EPAS500 Competition System

User Guide

Issue 1.0

Contents Page

1 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 Unit 1 Quayside Industrial Park Bates Road Maldon ESSEX CM9 5FA United Kingdom	DCE Inc 138 Cayuga Drive Suite C Mooresville NC 28117 USA

2 Operating Parameters

Below are the operating parameters of the EPAS500CE Competition 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 60A	The ECU regulates the motor duty PWM so that the average current is no more than 60A.
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 usage 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 EPAS500CH wiring harness.

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

3.1 EPAS500CH Competition Harness Electrical Connections and Set Up

1. Connect grey 2 pin connector marked “MOTOR” to the motor assembly.
2. Connect black 4 pin connector marked ”TORQUE” to the motor assembly.
3. Find a suitable location for the ECU (within cabin, away from heat and moisture), fix using the 4 built in anti-vibration mounting feet.
4. Find suitable location for rotary switch and mount.
5. Connect the large red wire to battery positive via a 60 amp slow blow fuse or circuit breaker.
6. Connect the large black wire to battery negative.
7. Connect thin white wire to ignition switched +12v.
8. Plug the main 18 way connector into the ECU and ensure the cable is secured so as to not apply any undue force on the ECU connector when in use.

3.2 Calibration of EPAS500M MGU

With the +12v supply to the white wire on the EPAS500CH Competition Harness switched off and with your hands removed from the steering wheel, carry out the following procedure:

- Rotate switch fully counter-clockwise (off).
- Switch on “Electronics +12v” until LED on the EPAS500CE Competition ECU illuminates. Immediately switch off and then back on until the 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 and the system is now ready for use.

Clicking the rotary switch one position clockwise will give you assistance Map 1, click again for Map 2 and so on. With each click of the switch, the steering should feel lighter.

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

4 Software

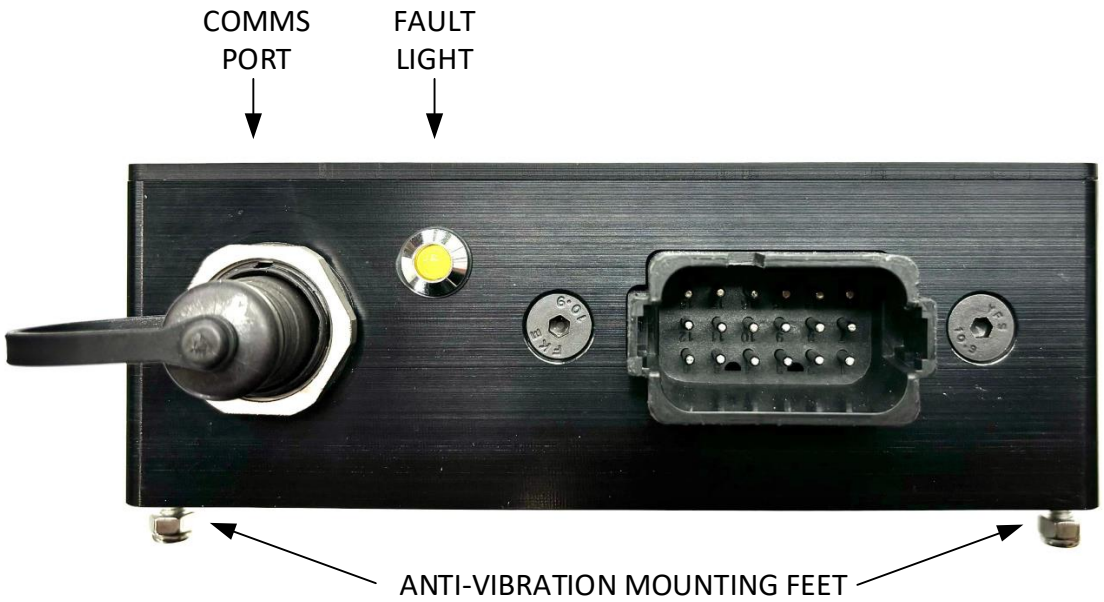
4.1 What is EPAS Desktop Pro?

The Program enables the operating parameters of the EPAS500CE Competition ECU to be viewed in real time. EPAS Desktop Pro also provides facilities for configuring and re-programming the EPAS500CE Competition ECU via the USB port of the host PC.

With EPAS Desktop Pro you can:

- View real-time data for:
  - Battery voltage
  - Current consumption
  - Applied steering torque
  - Steering motor duty
  - ECU box temperature
  - Steering angle (not used in this application)
  - Control switch setting
  - Digital input and output states (not used in this application)
- Read ECU serial number, firmware version and system type
- Configure the EPAS500CE Competition 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 EPAS500CE Competition ECU via the serial port of the host PC.

In order to connect with the EPAS500CE Competition ECU you will need to use the EPAS500CC Competition Comms Cable (available to order separately). This will connect between the comms port on the EPAS500CE Competition ECU (remove the protection cap first) and your PC USB Type A port.



EPAS500CC Competition Comms Cable

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/10/11
Hard Disk Space	10Mb
System Memory	32Mb (64Mb recommended)
Monitor/Display	Super VGA (800 x 600) or higher resolution with 256 colours
USB Port	One USB Type A port
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://dcemotorsport.com/technical-resources/
- Scroll down to the Software section and 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 Using 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 EPAS500CE Competition 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.

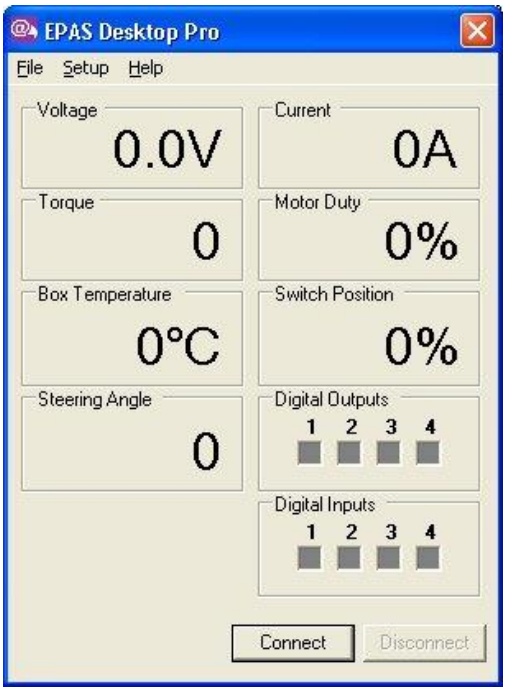


Figure 1 - EPAS Desktop Pro Main Screen (Inactive)

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 EPAS500CE Competition ECU Status

This chapter describes how EPAS Desktop Pro allows you to connect to an EPAS500CE Competition ECU and view its status.

6.1 Connecting to EPAS500CE Competition ECU

The status of an active EPAS500CE Competition ECU can be viewed in the following way:

1. Connect the USB connector on the PC to the “Comms” serial connector on the EPAS500CE Competition ECU using the EPAS500CC Competition Comms Cable (see page 7).

2. Click the **Connect** button on the main screen.

3. The live status of the EPAS500CE Competition ECU will be displayed in the various panels on the main screen and these will be updated every 500ms.

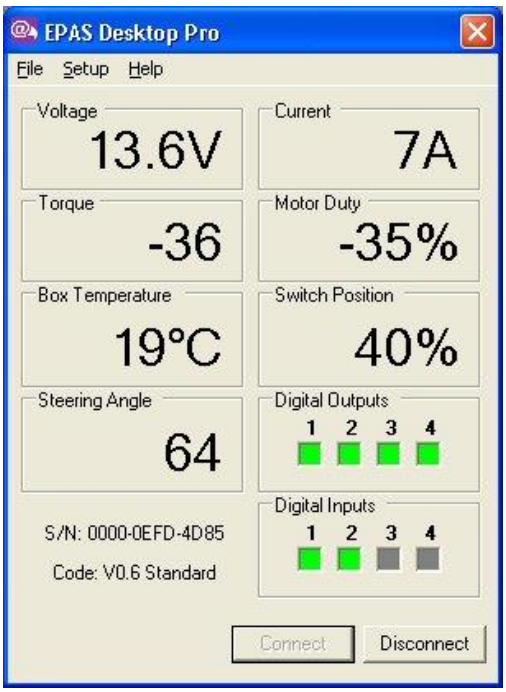


Figure 3 - EPAS Desktop Pro Main Screen (Active)

6.2 Main Screen Displays

The panels on the main screen display the following information:

Item	Description
Voltage	Displays instantaneous EPAS500CE Competition ECU supply voltage in Volt. Resolution is 0.1V and maximum reading is 25.5V (although the max. operating voltage is 16V).
Current	Displays instantaneous EPAS500CE Competition 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 EPAS500CE Competition ECU box temperature in °C. Resolution is 1°C and the ECU will shutdown if the box temperature rises above a preset safe limit.
Switch Position	Displays instantaneous steering control position in %. Display / Result / Analog Input Voltages 0% / No Assistance / > 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	Not used for this application so this value will remain static
Digital Outputs	Not used for this application so boxes may be coloured green or red
Digital Inputs	Not used for this application so boxes may be coloured green or red
S/N	Unique 64-bit serial number of EPAS500CE Competition ECU.
Code	Firmware version and system type.

6.3 Disconnecting EPAS Desktop Pro from the ECU

To stop viewing the status of an active EPAS500CE Competition 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 EPAS500CE Competition ECU will remain active and any attempt to reconnect will fail unless the ECU is reset first.

7 Configuration

EPAS Desktop Pro provides facilities for the EPAS500CE Competition 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 EPAS500CE Competition 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 EPAS500CE Competition ECU do the following:

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

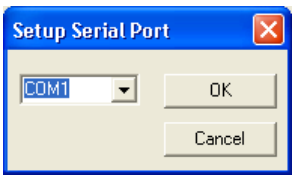


Figure 4 - Setup Serial Port Dialog

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 Changing Parameters

The operating parameters of the EPAS500CE Competition 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.

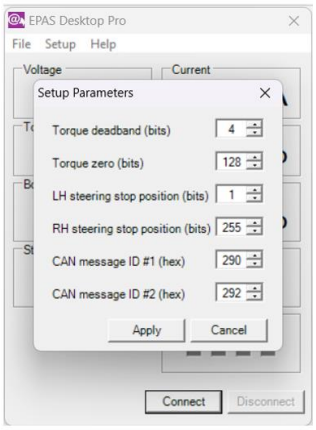


Figure 7 - Setup Parameters Dialog (Factory Settings)

2. The Setup Parameters dialog displays the current values of all the user configurable parameters of the EPAS500CE Competition ECU.

3. Make any changes that are required and click **Apply** or **Cancel** to leave the parameters unchanged.

WARNING: Great care must be observed when changing EPAS500CE Competition ECU parameters. Using the wrong values could damage both the ECU and the steering unit.

Currently, the following six parameters are defined:

- Torque deadband
- Torque zero
- LH steering stop position – Not required for this application so set to 1
- RH steering stop position – Not required for this application so set to 255

The two CAN ID values are not relevant for this application.

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 ECU 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.

The steering stops and CAN ID's are not relevant for this application and should be left at the factory settings.

7.3 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.

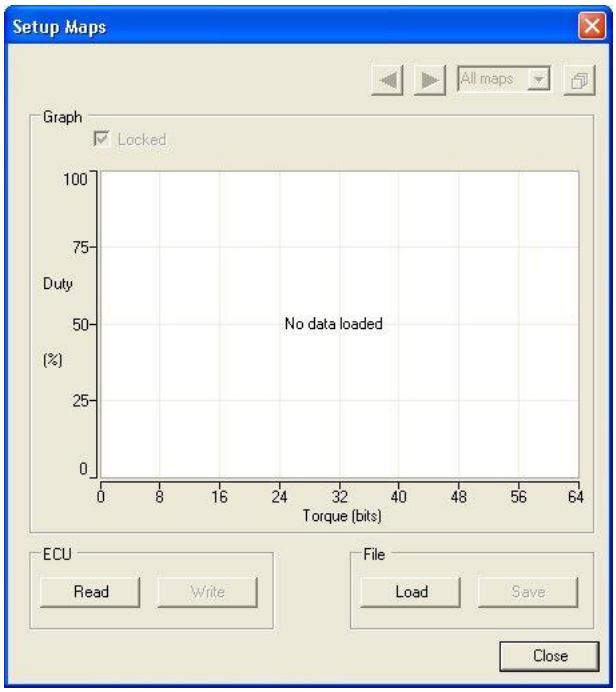


Figure 8 - Setup Maps Dialog (No Maps)

2. Click **Read** to read the maps from the EPAS500CE Competition ECU or **Load** to load map data from a disk file.

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

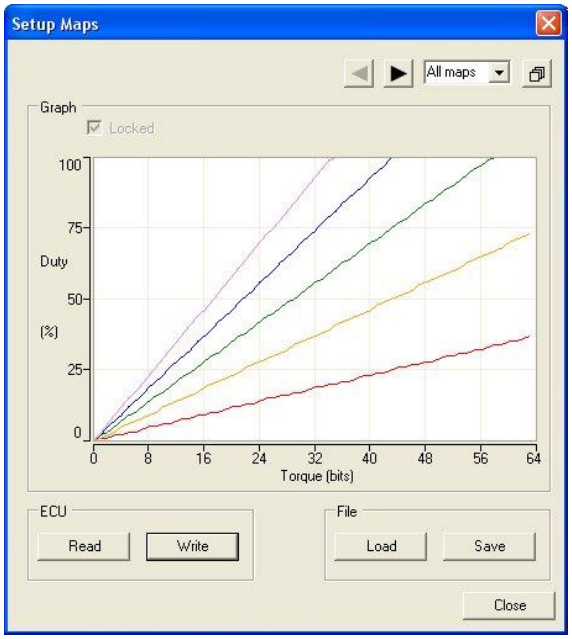


Figure 9 - Setup Maps Dialog (All Maps)

4. 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).

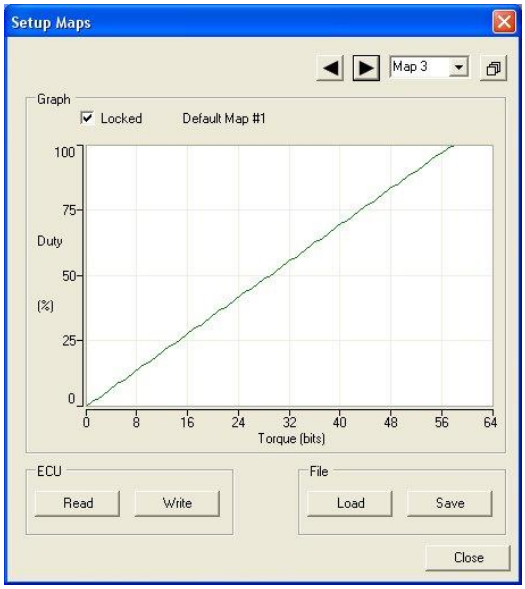


Figure 10 - Setup Maps Dialog (One Map)

5. 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.

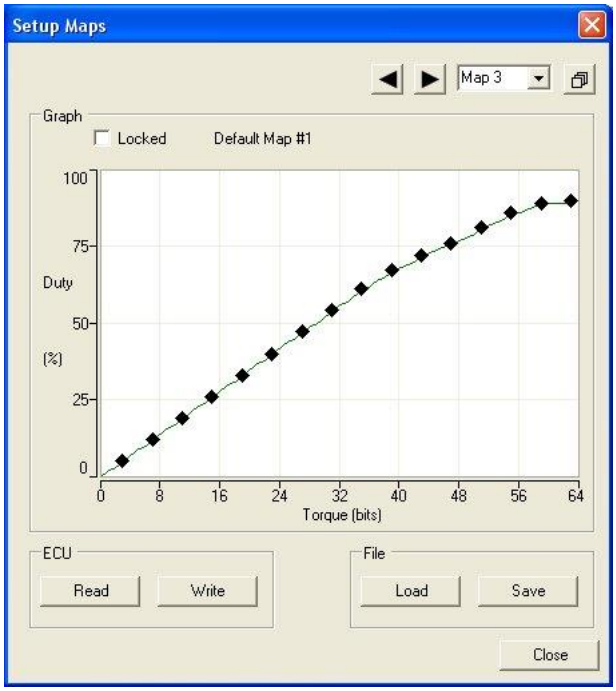


Figure 11 - Setup Maps Dialog (Map Edit)

6. When the map changes are complete click **Write** to write the map data to the EPAS500CE Competition ECU or **Save** to save the map data to a disk file.

7. 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 EPAS500CE Competition ECU.

Figure 12 - Edit Map Comment Dialog

8 Troubleshooting

Problem	**I can't connect to the EPAS500CE Competition ECU or read/write its parameters.**
Cause	The EPAS500CE Competition ECU is not powered up.
Action	Turn on the Master switch, and the ignition switch (if necessary).
Cause	The comms lead is not connected.
Action	Connect the EPAS500CE Competition ECU to the USB port of the host computer using the EPAS500CC Competition Comms 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 EPAS500CE Competition ECU and try again.

9 Error Messages

One of the following error messages will be displayed whilst trying to connect to an EPAS500CE Competition ECU using EPAS Desktop Pro when the fault light is lit. When the fault light is continuously lit, the ECU will not provide power assistance.

Message	Error 100 : Low battery voltage
Meaning	The battery supply voltage has fallen below a preset threshold and the EPAS500CE Competition 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 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.

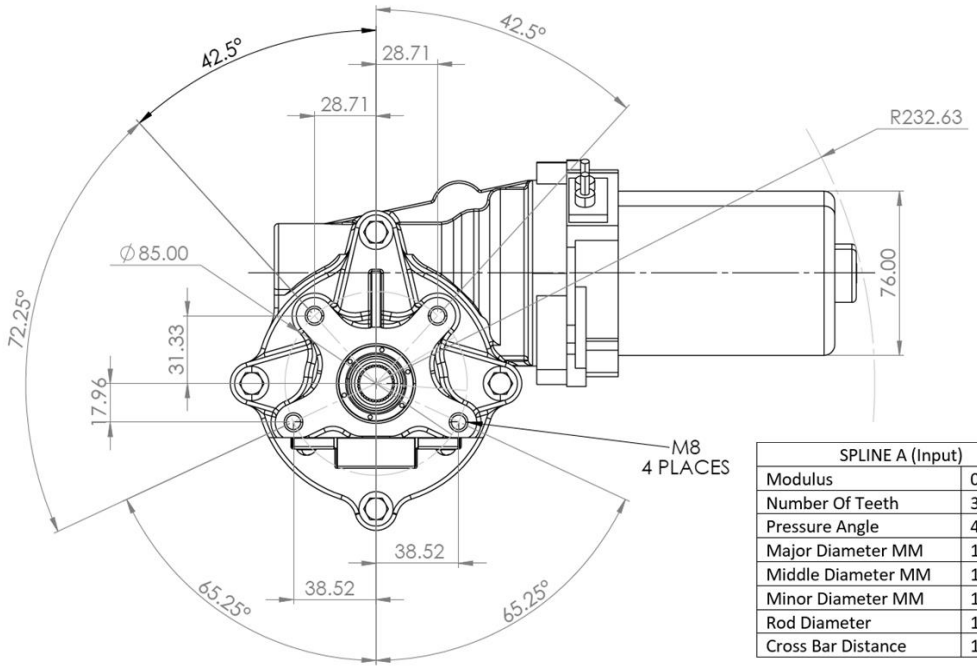
10 Fault Light

The Yellow LED mounted within the ECU has several different functions depending upon the status of the ECU at any given time. See table below for function.

Fault Light Status	Function
On for 2 seconds only when powered on	ECU is booting up and is functioning correctly
Flashing for 2 seconds only when powered on	ECU is in torque sensor calibration mode
Flashing continuously	ECU temperature has risen above 100°C (212°F) (see section 2, Operating Parameters)
On solid continuously	ECU fault condition (see section 9, Error Messages). ECU will not provide power assistance when in a fault condition.

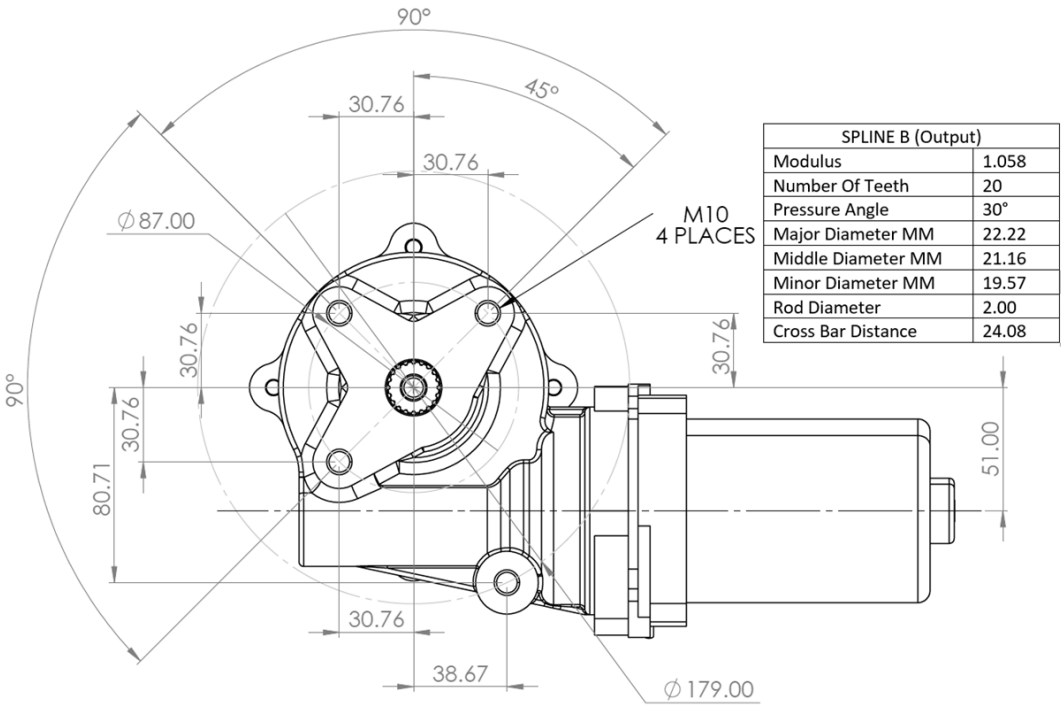
11 Dimensions

11.1 MGU Dimensions



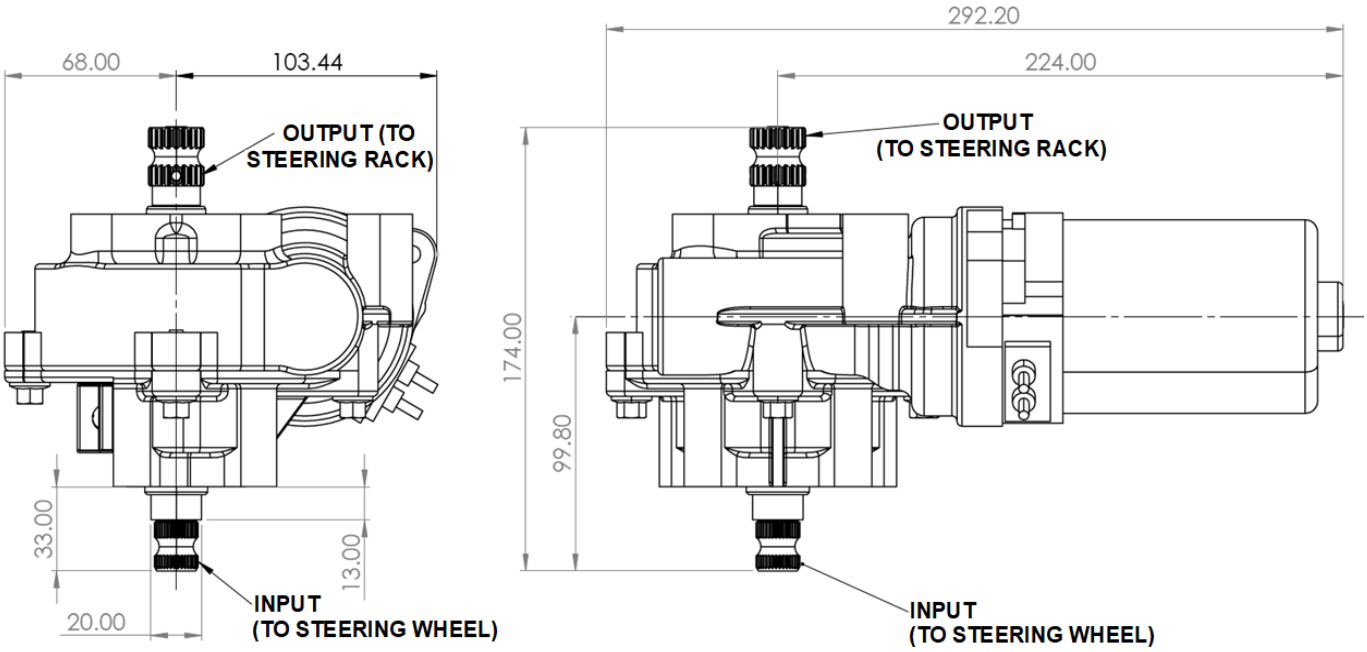
SPLINE A (Input)	
Modulus	0.4722
Number Of Teeth	36
Pressure Angle	45°
Major Diameter MM	17.50
Middle Diameter MM	17.00
Minor Diameter MM	16.40
Rod Diameter	1.00
Cross Bar Distance	18.50

INPUT SIDE

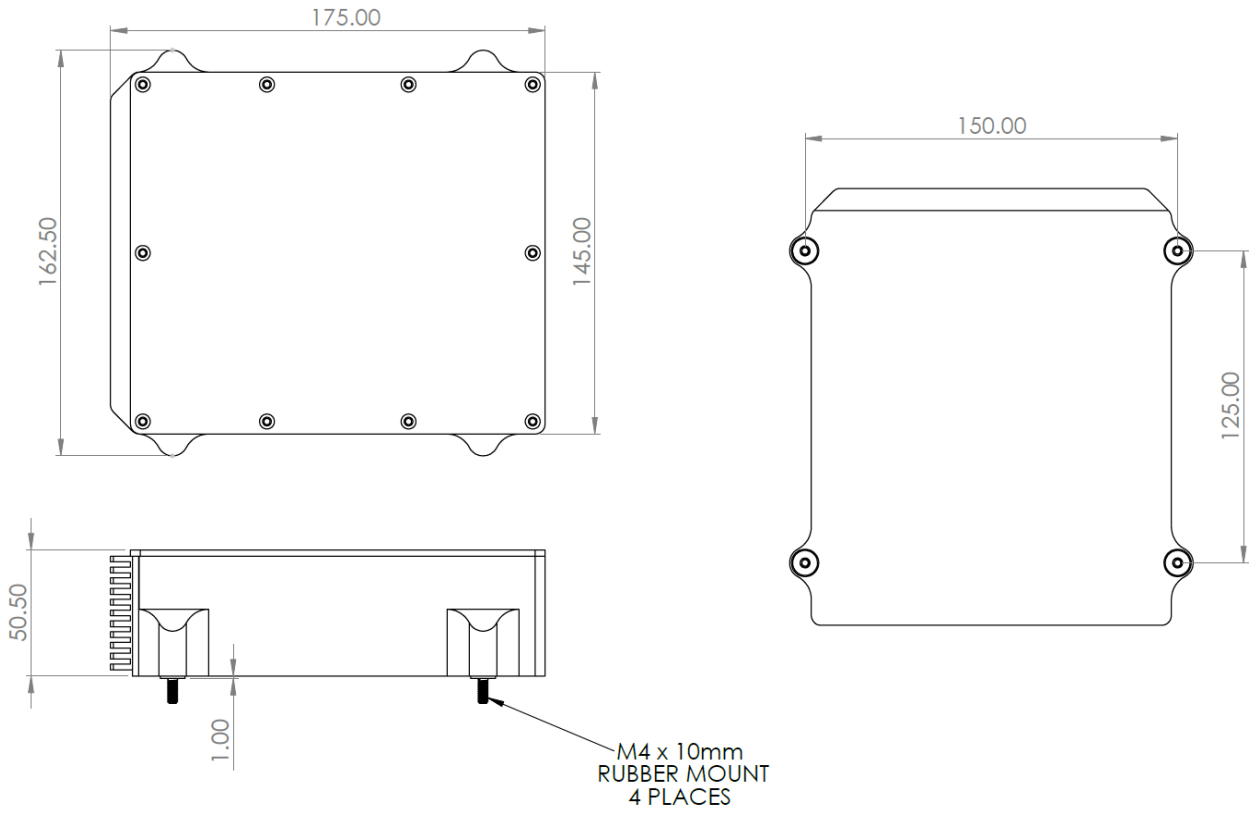


SPLINE B (Output)	
Modulus	1.058
Number Of Teeth	20
Pressure Angle	30°
Major Diameter MM	22.22
Middle Diameter MM	21.16
Minor Diameter MM	19.57
Rod Diameter	2.00
Cross Bar Distance	24.08

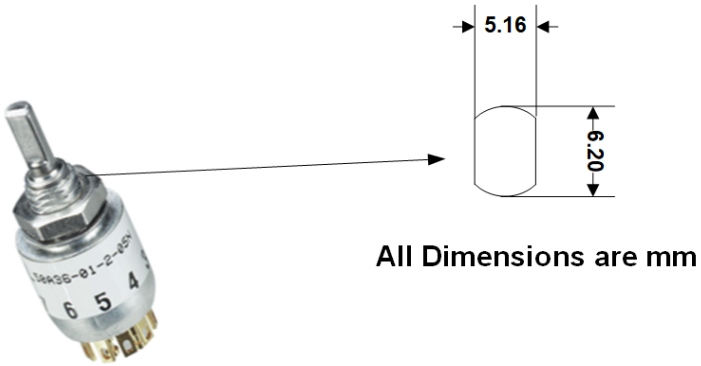
OUTPUT SIDE



11.2 ECU Dimensions



11.3 Map Switch Dimensions



All Dimensions are mm