The user will be prompted about the progress of the reset of the interceptor in the status bar. Once complete the status bar will display "Interceptor Connected" and the changes will be applied. Should the user need any further guidance then the user should press F1 or select help from the menu.

Saving and Loading files

To load information into the interceptor the user has two options. Firstly the user can select *File->Open* to load a file of their choice in familiar windows manner. This will load a new file but prevent accidental overwriting of the same map file name. If the user desires to reload the same file they can force this by selecting *File->Load File.*

The second option is to Tab to the Setup menu tree on the lower left side of the screen and select the load default map option. This option is recommended to load a default map when first starting a car. This presents the following dialog:



The user can select the map appropriate for their vehicle, and then click on the OK button.

To save files the user can use the *File->Save* menu to save over top of the current file name, or *File->Save As* menu to save the file to a different name.

Tuning and Navigating through the Front end

The interceptor program has been designed so that the user can navigate using only the keyboard. To navigate between the setup view and tuning view windows, the user can press the Tab key.

To navigate through the setup menu the user can press the up and down arrow keys. Once the user gets to the desired item, the enter key is pressed to select that item. This will display the corresponding setup dialog box. For the setup pages that contain multiple tabbed pages the user presses Ctrl – Tab to cycle through the pages. To apply any setup pages the user can press Enter or click OK.

To adjust the fuel, ignition and boost maps the user can press "F" to jump to the fuel map, "I" to jump to the ignition map, or "B" to jump to the boost map. This will shift the focus to the text view in the bottom right corner of the screen.

Once in tuning mode the user has several options for adjusting the maps. To change a single cell at a time the user simply uses the arrow keys to go to the desired cell, and types in the desired number. To select multiple values the user presses the Ctrl key and the up and down arrows to increase the selected cell range. To change these values to a desired value the user presses the V key and this changes all selected values to the entered value. A summary of the keystrokes is shown below:

Key	Function
Ctrl - C	Copy selected values
Ctrl - V	Paste copied values
Up arrow key	Move selected value up the RPM range
Down arrow key	Move the selected value down the RPM range
Right arrow key	Move the selected value up through the load index range.
Left arrow key	Move the selected value down through the load index range.
Ctrl - Up arrow key	Increases the no of selected points up the RPM range.
Ctrl - Down arrow key	Increases the no of selected points down the RPM range.
Ctrl - Right arrow key	Increases the no of selected points up through the load range.
Ctrl - Left arrow key	Increases the no of selected points
L	Linearise the selected values
Space bar	Take selected values to the current engine position
Ctrl - Space bar	This centers the selected values to one point.
V	This allows the user to enter a specified value for the selected values
Enter	This applies the changes
T	This turns the trace function on and off

Wiring Diagram