DVT

Applications Reference Manual

177/52505

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About the DVT

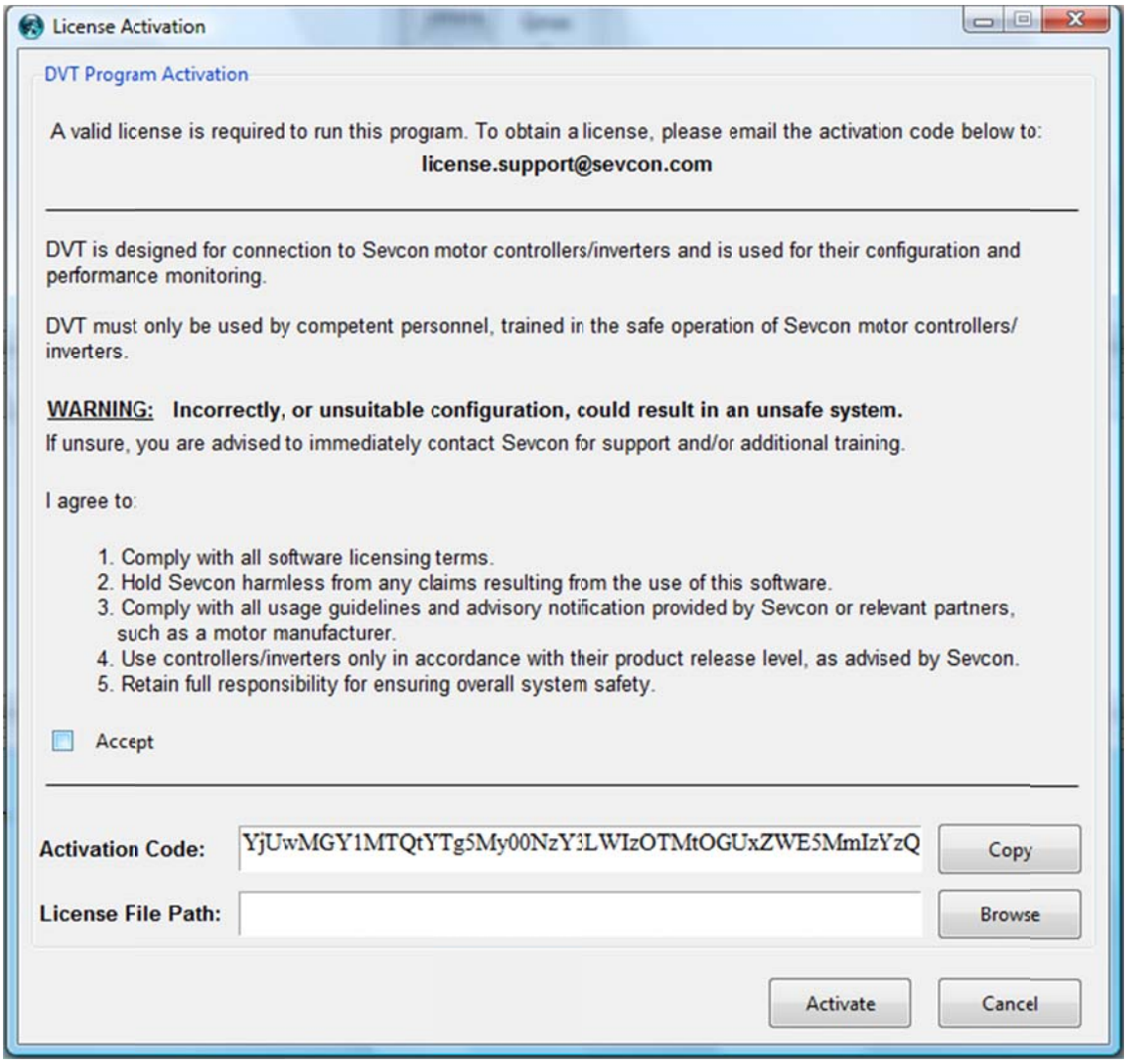
Introduction

Design Verification Test system, or DVT, is the main interface program used to interface with the Sevcon motor controller. Over the course of this manual, you will be instructed on how to effectively use the DVT and the user interface known as the helper.

Chapter 1: DVT Main Page

Starting out

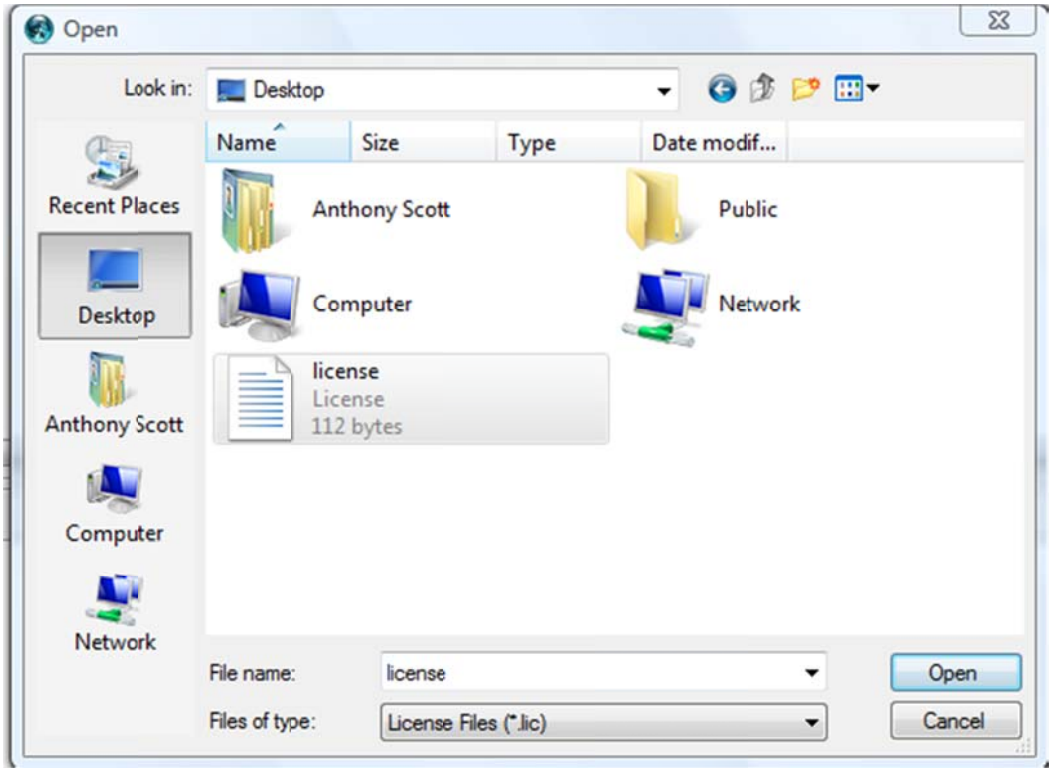
Upon first installing DVT, the user will receive a prompt asking the user to accept the terms and conditions of use, as well as a license file. This license file is used to ensure the copy of DVT is genuine.



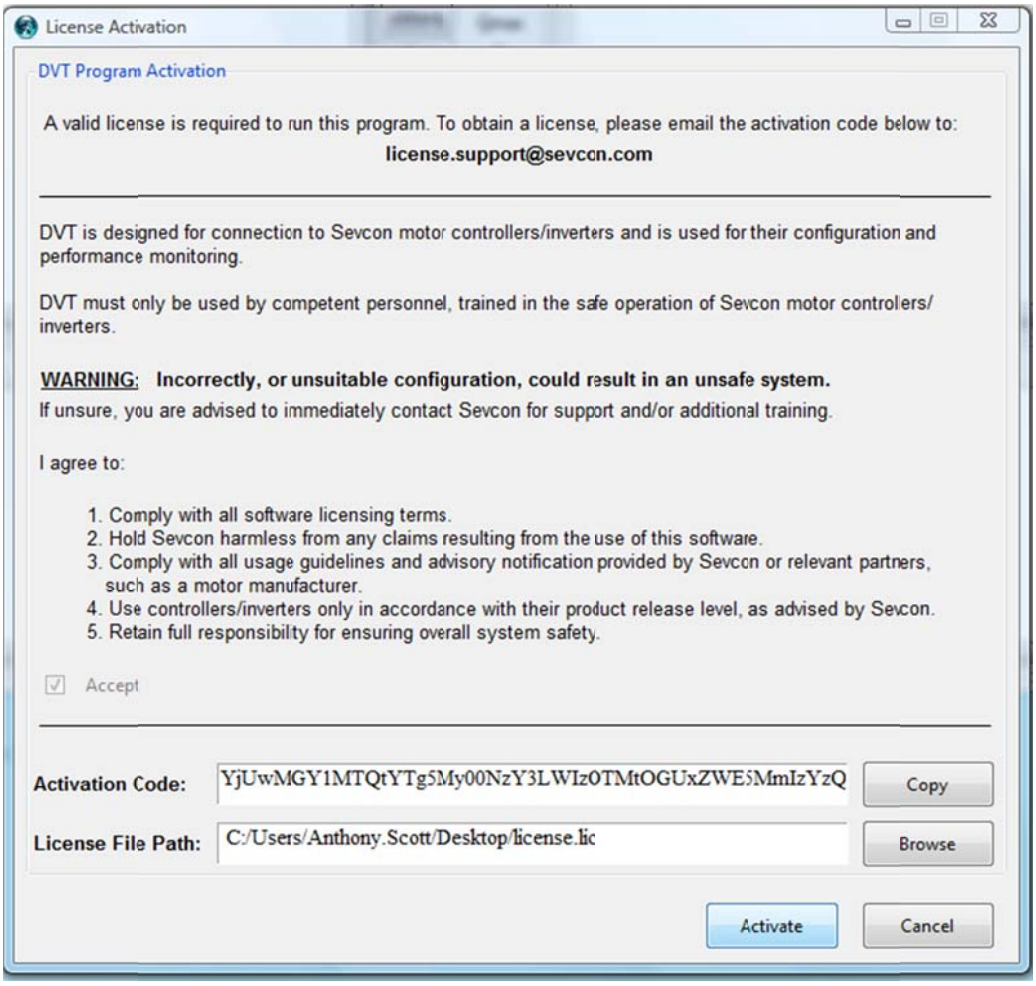
To accept the terms and conditions, the user will have to select the check box that says “Accept”

After emailing the address shown above, the user will receive a license via email as soon as possible.

Loading the License into DVT is as follows, first by selecting the “browse” button to open the local computer’s file directory. The file can be found wherever the user saves it.

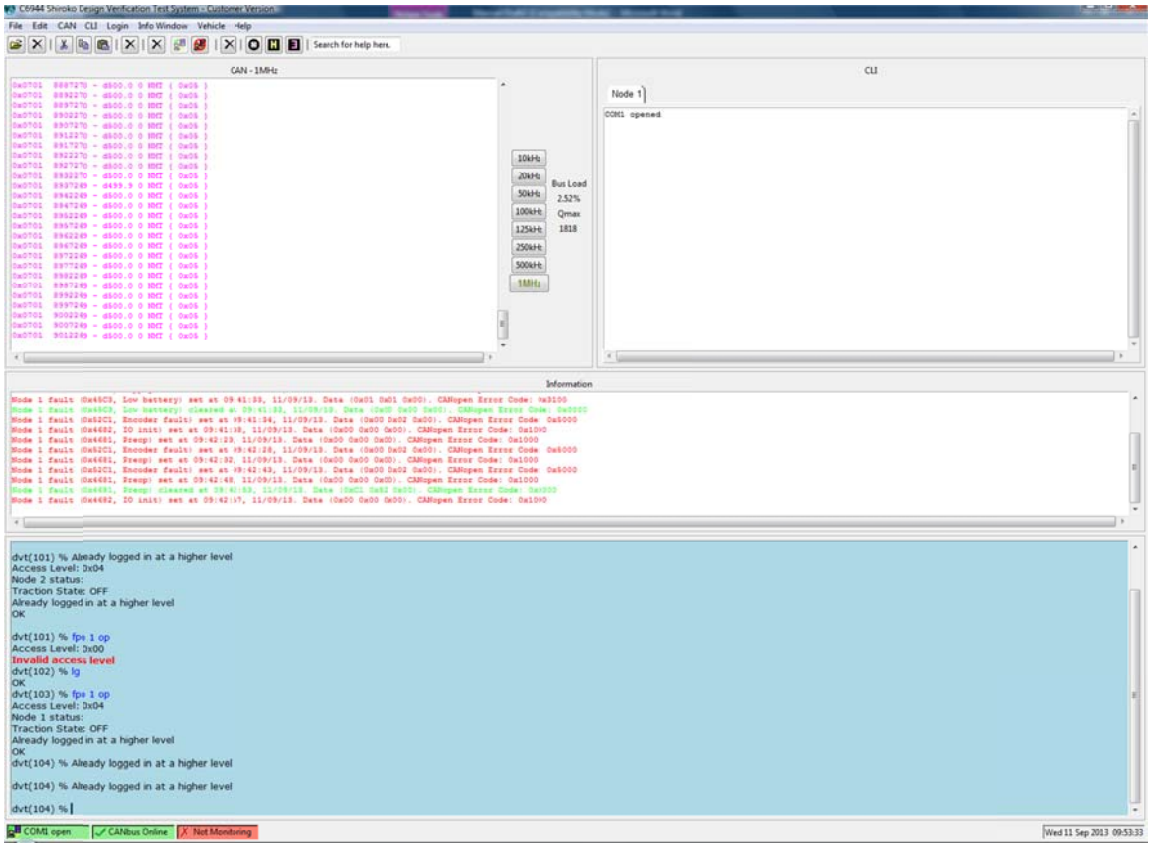


After selecting the file, its pathway will show in the activation window:



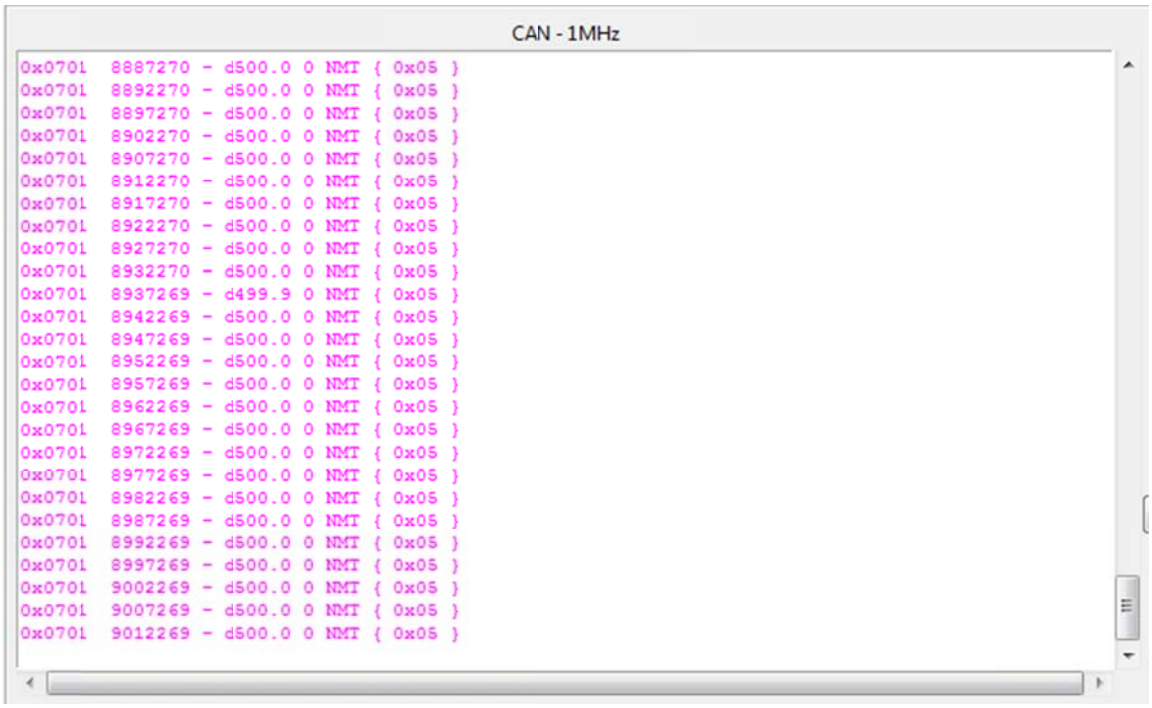
Select the “Activate” button and restart DVT. DVT will then be ready for use.

This is the main page of DVT. From here all of the functions and settings of the Sevcon motor controller can be accessed:



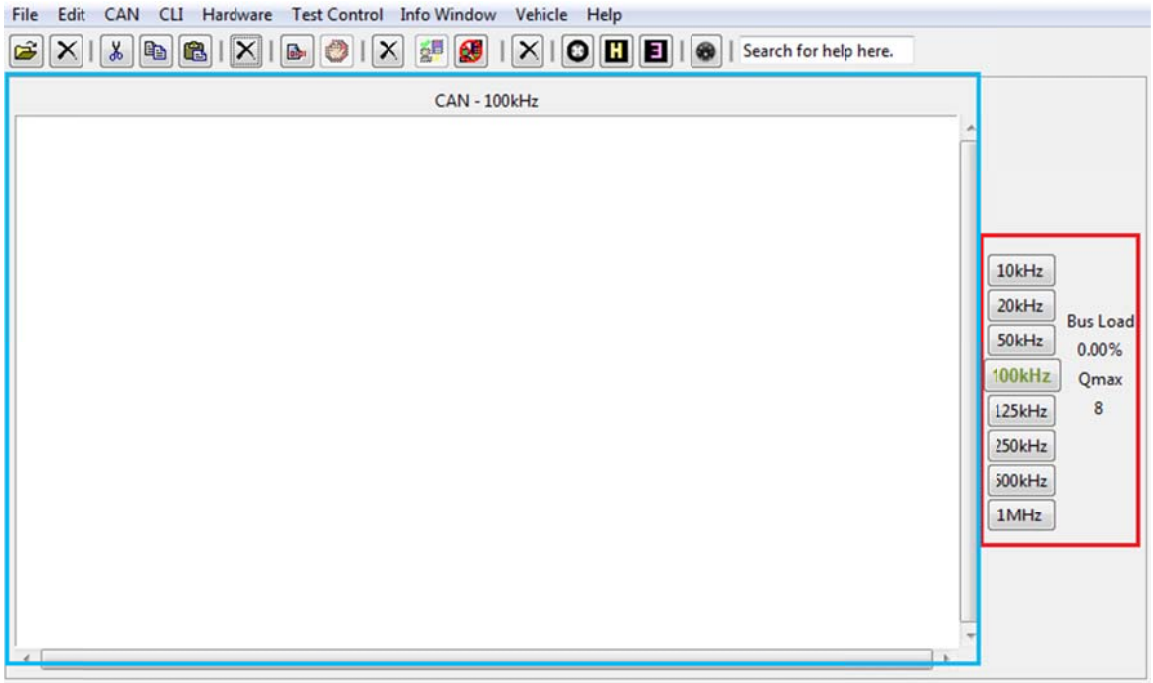
CAN Window

When there is an active connection between DVT and the Sevcon motor controller. The CAN window, found in the upper left corner of the DVT, will show the traffic being transmitted:

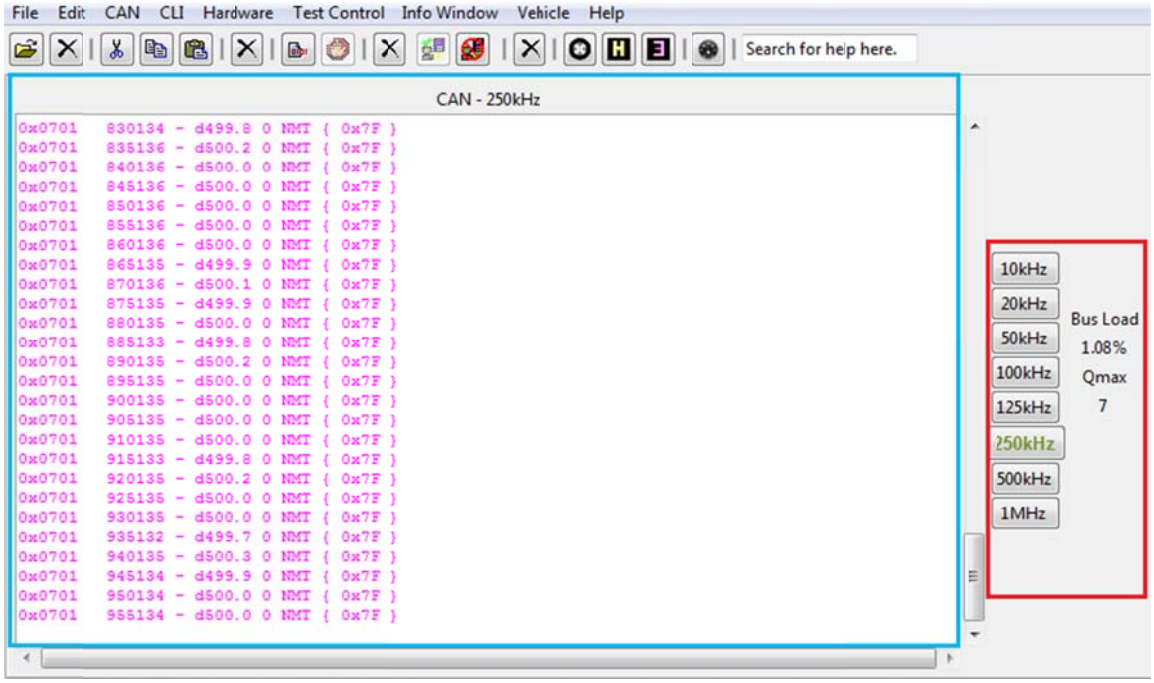


Baud Rate

The baud rate is the Button on the main screen is used to set the DVT to communicate at the configured Sevcon controller baud rate.



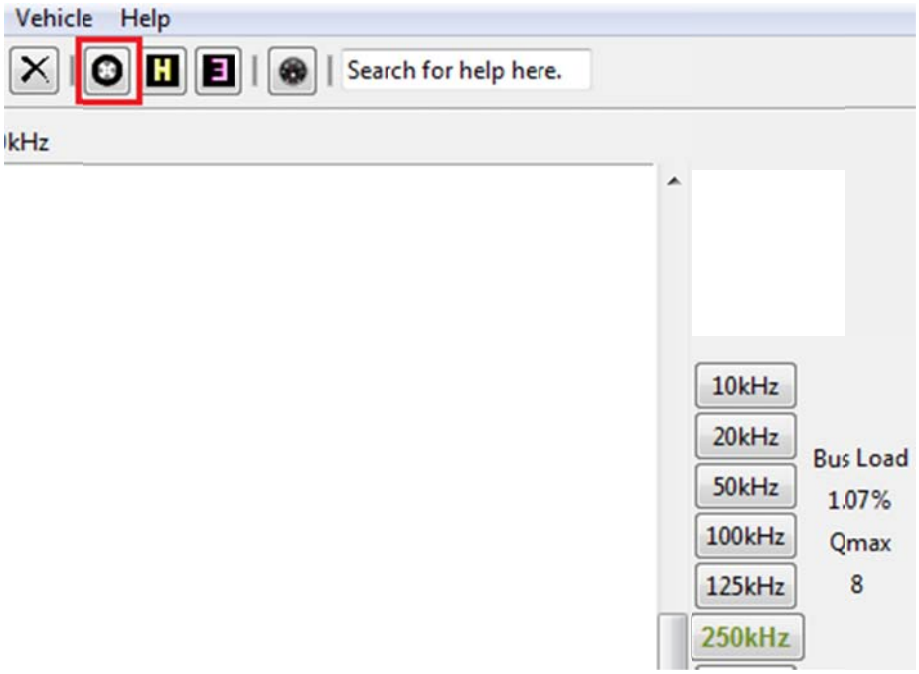
The different baud options can be seen inside the red box. There is currently an incorrect baud of 100 kHz rate selected. This is visible because the CAN window (seen in the blue box) is empty, and the software is unresponsive. If an incorrect baud rate is selected then the CAN window remains blank.



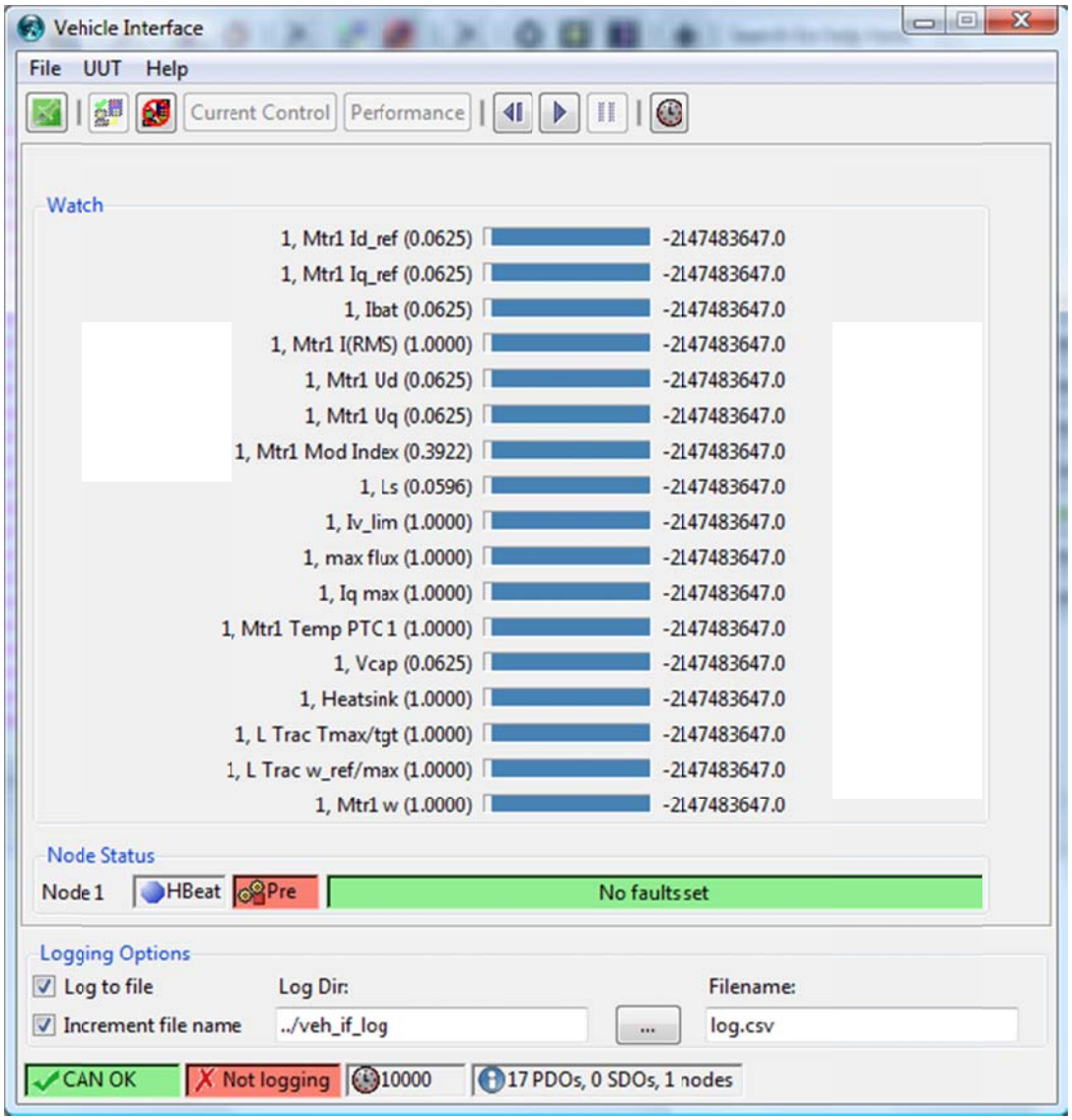
If correct baud is selected then CANBus transmissions will be seen scrolling in the CAN window. The DVT is now ready to perform operations

Vehicle interface

The DVT comes with a feature that will allow the user to view a variety of information on the motor, such as the current voltage and the temperature, in real time. This is the vehicle interface and it can be accessed by selecting the " " button found here:



Selecting the button will open a window separate to the DVT that looks like this:



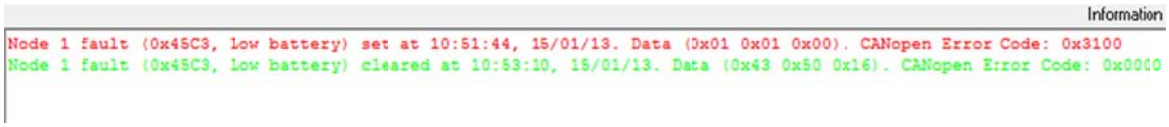
This window will update in real-time with settings and information about the motor controller setup. Information displayed depends on the TPDO setup of the motor controller.

Information Window

The window found in the center of the DVT homepage is known as the “Information Window”. This window can give a variety of information to the user such as current faults inside the controller, DLD download progress and EDS file creation progress.

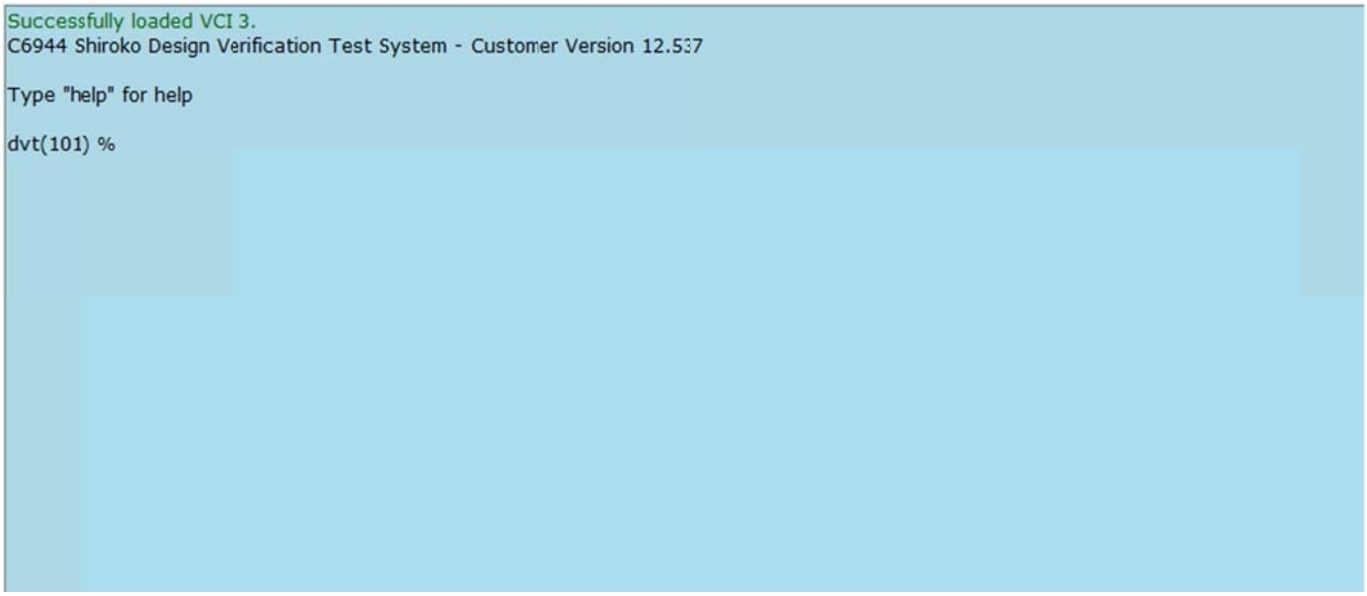
For example, here the window shows a “low battery” fault in the controller:

After clearing the fault, the DVT will report to the user that the fault has been cleared by showing the error message in green.



Input Window

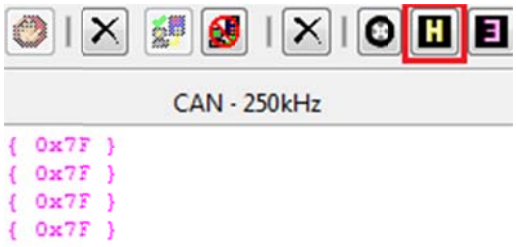
The DVT comes with a low-level input window for giving commands manually to the Sevcon motor controller, and is found here:



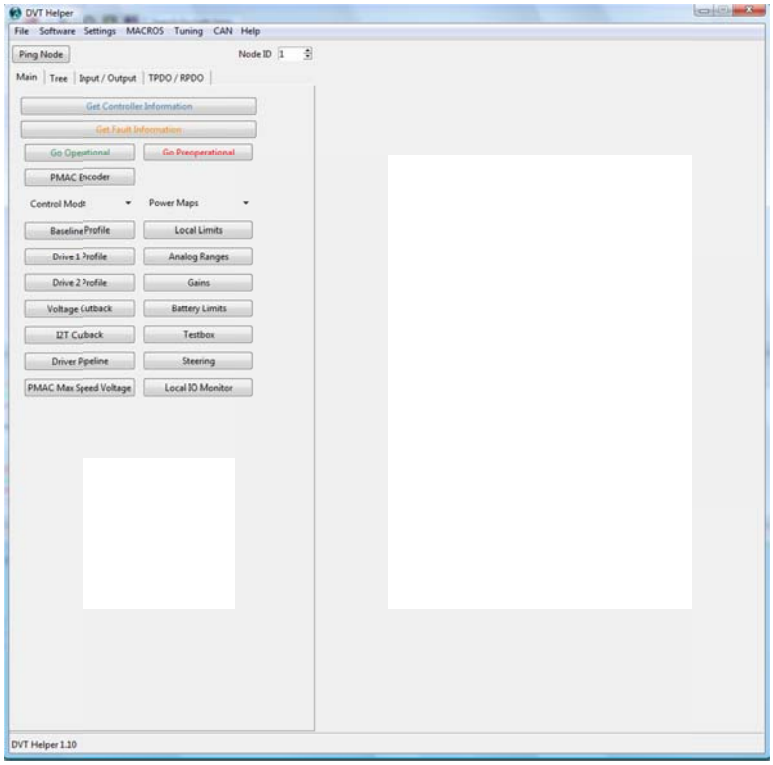
This tool is recommended for more experienced users of DVT only, for more information please contact Sevcon.

Accessing the Helper

The helper is the main user interface found in the DVT. Its function is to make viewing/changing settings inside the controller easier, creating TPDO/RPDO's and managing Input/output connections with a user friendly interface. The helper can be accessed through selecting the found here:

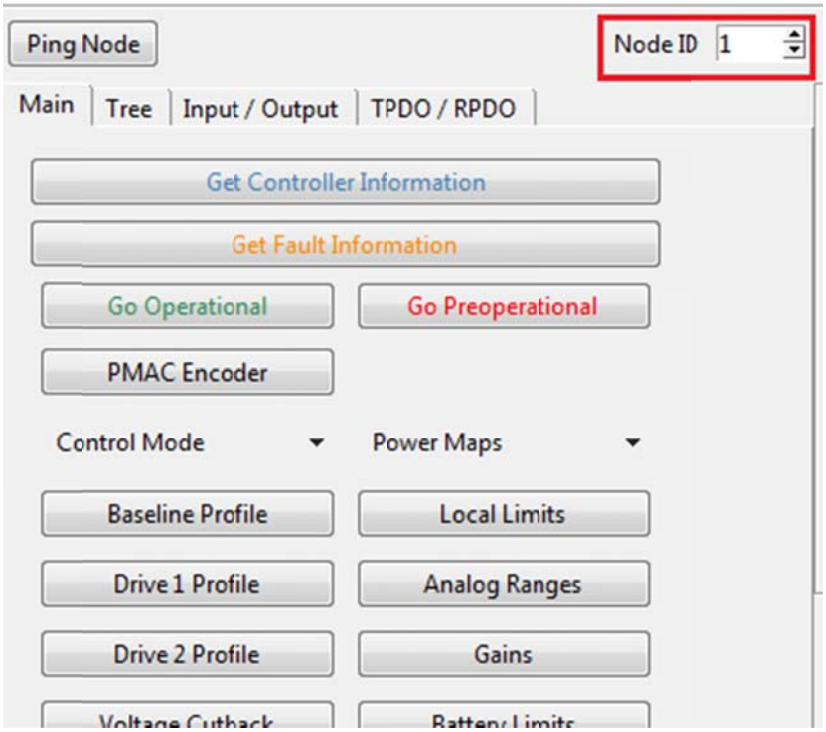


This is the helper, and all of its features will be detailed in the following chapter.



Accessing Different Nodes

If there is more than a single node connected to the network, DVT can be used to access each node via the helper. This is done through the node ID switch found here:

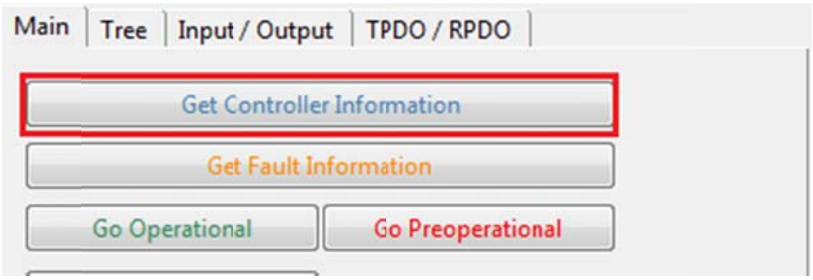


By clicking the small arrows seen above, I can cycle through different node ID numbers. There is no alert system or notification. As soon as the number changes; helper commands will be sent to that node.

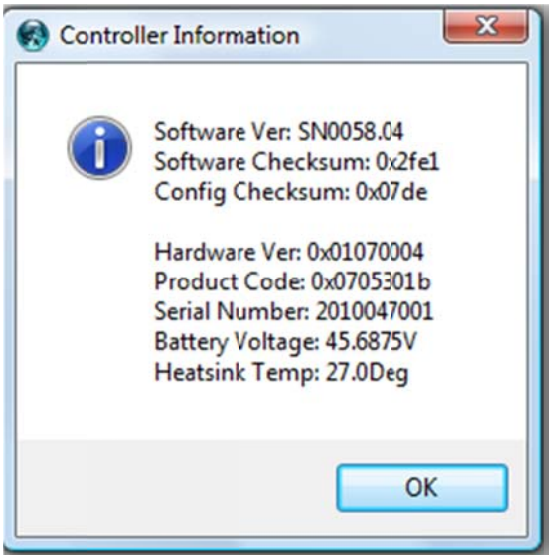
Chapter 2: Main Helper Functions

Getting Controller Information

Basic hardware and software information about the Sevcon controller can be found by selecting the “ Get Controller Information ” button. The first button found on the main page of the helper.

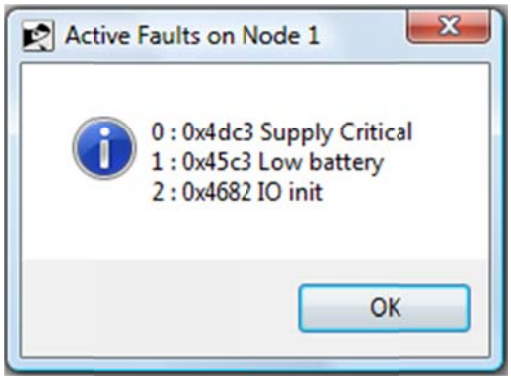


Selecting this button will cause a new window to open, which will fill with information on the controller:



This information can be refreshed at any time by selecting the Get Controller Information button again.

Gen4 is designed to detect a range of operational faults. Selecting the Get Fault Information button will open a window which displays the Fault ID code and simply description of any active faults at that time.



Operational and Pre-Operational

Two of the most important buttons on the Helper are the "Go Operational" and "Go Preoperational" buttons. These buttons are used to activate critical functions within the gen4.

Go Operational

Selecting the "Go-Operational" button will essentially set the controller to "ready to drive". While in this mode, the many of the motor controllers' settings cannot be changed.

Go Preoperational

Many of the controllers' objects can only be changed while in pre-operational mode. When in pre-operational mode, CAN PDO messages will not be transmitted from the controller.

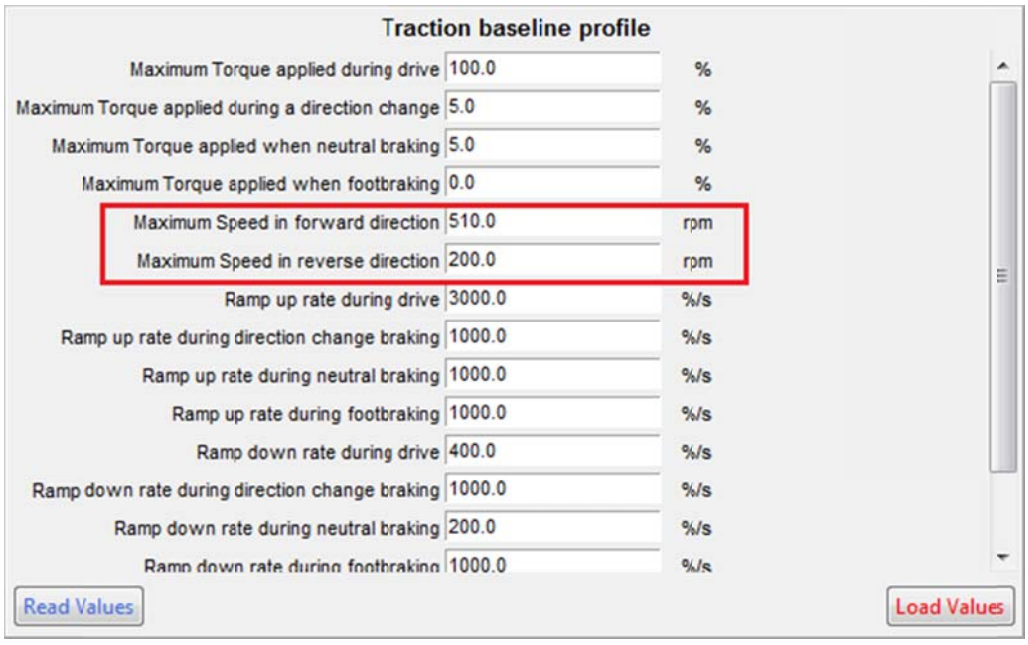
Baseline Profile

Once the helper is open, access to the majority of the variables within the DVT's object database is granted. Take for example: the maximum forward and reverse rpm in the motor. These are two settings that can both be changed very easily

First, select the button labeled "

". Doing so will bring up this menu full of objects on the right side of the helper:

Doing so will bring up this menu full of objects on the right side of the helper:



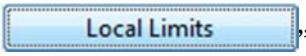
The setting highlighted above is going to be changed (in this case, the maximum forward rpm) to 600 and the reverse to 450. To do this, first click inside of the appropriate text box, and delete the contents.

Then, enter the desired figures into the boxes like so:

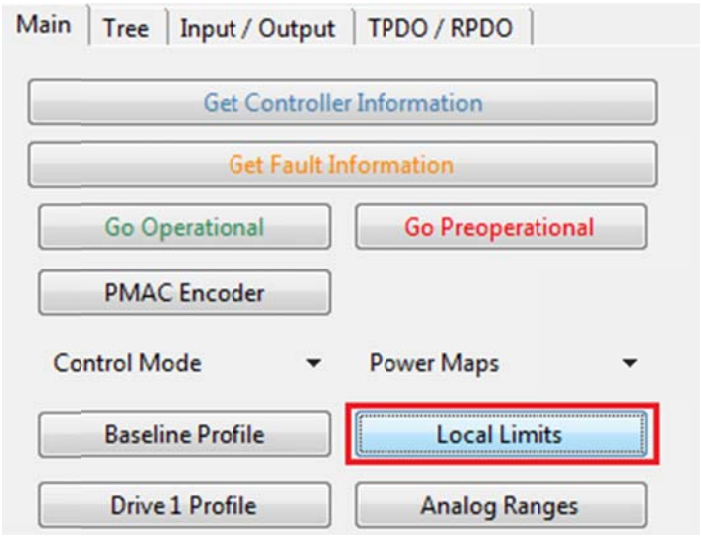
Finally select the

button found in the bottom right of the window to finalize the values.

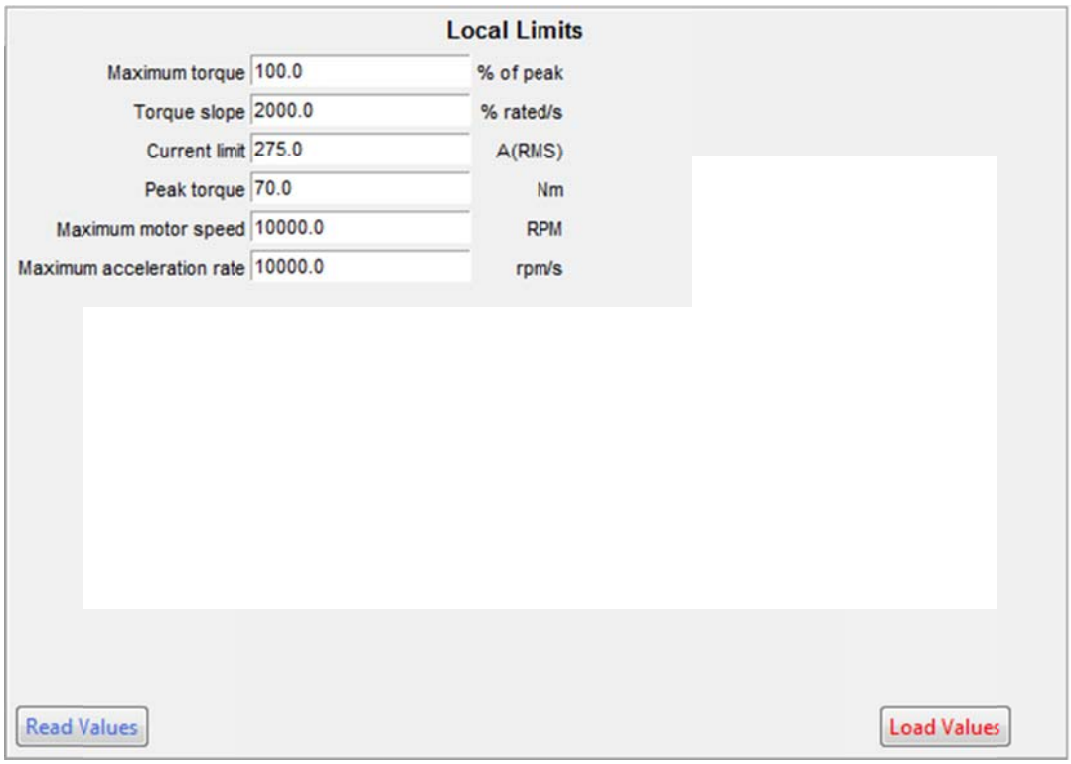
Local Limits

DVT Gives the user control over the limits in both current and torque of a motor through use of the controller. The easiest way to access these functions the local limits “ 

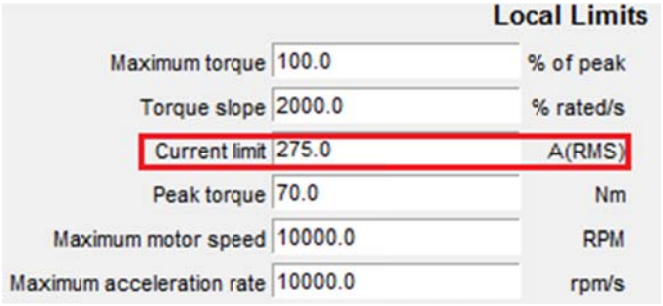
” button found here:



Selecting this button will open up the local limit menu.



From this menu, the user can access the torque and current settings of the motor attached to the system. To change the current limit (the minimum voltage that can be set without the line contactor opening) from 275A to 280A, the process is as follows:



First, clear the text box of the current limit.

And now enter the desired under voltage limit (in this case, 280A)

To confirm the change, select the

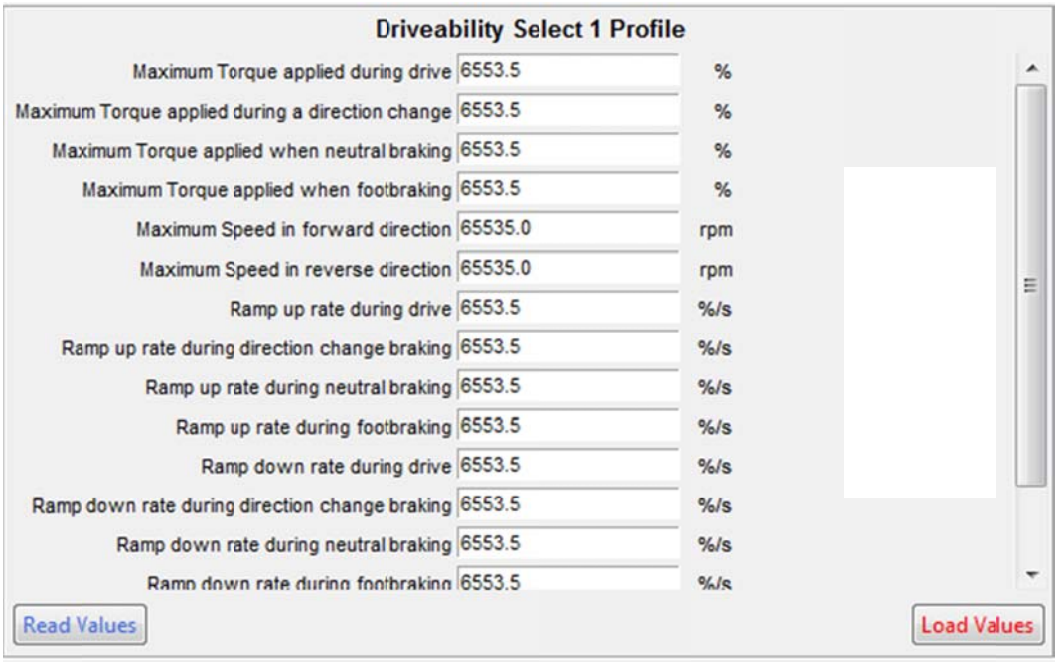
button in the bottom right of the window.

Driveability Profiles

DVT can be used to set alternate Drive Profiles in the Sevcon controller. Through the "Drive 1 Profile" and "Drive 2 Profile" buttons.

Driveability profiles allow vehicle operation under different speed, torque, acceleration and deceleration. The buttons to access them are shown below:

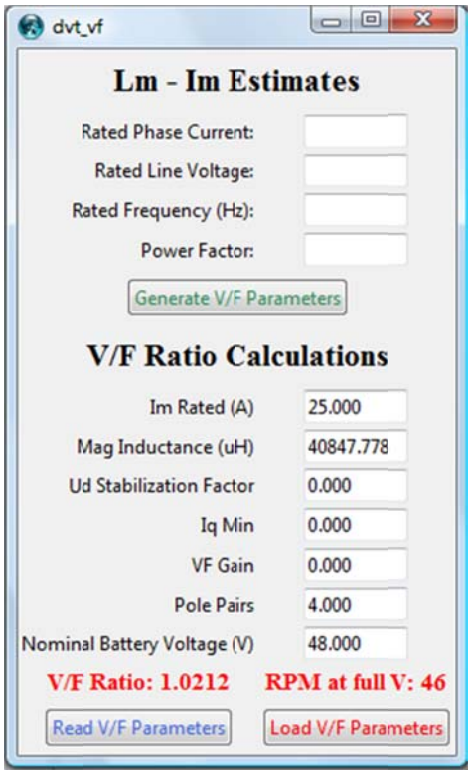
Selecting either of these buttons will open the appropriate profile window. The available parameters in DP1 and 2 are identical to the menu from "Baseline Profile" and can be edited in the same way.



V/F Ratio

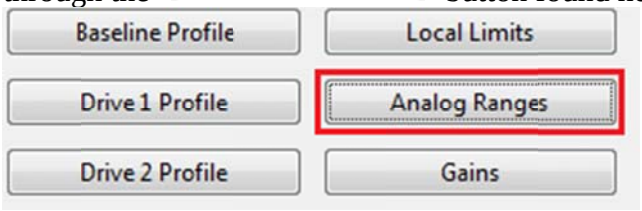
DVT can be used to control the voltage/frequency of the motor control through the “ V/F Ratio ” button found here:

Selecting this button will open up the v/f window in front of the helper:

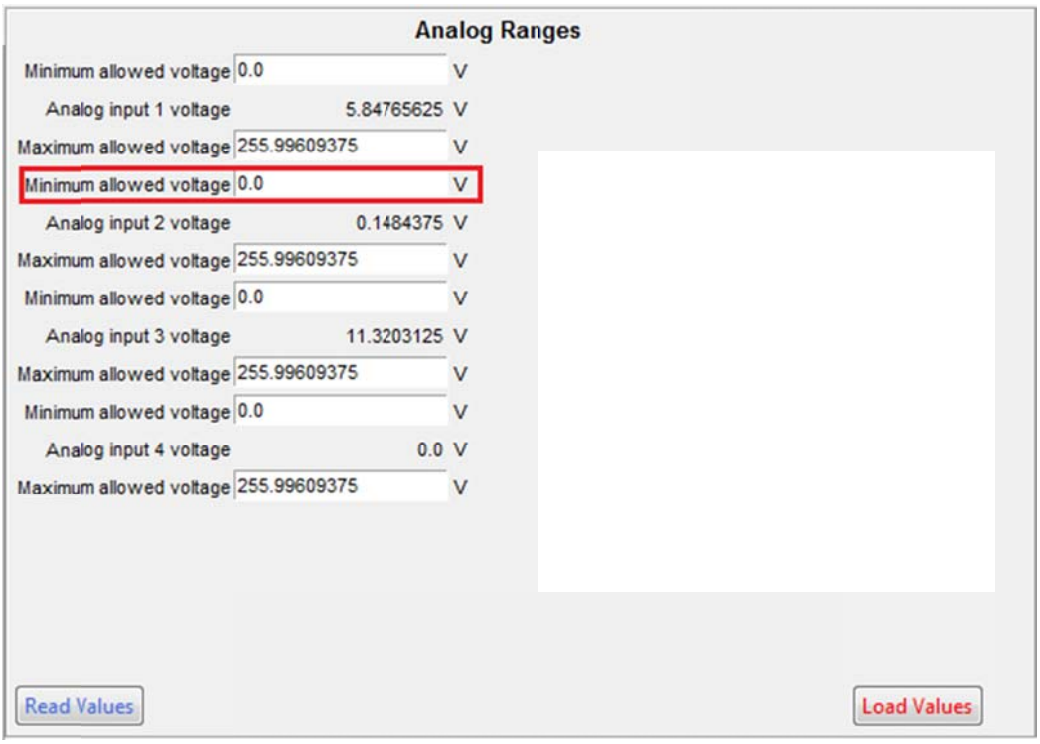


Analogue Ranges

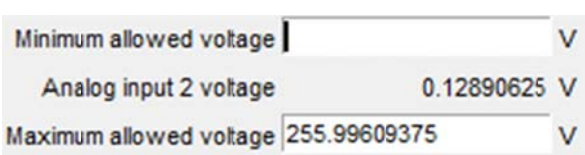
DVT allows the user to adjust the minimum and maximum allowed voltages on all of the analog inputs attached with the motor controller. These functions can be accessed through the “ Analog Ranges ” button found here:



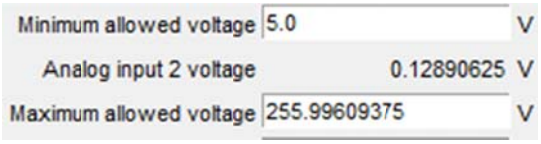
Selecting this button will open a menu on the right side of the helper:



The setting highlighted above is going to be changed (in this case, the minimum allowed voltage of AU2) from 0 to 5v. To do this, first click inside of the appropriate text box, and delete the contents.



Then, enter the desired figures into the boxes like so:



Finally select the

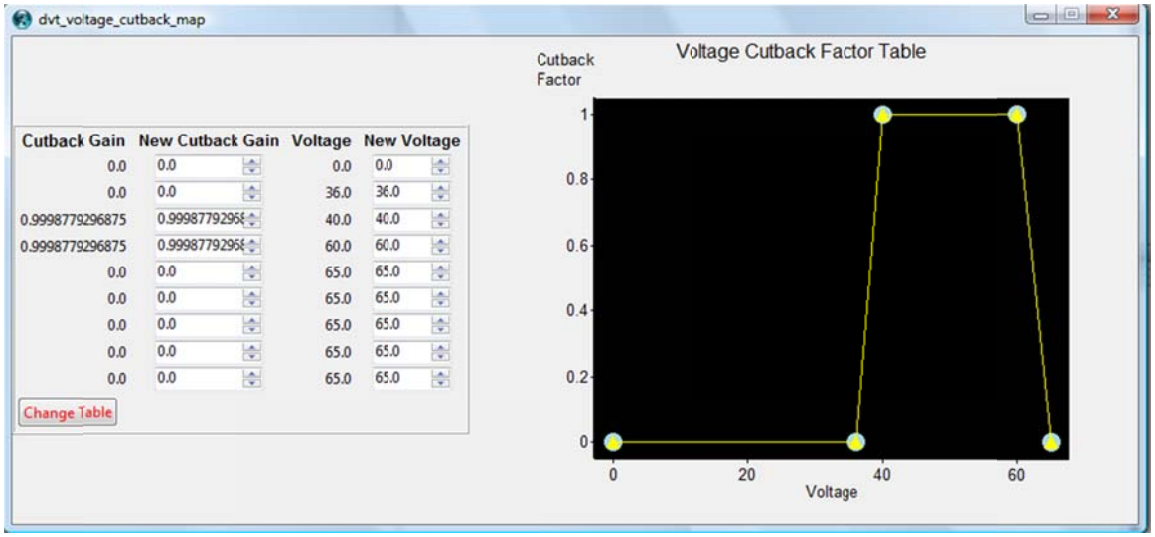
button found in the bottom right of the window to finalize the values.

Voltage Cutback

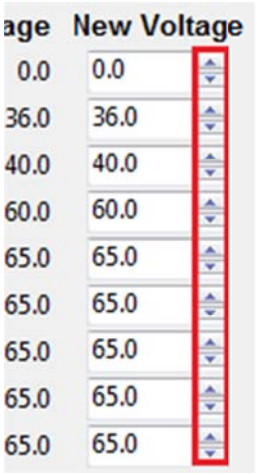
The DVT will allow control over the voltage cutbacks for the controller. This can be accessed through the "

" found here:

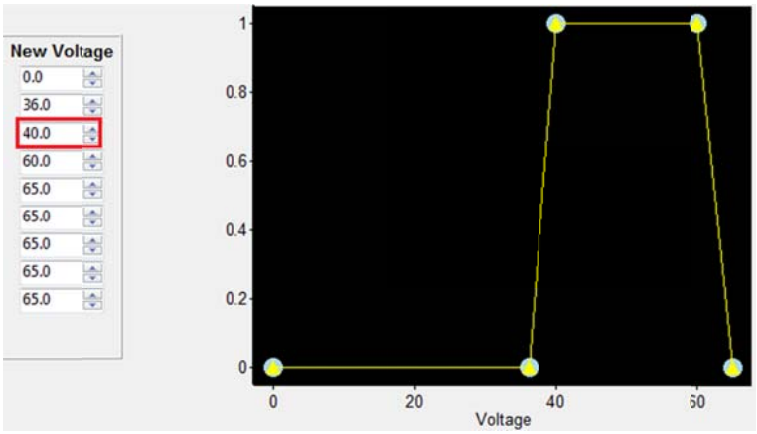
In the table below, it is shown that the voltage for the connected controller is between 36v and 60v. Inside this range, the torque applied by the motor will be as rated. Above or below these limits however; the torque will decrease in proportion to the actual measured voltage.



These limits are customisable however. Each value has two arrows shown here:

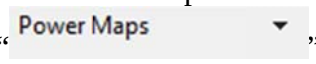


Each click of one of these arrows will increase/decrease the value in the corresponding box by a value of 1.

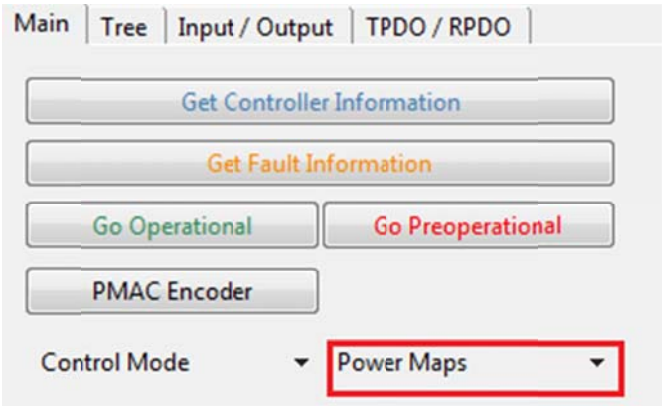


Alternatively, new values can be entered into the boxes manually through the keyboard. The same customisation can be applied to the level of torque that is cut back in the same way. This is seen under the “New cutback” gain.

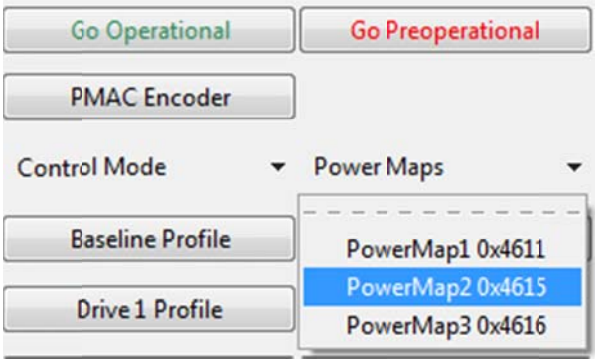
Power Maps

The DVT can be used to plot the entire torque/speed relationship of a motor through the use of the “ 

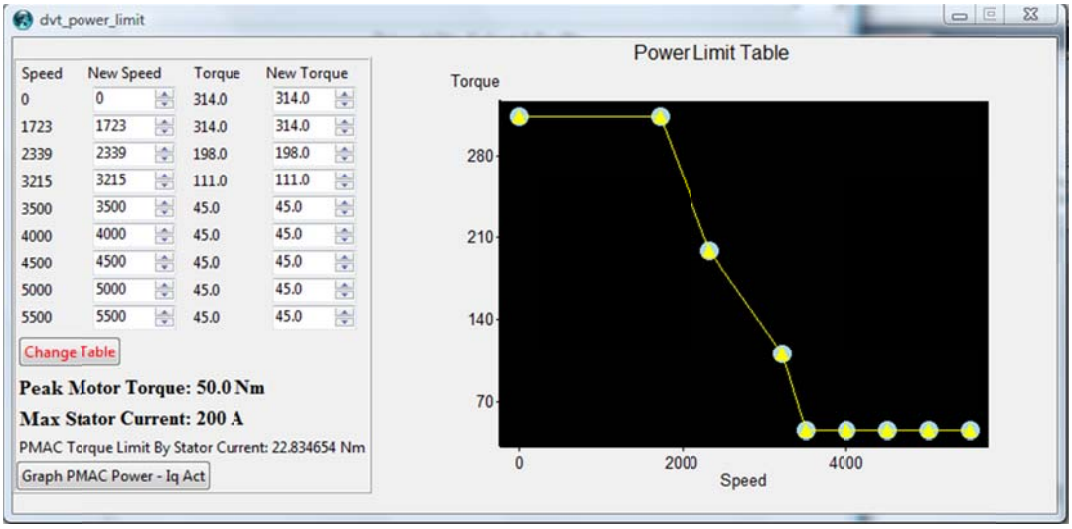
” button found here:



Selecting this button will create a dropdown from the button that looks like this:



Selecting a map will open a table and graph like this:



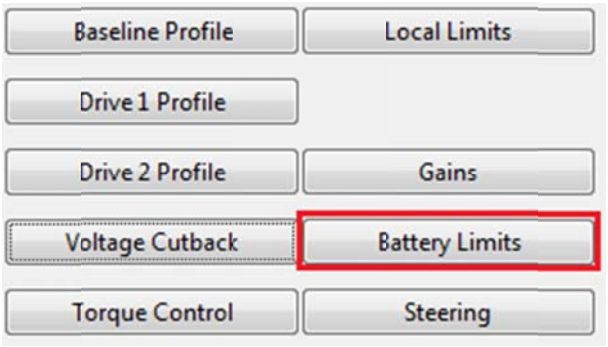
From this table/graph, the speed and torque settings can both be changed through the same means used in the *Voltage Cutback* section of this manual.

The main function of the power limit table is to protect the motor it is connected to. If the user tries to apply a torque beyond the motors' capabilities, the battery will apply more current to compensate; this can cause serious damage to the motor and other components through overloading. By setting a peak torque and appropriate torques for the speed being used, this can prevent these problems.

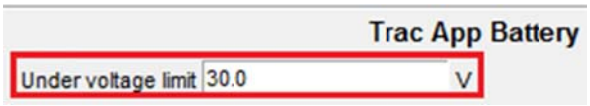
Battery Settings

Both the maximum and minimum voltages that can be applied to the controller are accessible in the DVT. These settings can be changed using the "

" button, which can be found here:



Selecting the button will bring up a menu on its' right side containing the voltage settings for the controller. To change the under voltage limit (the minimum voltage that can be set without the line contactor opening) from 21.0V to 30V, the process is as follows:

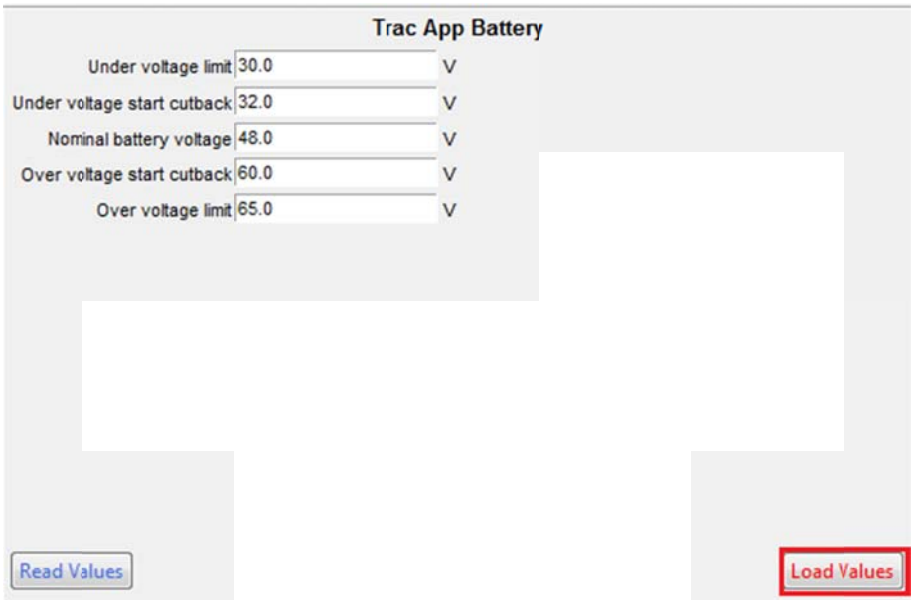


First, clear the text box of the current limit.

And now enter the desired under voltage limit (in this case, 30v)

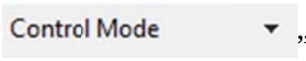
To confirm the change, select the

button in the bottom right of the window.



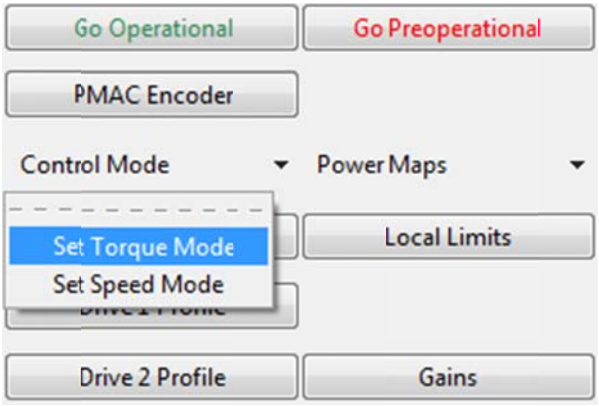
Control Modes

The Sevcon motor controller can be configured to motor torque, or speed control mode. DVT can be used to switch between the two modes, by using the “

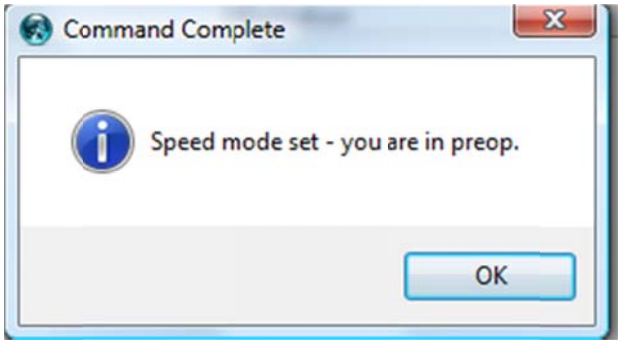


” button found:

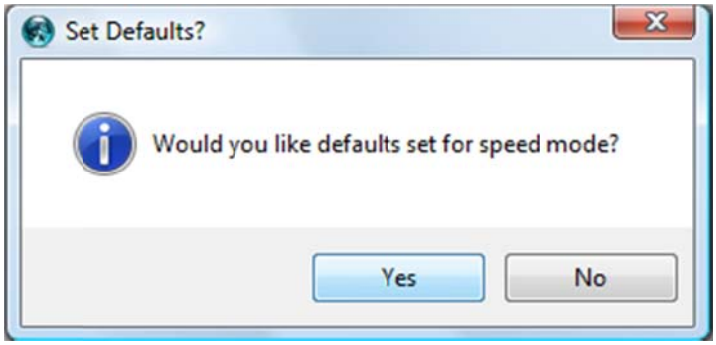
Once this button is selected, a small dropdown menu will come from the button:



When switching the control mode, DVT will first be automatically put into pre-op.



The DVT will then confirm whether or not to set the defaults of the set mode. It is recommended to only apply these settings if the default torque or speed mode configuration is needed configuration.

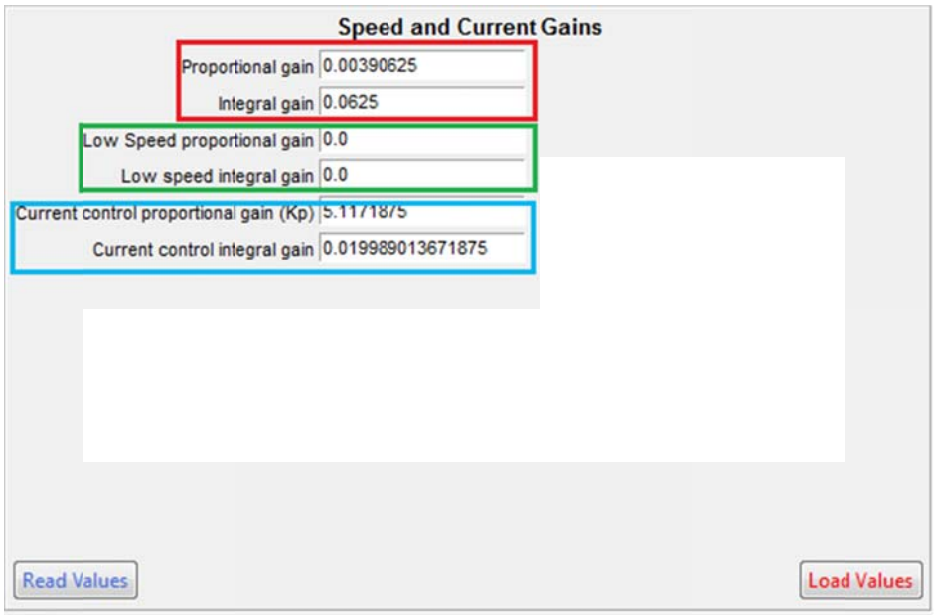


Controlling Gains

DVT allows adjustment of various motor control loop configuration, proportional and integral gains. These functions allow tuning of the motor control gains to smoothly

accelerate/decelerate and maintain the requested speed. The "Gains" button gives access to these settings and can be found:

Selecting this button will open up the gains window.



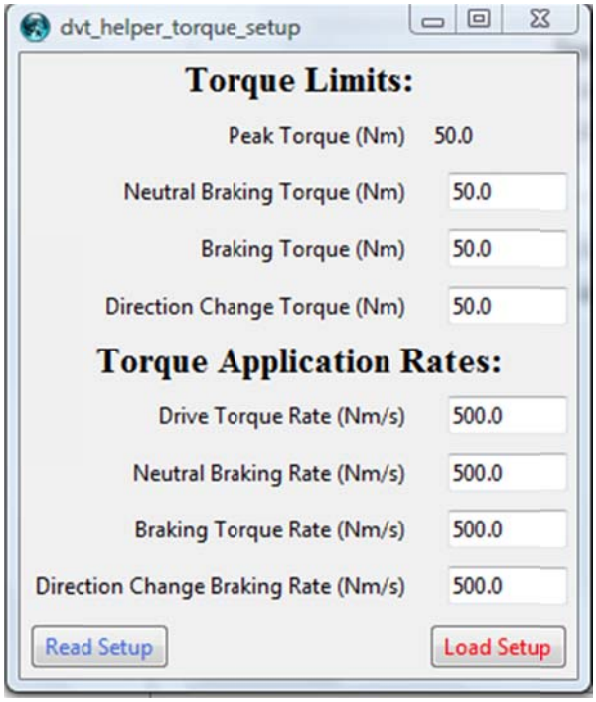
- The proportional and integral gains are related to the speed control gain.
- The low speed proportional and integral gains are also related to the speed control.
- The current control proportional and integral gains belong to the current control scheme.

In order to get a smooth response from the controller perform slight changes on these values until obtain the right desired response. For more information about tuning techniques please contact Sevcon.

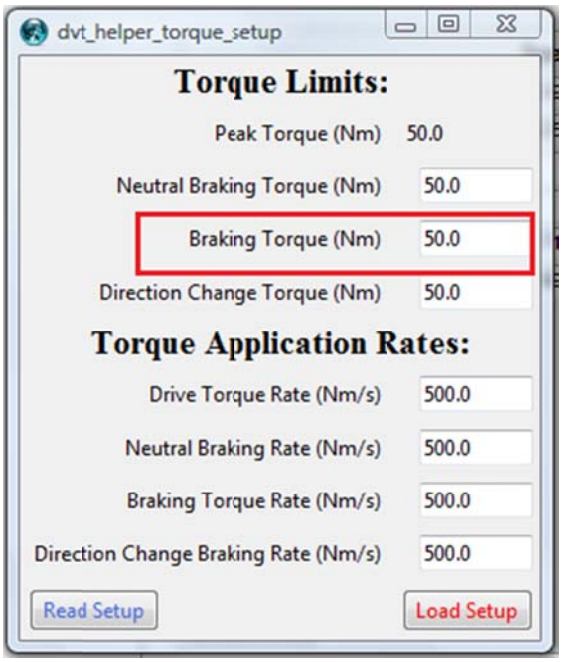
Controlling the Torque

While the baseline profile gives access to the percentage at which torque is applied during a drive/braking. The actual values for the torque can be accessed through the Torque Control button. It can be found here:

Selecting the button will open a separate window that looks like this:



The peak torque showed on this trace is the actual torque configured (See local limits window) in Nm and its dependent on the motor manufacturer. The values showed below peak torque are all related to the peak torque and the percentages set in the baseline profile. The torque limits are in Nm and rates are Nm/s.



The braking torque (highlighted above) will be changed from 3.5Nm to 20Nm as an example of how to change a setting. To do this, first click inside of the appropriate text box, and delete the contents.

Then, enter the new value into the box:

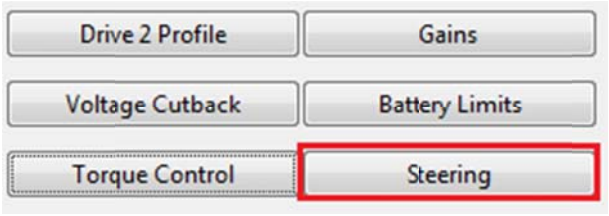
And finally select the

button to finalize the values.

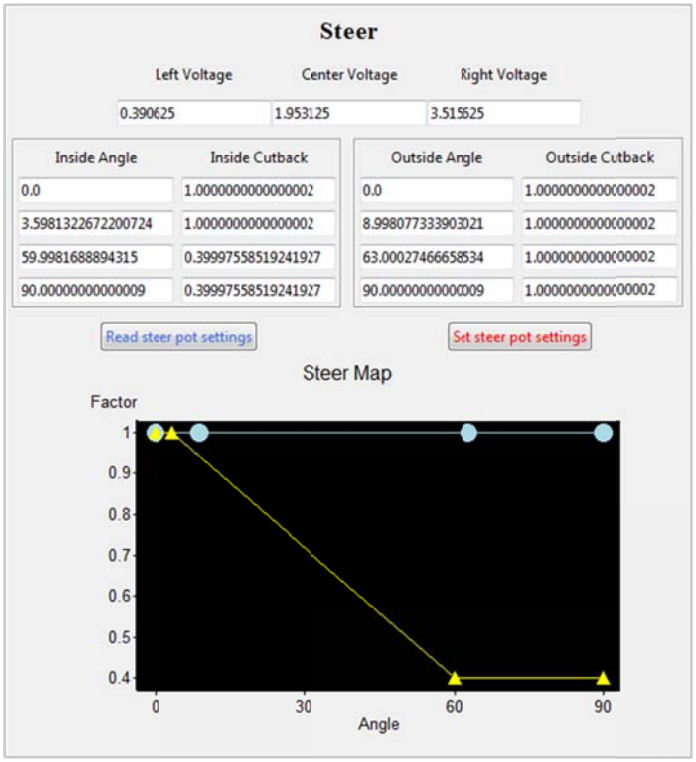
Once the values have been changed, there will also be changes to some values in the baseline profile as they are directly related.

Steering

Twin motor systems, which use the drive motors for turning, require some means of determining the angle of the steering wheel. Complete control of this is given in the “ Steering ” button.



Clicking the button will open a menu to the right of the helper:



From this menu, voltages corresponding to fully left (-90 degrees), straight ahead (0 degrees) and fully right (90 degrees) are accessible. The corresponding values are used by the Gen 4 to calculate the steering angle based on the analogue voltages from the steering potentiometer.

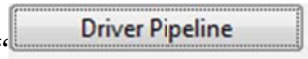
The steering map defines the relationship between the inner and the outer wheel speeds and the steering angle. Each map (inside table and outside table) has 4 definable points; this can be seen on the graph.

The steer map can be defined by 4 points relating the steering angle between 0 and 90 degrees and the torque/speed demand (p.u) between -1 and 1. Where a demand of -1 is shown at 90 degrees, this means the inner wheel demand will be equal and opposite of the outer wheel.

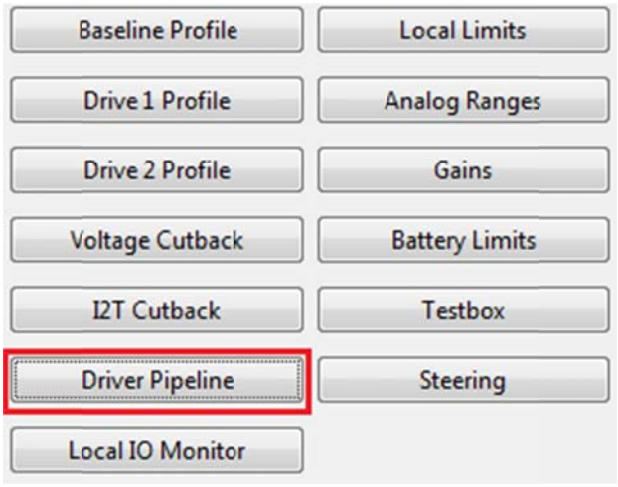
In speed mode, the outer wheel speed target and maximum torque is scaled according to the outer wheel map, while the inner wheel speed target and maximum torque is scaled to the outer wheel demands according to the inner wheel map.

In torque mode, both inner and outer wheel maximum speeds are scaled according the outer wheel map. The outer wheel target torque comes from the throttle. The inner wheel target torque is scaled to the outer wheel actual torque according the inner wheel map. By clicking on **Set steer pot settings** once the data is placed on the spaces and in preoperational, the data should be saved, recycle the power, go to operational and the steering should be ready to use.

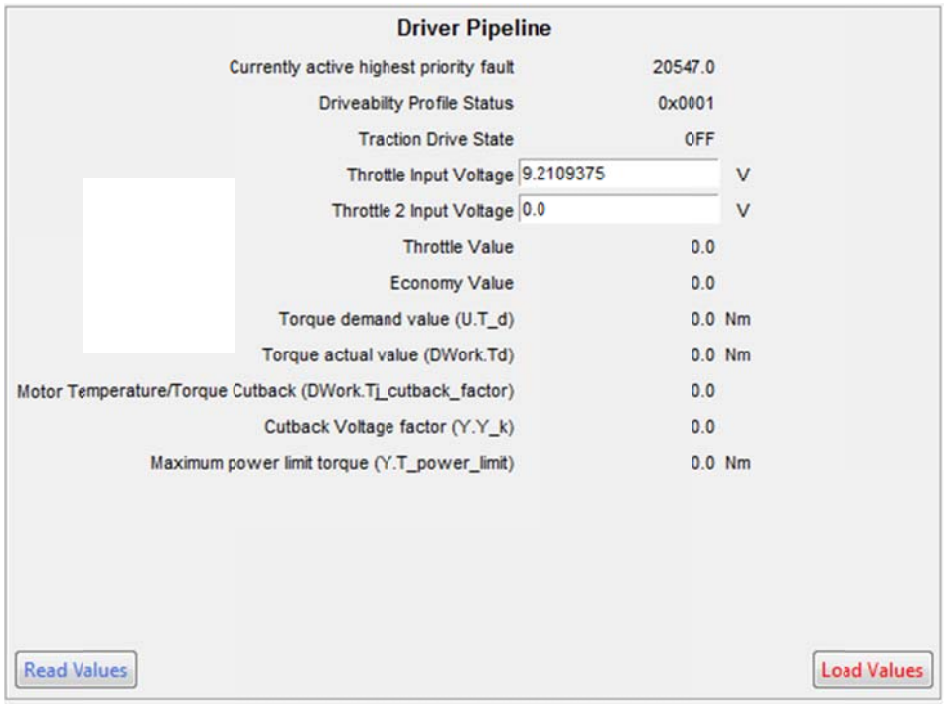
Driver Pipeline

The " 

" button is a useful window found in the helper that can be used to easily access some useful debugging objects found inside the controller. The button can be found here:

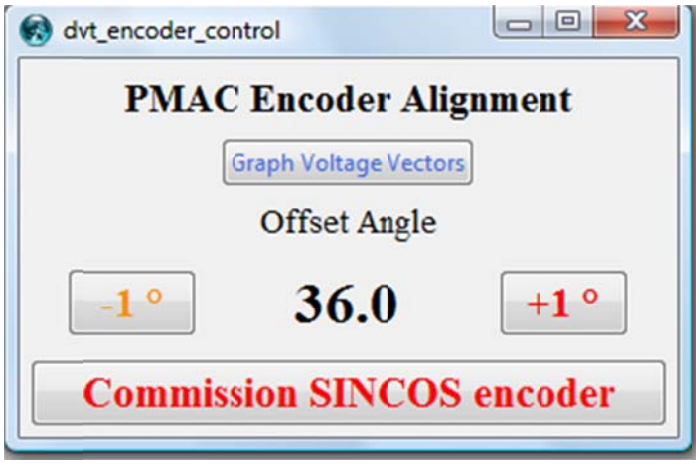


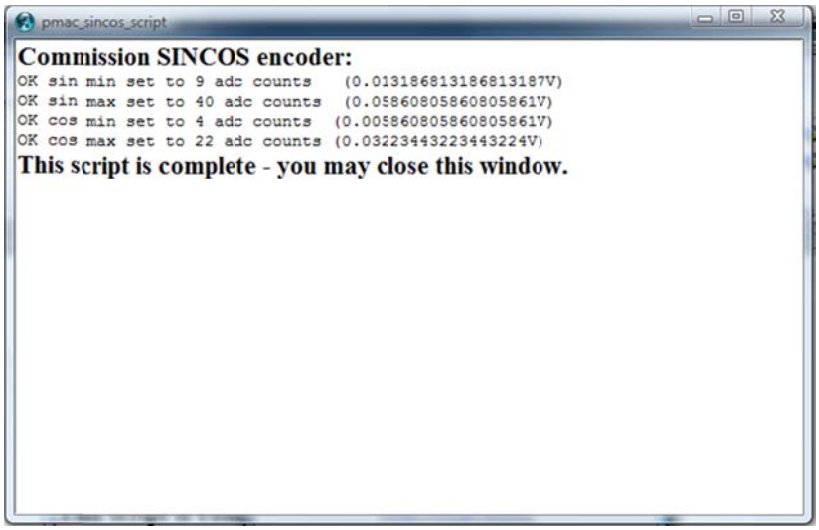
Selecting this button will open up the driver pipeline window to the left of the helper:



PMAC Encoder

The DVT can be used to manually align the PMAC encoder signals with the mechanical position of the rotor. With this, the controller will know angle of the flux to induce torque into the machine. A misalignment of the encoder will cause reduction of torque per amps available. The allowable range to configure the offset angle is between 128 and -128 degrees. The offset angle can be changed in steps of 1.

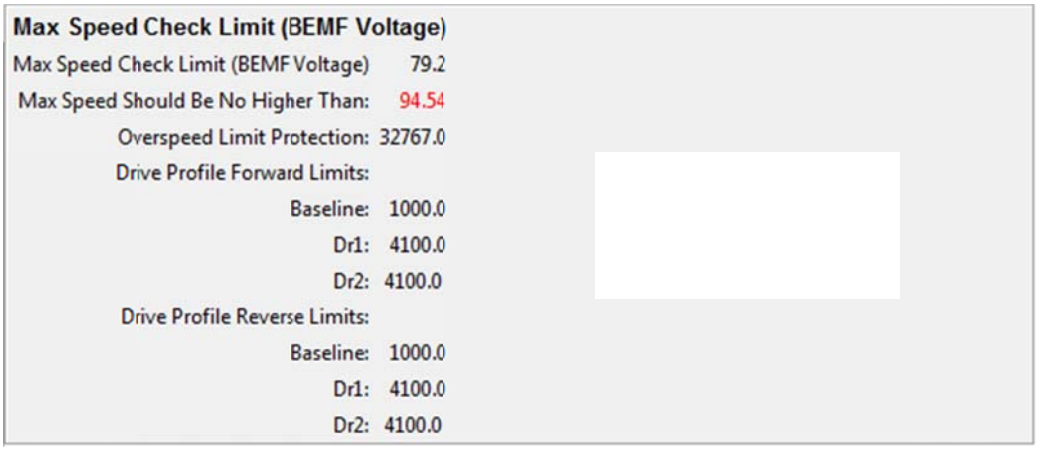




PMAC Max Speed Voltage

While connected to a PMAC motor, the DVT will perform a check on the allowed BEMF (Back-voltage) the attached motor. The results of these checks can be viewed through the "PMAC Max Speed Voltage" button found here:

Selecting this button will open up a menu containing the voltage data:



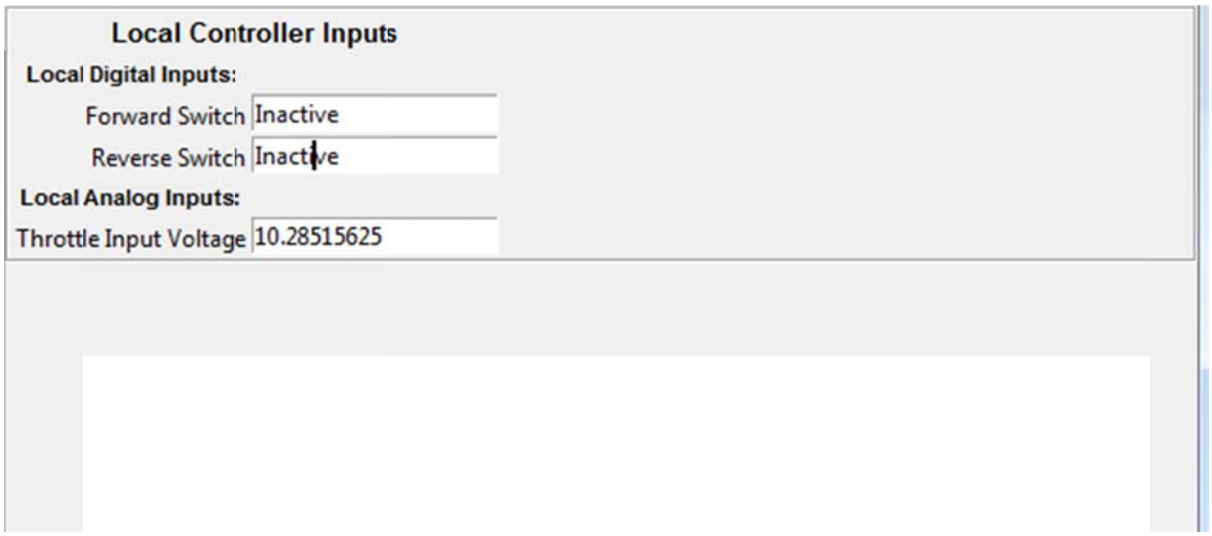
From this menu, the user can view all of the data regarding the motor's BEMF voltage limits in a more convenient manner then searching through the tree (see: chapter 3)

Local IO Monitor

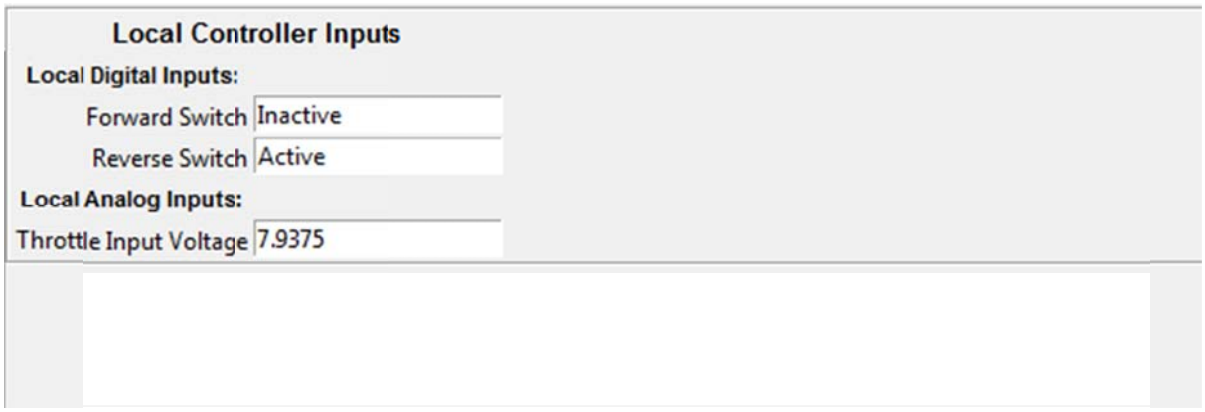
DVT can be used to monitor all of the inputs currently affecting the motor controller using the "

" button found here:

Selecting this button will open a menu on the right side of the helper:



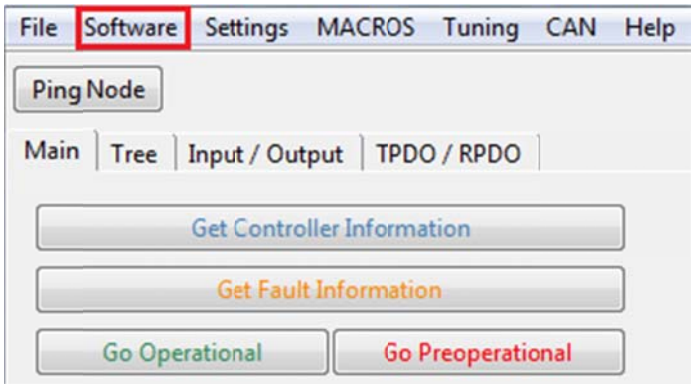
As shown here, the controller has a forward/reverse switch and a throttle. If the state of these inputs is changed, their value on DVT will change alongside them like so:



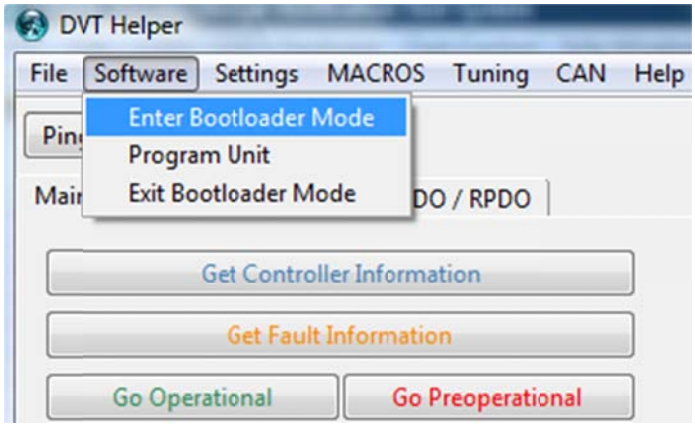
Firmware Installation

The firmware of the controller uses a DLD file extension and is an integral part of making the Sevcon motor controller function correctly. DLD is the firmware that configures the controller to different motor types (PMAC, AC induction etc.). Sevcon controllers will come with a DLD already installed that will suit your motor, installing a different DLD however; is fairly simple.

First open the tab found near the top of the helper window labeled “Software” found here:

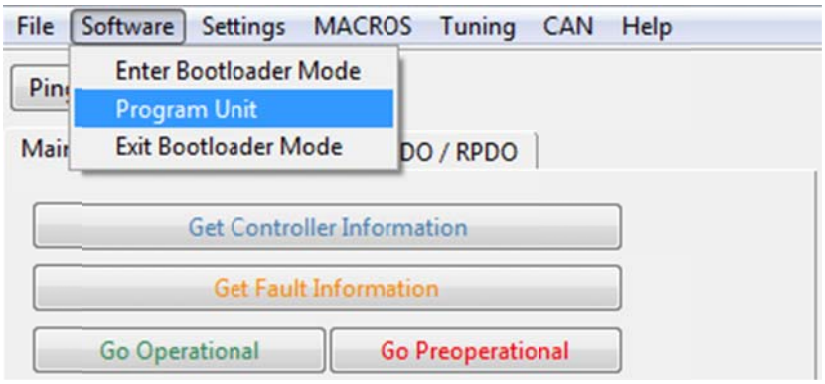


Selecting this tap will open a small drop down menu, to begin the process of installing a new DLD; first select the “Enter Bootloader Mode” option found here:



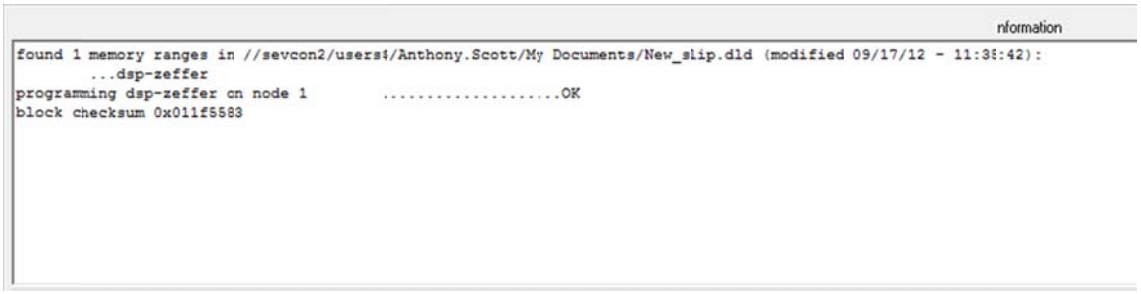
While in bootloader mode; the motor controller will be unresponsive to commands, and will display errors or timeout when changes are attempted to anything aside from software.

Selecting the “Software” tab again, this time select the “Program Unit” option found here:



Selecting this will open windows explorer, select the desired DLD and open it.

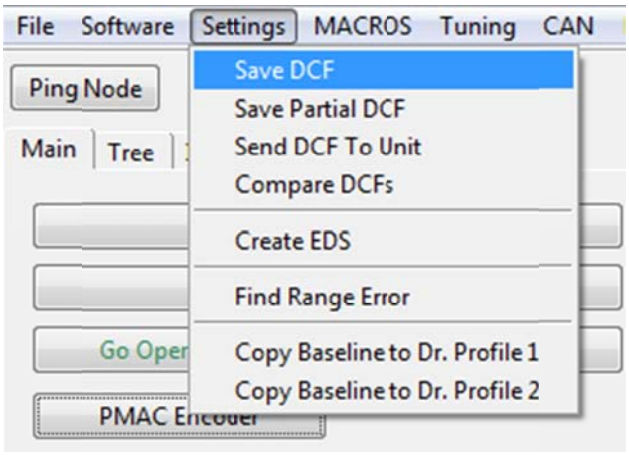
The DVT will then being automatically installing the DLD into the controller, its progress can be viewed in the “Information” window.



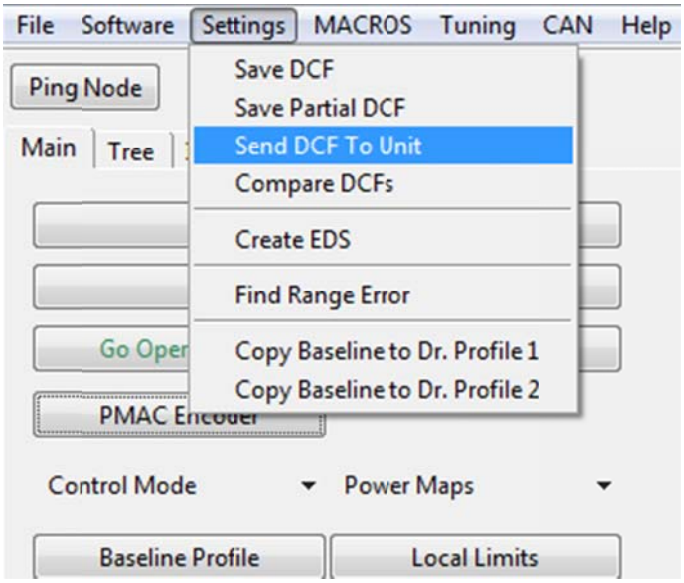
With that, the DLD is successfully installed. Open the software tab again, and select “Exit Bootloader Mode” to complete the process.

Uploading and Downloading Settings (DCF)

Configuration files have the DCF extension and are the files in which the settings and parameters of the controller are stored. DCFs can both be uploaded and downloaded from the controller through the “Settings” tab near the top of the Helper window.

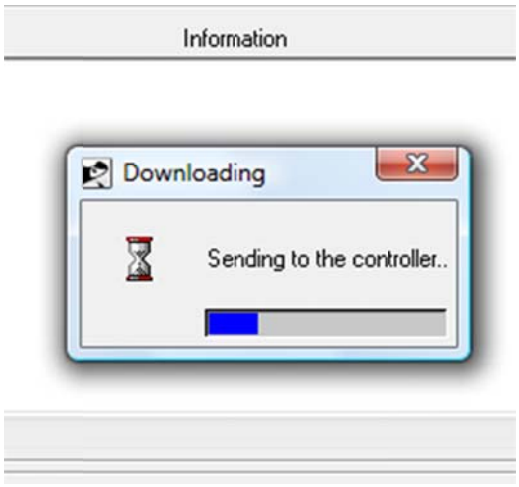


Selecting “Save DCF” will save the current configuration inside the controller to wherever the user wants. Changing DCF however is done through the “Send DCF to Unit” option found here:



Selecting this option will open windows explorer:

Selecting a DCF will result in an upload bar opening over the DVT main screen showing the progress of the DCF installation.

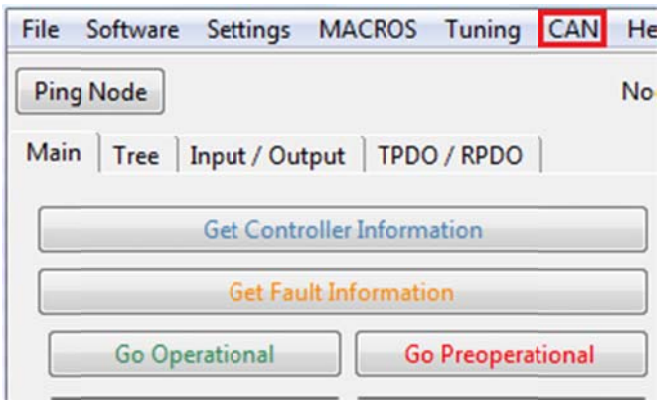


When the bar has filled, a message should appear at the bottom of the input window confirming the successful installation.

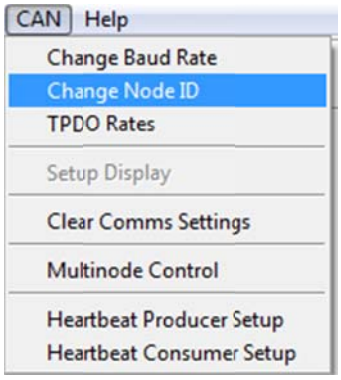
```
dvt(102) %
//sevcon2/users$/Anthony.Scott/My Documents/notbroken.dcf downloaded to device OK
Already logged in at a higher level
logged in... and in preop.
Already logged in at a higher level

//sevcon2/users$/Anthony.Scott/My Documents/notbroken.dcf downloaded to device OK
```

Changing Node ID Number

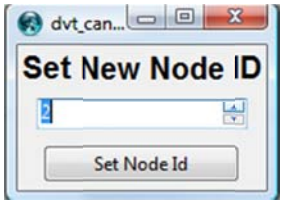
DVT can be used to change the node ID of a unit through the helper's CAN tab found here:



Selecting this tab will open a dropdown menu. To change the node ID of a unit, select the "Change node Id" option

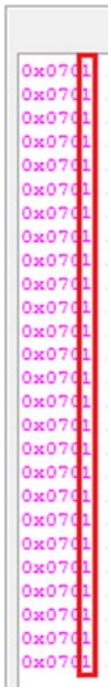


This will open a small window inside the helper in which the user can set the new CAN ID, in this scenario the ID will be set to 2.

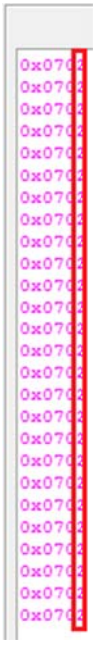


Select "Set Node ID" and DVT will prompt the user to recycle power on the system. After the power has been recycled, the new node ID will be set. This can be checked by looking at the numbers in the CAN traffic as shown below:

BEFORE (Node ID 1)

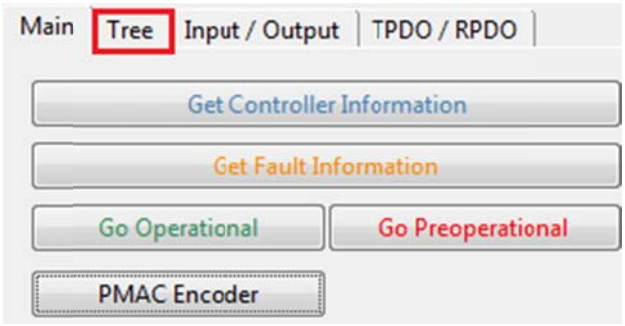


AFTER (Node ID 2)

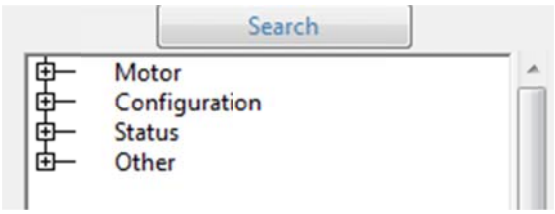


Chapter 3: Tree

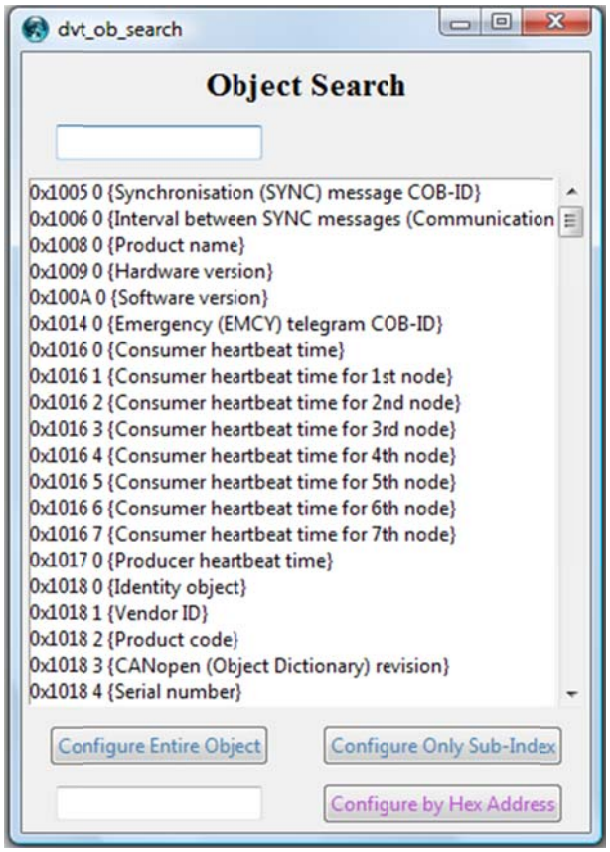
The easiest way to navigate the settings and features of the Sevcon motor controller is the Tree menu found here:



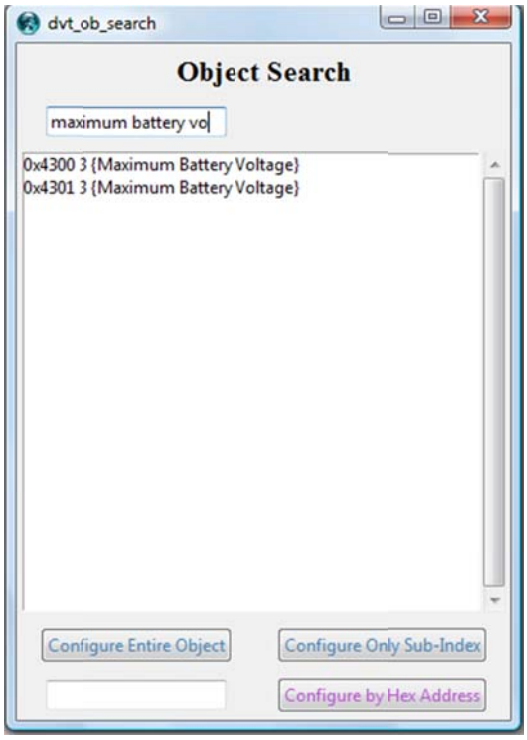
Selecting this tab will open the Tree menu:



From this menu, there are a couple of different methods that can be used in searching for specific variables or objects. For example, the most intensive of these is the “Search” button. Doing so will open a window that looks like so:

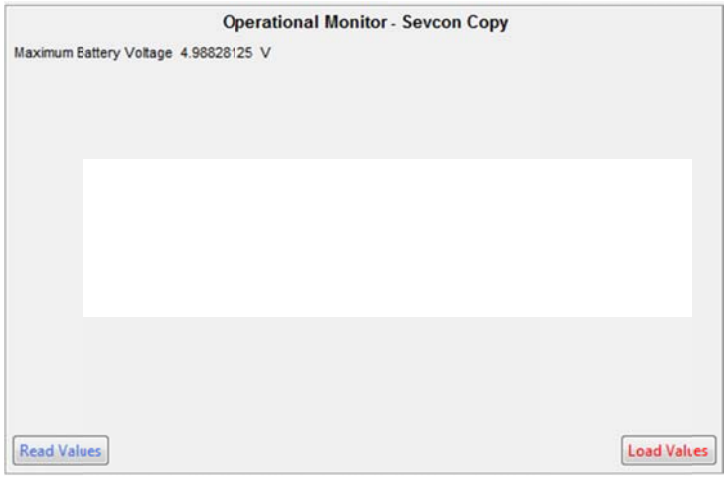


In this scenario, a search is going to be performed for the “Maximum Battery Voltage”. To do this, enter the term into the search bar found at the top of the object search window.

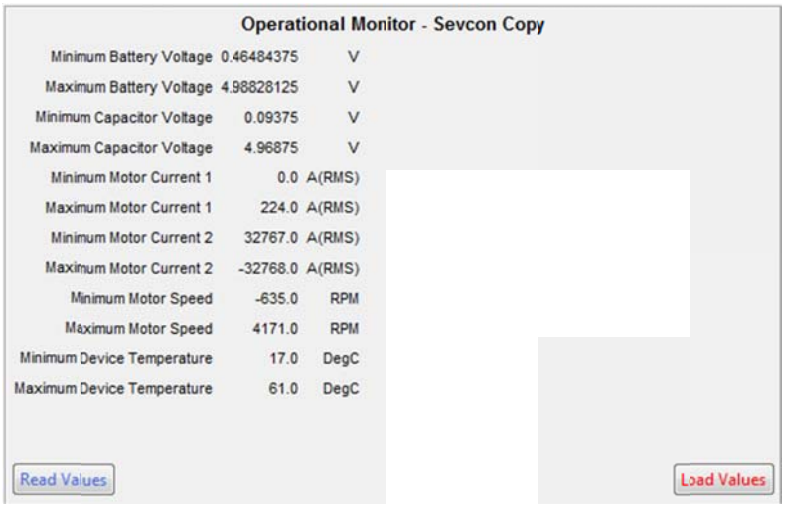


There is then a choice between viewing the single sub-index that has been searched for or the entire object the sub-index is contained in. Selecting either will present the selected object/index here:

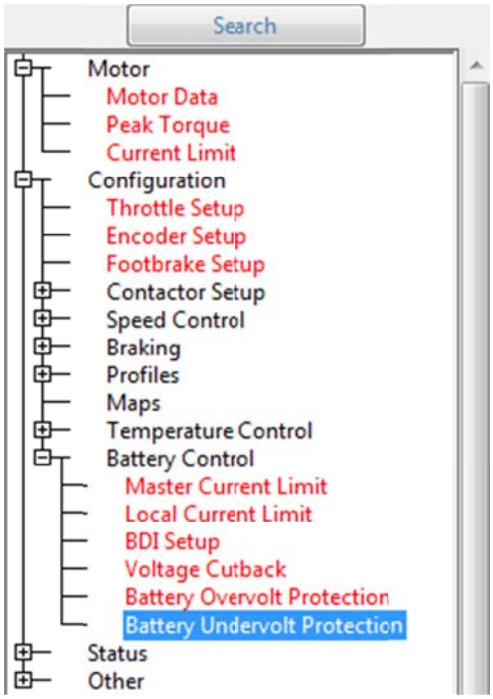
(Single index)



(Full Object)



Alternatively, the objects can be browsed through a series of drop-down menus found below the “search” button. For example, to find the under voltage cutback in the tree: first open drop down menus by selecting the “+” icon until finding the relevant heading. In this case the battery undervolt protection.

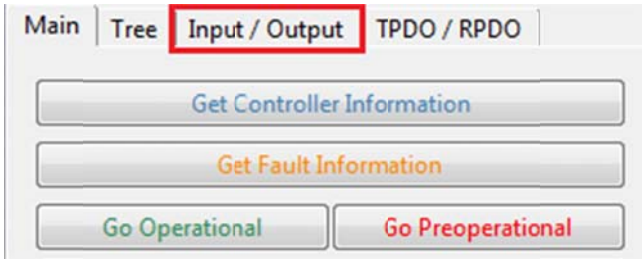


Selecting this will create a window to the right of the tree. The settings can then be read/changed using the same method as any other tab in the helper.

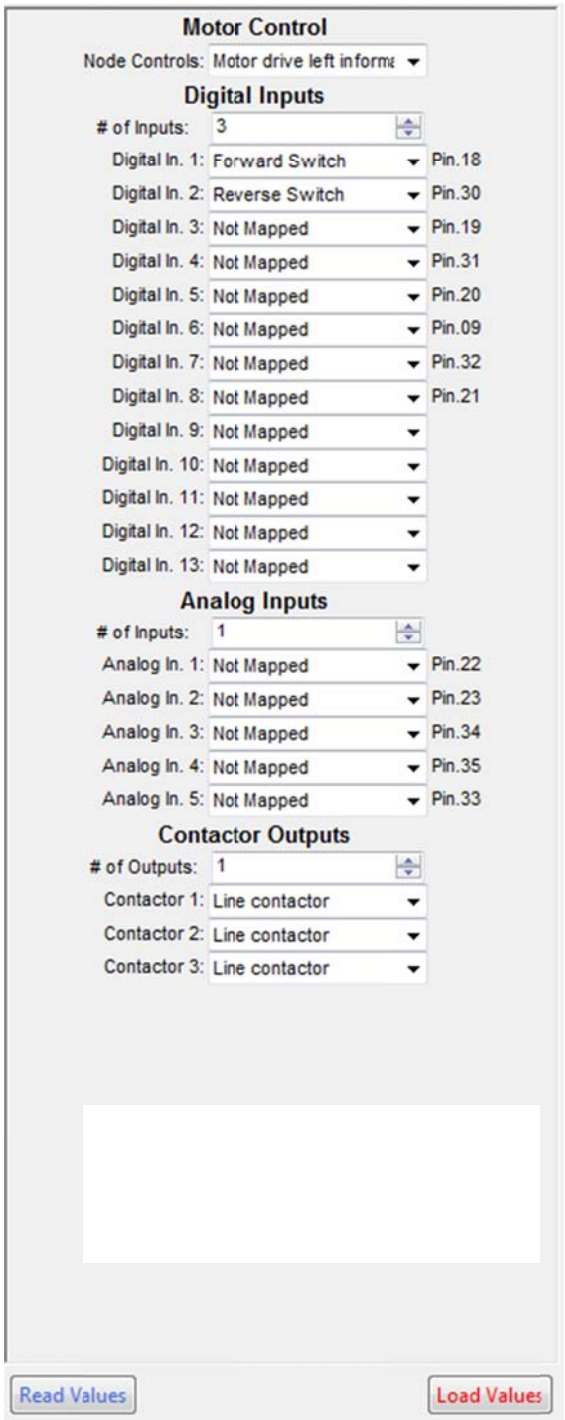
Chapter 4: Input/output Configuration

I/O Configuration

Sevcon motor controllers can be configured to work with a variety of input/output components of both analogue and digital nature. These features can be accessed through the “ Input / Output ” tab found here:



Selecting this tab will give access to the Input/output configuration menu:

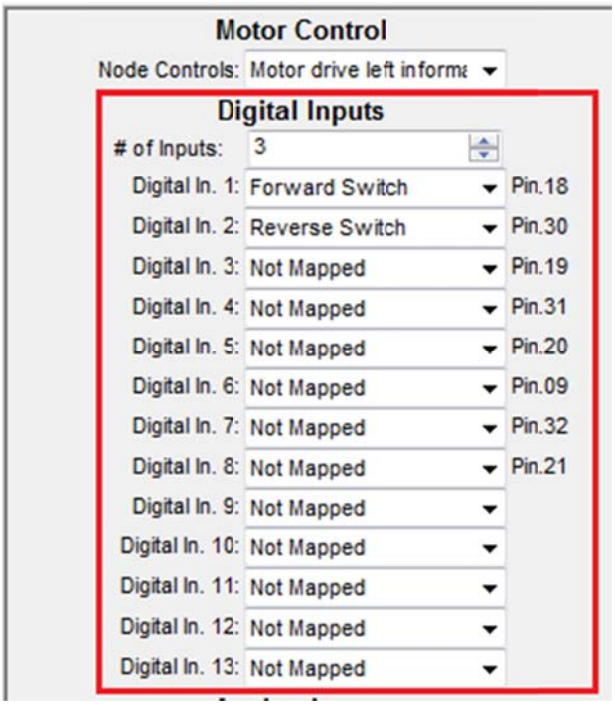

Motor Control
Node Controls: Motor drive left informa
Digital Inputs
# of Inputs: 3
Digital In. 1: Forward Switch Pin.18
Digital In. 2: Reverse Switch Pin.30
Digital In. 3: Not Mapped Pin.19
Digital In. 4: Not Mapped Pin.31
Digital In. 5: Not Mapped Pin.20
Digital In. 6: Not Mapped Pin.09
Digital In. 7: Not Mapped Pin.32
Digital In. 8: Not Mapped Pin.21
Digital In. 9: Not Mapped
Digital In. 10: Not Mapped
Digital In. 11: Not Mapped
Digital In. 12: Not Mapped
Digital In. 13: Not Mapped
Analog Inputs
# of Inputs: 1
Analog In. 1: Not Mapped Pin.22
Analog In. 2: Not Mapped Pin.23
Analog In. 3: Not Mapped Pin.34
Analog In. 4: Not Mapped Pin.35
Analog In. 5: Not Mapped Pin.33
Contactor Outputs
# of Outputs: 1
Contactor 1: Line contactor
Contactor 2: Line contactor
Contactor 3: Line contactor
Read Values
Load Values

Motor Control

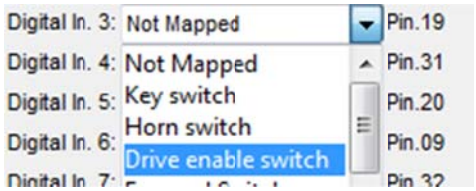
By default, the node control will be set to “Motor drive left information”. This is the default setting when a single traction motor system is being configured, if you would like information on the other settings however, contact Sevcon.

Digital Inputs

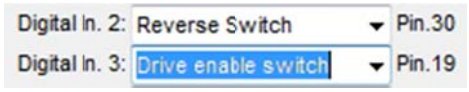
Both digital and analogue inputs are governed by the pins in the control unit harness. The settings for the digital inputs can be found here:



To begin with, the “’# of inputs” setting has to be set exactly. For example, if the number is set to four, but there are five inputs configured; the helper will stop reading after input number four.
The # of inputs can be changed by the small arrows (highlighted in blue), which will raise the number by one in each direction. Alternatively, the number can be entered manually in the white box beside the arrows. Setting the number to anything above thirteen will result in the # of inputs back to its default.
To change a digital input; selecting the arrow of the input that will be changed will open a drop-down menu like so:



Select the new input (in this case, an inch reverse switch), and select the Load Values button to finalize the changes.

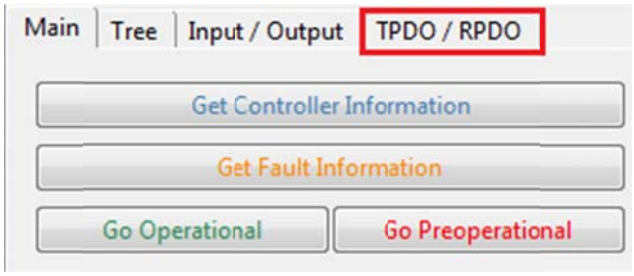


To ensure that changes have taken place, select the Read Values button.

Chapter 5:
TPDO/RPDO

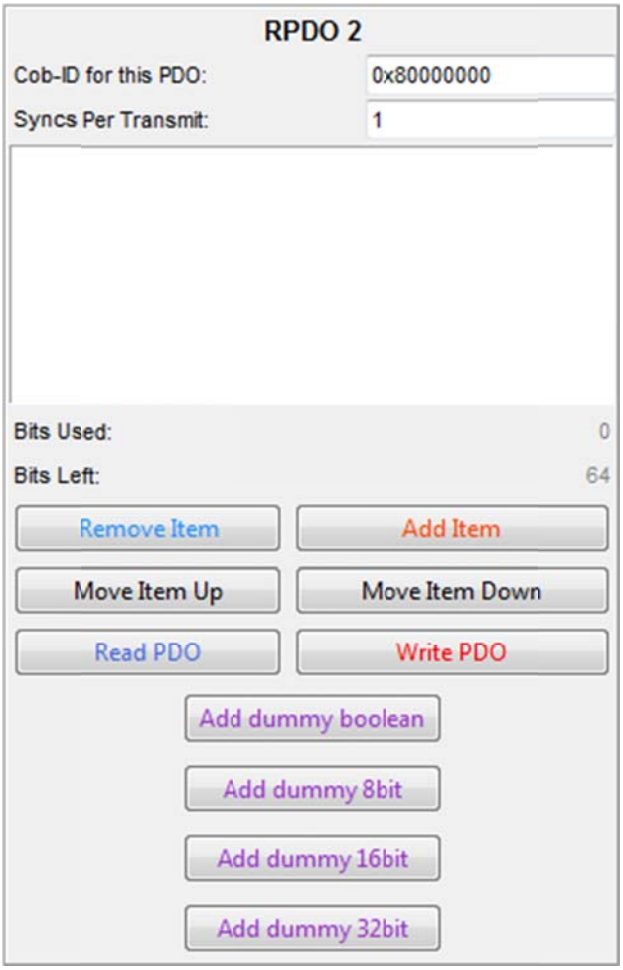
TPDOs/RPDOs

The Sevcon motor controller can be configured to transmit and/or receive PDOs information packets, known as TPDOs and RPDOs respectively. The configured message structures can be viewed and edited through the TPDO / RPDO tab, found here:



Selecting the tab will open the PDO configuration window.

Up to five RPDOs and TPDOs can be configured at any one time, per Sevcon controller. The creation/editing window looks like this:

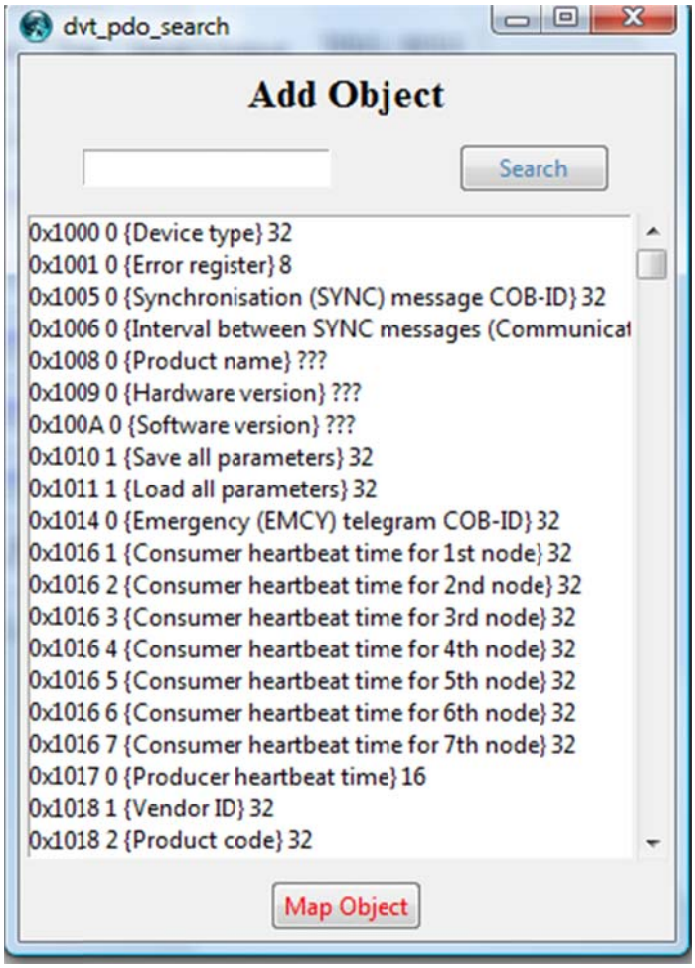


Each PDO must have a unique Cob-ID which denotes the priority of the associated PDO, the lower the number; the higher the priority of the PDO.
The PDOs have a data size limit of 64 bits (8 bytes), meaning that the RPDO can only contain a certain number of objects.

TPDOs

Begin by selecting the

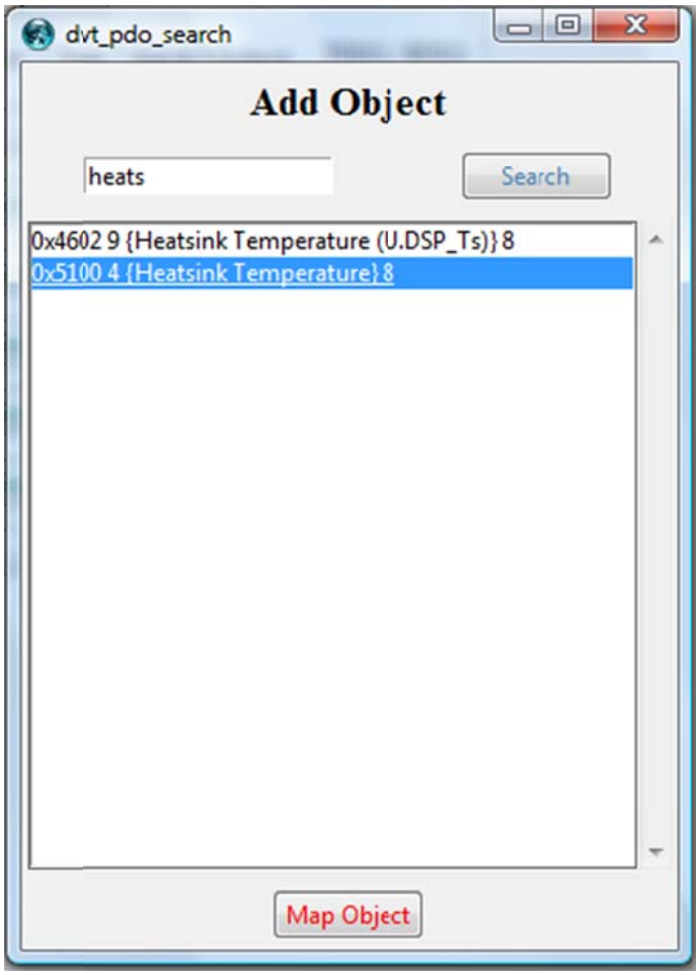
button; this will open a window in front of the helper:



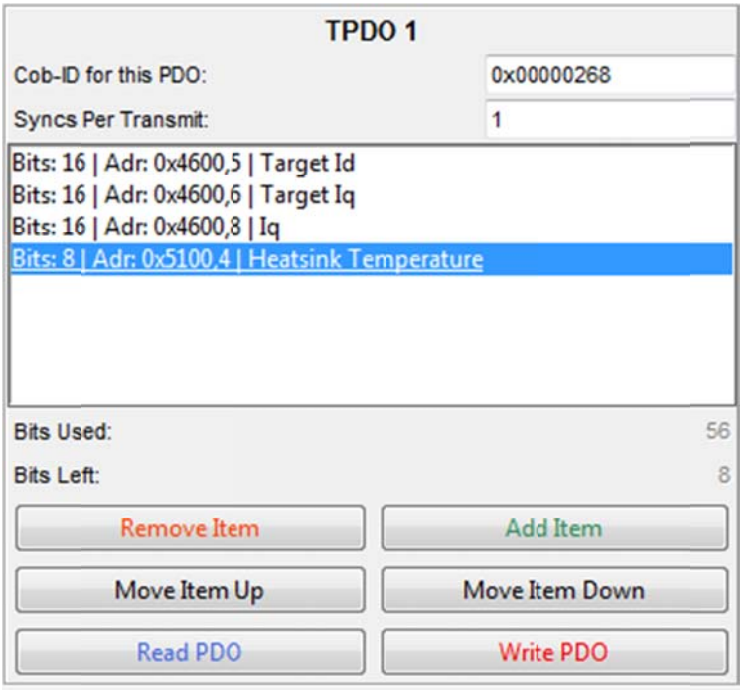
Selecting the search button or pressing any key will cause the window to fill with objects.

TPDO 1 in this scenario is going to be given the “Heatsink temp” object. To do this, enter the terms into the search bar found at the top of the add object window, and then select the search button.

Selecting the map objects button will add the object to the TPDO.



Finally, select the button, close and re-open the helper to ensure the changes have happened.

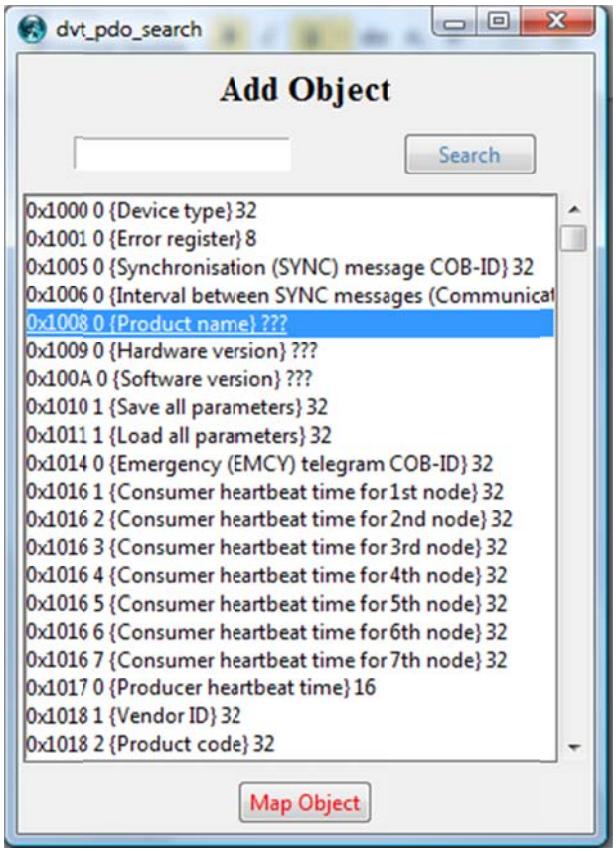


Note: When adding objects into a PDO, ensure that there are adequate bits left for the desired objects.

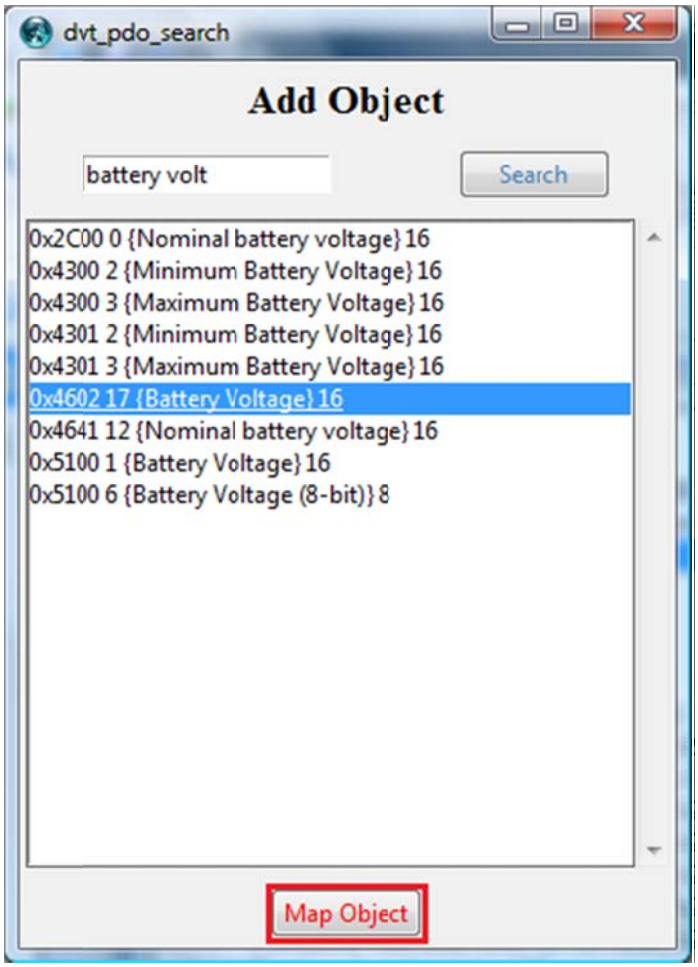
RPDOs

Begin by selecting the

button; this will open a window in front of the helper:
Selecting the search button or pressing any key will cause the window to fill with objects:



RPDO2 in this scenario is going to be given the “Battery Voltage” and “Vehicle Speed”. To do this, the procedure is the same as seen in the TPDO section of this guide:



Selecting the map objects button will add the object to the RPDO.