

# DESCPRO

Universal calibration software

for

Pectel Control Systems equipment



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## 1 Introduction

DESC Pro is the software used to calibrate all Pectel Control Systems ECUs. It will also calibrate all future vehicle electronics such as chassis-controllers. The software configures automatically to each device by using device profiles, which are supplied to developers as required. Developer's intellectual property can be protected by preventing other developers from accessing their calibrations, even if those developers have Pectel Control Systems ECUs with the same internal software.

This manual will tell you how to access and use all the features available in DESC Pro. It is not, however, a guide to mapping engines, or to the abilities of any particular Pectel Control Systems ECU.

## 2 Overview of DESC Pro

### 2.1 General abilities

DESC Pro was designed with three initial goals:

- No more hex. Gone are the days of calibrating using arbitrary ranges of numbers which do not relate easily to the real world. Wherever possible, quantities are displayed in engineering units (degrees of ignition, milliseconds of fuel, millibars of boost). Also, calibrations which select one item from a number of choices (standard sensor calibrations, for example) are shown as text rather than a raw number.
- Graphical displays. It is hard to get a good idea of trends and gradients from a screen full of numbers. DESC Pro can display curves and maps graphically, and all editing options are available in both textual and graphical modes.
- Instant response. All mapping changes made whilst connected to an ECU are applied immediately. This means quicker calibration and greater accuracy. Features like lock mode (where the cursor in a map automatically tracks the engine position) can also help you map more efficiently.

DESC Pro is under continuous development and since the initial versions there have been a number of noteworthy enhancements:

- Traces. Any two quantities from the monitoring section of the screen may be displayed as rolling traces under the mapping area. For example, this can help with mapping transients or keeping a close eye on air-charge temperature or air-fuel ratio.
- Paste buffer. A second set of maps can be loaded for selective copying or for comparison with main maps. Both textual and graphical editors can display differences between two sets of maps.
- Reports. Selective or full reports of maps can be output to a text file for note taking, record keeping, or analysis in other software such as Excel. If the paste buffer contains compatible maps, difference reports can be generated.
- Error monitoring. Pectel Control Systems ECUs contain a record of current and past sensor errors, allowing easier detection of intermittent problems. An error light keeps an eye on these to make you immediately aware of any problems, and the details for each sensor can be accessed.
- Mouse support. Almost all of DESC Pro can be accessed without using the keyboard. This includes click-and-drag selection and editing of maps in either textual or graphical modes.

- ECU Logbook and Histogram display and reset. Pectel Control Systems ECUs now contain an engine logbook which allows engine builders or series scrutineers to see at a glance the operating temperatures, pressures, voltages and RPM ranges that an engine has been subjected to in its most recent outings. Additionally, an engine-use histogram accumulates the time the engine spends at different RPMs over its entire life.

## 2.2 Protecting your investment

Engine developers spend a considerable amount of time calibrating ECUs to different engines and re-calibrating them as development progresses. Sometimes a developer is concerned that others may gain access to the fruits of his labour. DESC Pro and Pectel Control Systems ECUs provide several ways that this can be prevented.

### 2.2.1 Encryption

In order to prevent access to ECU maps other than through the DESC Pro program, maps are encrypted both when stored on PCs and when programmed into the ECU. If the maps are viewed with any other software, they will appear to be nonsense, and if the maps are randomly changed, the corruption is highly likely to be detected. *Note that sometimes a particular race series will insist that encryption is not used.*

### 2.2.2 Developers

The basic encryption described above is by itself useful in preventing others from gaining access to your maps if they do not have DESC Pro. However, we also prevent unauthorised transfer of maps between our customers by assigning each a *Developer ID* (we also currently have two IDs assigned to ourselves for one-off projects). The Developer ID consists of a set of keys known only to us, which are used, in various ways throughout the developer's ECUs and software. For example, one set of keys is factored into the encryption of maps by DESC Pro. This means that the maps can only be viewed or edited in the correct developer's version of the program. It also means that the maps can only be run in that developer's ECUs. In fact, the developer may lock a set of maps to the serial number of a single ECU if desired. Naturally, the developer may also choose to use the basic encryption only so that a set of maps can be deliberately shared with another developer.

### 2.2.3 Dongles

Some developers wish to go further with security for their work by making theft or misuse of their copies of DESC Pro less easy. For these developers, we use a hardware dongle. DESC Pro will not run at all unless the appropriate developer's DESC dongle is plugged into the PC's parallel port. The task of preventing someone copying their DESC Pro software is reduced to keeping track of their dongles. We usually dongle DESC Pro, but can supply un-dongled versions if the developer prefers.

## 3 Installation

### 3.1 Requirements and compatibility

DESC Pro requires a fully IBM PC-AT compatible computer with VGA graphics and 4MB RAM. You will need more RAM if you are using a significant amount for Smart Drive or similar disk-caching programs. We recommend a 486DX processor as a minimum, but you will see a significant performance improvement by using a more modern Pentium or PentiumII processor. The program will run on most 486SX and 386 PCs if they have enough memory, but performance will be poor. For clearer graphics, a fully VESA1.2 compatible graphics adapter supporting 800 by 600 by 16 colours is useful.

DESC Pro is a DOS-Extended program. This means that it runs either in DOS or in a Windows 95 DOS window. We do not recommend using it in a DOS box in Windows 3.x. If you are using Windows 95 you may wish to set up a DESC Pro shortcut on your desktop. See Appendix A for details.

We have encountered problems with screen-savers (Windows 95) and notebook PC power-saving software (Windows 95 and DOS) which either do not save the graphics adapter state properly or affect the serial ports. If you find that DESC Pro cannot communicate with the ECU when you come out of power-saving mode you will have to exit and restart the program; to fix this permanently you may need to disable your power-management software. If you find that Windows 95 cannot restore DESC Pro after running a screen-saver, disable your screen saver.

## 3.2 Running the install script

DESC Pro is currently supplied on a single floppy disk, with a batch file to install it. The installation location is a fixed directory on the c: drive of your PC. The name of the directory depends upon the engine developer. For example, for Pectel (External) the directory would be c: \desc\pect. To install, place the floppy disk in a: and type

```
a: \i nstal l 
```

at a DOS prompt (or in Windows 95 press Start, Run and then type the line above). The batch file will copy the software, profiles and initial maps to the PC's hard disk. When complete, remove the floppy disk and store in a safe place.

## 3.3 Configuring for best performance

There are several PC- and performance-related options which you may specify when you run DESC Pro (see section 4 below for where to type these).

### 3.3.1 Standard options

If you have a monochrome screen you may specify /mono to make the display more readable.

If you have a high resolution screen (most recent desktop PCs and an increasing number of modern notebook PCs do) you may run DESC PRO in high resolution mode by specifying /svga. The technical requirement for high resolution is that your PC graphics card is fully VESA 1.2 compatible and supports 800 by 600 by 16 colours via VESA). If you aren't sure if your PC supports this mode, it is probably worth trying anyway. *Note that some notebook PCs (we have seen Gateway and Dell notebooks do this) stretch a standard VGA screen to fill their 800 by 600 display, resulting in badly disfigured text and graphics - on these PCs using /svga is highly recommended.*

### 3.3.2 Unusual options

If you experience lots of problems losing and regaining communications between DESC Pro and your ECUs, such as failing map upload and downloads, it may be that your PC cannot quite manage the faster serial port rates that are often selected. Specifying /19200 may help. Note that we have only seen one or two PCs where this was actually a problem.

If you are having problems associated with the mouse on your PC, or you simply do not wish to see the mouse cursor, use /nomouse.

## 4 Running DESC Pro

### 4.1 Online or offline

DESC Pro may be run in two ways - with or without an ECU. We call these working *online* or *offline*, respectively. Working offline allows changes to be made to maps previously saved on the PC without the need for an ECU. Changes made are saved on the PC and may be programmed into an ECU later. Working online is the mode for mapping on a dyno, in-car *etc.* DESC Pro must be connected to a powered ECU and changes made are immediately transmitted to the connected ECU and are immediately incorporated into the ECU's calculations. Note that a few items (such as the injector impedance) require the ECU to be reprogrammed before a change takes affect.

If you have set up Windows 95 shortcuts as described in Appendix A, just double-click on the appropriate shortcut. To run DESC Pro from DOS or a Windows 95 DOS windows, first change your DOS prompt to the directory the software was installed in (for a Pectel (External) developer this would be c: \desc\pext):

```
c: 
cd \desc\pext 
```

Then, to run DESC Pro offline, type descpro followed by any options you require, separated by spaces. For example, to run offline and use a high resolution screen would be:

```
descpro /svga 
```

Alternatively, to run DESC Pro online (with an ECU), type the word `online` in addition. The above example would become:

```
descpro /svga online 
```

You will see some initial text messages and then the screen will change to a grey-blue graphical display. The words "DESC Pro", the software version number and the name of the engine developer this version of DESC Pro has been prepared for are all shown in the top left corner of the screen. The rest of the top line gives an indication that no maps or profiles have been loaded. If you are running offline, a small dialog box will be displayed in the centre of the screen to confirm that; otherwise a dialog box will be displayed which indicates that DESC Pro is waiting to connect to an ECU.

#### 4.1.1 Loading maps

If you are running DESC Pro online, this is automatic; the maps are obtained from the ECU when you connect to it. If you are running DESC Pro offline, you must dismiss the "Running offline" dialog box by pressing , press **F** (*or press the File button with the mouse*) to bring up the file menu, select "Load maps" and select a map file to load.

#### 4.1.2 Flash vs RAM

The ECU contains two distinct areas, which contain maps. These are the FLASH, which stores maps permanently, and the RAM, which gets lost when power is removed from the ECU. Each

time the ECU is powered up, the maps are taken from the FLASH and copied to the RAM. The engine is then run using the RAM maps.

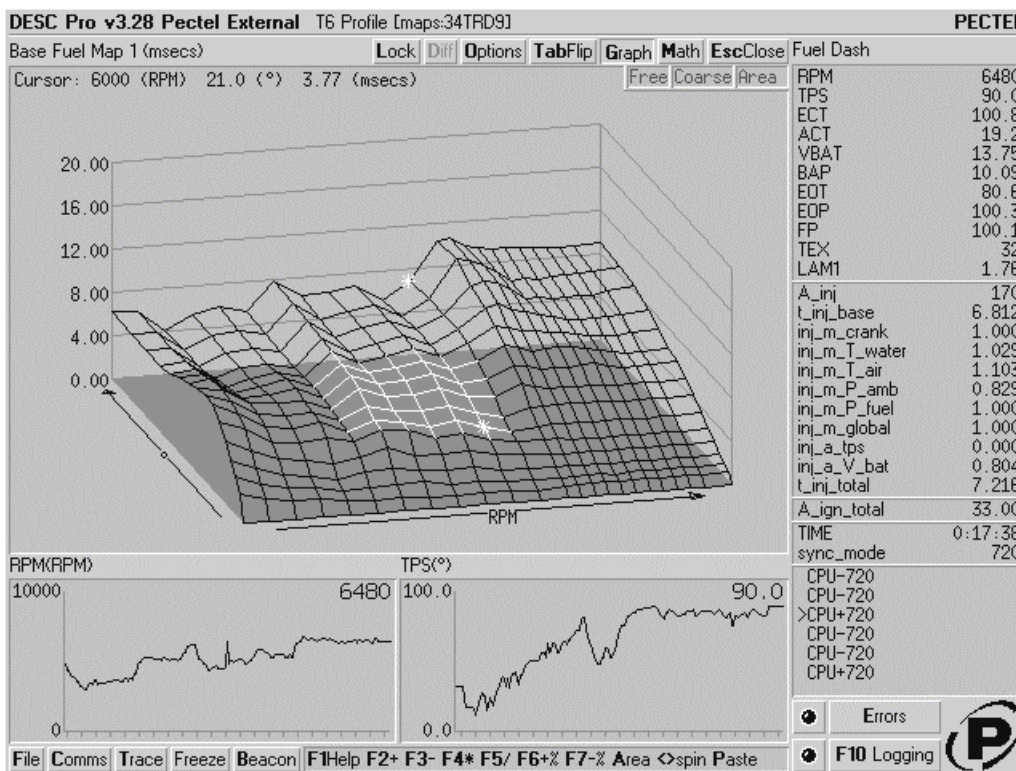
Any changes you make with DESC Pro are applied to the RAM maps and therefore immediately affect the running of the engine. These changes are not permanent! Any changes you make will be lost when the ECU is turned off (*if you are mapping, DESC Pro will immediately send your changes to the ECU again when it is turned back on*).

The most important point to remember is:

**Mapping changes you make whilst connected to an ECU are not stored permanently in the ECU until you program the FLASH. This is never done automatically - you must choose to do it (see section 4.5 Saving and programming).**

## 4.2 How the screen is divided

The screen is divided into a number of areas. Some of these are only present if you are running DESC Pro online.



### 4.2.1 Title bar

Apart from the program name, version number and developer, this area displays the filenames of the main maps, paste buffer maps, and gives a warning indication if you have frozen the ECU state display and traces.

### 4.2.2 Main buttons

The buttons at the bottom-left corner are the main starting point for mapping. If a button is usable, the text on it will be black and the highlighted letter or the mouse can be used to press it, activating the function (Freeze or Beacon) or bringing up an appropriate menu (File, Comms or Trace). If the button is not available, the text on it will be faded. The buttons are:

- **File button.** This button brings up a menu which allows saving and loading of the main maps and the paste buffer maps. If running online, the ECU FLASH is programmed from here. This is also where you can view the comments and overall information for the main maps. Finally, you exit the program from this menu.
- **Comms button.** This button brings up a menu which allows you to clear the system message area in the dashboard and view or clear the ECU Logbook and Engine Histogram. You can also check the hardware configuration of an ECU or review the PC-to-ECU communications link statistics.
- **Trace button.** This button brings up a menu, which allows you to display change or remove one or two rolling traces of any item(s) displayed on the dashboard.
- **Freeze button.** If online, this button is used by pressing `[Space]` (or using the mouse). When depressed, the word FROZEN will flash red in the title bar and all traces and dashboard items will be fixed at their current values until the button is released by pressing `[Space]` again.
- **Beacon button.** This button is intended for use in conjunction with ECU datalogging (with the DATALOG program) during dyno work. When working online, pressing this button sends a message to the ECU which requests a Lap Beacon to be placed in the ECU datalogging. Provided lap-beacon logging is enabled in the ECU, this allows particular moments in a dyno session to be easily distinguished.

### **4.2.3 Selector/editor**

Once maps have been loaded, this is where the list of available calibrations is shown, and where individual maps are shown as you view or edit them. There are buttons displayed along the top edge to provide access to various reporting and editing functions.

### **4.2.4 Dashboard**

This is where ECU state is displayed when online. It is not displayed when offline, in which case the selector/editor area expands. The top sections display various ECU state information (engine speed, throttle angle *etc*). These sections may change when you select different maps, to display additional information pertinent to the contents of those maps (transient fuelling or closed loop lambda calculations for example). The lower section displays system messages from the ECU. These are one-off indications that the ECU gives when certain events occur (gaining and losing 360° or 720° sync for example).

### **4.2.5 Traces**

This is not available when offline. When online, the area is initially used by the selector/editor. If you request a trace display (with the trace button) the selector/editor will be compressed to make room for rolling traces here.

### **4.2.6 Errors light and button**

Displayed only when online, this light indicates the overall state of the sensor error logs in the ECU. If no errors have occurred, the light will be out (black). If there is a history of errors (a non-zero error count for one or more sensors) but no current error, the light will flash yellow. If one or more sensors is currently in an error condition, the light will flash red.

Pressing the error button will bring up an errors window. The sensor logs are then obtained from the ECU and displayed. For each sensor, the window displays an error light (black, yellow or red as the main light), the count of errors which have occurred on the sensor since the ECU was powered up, a total count of errors which have occurred on the sensor, the sensor name and the cause of the last error (if known). The total count is retained when the ECU is turned off, and is only reset when you press the zero button in this error window.

*If your ECU is not capable of error tracking, the light will be black and the button will be unavailable (the text will be faded).*

### 4.2.7 Logging light and button

Displayed only when online, this light indicates whether the ECU is currently performing internal datalogging. If the ECU is not datalogging, the light will be out (black). Otherwise, it will flash green.

Pressing the logging button will send a message to the ECU to start or stop logging. If the ECU does not start logging when requested, there are several possibilities:

- The ECU may not have datalogging enabled. This is a setting in the ECU which you can alter using the DATALOG software.
- The ECU datalogging memory may be full and the overwriting may be disabled. From the DATALOG software you can download or delete data and/or enabled overwriting.
- The ECU datalogging configuration may be null. If no channels are set up, the ECU won't log. Again, this is a job for the DATALOG software.

*If your ECU is not capable of datalogging, the light will be black and the button will be unavailable (the text will be faded).*

## 4.3 Selecting maps

Individual maps within the ECU are arranged in two ways. First, the maps are grouped so that like calibrations appear together under a single heading (for example all fuel multipliers appear together in a group). Groups may also contain sub-groups (for example, the Fuel Multipliers group may be placed with a number of other groups and maps in a group called Fuel Corrections). Second, the groups are placed into different overall mapping menus to restrict the amount of information you have to see on the screen at one time (for example, the Standard Mapping menu will not include sensor calibration tables).

The selector allows you to choose between the different mapping menus (press M or use the mouse to press the menu button at the top right of the selector), and then to open the groups you are interested in and access the individual calibrations. You can use the mouse or movement keys (↑ ↓ PgUp PgDn Home End) to move the highlight around the list. To open or close a group, or to select a map for viewing or editing, double-click with the mouse or press .

Some maps may have help associated with them. Highlight the map you are interested in and press .

## 4.4 Editing maps

There are two editing modes, textual and graphical. All editing functions are available in both modes. When you select a map from the selector, the first thing you see is a the textual editor. At the top left of the editor, the name and units of the map you are editing are displayed, and at top right are seven buttons. These are:

- Lock. Lock mode (see §4.4.3 SPECIAL FUNCTIONS AND OPTIONS).
- Diff. Difference mode (see §4.6.2 DIFFERENCE DISPLAYS).
- Options. This button brings up a menu of editing options. In text mode the only choice is between Find and Coarse adjustments on the plus and minus keys. In graphical mode there are several more (see below).
- Flip. Quick flip (see §4.4.3 SPECIAL FUNCTIONS AND OPTIONS).

- Graph. Pressing this button switches between textual and graphical editing (and back again). Cursor position and all other selections (including difference mode) are retained.
- Math. Area maths functions (see §4.4.3 SPECIAL FUNCTIONS AND OPTIONS).
- Close. Pressing this button (with the mouse or by pressing **[Esc]**) closes the editor and returns you to the selector.

Selecting values to edit is the same in both editors. Use the movement keys (**[←]****[→]****[↑]****[↓]****[PgUp]****[PgDn]****[Home]****[End]**) or the mouse to position the cursor at the desired site. If you want to change several sites at once, you can drag a rectangle with the mouse (press the left button at one corner of the area you want to change, hold it down while you move the mouse to the diagonally opposite corner, then release the button) or you can press A to set area-mode. In area mode moving the cursor with the movement keys drags a rectangle and edits are applied to all cells in the rectangle (press A when you want to turn area mode off again).

There are several ways to edit the values:

- Plus and minus keys. These apply small increments or decrements to the selected values. Two sizes of increment/decrement are available, controlled by selecting fine or coarse from the options menu.
- Function keys. **[F2]** through **[F7]** allow a value to be entered which affects all selected cells by addition, subtraction, multiplication, division or percentage increment or decrement. The reminder bar at the bottom of the screen indicates which key does what. Note that some of these may not be available if they are not appropriate to the map.
- Mouse. You can use the mouse to drag values up or down. With the mouse cursor in the editor area, press and hold down the right mouse button. Then move the mouse up or down. Release the mouse button when the values are where you want them.
- Mapping box. If you have DESC Pro and the Pectel Control Systems mapping box, turning the black (third) rotary encoder continuously increments or decrements the selected values.
- Direct entry of a value. Press return (or start typing a value beginning with a number from 0 to 9). You can just type the engineering unit value that you want. If the map is not displayed as values (for example the injector type map is displayed as HIGH or LOW) you will be offered a menu of the possible choices.

If you are online, all edits are applied immediately to the ECU as you make them.

If there is any help available for the map, you may press **[F1]** (as in the selector) to view it.

#### **4.4.1 The text editor**

In this mode, the map is displayed as a table of figures in engineering units. The full title of the X and Y axis (if the map is 2- or 3-dimensional) are displayed along with units.

Some maps may be too large to fit in the editor area, particularly if you are running online and have traces displayed. The map display will scroll when the cursor gets to the edges to allow the whole map to be accessed. In addition, if you are dragging with the mouse to select an area, the map will scroll automatically when the mouse reaches an edge.

If you are online and DESC PRO has sufficient information, the current position of the engine within the map is shown by thick dashed white crosshairs.

The plus and minus key resolution (fine or coarse) is the only setting available in the text-mode options menu.

### 4.4.2 The graphical editor

In this mode, the map is displayed as a curve (2-dimensional maps) or an isometric wire-frame surface (3-dimensional maps). The abbreviated axis names are used to display the cursor position values at top left, and the axis units are used with arrows to indicate the direction of increasing breakpoint values.

The cursor position is indicated with a red star, and any selected area is also drawn in red. The mouse may be used to move or drag the cursor; the site nearest the mouse pointer is selected.

Two additional movement keys are available:  $\leftarrow$  and  $\rightarrow$  rotate the map in  $10^\circ$  steps to allow viewing from any rotation. Clicking the left mouse button with the mouse pointer in the bottom left or bottom right corners of the map will cause the same rotation.

If you are online and DESC PRO has sufficient information, the current position of the engine within the map is shown by a white crosshair for 2-dimensional maps or a white star for 3-dimensional maps.

#### 4.4.2.1 Slice mode

When calibrating a 3-dimensional map it is often convenient to calibrate a line at a time (*eg* to calibrate fuel pulse width for all pressure values at a fixed RPM). This may be done as part of a methodical technique or as part of creating a base map, where the shape of one breakpoint line may be copied across the rest of the map as a reasonable starting point.

This sort of mapping is easiest in *slice mode*. When viewing a 3-dimensional map in the graphical editor, the options menu has the options View X slices and View Y slices. Using these options a breakpoint line from a 3-dimensional map may be viewed as if it were a 2-dimensional map. Mapping then proceeds as for a 2-dimensional map, but with two exceptions:

- The cursor keys ( $\uparrow$   $\downarrow$ ) may be used to move the slice viewed forwards and backwards through the map. Clicking above or below the curve with the mouse achieves the same effect.
- Lock mode (see below) *does not automatically move to the correct slice* - that is up to you. For example, set a dyno to maintain a certain RPM, then map RPM slices by varying throttle or manifold pressure.

To switch back to the original view, select View in 3D from the options menu.

### 4.4.3 Special functions and options

Three mapping functions deserve special comment:

#### 4.4.3.1 Lock mode

This is only available online and only in 2- or 3-dimensional maps, and if DESC Pro has enough information.

In lock mode the mapping cursor automatically follows the engine state. The cursor will stay on the site nearest the current engine position unless you use the cursor keys, which allow you to nudge the cursor to any of the two (or four) cells adjacent to the current engine position.

Caution: in slice mode, a locked cursor *does not automatically keep changing the slice*.

#### 4.4.3.2 Quick flip

The quick flip button (press with the mouse or by pressing  $\overline{\text{Tab}}$ ) takes you immediately to a companion map to the one you are editing. For example, if you are editing the Base Fuel Map and press  $\overline{\text{Tab}}$ , you will be taken to the Base Ignition Map. Most mode selections (text or graph mode, lock or free) and the current cursor position are retained in the new editor. The exception is difference-mode, which you must turn on or off for each map editor individually.

#### 4.4.3.3 Area math functions

If you are editing a 2- or 3-dimensional map and you engage area-mode editing, the Math button brings up a menu which gives you some functions you can apply to the selected area: copying one edge up, down, left or right across the area or performing a linear interpolation between the end-points of all the breakpoint lines running in the X or Y directions.

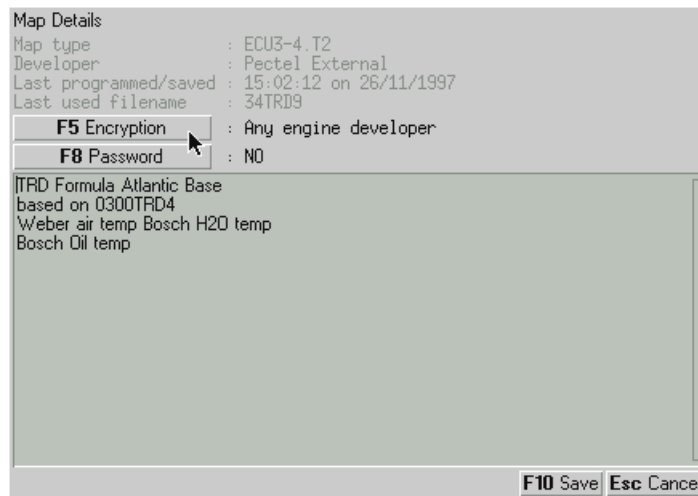
#### 4.4.3.4 Changing breakpoint interpolation

This is very rarely used. Most of the time it is desirable for the graphical display to show the true shape of the map curve or surface, by spacing the breakpoint lines in proportion to the breakpoint values. If, however, several breakpoints have been set very close together, the display may get quite dense around those breakpoints.

The options menu in graphical mode contains the options Interpolated breakpoint spacing and No breakpoint interpolation. The former is the default, "correct" display method. Selecting the latter forces all breakpoint lines to be equally spaced. Unless the breakpoints are truly equally spaced, this option will give a false picture of the curve or surface, but it will expand a busy area so that it is easier to work with.

### 4.5 Saving and programming

These are very similar processes. To save a file to disk, select the File menu and select Save. To program the ECU FLASH (you must be online) select the File menu and select Program. After selecting an output filename or confirming that you wish to program the ECU, you will be shown the map details alteration dialog box:



This box allows you to do several things:

- Enter description or comment information. This information is displayed to you when you connect to an ECU or when you are loading maps from disk. You can enter up to 799 characters of comment split into as many paragraphs as you like.
- Password-protect the maps (press **F8**). If you really don't want anyone to see your work, you can take this final security measure. Even with the correct DESC Pro software no-one can even view the maps without this password. **Warning: if you forget the password you have used, you will be unable to retrieve the maps except by sending the file or ECU to us!**
- Change the encryption type (press **F5**). Normally this will be set to allow access to the maps only by ECUs with your Developer ID (and if saved to disk, readable only by your version of DESC Pro). If you wish the maps to be usable in any ECU (by any

developer) or if you wish to lock the map chip to just the one ECU you are programming (this is not usually relevant for a disk file) you can alter that here.

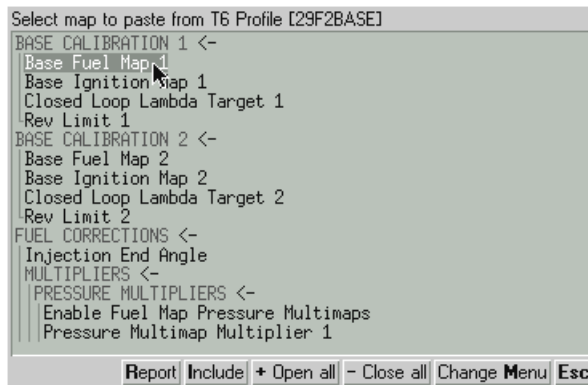
When you are done, press **F10** to save or program.

## 4.6 The paste buffer

The paste buffer is used for selective map copying and comparison. You load the paste buffer similarly to loading the main maps from disk, by selecting the File menu and then Load paste buffer.

### 4.6.1 Pasting

If, for example, you have some maps you want to use in a new software level base set, or a fuel map created with an alternate fuel but don't wish to change anything else, you will want to paste maps from one calibration file to another. Load the set of maps you are copying from into the paste buffer and the set of maps you are copying to into the main buffer. Select one of the maps you wish to paste and, in either the textual or graphical editor, press P. You will be presented with a paste selector:



Simply use this as you would the main selector to select the map you wish to paste from. Note that *any map the same size* as the target map is legal for pasting, although not all will yield sensible values! Note that you can generate reports on the paste maps from here.

### 4.6.2 Difference displays

If the paste buffer has been loaded with a set of maps with the same software level as the main maps, difference displays will become available.

In either the textual or the graphical editor, press the difference button (with the mouse or by pressing D). This engages difference mode. The display changes to show you the difference between the map you are editing and the equivalent map in the paste buffer. You cannot currently make changes in this mode. Press again to exit difference mode.

## 4.7 Generating reports

DESC Pro can generate ASCII text reports on a calibration. Pressing the Report button (or the key R) in the main selector brings up a menu asking which type of report is desired. Initially only Standard report (all maps) is available. This option writes a textual representation of every single map in the calibration (*ie* all maps in all groups across all menus) to a disk file.

### 4.7.1 Including only some of the maps

If a report on only certain maps is desired, use the Include button on the selector to mark the maps you are interested in. You can press Include while the highlight is over a group to mark

everything in the group. Pressing Include for an item already marked removes the mark. You can place marks across all menus: they are remembered as you switch from one menu to another.

Once at least one mark has been made, the Standard report (included maps only) option becomes available on the Report menu. This does exactly what it says.

#### **4.7.2 Difference reports**

If you have loaded the paste buffer with maps of the same software level as the main maps, difference reports become available. These two options on the Report menu compare either all maps or just those included for any differences between the paste buffer and main calibrations. Only those maps that contain differences will be written to the text file. The actual map values are not output - the text written is a difference map, similar to the text editor in difference mode.