



EPAS Ultra User Manual

EPAS18



**This document refers to the EPAS18 Ultra ECU with V3 firmware.
Please consult DCE for confirmation of firmware installed into your Ultra ECU.
For all autonomous applications, please refer to 'EPAS18A EPAS Ultra Autonomous User Guide' .**

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1 Getting Technical Support

For technical support, please contact:

sales@dcemotorsport.com (Europe) or salesusa@dcemotorsport.com (Americas)

The table below lists the ways to contact DC Electronics:

Contact Method	Europe	Americas
Company:	DC Electronics	DCE Inc.
Website:	www.dcemotorsport.com	www.dcemotorsport.com
Email:	sales@dcemotorsport.com	salesusa@dcemotorsport.com
Telephone:	+44 (0)1621 856451	+1 (704) 230 4649
Mail:	DC Electronics – Motorsport Specialist Ltd Units 1 & 2 Quayside Industrial Park Bates Road Maldon ESSEX CM9 5FA United Kingdom	DCE Inc 119 Poplar Pointe Drive Suite B Mooresville NC 28117 USA

2 Operating Parameters

Here we list the operating parameters of the EPAS Ultra ECU.

Parameter	Value	Notes
Voltage	Max 16V	Over voltage will cause the ECU to shut down and could cause permanent damage.
	Min 9V	Under voltage will cease control of the motor.
Temperature	Max 100°C	Over 100°C will result in half motor duty mode until temperature drops below 95°C. Fault lamp will flash.
	Max 120°C	Over 120°C will result in ECU shutdown. Fault lamp will be on solid. Power cycle required to reset fault.
Current	Max 80A	The ECU regulates the motor duty PWM so that the average current is no more than 80A.
Time-out	10s	If the torque input does not change by +/- 2 bits, after 10 seconds motor duty will cease. This is a protection feature for the ECU and motor and cannot be disabled. Under normal driving conditions, this time-out limit is not reached and will not activate. If time-out has activated, any change in torque input by +/- 2 bits will cancel time-out.
PWM Frequency	19.5kHz	The motor PWM control is set at 19.5kHz.

3 Electrical Connections and Calibration Guide

Before Installation is undertaken, please read the following notes.

NOTE 1: WELDING

Electronic components situated within the motor assembly and control unit could be damaged if welding takes place upon the vehicle chassis or frame.

If welding is to take place it is advisable to remove both the motor assembly and the control unit from the vehicle.

If only the control unit can be removed, ensure both electrical connections to the motor assembly are disconnected and the vehicles battery is removed.

UNDER **NO** CIRCUMSTANCES SHOULD ANYTHING BE WELDED TO THE CASING OF THE MOTOR ASSEMBLY.

NOTE 2: ELECTRICAL CONNECTIONS

The electronic power assisted steering system should be connected using the EPAS Ultra interface loom (available separately) or by following the DC Electronics supplied wiring diagram.

FAILURE TO CORRECTLY CONNECT VEHICLE POWER SUPPLY WILL DAMAGE THE CONTROL UNIT.

3.1 EPAS ULTRA ELECTRICAL CONNECTION & SET UP GUIDE

These instructions presume the use of our EPAS19 Ultra Wiring Harness.

1. Make all electrical connections as per the DC Electronics wiring diagram (available upon request) or if using the EPAS Ultra interface loom (available separately) follow steps 2 to 9.
2. Connect 2 pin connector marked "MOTOR" to the motor assembly.
3. Connect 4 pin connector marked "TORQUE" to the motor assembly.
4. Find a suitable location for the ECU (within cabin, away from heat and moisture), fix using suitable cradle with anti-vibration mounts and connect to both Autosport connectors on the loom.
5. Find suitable location for rotary switch and mount.
6. Fit LED to loom (Red cable to Gold pin, White cable to Silver pin).
7. Connect 2 pin connector marked "POWER" to Vehicle power supply , #1 to +12v and #2 to ground

8. Connect 8 pin connector marked "ELECTRONICS" as follows:-

Pin No.	Description	Destination	Required?
1	+12v (Input)	Ignition Switched +12v	Yes
2	Ground (Input)	Chassis Ground	Yes
3	CAN Hi	Data Logger CAN Hi	Optional
4	CAN Lo	Data Logger CAN Lo	Optional
5	Sensor +5v Supply (Output)	Steering Angle Sensor +5v	Yes
6	Steering Angle (Analog Input)	Steering Angle Sensor Signal	Yes
7	Sensor 0v Supply (Output)	Steering Angle Sensor 0v	Yes
8	Not Used		

No CAN termination resistor is fitted within the ECU.

9. If no steering angle sensor is fitted, the over current protection for rack end stops will not be present. Holding the steering against the stops will **SEVERLY DAMAGE THE CONTROLLER!** We strongly recommend connecting a steering angle sensor.

FAILURE TO COMPLY WITH THE ABOVE INSTRUCTIONS WILL DAMAGE THE CONTROL UNIT AND WILL VOID ANY WARRANTY.

3.2 CALIBRATION OF COLUMN

It is normal for the steering wheel to move on initial power up and during calibration. Do not attempt to hold the wheel at this time or the settings may become corrupted.

- Set rotary switch fully counter clockwise.
- Switch on "Electronics +12v" until LED lights up. Immediately switch off and then back on until LED lights again.
- Continue to do this 3 more times until on the 4th time the LED lights and flashes, this is the calibration phase.
- The LED will extinguish at the end of calibration when you can now use the system.

Calibration only needs to be carried out once at installation as the settings will be retained even when power is removed.

3.3 CALIBRATION OF STEERING ANGLE SENSOR

- Attach a Steering Angle sensor to the specified pins in section 8.
- Calibrate column using the procedures above.
- Keep the rotary switch turned fully anticlockwise.
- Connect to the EPAS system using a suitable serial lead.
- Open EPAS Desktop Pro software and click 'connect' (the latest version can be downloaded from our website).
- Turn the Steering wheel fully anticlockwise until the stop is reached, release the wheel and note the steering angle value shown on the desktop.
- Repeat for fully clockwise stop.
- **NOTE:** The LH value must be lower than the RH value. If this is not true, the +5v and 0v wires need to be reversed in the Steering Angle sensor.
- Keeping the power on, click on 'disconnect' on the Desktop Pro software screen.
- Go to the 'Setup' menu and scroll to 'Parameters', pick 'LH stop'
- Scroll to the value that had been noted for anticlockwise stop.
- Next pick 'RH stop' and put in the value noted for clockwise stop.
- Click on 'apply'.
- Test calibration by setting rotary switch to position 1, turn steering fully anticlockwise and check if motor duty switches to 0% on the Desktop Pro when the pre-set angle is reached, repeat for clockwise steering.

4 Software

4.1 What is EPAS Desktop Pro?

The Program enables the operating parameters of the DC Electronics' EPAS Ultra ECU to be viewed in real time. EPAS Desktop Pro also provides facilities for configuring and re-programming the EPAS Ultra ECU via the serial port of the host PC.

With DCE's EPAS you can:

- View real-time data for:
 - Battery voltage
 - Current consumption
 - Applied steering torque
 - Steering motor duty
 - ECU box temperature
 - Steering angle
 - Control switch setting
 - Digital input and output states
- Read ECU serial number, firmware version and system type
- Configure the EPAS Ultra ECU via the serial port of the host PC
- View and alter the relationship between torque input and motor duty for each control switch position
- Update the firmware of the EPAS Ultra ECU via the serial port of the host PC

4.2 System Requirements

Before attempting to install EPAS Desktop Pro, make sure that your computer meets the following minimum system requirements shown in the table below:

Component	Requirement
Processor	Pentium class processor or equivalent
Operating System	Microsoft Windows 98/Me/NT4/2000/XP/Vista/10
Hard Disk Space	10Mb
System Memory	32Mb (64Mb recommended)
Monitor/Display	Super VGA (800 x 600) or higher resolution with 256 colours
Serial Port	One serial port or USB port with USB-Serial adapter
Pointing Device	Microsoft Mouse or compatible pointing device

4.3 Installing EPAS Desktop Pro

Before you can run EPAS Desktop Pro you must install it on the hard disk of your computer.

Follow these steps to install the software:

- Switch on your computer and log on in the normal way.
- Go to <https://www.dcemotorsport.com/Home/EPAS>
- Click on **EPAS Desktop Pro Software**
- Follow the on-screen instructions.
- The installation process places shortcuts to EPAS Desktop Pro on the computer's desktop and Start menu.

4.4 Uninstalling EPAS Desktop Pro

EPAS Desktop Pro can be removed from your computer by selecting the **Add and Remove Programs** option within Windows **Control Panel**. Find EPAS Desktop Pro in the list of installed software, select it, and then click **Remove**.

This will remove the EPAS Desktop Pro software together with its shortcuts and configuration entries.

5 Getting to Know EPAS Desktop Pro

This chapter provides an overview of the EPAS Desktop Pro user interface. It describes the main window, menu, and other important features. To help you better understand the program and become familiar with its features, please review this chapter thoroughly prior to connecting a PC to an EPAS Ultra ECU.

5.1 Tour of the EPAS Desktop Pro User Interface

When you start EPAS Desktop Pro the main program window appears as shown below.

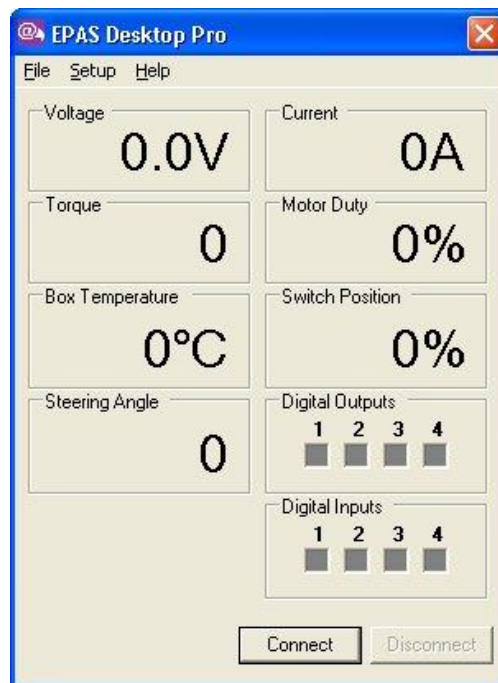


Figure 1 - EPAS Desktop Pro Main Screen (Inactive)

At the top of the main program window a menu provides access to a majority of the program's features.

5.2 Main Menu



Figure 2 –EPAS Desktop Pro Main Menu

The Main Menu (Figure 2), which is directly below the title bar, displays the menu headings. Click a menu heading to open the menu and choose a command.

Use either of the following methods to choose a menu command:

- Open the menu and click the command, or
- Open the menu, use the Up arrow or Down arrow key to highlight a command, and then press <Enter>.

6 Viewing EPAS Ultra ECU Status

This chapter describes how EPAS Desktop Pro allows you to connect to an EPAS Ultra ECU and view its status.

6.1 Connecting to EPAS Ultra ECU

The status of an active EPAS Ultra ECU can be viewed in the following way:

1. Connect the serial port connector on the PC to the “Comms” serial connector on the EPAS Ultra harness using a suitable cable. Alternatively, connect a Serial-USB adapter cable to the USB port on the PC and to the “Comms” connector on the harness supplied.
2. Click the **Connect** button on the main screen.
3. The live status of the EPAS Ultra ECU will be displayed in the various panels on the main screen and these will be updated every 500ms.

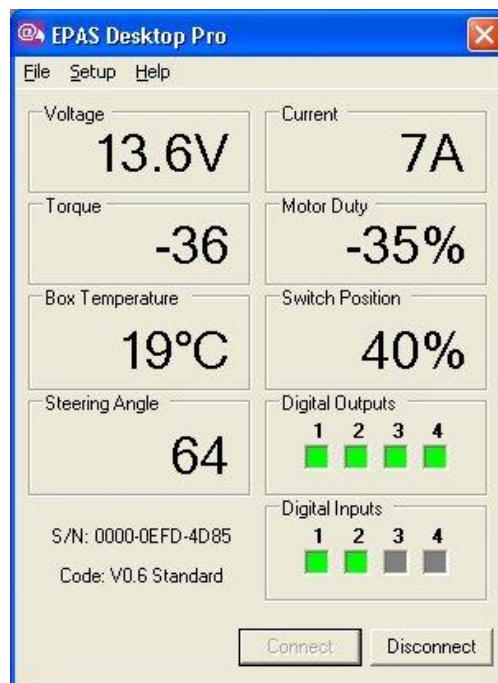


Figure 3 - EPAS Desktop Pro Main Screen (Active)

6.2 Main Screen Displays

The panels on the main screen display the following information:

Item	Description																					
Voltage	Displays instantaneous EPAS Ultra ECU supply voltage in Volt. Resolution is 0.1V and maximum reading is 25.5V.																					
Current	Displays instantaneous EPAS Ultra ECU current consumption in Amp. Resolution is 1.0A and maximum reading is 128A.																					
Torque	Displays instantaneous applied steering torque in bits. Resolution is 1 bit and maximum reading is 255 bits. This value is positive when the applied steering torque is in the clockwise direction.																					
Motor Duty	Displays instantaneous motor duty in %. Resolution is 1%. A value of 100% indicates that the motor is operating at full power.																					
Box Temperature	Displays instantaneous EPAS Ultra ECU box temperature in °C. Resolution is 1°C and the EPAS Ultra ECU will shutdown if the box temperature rises above a preset safe limit.																					
Switch Position	<p>Displays instantaneous steering control position in %.</p> <table border="1"> <thead> <tr> <th>Display</th> <th>Result</th> <th>Analog Input Voltages</th> </tr> </thead> <tbody> <tr> <td>0%</td> <td>EPAS Off</td> <td>> 0.00V, < 0.82V</td> </tr> <tr> <td>20%</td> <td>Map 1</td> <td>> 0.82V, < 1.67V</td> </tr> <tr> <td>40%</td> <td>Map 2</td> <td>> 1.67V, < 2.50V</td> </tr> <tr> <td>60%</td> <td>Map 3</td> <td>> 2.50V, < 3.33V</td> </tr> <tr> <td>80%</td> <td>Map 4</td> <td>> 3.33V, < 4.18V</td> </tr> <tr> <td>100%</td> <td>Map 5</td> <td>> 4.18V, < 5.00V</td> </tr> </tbody> </table>	Display	Result	Analog Input Voltages	0%	EPAS Off	> 0.00V, < 0.82V	20%	Map 1	> 0.82V, < 1.67V	40%	Map 2	> 1.67V, < 2.50V	60%	Map 3	> 2.50V, < 3.33V	80%	Map 4	> 3.33V, < 4.18V	100%	Map 5	> 4.18V, < 5.00V
Display	Result	Analog Input Voltages																				
0%	EPAS Off	> 0.00V, < 0.82V																				
20%	Map 1	> 0.82V, < 1.67V																				
40%	Map 2	> 1.67V, < 2.50V																				
60%	Map 3	> 2.50V, < 3.33V																				
80%	Map 4	> 3.33V, < 4.18V																				
100%	Map 5	> 4.18V, < 5.00V																				
Steering Angle	Displays instantaneous steering angle in bits. Resolution is 1 bit and maximum reading is 255 bits.																					
Digital Outputs	Displays instantaneous status of the four digital outputs. Note; these are not used and are for future expansion only.																					
Digital Inputs	Displays instantaneous status of the two digital inputs. Note; these are not used and are for future expansion only.																					
S/N	Unique 64-bit serial number of EPAS Ultra ECU.																					
Code	Firmware version and system type.																					

6.3 Disconnecting from EPAS Ultra ECU

To stop viewing the status of an active EPAS Ultra ECU click the **Disconnect** button on the main screen.

NOTE: It is important to disconnect in this way, rather than just closing the EPAS Desktop Pro application, as otherwise the connection to the EPAS Ultra ECU will remain active and any attempt to reconnect will fail unless the EPAS Ultra ECU is reset first.

7 Configuration

EPAS Desktop Pro provides facilities for the EPAS Ultra ECU to be configured via the serial port.

This chapter describes how this configuration is carried out.

NOTE: Configuration changes can only be made whilst EPAS Desktop Pro is not actively communicating with an EPAS Ultra ECU. Disconnect any active connection, by clicking the **Disconnect** button on the main screen, before attempting to make changes to the configuration.

7.1 Serial Port

To alter the serial port that EPAS Desktop Pro uses to communicate with the EPAS Ultra ECU do the following:

1. Choose **Setup** ➔ **Serial Port** from the main menu. The Setup Serial Port Dialog (Figure 4) appears.

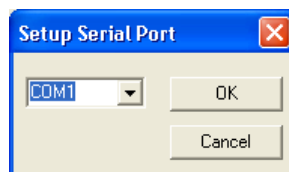


Figure 4 - Setup Serial Port Dialog

2. Select the new serial port from the list.
3. Click **OK** to update the serial port or **Cancel** to leave it unchanged.

7.2 Firmware

The firmware of the EPAS Ultra ECU can be re-programmed via the serial port.

The **Setup** ➔ **Firmware** option from the main menu has been provided to enable this.

IMPORTANT: Do not attempt to upload new firmware to the EPAS ECU without first contacting DC Electronics and obtaining the correct file for your system and application.

Procedure

Do the following to update the firmware:

1. Connect the PC to the EPAS ECU via the serial lead.
2. Start EPAS Desktop or EPAS Desktop Pro.
3. Ensure that the EPAS ECU is not powered up.
4. Select **Setup** ➔ **Firmware** from the main menu, the File Open dialog will be displayed.
5. Locate the required .hex file and click **Open**, the Upload Hex File dialog (Figure 1) will be displayed.
6. Check the connection between the PC and the EPAS ECU and click **OK** or **Cancel** to abandon the firmware update process.
7. The Upload Hex File dialog shows that EPAS Desktop is attempting to communicate with the EPAS ECU (Figure 5).

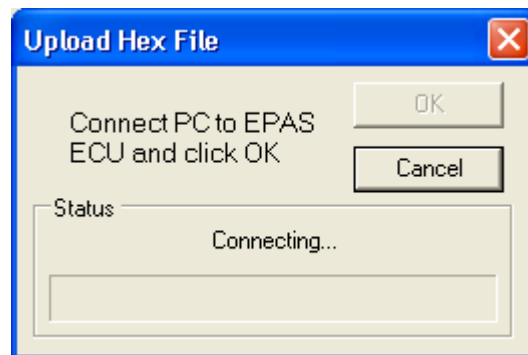


Figure 5 - Upload Hex File Dialog (Connecting)

8. Switch on the EPAS ECU, the Upload Hex File dialog shows that the selected hex file is being uploaded to the EPAS ECU (Figure 6).

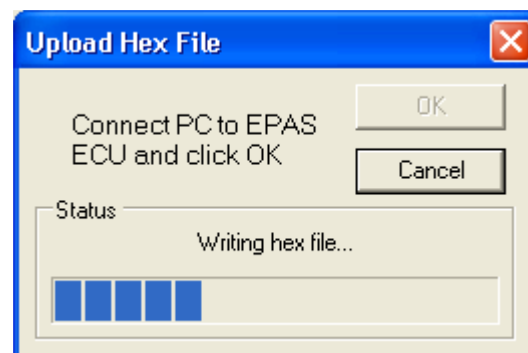


Figure 6 - Upload Hex File Dialog (Writing)

9. Once the entire hex file has been written the EPAS ECU will reset and run with the new firmware.

7.3 Changing Parameters & CAN Message IDs

The operating parameters of the EPAS Ultra ECU can be viewed and altered via the serial port in the following way:

1. Select the **Setup** ➔ **Parameters** option from the main menu. The Setup Parameters dialog (Figure 7) is displayed.

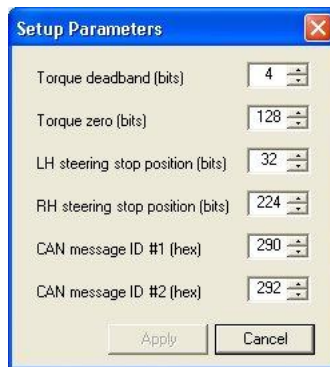


Figure 7 - Setup Parameters Dialog

2. The Setup Parameters dialog displays the current values of all the user configurable parameters of the EPAS Ultra ECU.
3. Make any changes that are required and click **Apply** or **Cancel** to leave the parameters unchanged.

WARNING: Care must be observed when changing EPAS Ultra ECU parameters. Using the wrong values could damage both the EPAS Ultra ECU and the steering unit.

Currently, the following six parameters are defined:

- Torque deadband
- Torque zero
- LH steering stop position
- RH steering stop position
- CAN message ID #1
- CAN message ID #2

These will be described in detail in the following sections.

Torque Deadband

The torque deadband, measured in bits, defines the amount that the steering torque sensor value needs to move from the zero value before any steering power assistance is delivered.

The default value for the torque deadband is 4 bits. Decreasing the torque deadband value can make the steering more responsive but can also lead to 'hunting' where the control unit constantly attempts to counteract a very small steering torque offset.

Increasing the torque deadband value will make the steering less responsive but can compensate for a drifting or noisy torque sensor.

Torque Zero

The torque zero, measured in bits, defines the steady state torque reading where no steering torque is applied. All the steering torque sensors encountered so far have a zero of 128 ± 10 bits. The default value for the torque zero is 128 bits.

The torque zero parameter value is normally altered using the zeroing procedure built into the firmware of the unit which does not need a computer to be connected. In this procedure the power to the unit is switched on and then off (before the fault LED has gone out) three times in succession. The next time power is applied the fault LED will flash while the torque zero parameter is updated. It is important that, during this procedure, no steering torque is applied otherwise a false zero value will be set.

If the torque zero parameter is incorrect then the steering will tend to be more responsive, or lighter, in one direction than the other.

Steering Stop Settings

A steering angle sensor can be used to limit the motor power when the steering reaches either end stop. This sensor must be fitted so that its output voltage is at its lowest point when the steering is against the left-hand steering stop and at its highest when the steering is against the right-hand steering stop.

When the steering reaches either end stop the motor power is progressively reduced over a 1.5 second period.

LH Steering Stop Position

The LH steering stop position, measured in bits, is the position of the left-hand steering stop as indicated by the steering angle sensor.

Motor power reduction will occur when the measured steering angle is less than the LH steering stop position setting.

RH Steering Stop Position

The RH steering stop position, measured in bits, is the position of the right-hand steering stop as indicated by the steering angle sensor.

Motor power reduction will occur when the measured steering angle is greater than the RH steering stop position setting.

CAN Message IDs

The EPAS Ultra ECU has a CAN interface through which instantaneous sensor values and operating status are transmitted. Standard Baud rate is 1Mbit/s.

This information is grouped into three 8-byte messages each with their own ID. The CAN interface employs 11-bit message IDs so valid CAN message ID values lie in the range 0x001 to 0x7FF (1 to 2047).

CAN Message ID #1

Sets the ID for the first CAN message.

CAN Message ID #2

Sets the ID for second CAN message.

7.4 Transmitted CAN Messages

Three CAN messages are currently defined.

The 11-bit ID for each CAN message can be set by the user but the format of the payload of each message is fixed and is described in the following sections.

7.5 CAN Message #1

Message ID: 0x290 (default)

Update rate: 5ms

Message Byte	Description
D0	Torque (bits)
D1	Motor duty (%)
D2	Current (A)
D3	Supply voltage (1 bit = 100mV)
D4	Switch position (0 to 15)
D5	Box temperature (°C)
D6	Torque A (raw value in bits)
D7	Torque B (raw value in bits)

7.6 CAN Message #2

Message ID: 0x292 (default)

Update rate: 5ms

Message Byte	Description
D0	Steering angle, 8-bit version (bits)
D1	Steering angle, 10-bit version MSB (bits)
D2	Steering angle, 10-bit version LSB (bits)
D3	Selected map (0 to 5)
D4	Active error code
D5	Bit field of digital I/O values
D6	Bit field of status flags: b0 – Program paused b1 – Motor moving forwards b2 – Motor moving in reverse b3 – Host mode active b4 – Fault light status b5 – Reserved b6 – CAN map available b7 – Reserved
D7	Bit field of limit flags: b0 – Steering at LH stop b1 – Steering at RH stop b2 – Over-temperature condition b3 – Motor protect active b4 – Not used b5 – Not used b6 – Not used b7 – CAN map selection active

7.7 CAN Message #3

A third CAN message has been defined to allow an external system to set the steering map remotely. The steering map is only accepted via CAN when the steering map control switch connected to the EPAS ECU is in the 'off' position.

Message ID: 0x296 (fixed)

Update rate: 10ms

Message Byte	Description
D0	Steering map: 0 to 5 – Steering map
D1	Not used
D2	Not used
D3	Not used
D4	Not used
D5	Not used
D6	Not used
D7	Not used

Note:

**The analogue rotary map switch has priority over the CAN steering map input.
The CAN map switch input is only active when rotary map switch is set to 0%.**

7.8 CAN Error Messages

These error code resides in byte d4 of CAN Message #2.

Defined error codes are as follows:

100	Low battery voltage
101	Torque sensor not connected
102	Torque sensor fault
103	Current sensor fault
104	Motor power fault
105	Motor not connected
106	Motor is stalled or shorted
107	Clutch not connected
108	Clutch is stalled or shorted
109	Over current
110	Over temperature
111	Internal error

Not all error codes can be produced by all systems, e.g. EPAS01 Motorsport assembly does not have a clutch so error codes 107 and 108 cannot occur.

7.9 Maps

The relationship between steering torque input and motor duty output for each control switch setting can be altered via the serial port in the following way:

1. Select the **Setup** ➔ **Maps** option from the main menu. The Setup Maps dialog (Figure 8) is displayed.

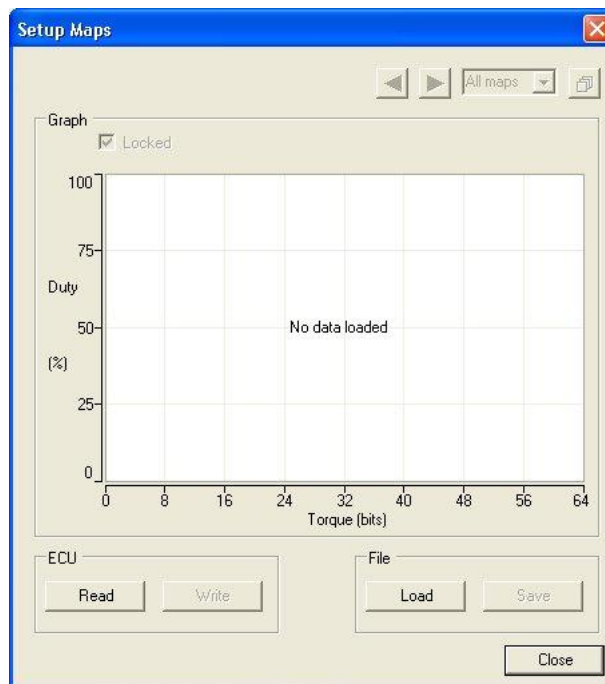


Figure 8 - Setup Maps Dialog (No Maps)

2. Click **Read** to read the maps from the EPAS Ultra ECU or **Load** to load map data from a disk file.

- Once map data is available the Setup Maps dialog displays all five maps on the same set of axes (Figure 9).

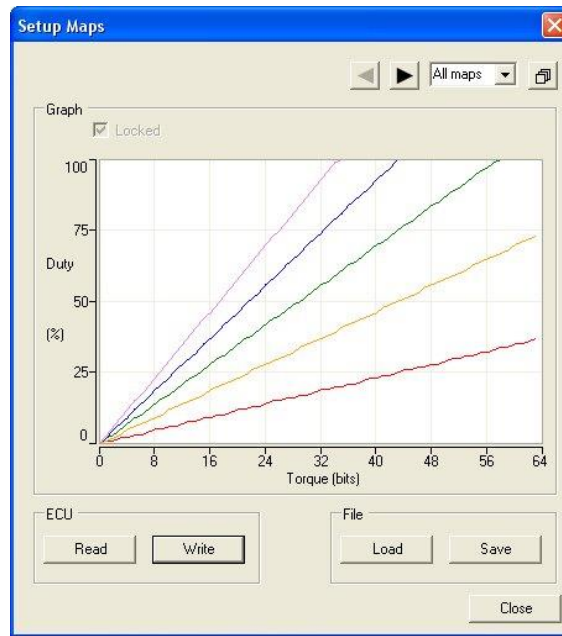


Figure 9 - Setup Maps Dialog (All Maps)

- Use the arrow buttons or the drop-down box in the top right-hand corner of the dialog to select the map to be edited (Figure 10).

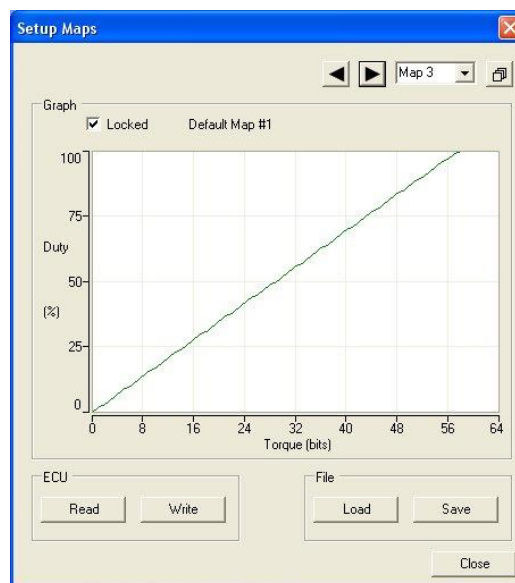


Figure 10 - Setup Maps Dialog (One Map)

- When the **Locked** checkbox is not checked edit markers are displayed at 16 places along the map (Figure 11). Use the mouse to drag each of the markers until the required map shape is obtained. Note that each marker is constrained by the markers either side of it.

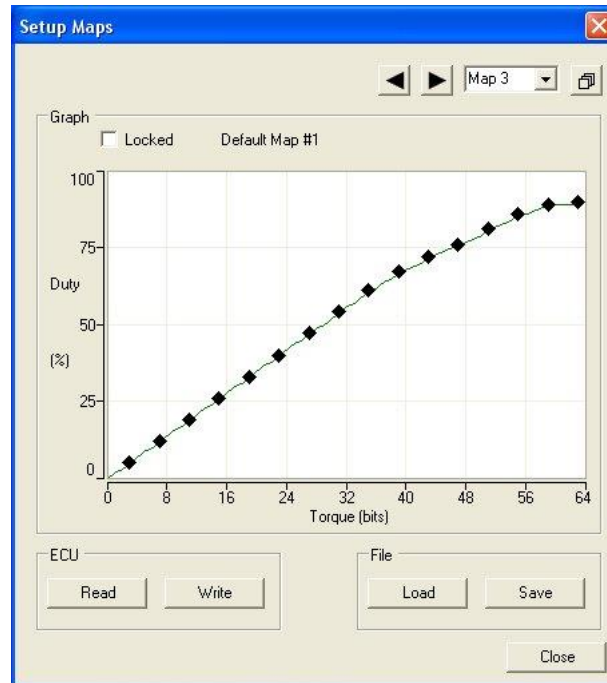


Figure 11 - Setup Maps Dialog (Map Edit)

- When the map changes are complete click **Write** to write the map data to the EPAS Ultra ECU or **Save** to save the map data to a disk file.
- When editing a map clicking the right mouse button in the graph area brings up a context menu that allows the comment associated with the map to be edited. When this menu option is selected the Edit Map Comment dialog (Figure 12) is displayed. Make any changes that are required and then click **OK** or **Cancel** to leave the comment unchanged. Note that these comments are only stored in the disk file and are not read from or written to the EPAS Ultra ECU.

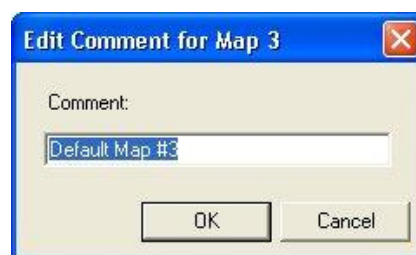


Figure 12 - Edit Map Comment Dialog

8 Troubleshooting

Problem I can't connect to the EPAS Ultra ECU or read/write its parameters.

Cause The EPAS Ultra ECU is not powered up.

Action Turn on the Master switch, and the ignition switch (if necessary).

Cause The serial lead is not connected.

Action Connect the EPAS Ultra ECU to the serial port of the host computer using the correct cable and try again.

Cause The lead is not making a good connection.

Action Ensure both connectors are fully home and that the lead is not damaged in any way.

Cause The serial port is not configured correctly.

Action Choose **Setup** ➔ **Serial Port** from the main menu and select the correct serial port. If you are using a USB to serial adapter use Windows Device Manager to determine the COM port number.

Cause A previous connection was not disconnected correctly.

Action Reset EPAS Ultra ECU and try again.

9 Error Messages

One of the following error messages will be displayed whilst trying to connect to an EPAS Ultra ECU using EPAS Desktop Pro when the EPAS Ultra ECU fault light is lit:

Message	Error 100 : Low battery voltage
Meaning	The battery supply voltage has fallen below a preset threshold and the EPAS Ultra ECU cannot continue to operate safely.
Message	Error 101 : Torque sensor not connected
Meaning	The torque sensor is not responding either because it is faulty or because it is not connected correctly.
Message	Error 102 : Torque sensor fault
Meaning	The reading from the torque sensor is incorrect either because it is faulty or because it is not connected correctly.
Message	Error 103 : Current sensor fault
Meaning	The reading from the internal current sensor is incorrect.
Message	Error 104 : Motor power fault
Meaning	The power drawn when the motor power relay is energised is higher than expected.
Message	Error 105 : Motor not connected
Meaning	The power steering motor is not drawing enough current indicating that it may not be connected.
Message	Error 106 : Motor is shorted or stalled
Meaning	The power steering motor is drawing too much current indicating that it is either shorted or stalled.

Message	Error 107 : Clutch not connected
Meaning	The motor clutch is not drawing enough current when energised indicating that it may not be connected.
Message	Error 108 : Clutch is shorted or stalled
Meaning	The motor clutch is drawing too much current when energised indicating that it is either shorted or stalled.
Message	Error 109 : Over current condition detected
Meaning	The internal current limit has been exceeded.
Message	Error 110 : Maximum safe temperature exceeded
Meaning	The box temperature has exceeded the maximum safe value.