Use of the DVTC Software Tool for the SEVCON GEN4 AC Controllers

Application Note – EK016-EN – September 2019

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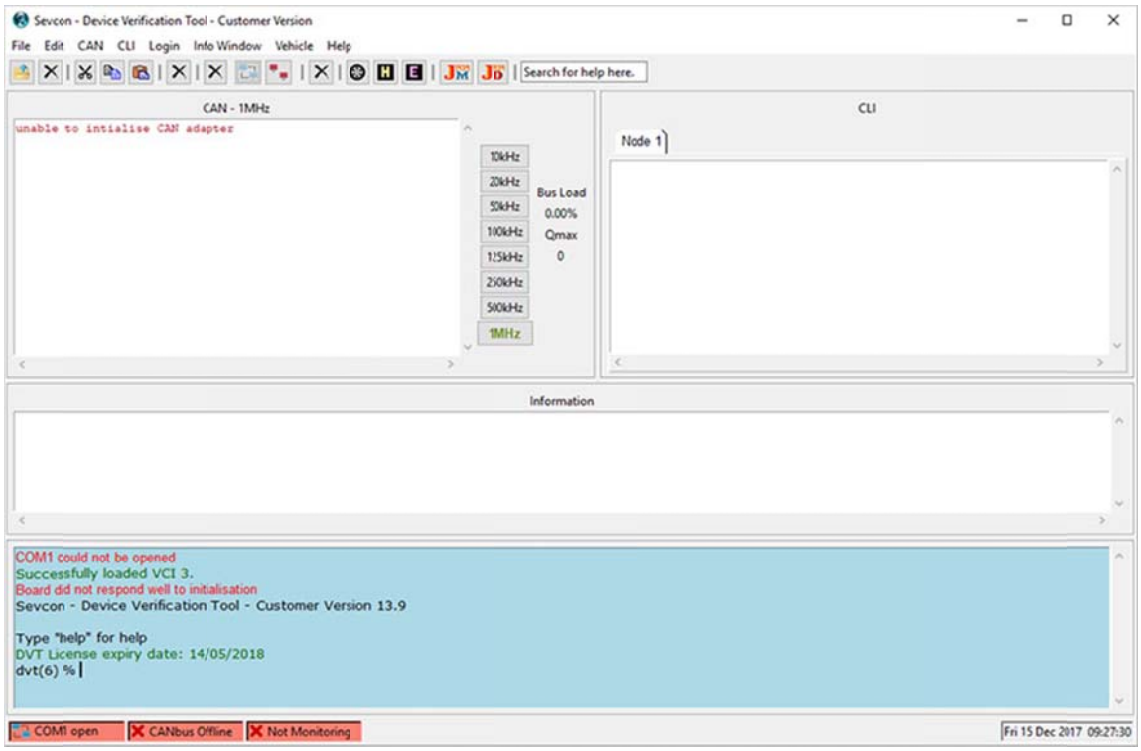

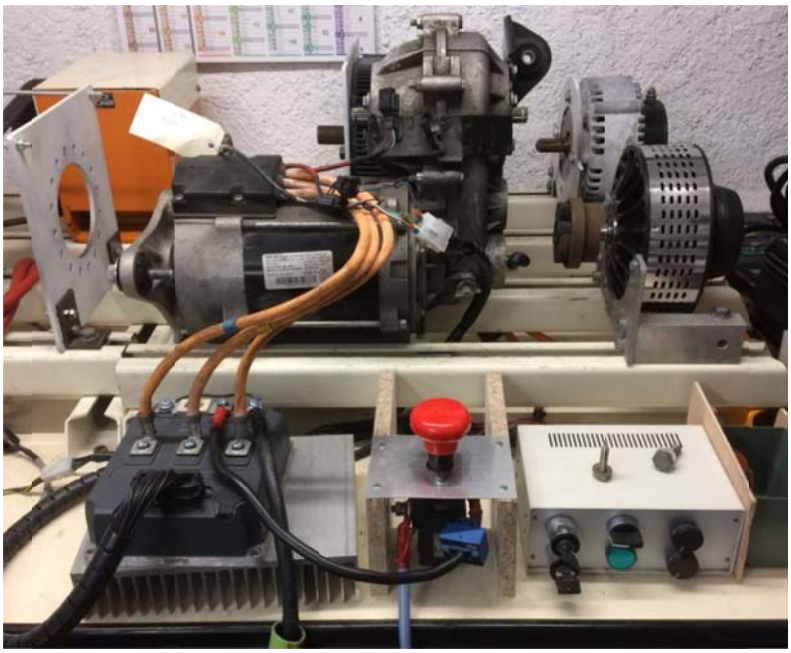

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1 Introduction

1.1 Foreword

This application note explains how to use the SEVCON DVTC software tool to configure SEVCON GEN4-series AC controllers. The installation of the DVTC software tool was covered in the AN-EK015 application note [1]. It is strongly recommended to read the SEVCON drive documentation [4] and the AN-EK005 [5] application note.

The version of the SEVCON DVTC software tool used in this report is the April 2019 version (*i.e.*, "version 13.9").

1.2 Pre-launch Verification of the DVTC Software Tool

The IXXAT USB-to-CAN interface has two LEDs: the first one for the USB bus, and the second one for the CAN bus. These LEDs provide information on the communication status [6].

Fig. 1. The IXXAT USB-to-CAN interface [6].

If the LED for the USB bus is green, the communication with the interface via the USB port is possible. However, if the USB indicator is red, the communication is not possible.

In this case, it will be necessary to check if you have installed the latest drivers for your operating system (*i.e.*, "VCI version 4").

In case of problems, the latest versions of the USB-to-CAN interface drivers can be downloaded from the IXXAT website at:

https://www.ixxat.com/support/file-and-documents-download/drivers

When the communication via the USB port is operational, you can then launch the DVTC software tool.

1.3 Launching the DVTC Software Tool

The DVTC launch script is available in the following directory:

C:\DVTC\customer\program\dvt.tcl

It is strongly recommended to create a shortcut on the desktop for the execution of the DVTC software tool.

Fig. 2. Shortcut for the execution of the DVTC software tool (version 2018).

The DVTC software tool (*i.e.*, version 13.9) is composed of several information windows.

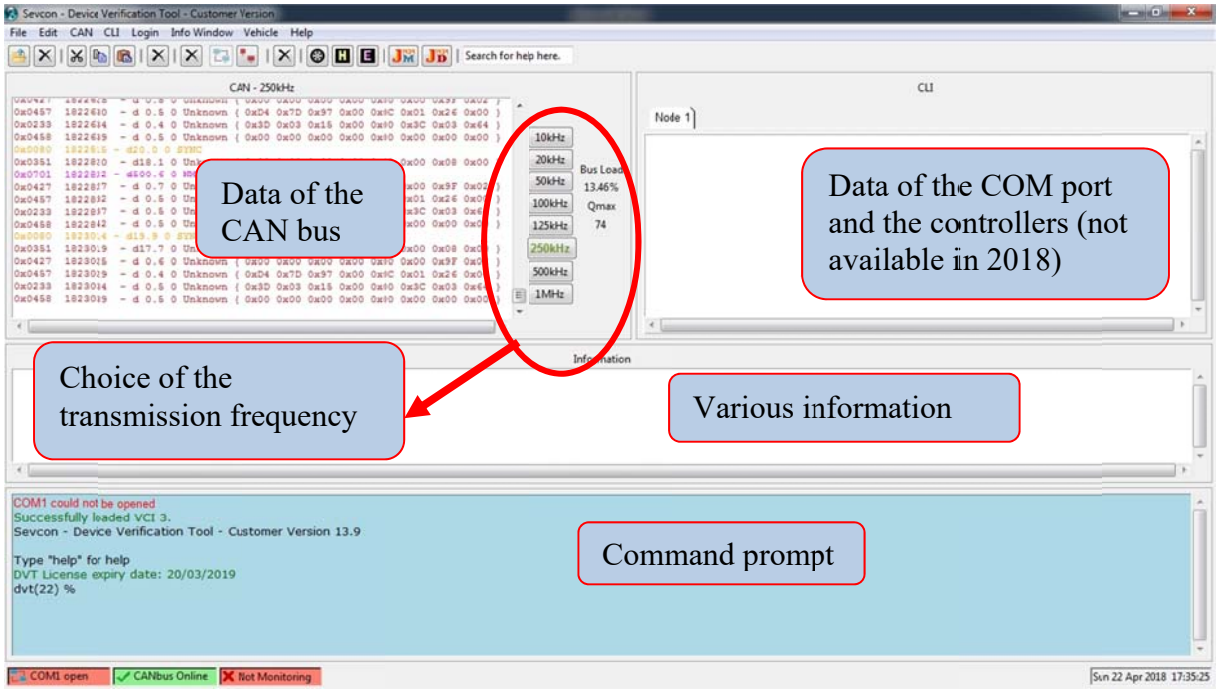

Fig. 3. Information windows of the DVTC software tool (i.e., version 13.9).

1.4 Choice of the Transmission Frequency of the CAN bus

The "CAN" window displays the frames when the communication speed is correct (in that case, 250 kHz).

To display the traffic on the CAN bus, the different baud rates must be selected until the "Bus load" is different from 0%.

It is also necessary to check in the "CAN" drop-down menu that there is indeed data selected in the display.

The "CAN" drop-down menu is also used to suppress the display of CAN frames by the "Show None" option.

This menu is also used to display the CAN bus speed selection buttons on the main window by checking the "Show Can baud Buttons" option.

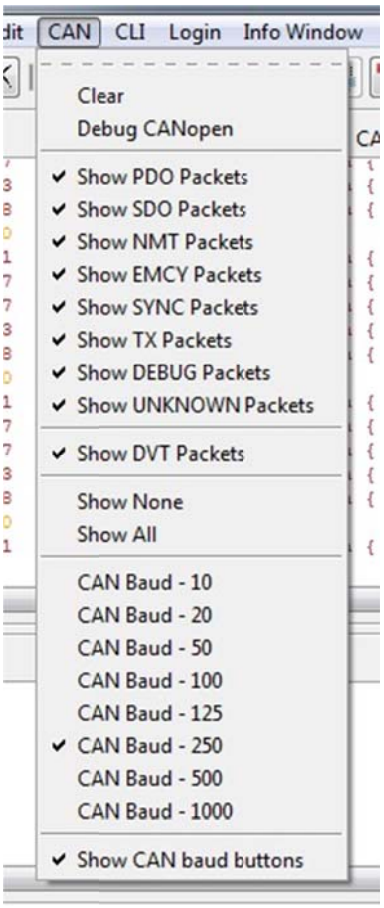

Fig. 4. The CAN menu of the DVTC tool.

1.5 The "Information" Window

To display the "Information" window, it is important to tick the "Show" option in the "Info Window" menu.

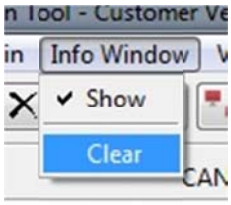

Fig. 5. The "Info Window" menu.

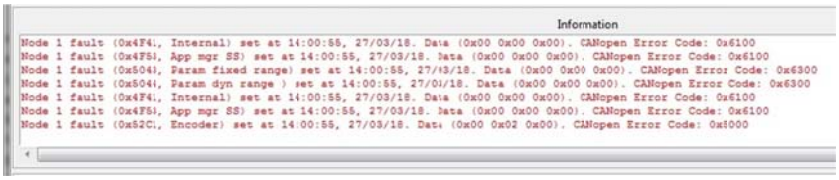

Fig. 6. The "Information" window.

The information window displays the CAN bus states, GEN4 drive error messages, progress of DVTC software tasks...

1.6 The Online Command Window

The lower area of the DVTC software window allows you to enter orders online. More information is available in section 9.2 of Appendix 3 and by typing the "help" command.

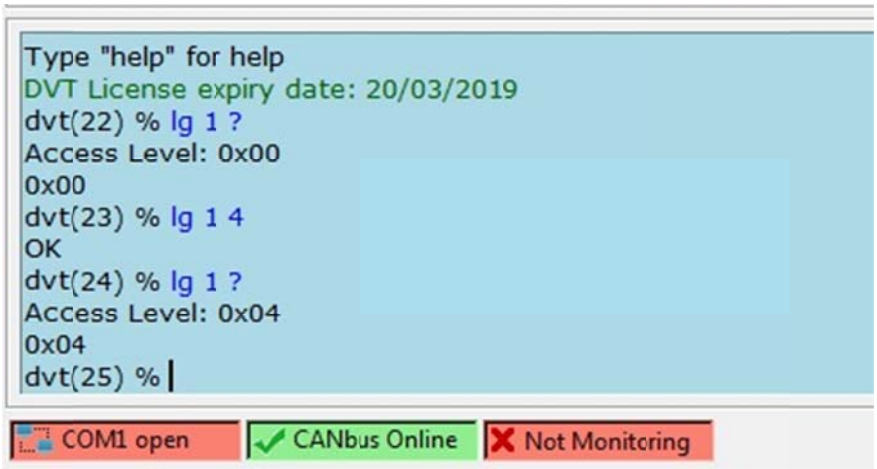

Fig. 7. The online command window of the DVTC software tool.

1.7 The Other DVTC Software Modules

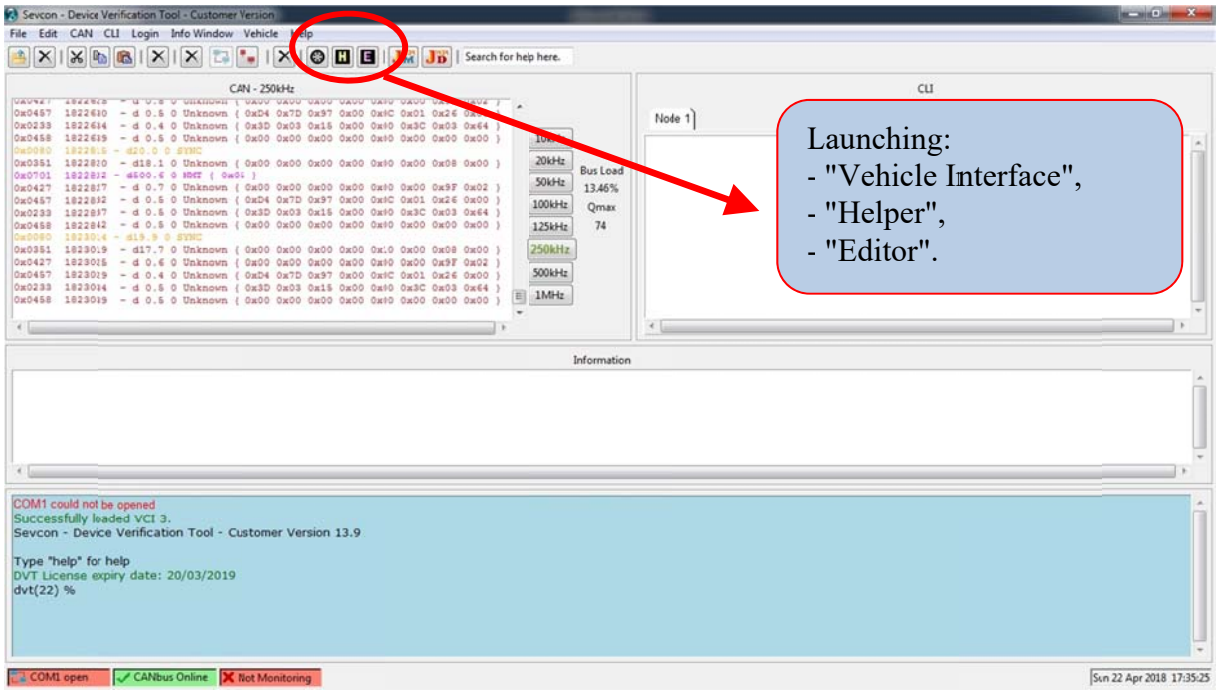

Fig. 8. Choice of the CAN bus speed and launch of the "Helper".

The "**CROSS**" or small "**WHEEL**" button allows the launch of the "Vehicle Interface" window, which is a graphical interface for displaying and recording drive variables.	 *Fig. 9. Execution button of the "Vehicle Interface" script.*
The "**H**" button allows the launch of the "Helper" window, which is a graphical interface both for communication and configuration of the controller.	 *Fig. 10. Execution button of the "Helper" script.*
The "**E**" button allows the launch of the "Editor" window, which is a graphical interface for reading and editing offline DCF files.	 *Fig. 11. Execution button of the "Editor" script*

2 The "Helper" Script – Getting Started with the SEVCON GEN4 AC Controller

2.1 Foreword

The "Helper" script is a graphical interface for communication and configuration of the AC controller. This chapter presents the main commands used to operate the controller and adjust the parameters to a specific application.

2.2 Creating the EDS File when the "Helper" Is Launched

When the "Helper" is executed for the first time or if a new AC controller is installed, the script checks the presence of the EDS file on the computer.

If this is not the case, it is proposed to create a new one: it is **IMPERATIVELY NECESSARY to answer "YES"** to the question "Do you want to create one?"!

At the end of the procedure (which is very long, but only once), an EDS file is created in the directory:

C:\DVTC\common\program\EDS

The file name follows the following formalism:

Gen4_pc0x0705301b_rev0x0001001c.eds

- "**Gen4**": type of product;
- "**_pc**": product number "Product code: 0x0705301b";
- "**_rev**": software revision number "Rev. Number: 0x0001001c".

The ".eds" file is a text file in XML format.

It contains about 22,000 lines of text, for a size of about 450 kB.

It represents the definition and values of the 4200 CAN objects defined for the parameter setting of the SEVCON GEN4 drives. The list of objects is available in the file:

C:\DVTC\Object Dictionary\Master_Object_Dictionary_Database.xls

2.3 The GEN4 Controller Home Screen

The "Helper" home screen is empty of information when it is opened.

IMPORTANT: Make sure that the CAN node number is correct! "Node ID".

By clicking on "Get Controller Information", you can retrieve the drive configuration information:

- Software Ver.: 0705.0012
- Hardware Ver.: 0x01070004
- Product Code: 0x0705301b
- Serial Number: 1012200139

This allows to validate the communication between the software and the GEN4 drive.

This information partly corresponds to the information on the product identification label (see §8.1).

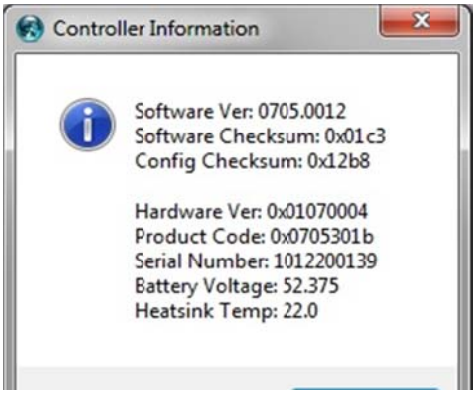

Fig. 12. AC controller home screen with the "DVT Helper".

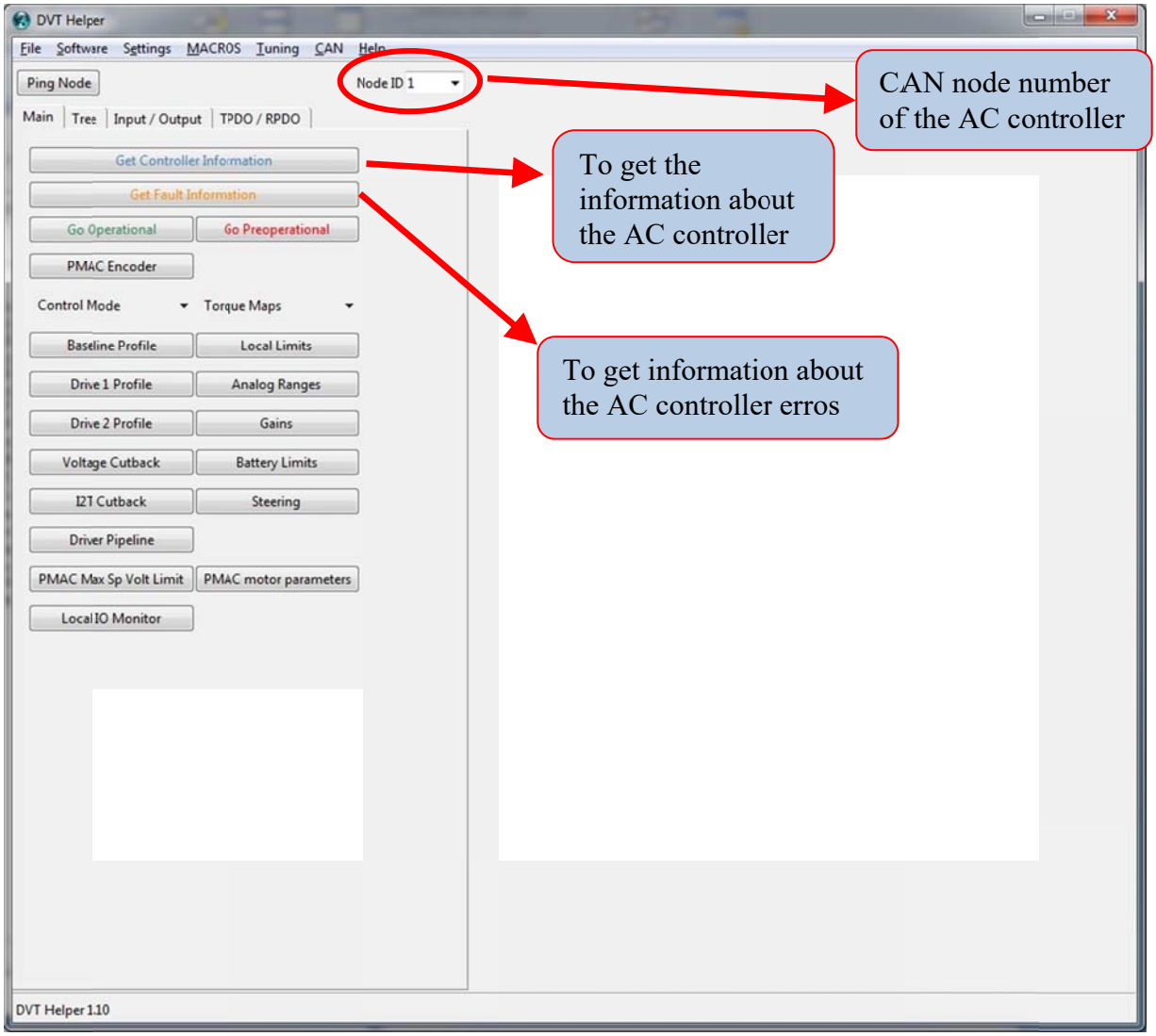

Fig. 13. AC controller home screen with the "DVTC Helper".

It is also from this screen that the configuration modes are switched:

1) GREEN: "Go Operational" to resume normal drive operation. The line contactor (power relay) must close;
2) RED: "Go Preoperational" to switch to drive configuration mode: the power relay is disabled and the motor cannot operate.

General information:

- **IMPORTANT:** the CAN node number must be checked if several controllers are available.
- When starting when the drive is in "Pre-operational" mode, the "External LED" error light does not light up. It is necessary to switch to "Operational" mode for the indicator to light up.
- When first receiving a SEVCON GEN4 drive, it may be prudent to save the initial drive configuration BEFORE changing it. To do this, refer to section to save the DCF file of the controller parameters.

2.4 The "Input/Output" Tab – Definition of Inputs/Outputs

Most of the settings in this tab will only be taken into account if the controller is in "Preoperational" mode (RED button: "Go Preoperational").

This tab allows you to define the functions available on the 13 digital inputs, the 5 analog inputs and the 3 digital power outputs.

In the minimum version, the controller requires the following functions:

3 digital inputs:

1) a Forward Switch on pin 18;
2) a Reverse Switch on pin 30;
3) a Foot Switch ("FS1") accelerator sensor on pin 19.

1 analog input:

1) a "Throttle" accelerator potentiometer on pin 22, the power supply being between pin 34 "Pot 1 Power Supply" and terminal B- of the controller.

2 digital power outputs:

1) the power relay coil between "Cont1" N°3 and "Cont1 Supply" N°4;
2) an external indicator between pins "Cont3" N°11 and "Cont3 Supply" N°12.

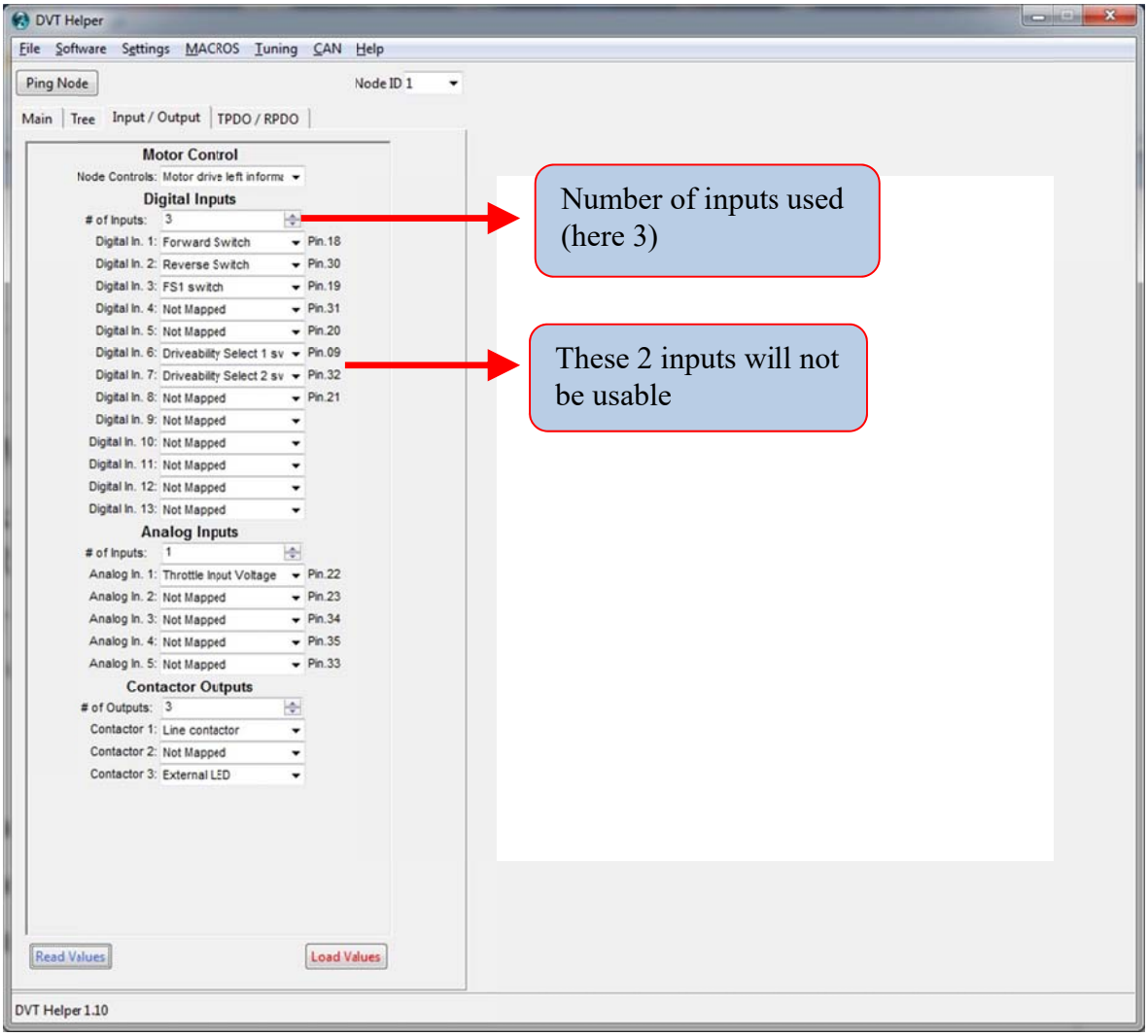

Fig. 14. Input/Output tab aimed at defining digital and analog inputs and power outputs.

The "Load Values" RED button is used to send the values to the AC controller. It takes a few seconds for all parameters to be sent.	
The "Read Values" BLUE button is used to read the values from the AC controller: this action verifies that the controller's programming has been taken into account.	

The AC controller can use more analog and digital inputs as long as the number of inputs used is changed to "# of inputs". Otherwise, the functions defined on these new entries will not be taken into account.

The digital power outputs used to supply the power contactors are at least 3; in minimum, only the "Contactor 1" output is used for the line contactor (on the "Cont1" N°3 and "Cont1 Supply" N°4 pins).

It may be interesting to have the flashing information of the green LED of the inverter on the dashboard of the vehicle. To do this, output 3 is configured in this direction by setting "External LED" in the "Contactor 3" field (see Figure 15).

The outputs for "Contactor 2" are not used, so the field "Contactor 2" is set to "Not Mapped": this output is reserved for example for an electric brake magnet ("Electro Brake") or for a STOP light.

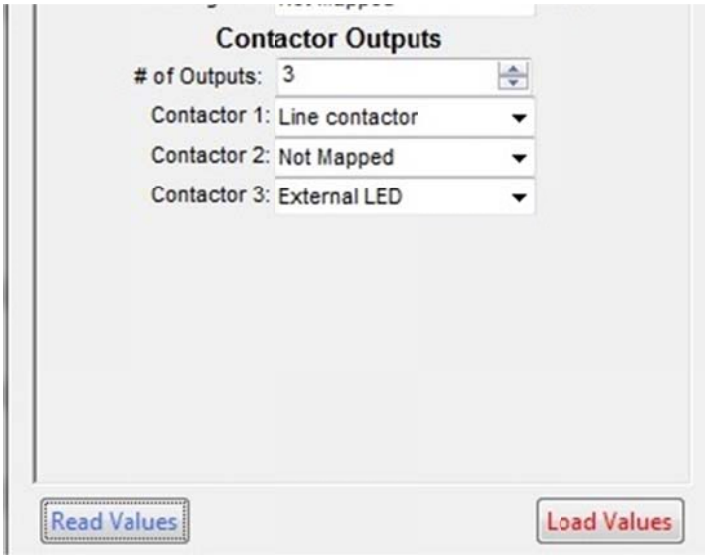

Fig. 15. "Input/Output" tab for defining digital power outputs.

2.5 The "Tree" Tab – Function Settings

Most of the settings in this tab will only be taken into account if the controller is in "Preoperational" mode (RED button: "Go Preoperational").

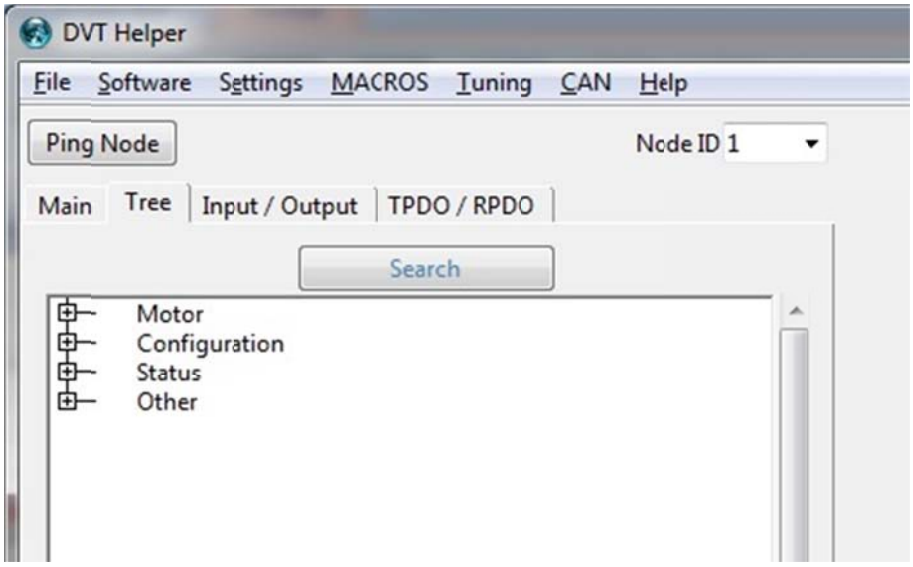

Fig. 16. The "Tree" tab in the "Helper" window.

2.5.1 The « Search » Button

The "Helper" script only manages and displays the main "useful" commands for setting the AC controller.

All registers are accessible via the "Search" button in the "Tree" tab.

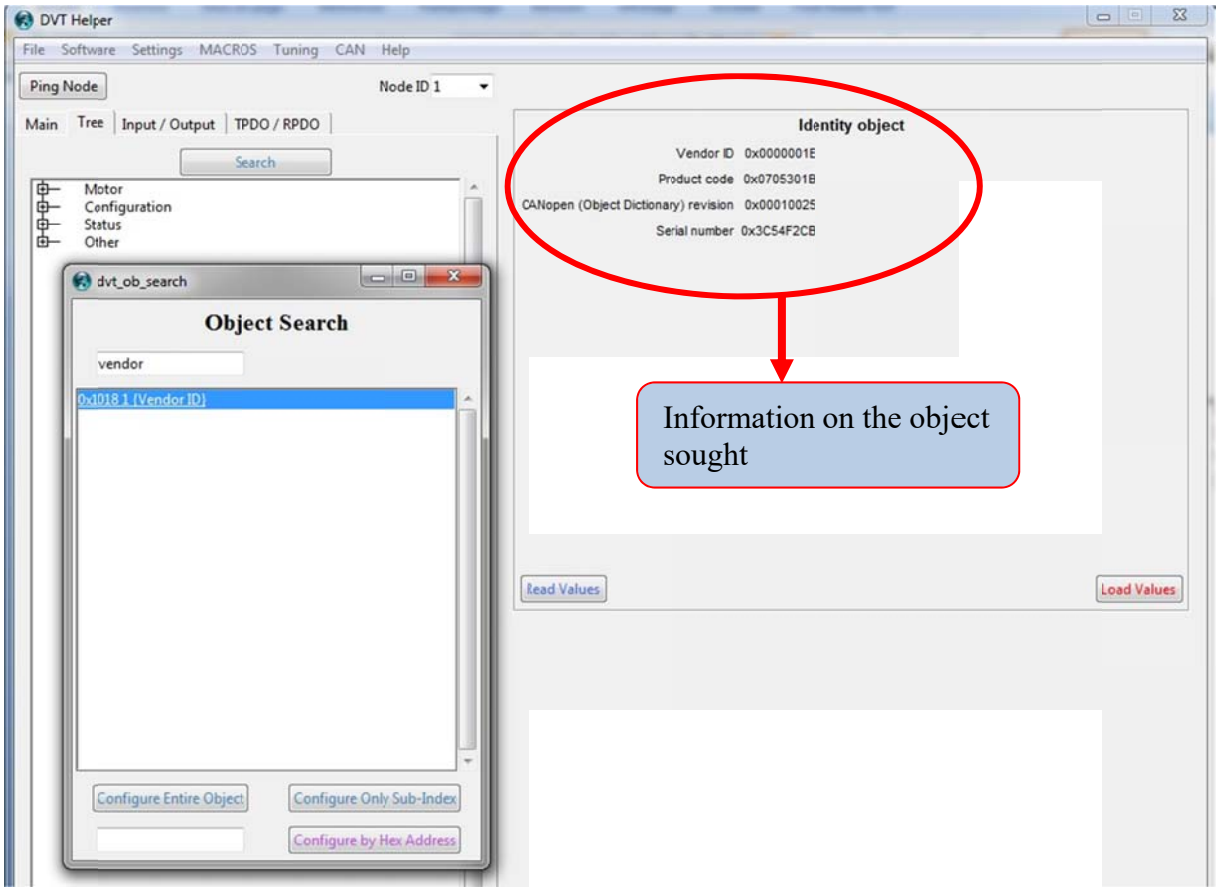

Fig. 17. Example of using the "Search" button.

2.5.2 Setting of the Line Contactor

Whatever the nominal voltage of the batteries, it is interesting to install a power contactor with a single nominal voltage of 24 V. The SEVCON GEN4 AC controller reduces the supply voltage to the nominal voltage of the line contactor coil.

This possibility can be configured in the menu:

- the "Tree" tab;
- "Configuration" menu;
- "Contactor" menu;
- red line "Voltages".

It must be checked that the "Pull-In Voltage" voltage reduction equals 24 V (nominal voltage of the power relay coil). After the "Pull-in Time" time, here 1 second, the voltage at the relay terminals is reduced to the 18 V value specified in "Hold-In Voltage".

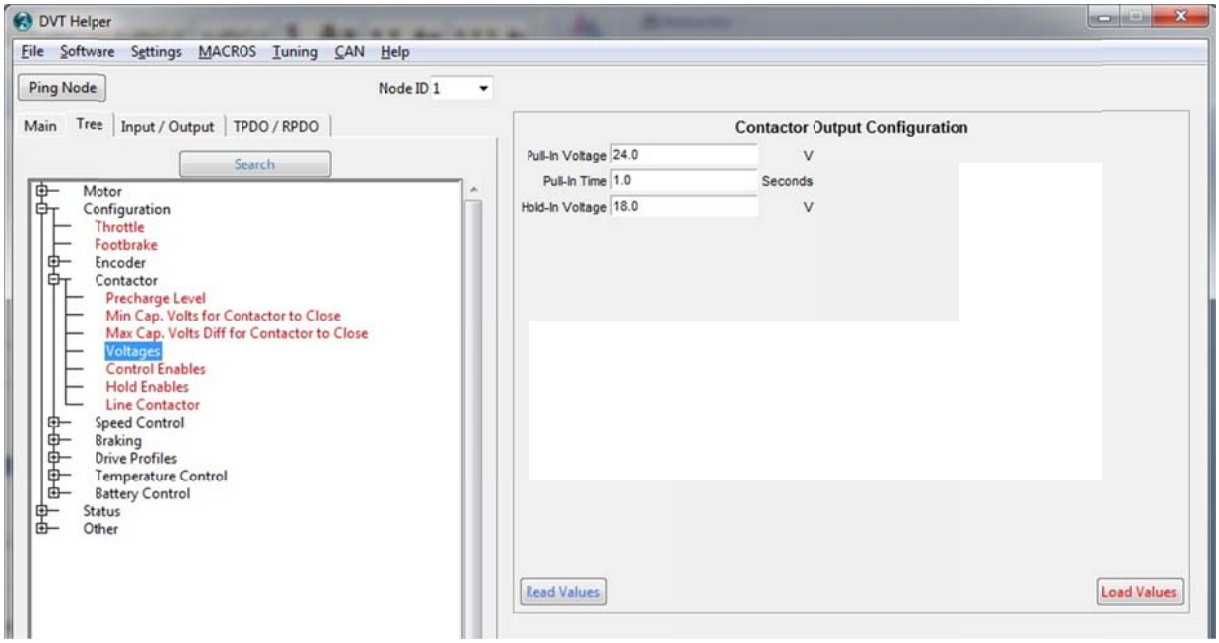

Fig. 18. Menu "Tree structure - Configuration - Contactor - Voltages".

The "Line Contactor" power relay is used to isolate the power section of the three-phase inverter from the inverter's battery voltage in the event of a problem. It is activated when the controller considers that there is no longer any problem for the motor to operate.

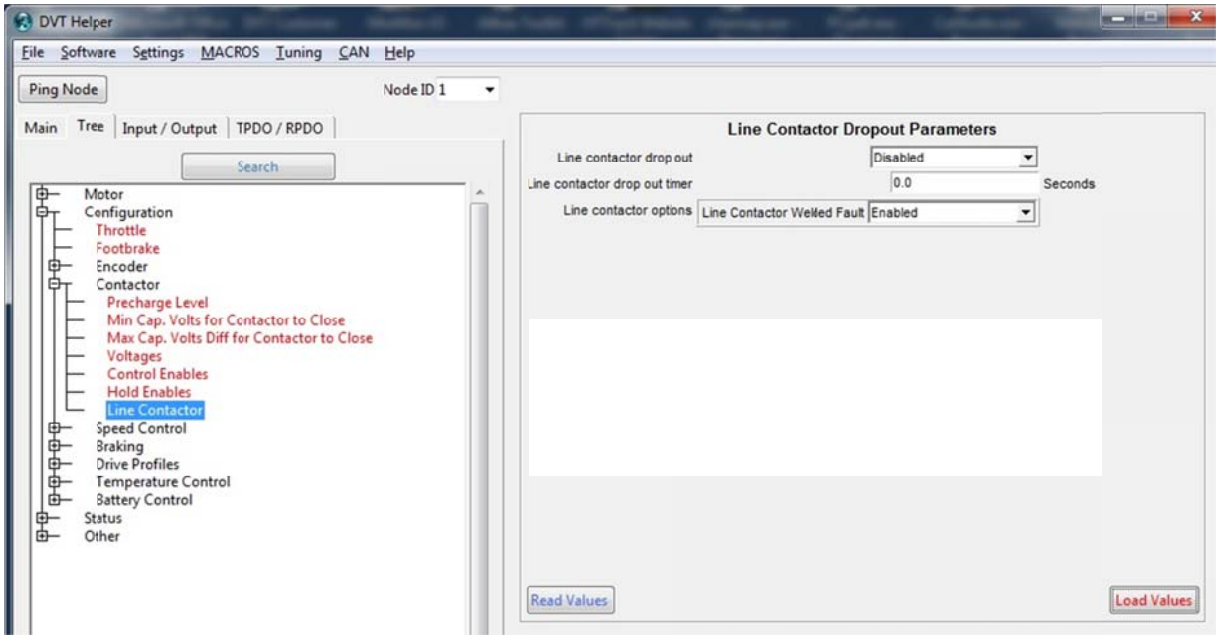

Fig. 19. Setting the "Line Contactor Dropout" function.

When the "Line contactor drop out" parameter is activated, "Enabled" is activated, the relay power supply can be switched off if the controller (and therefore the motor) is not active. This reduces the power consumption on the batteries and reduces the heating of the power relay.

The value indicated in "Line contactor drop out timer" corresponds to the idle time at which the contactor will be opened again.

The "Line contactor options" option must be set to "Enabled" so that the controller can detect a fault if the power relay remains permanently closed "Line Contactor Welded Fault".

2.5.3 A Few Words about Voltage Reduction

The voltage reduction to +24 V for the power relay is also interesting when using +24 V signal lights such as XB4-BVB3.

The voltage reduction and the "Hold-In Voltage" value are the same for all 3 power outputs. However, it is possible to activate or not these options for the different functions that can be used as outputs.

Fig. 20. The XB4-BVB3 24 V signal light

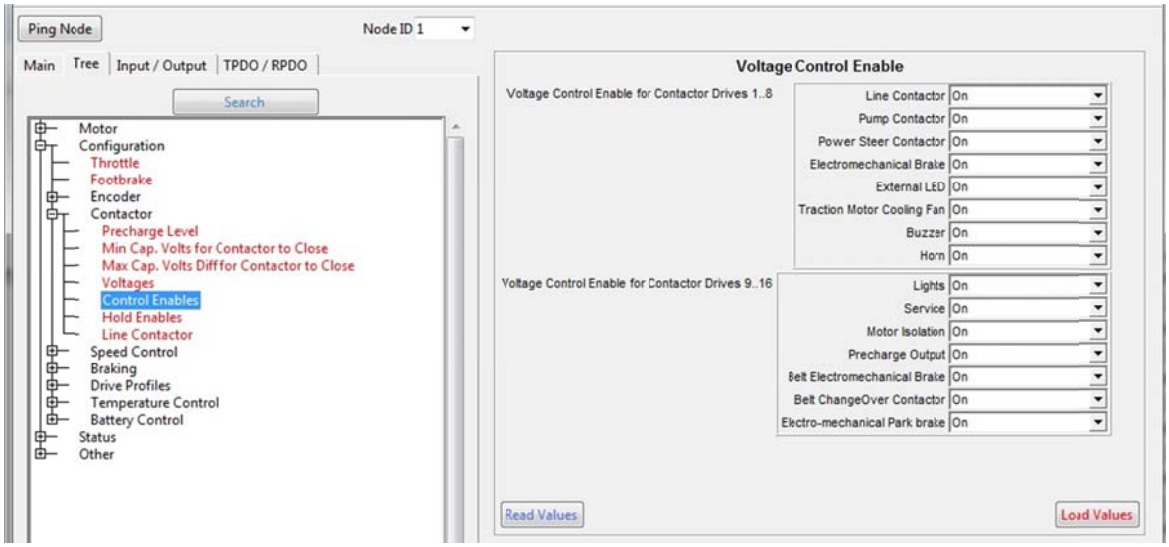

Fig. 21. Menu named "Tree structure - Configuration - Contactor - Control activation".

The "Control Enables" menu is configured here to activate voltage reduction on all output functions of the SEVCON GEN4 AC controller.

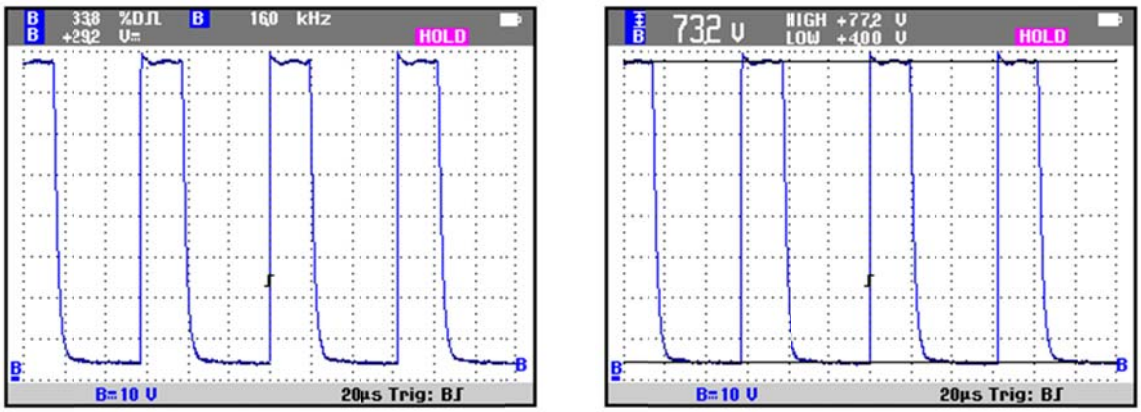

Fig. 22. Example of voltage reduction at the terminals of the indicator. Case of a 72 V power supply and a 24 V configuration.

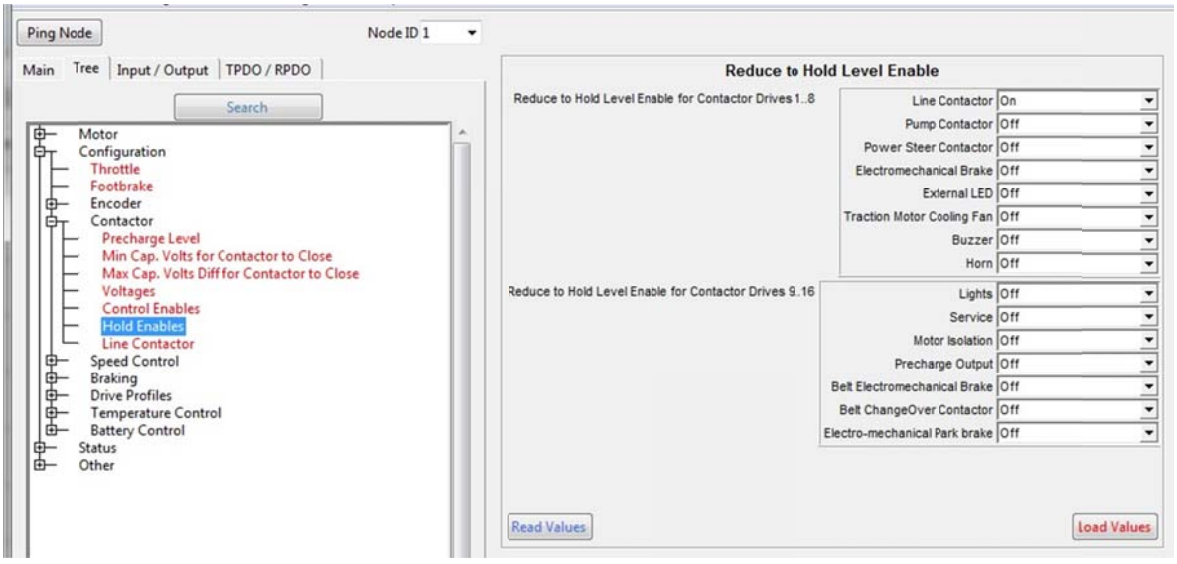

Fig. 23. Menu named "Tree – Configuration – Contactor – Hold Enables".

The "Hold Enables" menu specifies here that only the "Line Contactor" output will change to +18 V after one second.

2.5.4 Accelerator Pedal Settings

IMPORTANT: this setting is often a source of problems when receiving the controller. The configuration is carried out in "factory" on a specific test bench, with an acceleration potentiometer different from the one installed on the vehicle.

The first step is to measure the voltage range of your accelerator. After setting the controller to "Preoperational" mode (RED button: "Go Preoperational") so that the motor does not operate, it is possible to "read" the voltage measured on analog input N°1 through the "Status / Raw Analog Inputs" menu.

The minimum and maximum value of the accelerator tension must then be determined by operating the accelerator pedal.

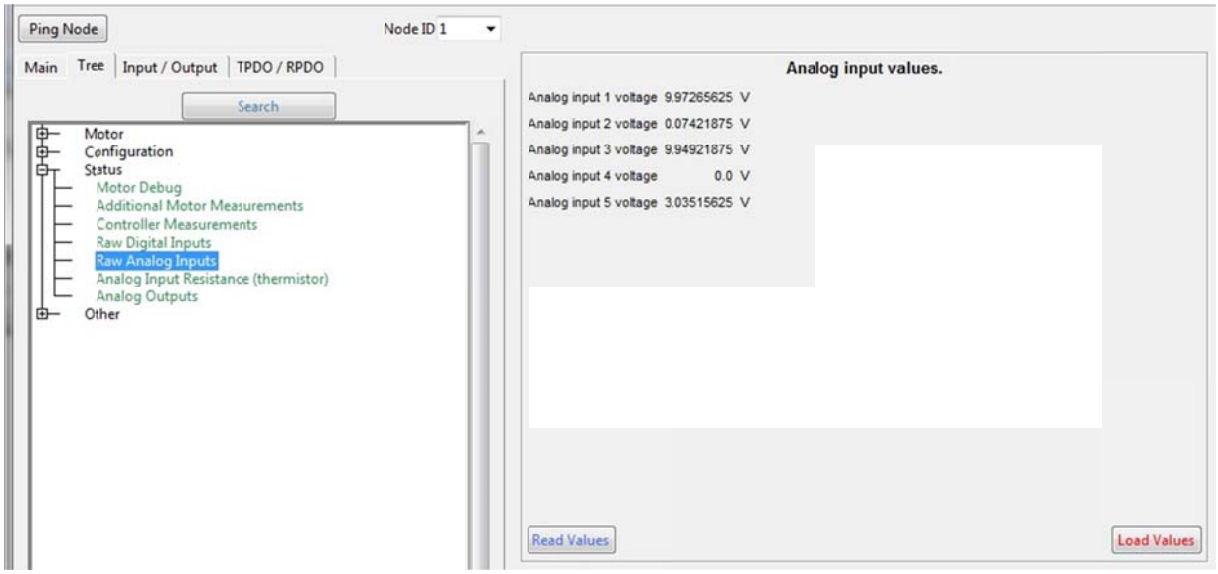

Fig. 24. Menu named "Tree – Status – Raw Analog Inputs".

Comment:

The fifth analog input corresponds to the temperature sensor of the PTC motor, here a KTY84 sensor connected to the -BAT. The voltage of 3.035 V corresponds to an ambient temperature of 21 °C.

The adjustment of the useful range of the accelerator can be configured in the "Tree" tab, "Configuration / Throttle" menu.

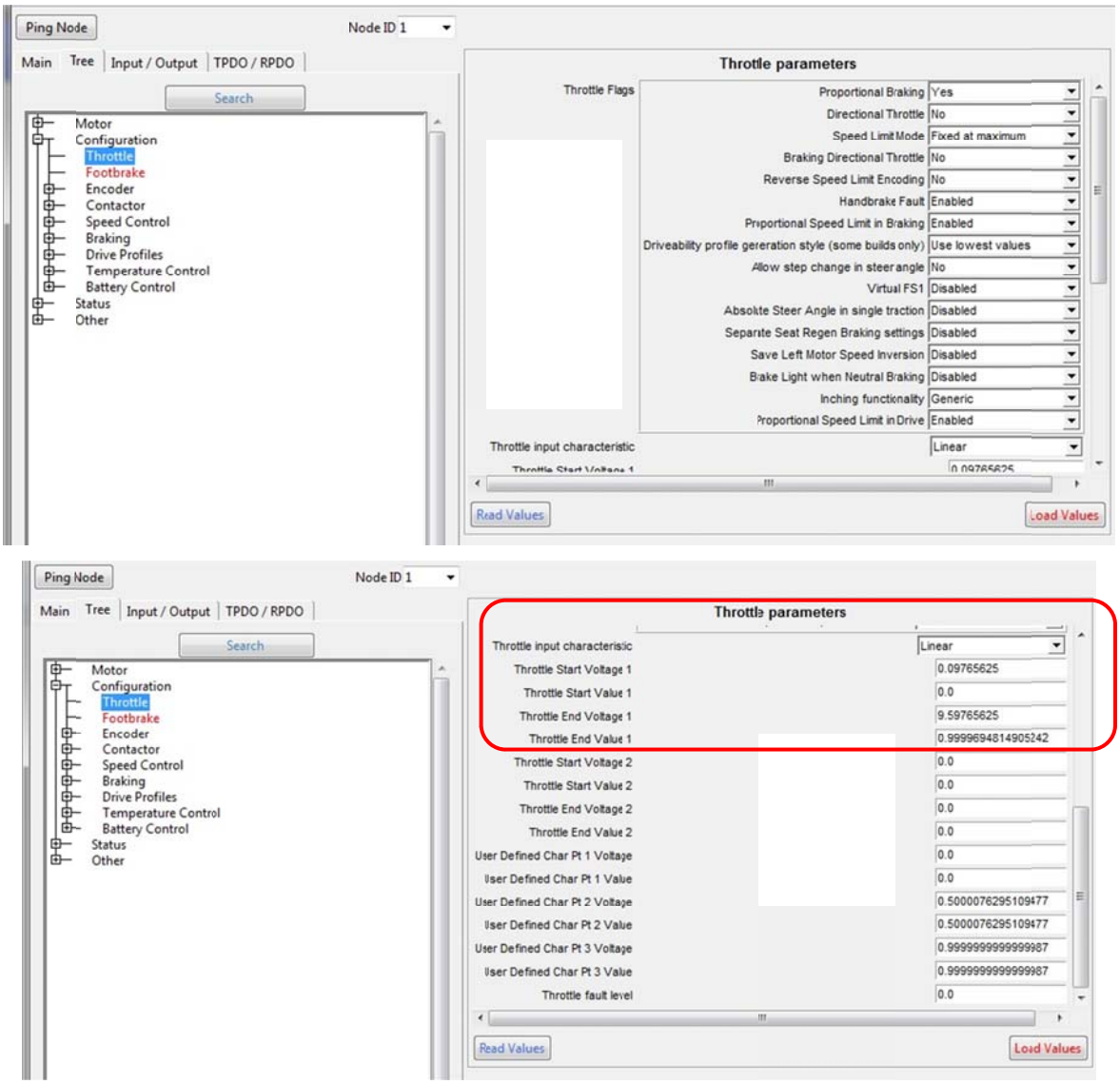

Fig. 25. Menu named "Tree – Configuration – Throttle".

In the "Throttle parameters" window, it is then possible to configure:

- "**Throttle Start Voltage 1**": it is the minimum voltage value that will be taken into account for the acceleration set point. It is recommended to create a dead band of operation by adding 0.1 V-0.2 V to the measured value.
- "**Throttle Start Value 1**": this value is always 0 (0%). If this value is 1, the minimum voltage "Throttle Start Voltage 1" corresponds to the MAXIMUM set point value. In this case, put 0 in "Throttle End Value 1".
- "**Throttle End Voltage 1**": it is the maximum voltage value that will be taken into account for the acceleration set point. It is recommended to create a dead band of operation by subtracting 0.2 V from the measured value for this maximum voltage.
- "**Throttle End Value 1**": this value is always 1 (100%). If this value is 0, the maximum voltage "Throttle End Voltage 1" corresponds to the MINIMUM set point value. In this case, you must put 1 in "Throttle Start Value 1".

2.5.5 Parameter Setting of the Motor Temperature Sensor

This setting is important for the thermal protection of the motor. It can be configured in the menu:

- the "Tree" tab;
- the "Configuration" menu;
- the "Temperature Control" menu;
- the "Sensor Config" line in red.

Figure 26 gives an example with a temperature sensor of type KTY84. Default values for high and low voltages are provided by SEVCON.

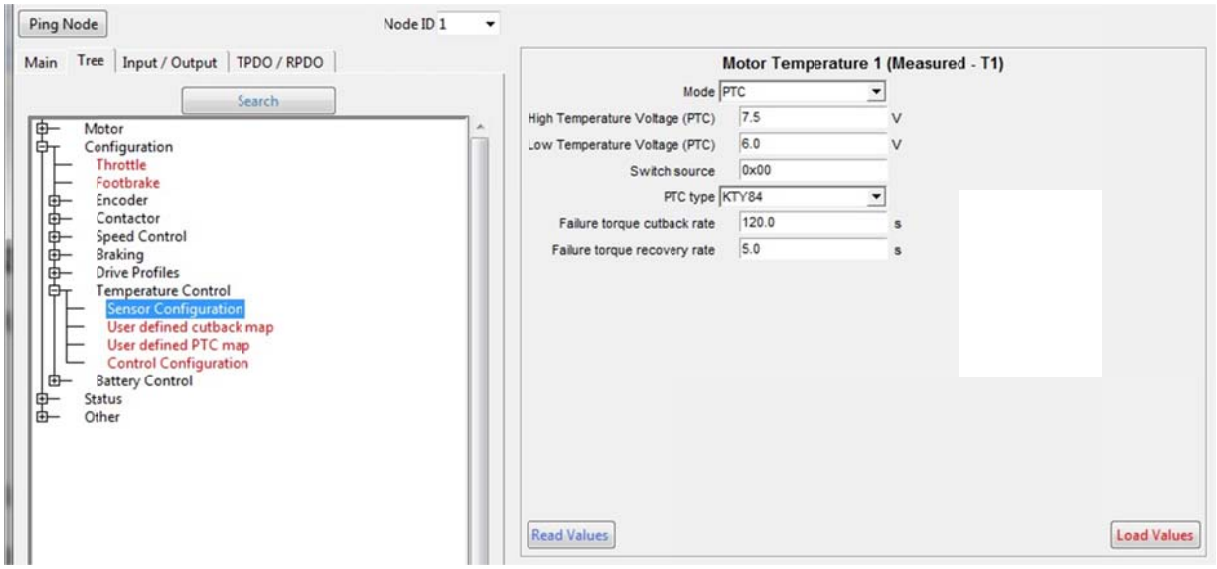

Fig. 26. Menu named "Tree – Configuration – Temperature Control – Sensor Configuration".

Comment:

The analog input N°5 corresponds to the temperature sensor of the PTC motor, here a KTY84 sensor connected to the -BAT. The voltage of 3.035 V corresponds to an ambient temperature of 20 °C. For this temperature the resistance is given by the following table.

Table 1. Resistance value of the KTY84 temperature sensor.

Température	KTY84/150 Min.	KTY84 typ.	KTY84/150 Max.
0 °C	464 Ω	498 Ω	532 Ω
20 °C	544 Ω	581 Ω	618 Ω
100 °C	950 Ω	1,000 Ω	1,050 Ω

The measurement of the voltage of analog input N°5 and the motor temperature via the PTC probe KYT84 by replacing the current probe by a variable resistance allows to validate the correct functioning of the motor temperature measurement with this probe KTY84 (see measurement table AN-EK016.xlsx).

The "High Temperature Voltage (PTC)" = 7.5 V and "Low Temperature Voltage (PTC)" = 6.0 V voltages are only used for a temperature sensor other than the KTY84.

- High Temperature Voltage (for external PTC only # KTY84 !). This is the voltage at the input when the temperature is 100 °C.
- Low Temperature Voltage (for external PTC only # KTY84 !). This is the voltage at the input when the temperature is 0 °C.

2.5.6 Voltage Limits of the Battery

There are 2 characteristics concerning the voltage limits of the battery:

1. The "app_cutback" YELLOW curve is set by "Battery Overvolt Protection" and "Battery Undervolt Protection". This limit concerns the value of the voltage read between pin key N°1 "Keyswitch" and terminal B-.
2. The "motor_cutback" BLUE curve is set by "Voltage Cutback". This limit concerns the voltage between terminals B+ and B- of the GEN4 AC controller.

The EXCEL file named "SEVCON-GEN4-Calculs-voltages.xlsx" provides the correct setting values of the 2 curves for the different models of SEVCON GEN4-series.

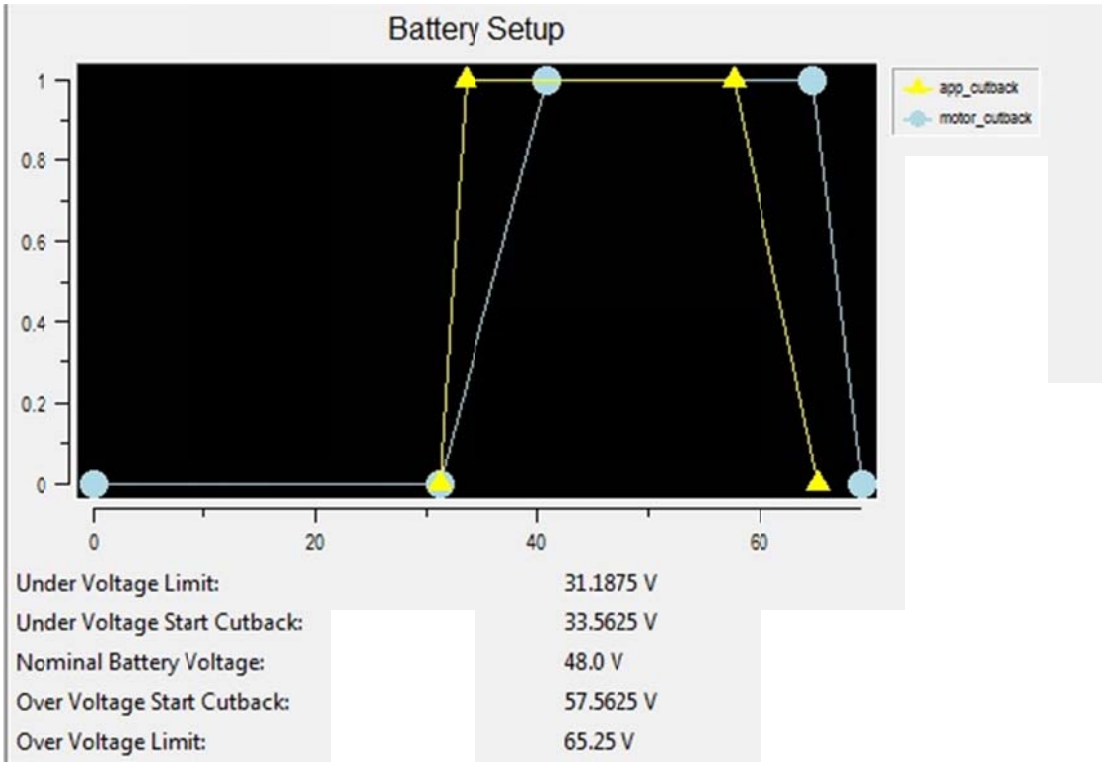

Fig. 27. Menu named "Main –Battery Limits" – Default settings.

2.5.6.1 The Limits of the "app_cutback" Battery

The "Tree - Configuration - Battery Control" menu is used to define the nominal battery voltage and its high and low limits.

The "start cutback" limits define a threshold where the engine torque will be reduced.

Beyond the "Over voltage limit" and "Under voltage limit" limits, the motor will be stopped.

This limit concerns the value of the voltage read between pin key N°1 "Keyswitch" and terminal B-. This voltage may be slightly different from the instantaneous value of the voltage between terminals B+ and B- of the GEN4-series controllers.

This limit is important when using the electric motor brake. Indeed, the current re-injected into the battery causes the battery voltage to increase.

Commonly, the values of the two tables named "app_cutback" and "motor_cutback" can be superimposed. In order to best protect the controller, the "motor_cutback" values must be less than or equal to the "app_cutback" values, the voltage between B+ and B- being higher and faster than that between pin N°1 "Keyswitch" and terminal B-.

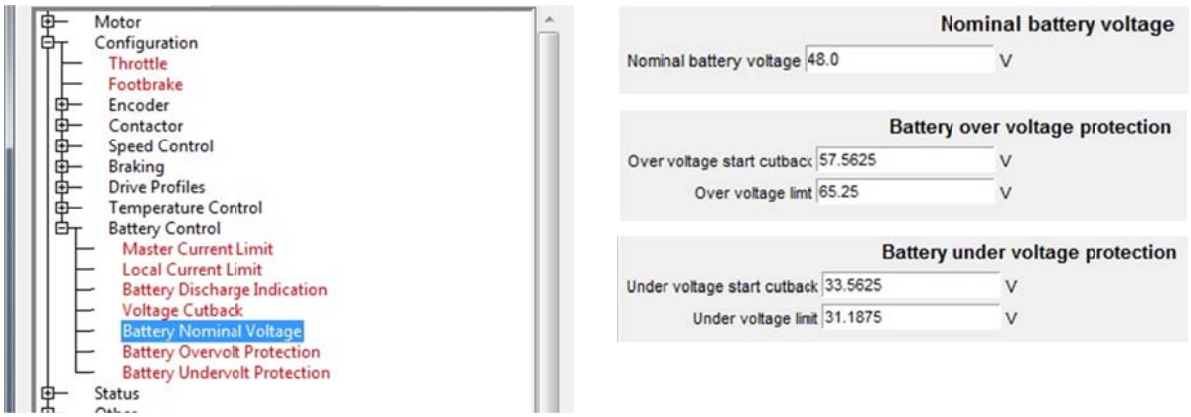

Fig. 28. Menu named "Tree – Configuration – Battery Control".

2.5.6.2 Limiting Voltages of the "motor_cutback" Application

The "Voltage cutback" menu defines a function with thresholds beyond which the motor torque will be reduced or even zero.

This limit concerns the voltage between terminals B+ and B- of the GEN4 controller. This voltage may be slightly different from the instantaneous value of the voltage between pin 1 "Key switch" and terminal B-.

This limit is important when using the electric motor brake. Indeed, the current re-injected into the battery increases the voltage across the GEN4 controller's filtering capacities (before the fuse, power relay and cables connecting to the battery).

Commonly, the values of the two tables "app_cutback" and "motor_cutback" can be superimposed. In order to best protect the controller, the "motor_cutback" values must be less than or equal to the "app_cutback" values, the voltage between B+ and B- being higher and faster than that between pin N°1 "Key switch" and terminal B-.

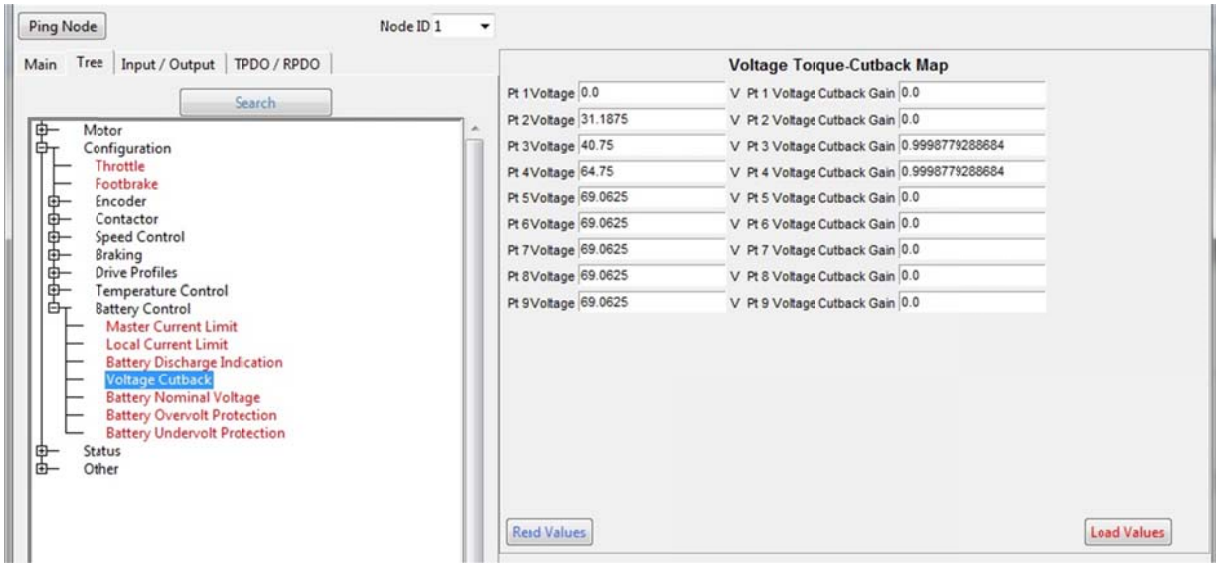

Fig. 29. Menu named "Tree – Configuration – Battery Control – Voltage cutback" 1/2.

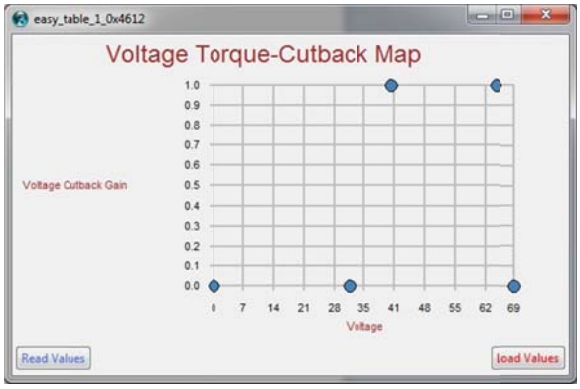

Fig. 30. Menu named "Tree – Configuration – Battery Control – Voltage cutback" 2/2.

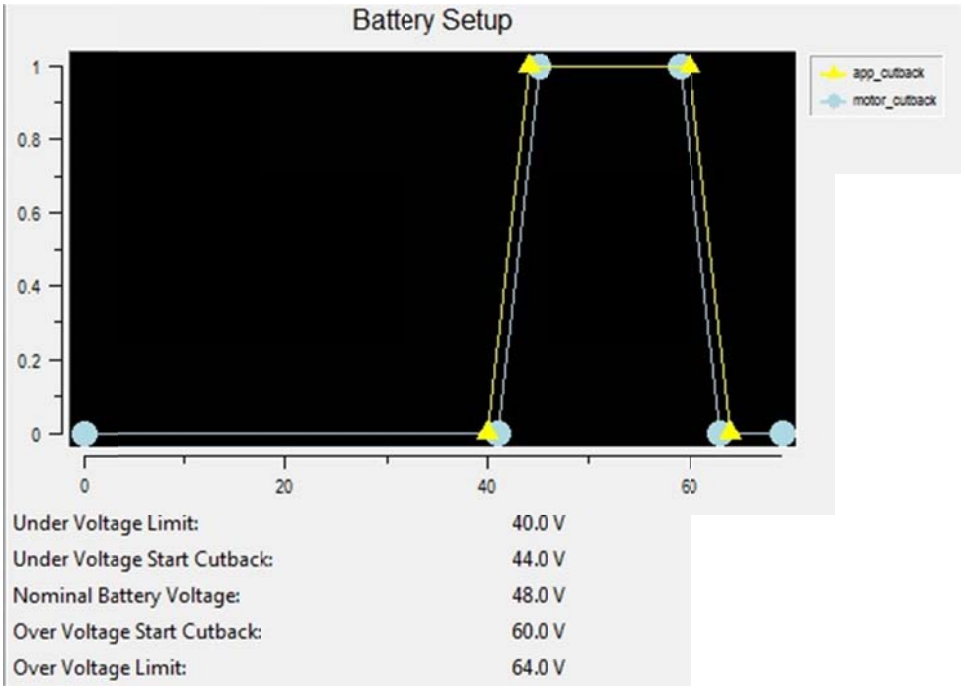

Fig. 31. Menu named "Main –Battery Limits" – Correct values.

2.5.6.3 Limiting Voltages of the SEVCON GEN4 AC Controller

The different limits must be compared with the absolute limits of the controller:

	24V only (Size 2 24V)	24/36V controllers	36/48V controllers	72/80V controllers	96/110V controller
Conventional working voltage range (Note 1)	16.8V to 28.8V	16.8V to 43.2V	25.2V to 57.6V	50.4V to 96V	67V to 132V
Working voltage limits (Note 2)	12.7V to 34.8V	12.7V to 52.2V	19.3 V to 69.6 V	39.1 V to 120 V	48V to 150V
Non-operational overvoltage limits:	39.6V	59.4V	79.2 V	132 V	150V

Fig. 32. Limiting voltages of the SEVCON GEN4 AC controller.

2.5.7 Motor Torque-Speed Characteristic

In the "Main" tab of the "Helper" script, the "Torque Maps" drop-down menu gives access to the setting of the "TorqueMap1 0x4611". This menu allows you to set the curve giving the evolution of the maximum torque in the motor (in Nm) according to its rotation speed (in rpm).

The "Peak Motor Torque" (about 3 times the nominal torque) and the "Max Stator Current" are the values indicated in the "Tree - Motor - Motor Data" menu.

The control law also indicates the maximum value of the torque that can be obtained as a function of the stator current "PMAC Torque Limit By Stator Current".

The YELLOW curve can be compared to 2 interesting curves (in RED):

- either a power limit calculated from a maximum current in the battery: $P_{max} = U_{bat} \times I_{bat}$;
- or a power limit given by "Power Limit". At constant power, the torque is given by a hyperbolic function: $\Gamma_{max}(Nm) = \frac{P_{max}(W)}{\Omega(\mathrm{rd/s})}$.

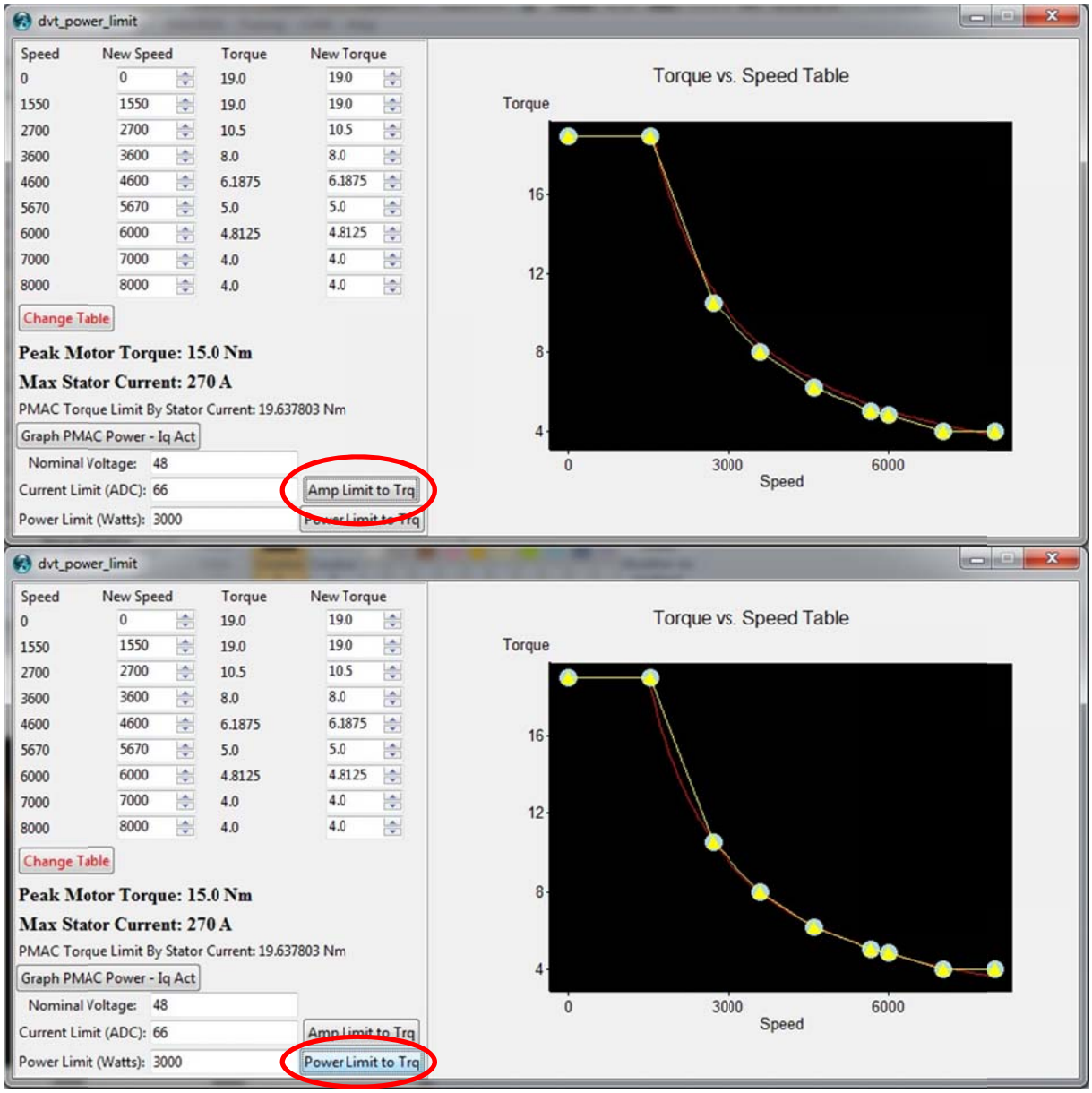

Fig. 33. Maximum torque (Nm) depending on motor speed (rpm).

2.5.7.1 Setting the Motor Limits: the "Profiles"

3 profiles are available in the SEVCON GEN4 AC controller:

1) The "Baseline Profile": this is the default profile enabled when other profiles are not used. It is the profile that must contain the largest settings (higher than the two other profiles).
2) The "Driveability Select 1 Profile" profile is a profile that can be activated by a logic input (digital input 6, pin N°9). This profile must contain the lowest parameter values than the "Baseline Profile".
3) The "Driveability Select 2 Profile" profile is a profile that can be activated by a logic input (digital input 7, pin N°32). This profile must contain the lowest parameter values than the "Baseline Profile".

By default, if several profiles are activated simultaneously, the controller will use the lowest parameter value of the 3 profiles.

The parameter settings in the various "Profiles" can be made in "Operational" mode and are taken into account immediately after applying the values in the controller. By the "Load Values" button.

When the controller is in "Torque Mode" ([4] "Vehicle performance configuration", section 6-16, page 82), only the values "Speed limit ramp up rate when in torque mode" and "Speed limit ramp down rate when in torque mode" are used. The other ramp values in "%/s" are not used.

2.5.7.2 "Traction Baseline Profile"

The maximum torque and speed limits, as well as the acceleration and braking ramps, can be configured in the "Main" tab and the "Baseline Profile" button. The values are also available in the "Tree" tab, "Configuration - Drive Profiles - Baseline Profile" menu ([4] section 6-24 page 90).

<u>BE CAREFUL</u>: do not exceed the maximum speed of the motor!

An absolute limit of the motor speed is specified in the "Tree" tab, menu "Configuration - Speed Control - Overspeed").

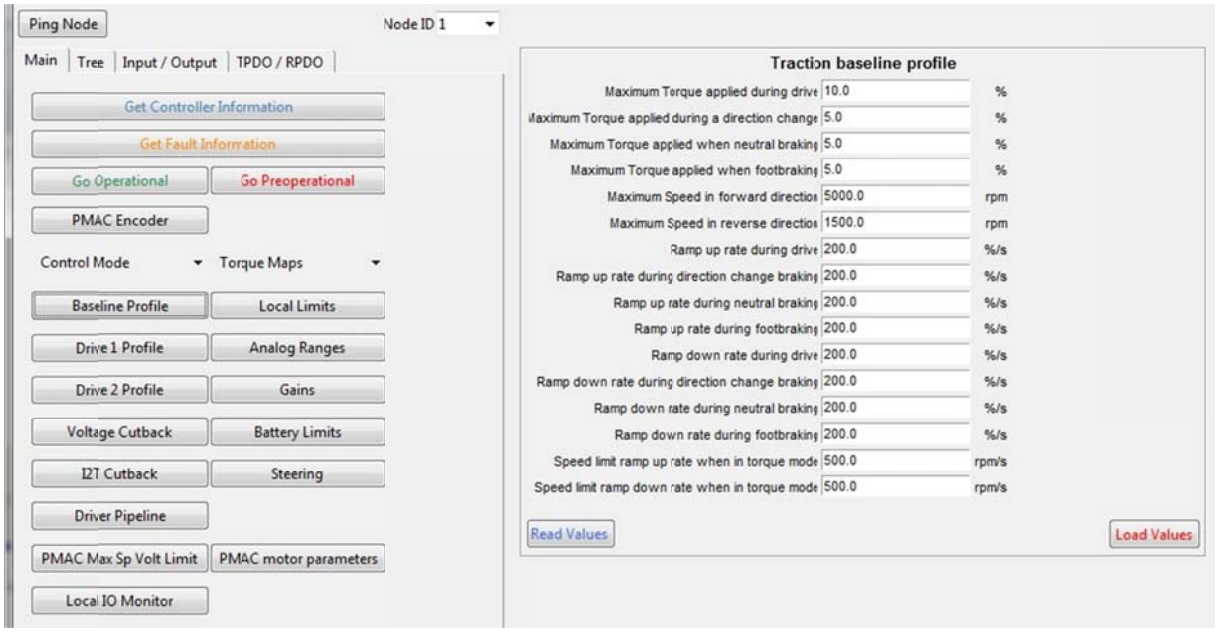

Fig. 34. Setting the operating limits of the motor in the "Baseline Profile" configuration.

2.5.7.3 "Driveability Select 1 Profile"

The "Driveability Select 1 Profile" profile can be activated by the sixth digital input (pin N°9). This profile can define a "Normal" or "Kids" mode compared to a "Sport" mode defined by the parameters of the "Baseline Profile".

The maximum torque and speed limits, as well as the acceleration and braking ramps, can be configured in the "Main" tab and the "Drive 1 Profile" button. The values are also available in the "Tree" tab, "Configuration - Drive Profiles - Drive Profile 1" menu.

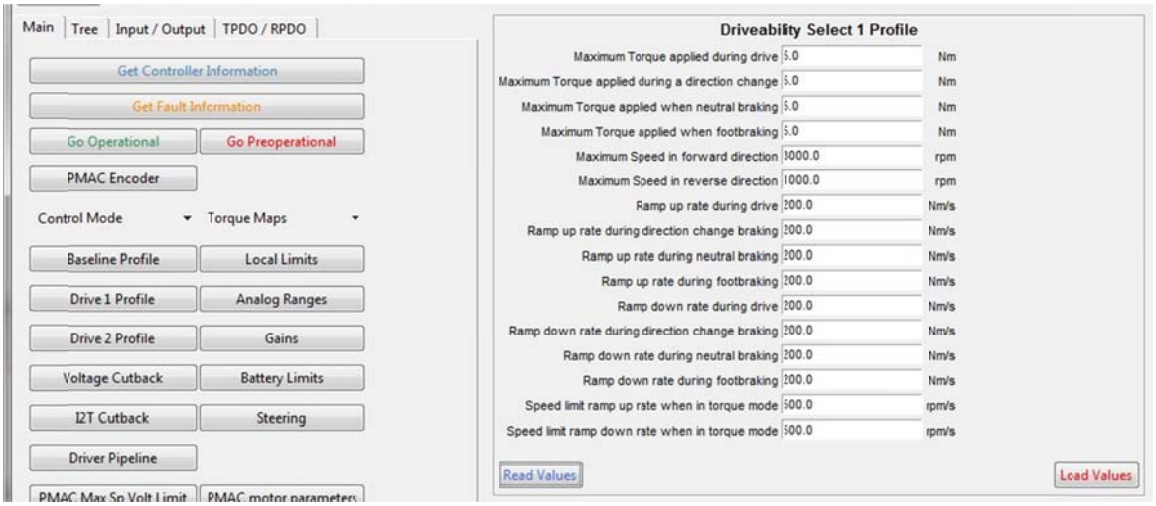

Fig. 35. Setting the operating limits of the "Driveability Select 1 Profile" motor.

2.5.7.4 "Driveability Select 2 Profile"

The "Driveability Select 2 Profile" can be activated by the seventh digital input (pin N°32). This profile is generally used to define a "Free Wheel" mode when the mechanical brake pedal is depressed. With zero speed set points, the GEN4 controller will try to slow the motor (programmable electric brake) when trying to stop the vehicle.

The maximum torque and speed limits, as well as the acceleration and braking ramps, can be configured in the "Main" tab and the "Drive 1 Profile" button. The values are also available in the "Tree" tab, "Configuration - Drive Profiles - Drive Profile 1" menu ([4] section 6-24 page 90).

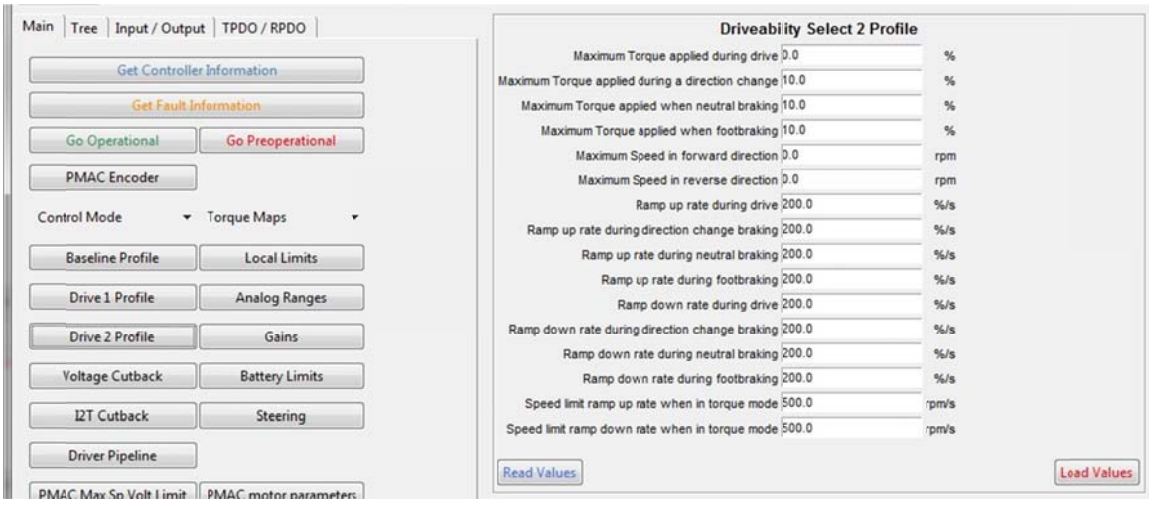

Fig. 36. Setting the operating limits of the "Driveability Select 2 Profile" motor.

2.6 Managing DCF Configuration Files

The different configuration values of a SEVCON GEN4 AC controller can be stored in a "Device Configuration File" with the extension "DCF".

IMPORTANT: it is recommended to create a DCF file as soon as the controller is received with the initial configuration. This configuration has been tested on a test bench, it will be used as a reference and can be recharged if necessary.

IMPORTANT: as soon as a configuration seems "acceptable", it is recommended to create a DCF file with a different file name, corresponding to the different settings made.

2.6.1 The "Save DCF" menu

Saving a DCF file is accessible from the menu:

- in the "Helper" script window;
- the "Settings" menu;
- the "Save DCF" menu.

It is not necessary to be in the "PreOp" mode to save the controller configuration in a DCF file. The operation takes a few minutes: the process must not be interrupted before the end and the power supply to the controller must not be cut off.

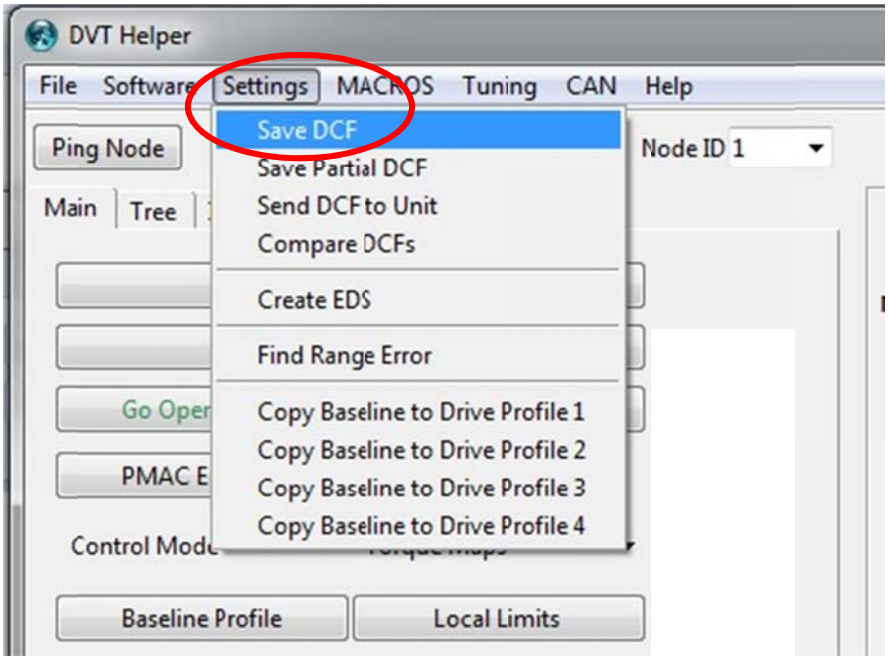

Fig. 37. The "Save DCF" menu in the "Helper" script window.

2.6.2 File Naming

The multiplication of controller configurations likely to produce a DCF file requires rigorous naming of configuration files.

File names are also used to sort them in the same directory: there are therefore several sorting options, by date or by controllers.

The file name will then be composed of:

- "**2018-03-31**": the date in reverse format (here March 31, 2018) to sort by year, then by month, then by day;
- "**PMS100**": the type of motor;
- "**0705-0012**": the version of the software used (here software for synchronous motor, version 0705.0012);
- "**48V**": the controller supply voltage (battery voltage);
- "**S2**": the type of controller: "size 2", "size 4" or "size 6";
- "**37A4**": an identification of the final customer (here the number of the kart);
- "**17h22**": the backup time;
- "**config-a-vide**": a comment on the function of the configuration.

2018-03-31-PMS100-0705-0012-48V-SIZE2-37A4-17h22-config-a-vide.dcf

The files will be stored in a different directory from the "DVTC" script not to be deleted when the software is updated:

C:\SEVCON-GEN4\DCF

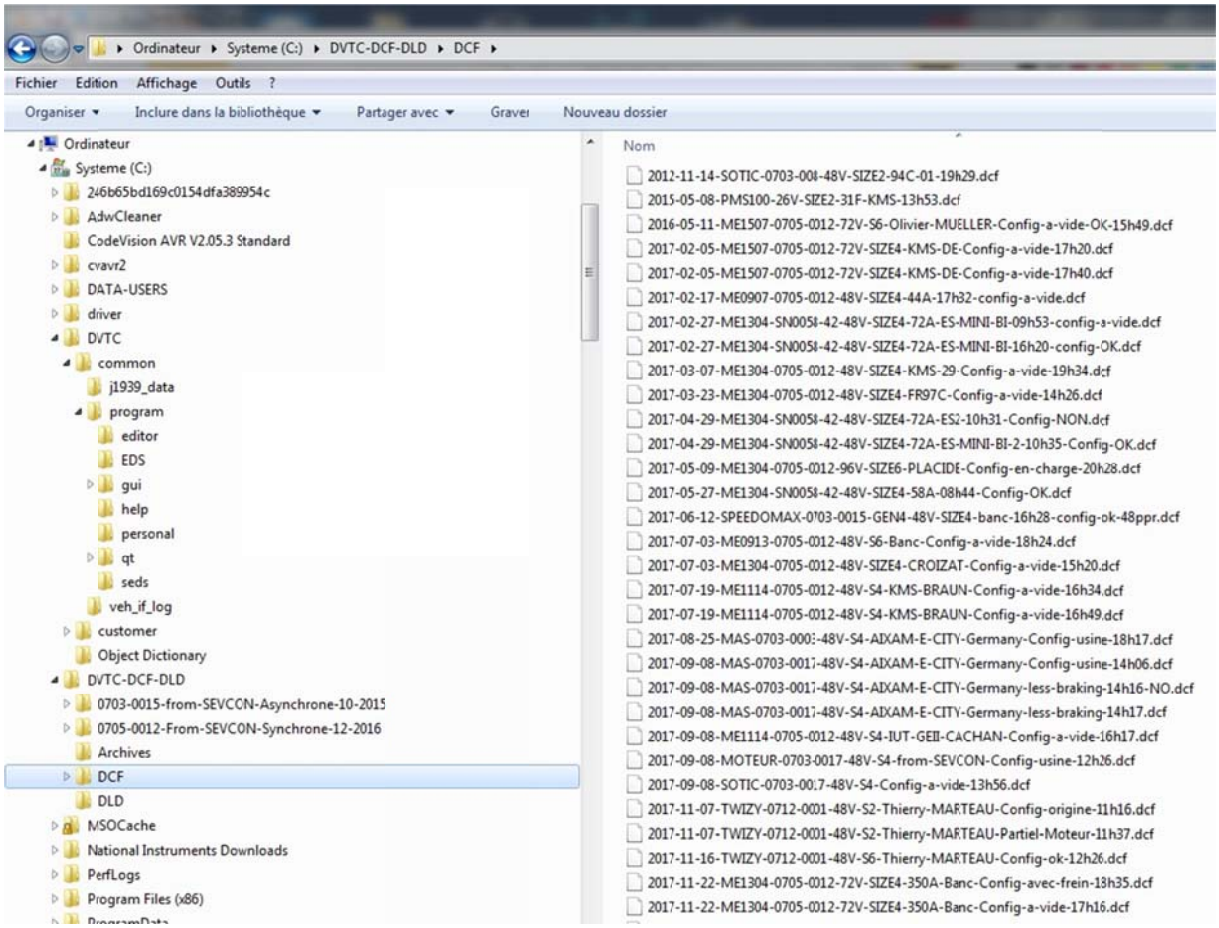

Fig. 38. The naming of the "DCF" files in the "C:\SEVCON-GEN4\DCF" directory.

2.6.3 The "Send DCF to Unit" Menu

This menu allows you to load a configuration into a controller.

BE CAREFUL the DCF file must have been generated with a controller having the same "hardware" (same "Part" number, see §8) and the same "software" (see §2.3).

Loading a DCF file into a controller is accessible from the menu:

- in the "Helper" script window;
- the "Settings" menu;
- the "Send DCF To Unit" menu.

IMPORTANT: it is necessary to be in the "PreOp" mode (RED button: "Go Preoperational") (so that the motor does not work) to be able to load a new configuration into the controller. The operation takes a few minutes and is **VERY CRITICAL**: the process must not be interrupted before the end and the power supply to the controller must not be cut off. In case of problems during transfer, the controller must return to the factory and may be unrecoverable.

At the end of the transfer, a window appears asking you to turn off the power to the controller and turn it back on ("Power Recycle"). It is only when the power is restored that the parameters of the new DCF file will be taken into account by the GEN4 AC controller.

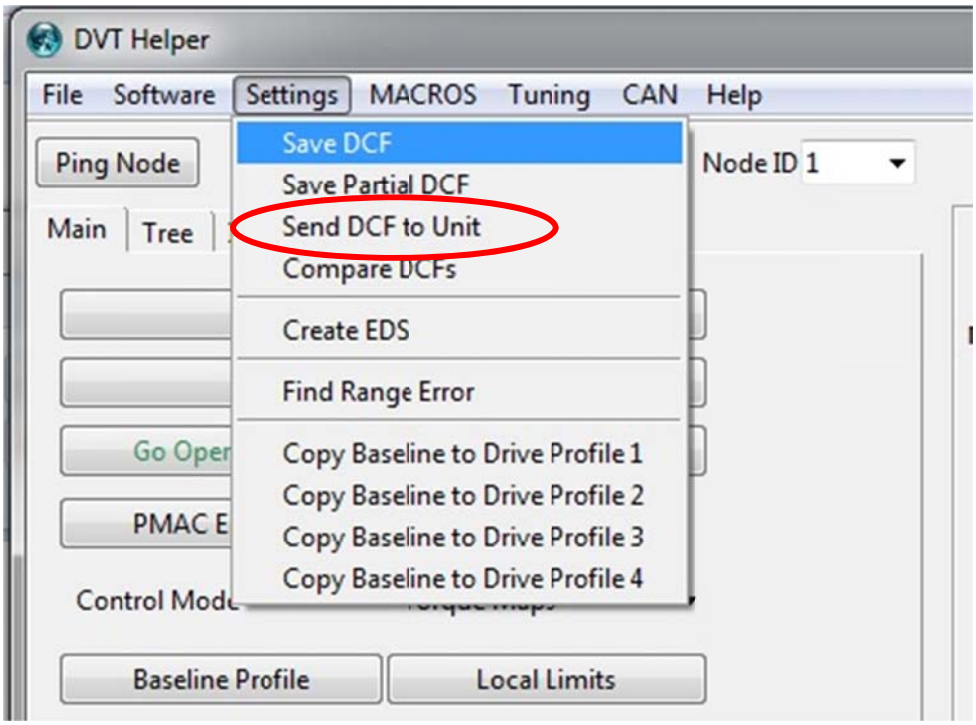

Fig. 39. The "Send DCF To Unit" menu in the "Helper" window.

3 The "Helper" Script – Advanced Functions

3.1 Changing the Access Level

In the "DVTC" script window, in the online command area, it is necessary to check the access level to the controller with the command "lg 1? ». It is possible to change this access level by using the "lg 1 4" command. Example:

```
dvt(9) % lg 1 ?
Access Level: 0x00
0x00
dvt(10) % lg 1 4
OK
dvt(11) % lg 1 ?
Access Level: 0x04
0x04
```

3.2 Changing the Nominal Voltage and Current Values

It is possible to adapt a DCF file to a controller with different voltage and current ratings with the command: "configure_voltage_items nodeid voltage block_rating". The access level must be 4, here is an example of a 72 V, 550 A switch with the control:

```
dvt(12) % configure_voltage_items 1 72 550
```

set 0x2c00 0 to 0x0480	set 0x4612 7 to 0x0613
set 0x2c01 1 to 0x0566	set 0x4612 9 to 0x067a
set 0x2c01 2 to 0x061e	set 0x4612 11 to 0x067a
set 0x2c02 1 to 0x0326	set 0x4612 13 to 0x067a
set 0x2c02 2 to 0x02ec	set 0x4612 15 to 0x067a
set 0x2C30 6 to 0x24	set 0x4612 17 to 0x067a
set 0x4612 1 to 0x0000	set 0x6075 0 to 0x00086470
set 0x4612 3 to 0x02ec	set 0x4641 2 to 0x0226
set 0x4612 5 to 0x03d3	set 0x4641 12 to 0x0480

```
invalid bareword "Abort"
in expression "Abort 0x06020000 / pow(2,6)";
should be "$Abort" or "{Abort}" or "Abort(...)" or ...
dvt(13) %
```

This macro control modifies the parameters related to the direct voltage of the battery and the RMS current in the motor phases. The file named "SEVCON-GEN4-Calculs-voltages.xlsx" summarizes the changes made:

	HEX	DEC	x 0,0625	
set 0x2c00 0 to 0x0480	0480	1152	72,00	V
set 0x2c01 1 to 0x0566	0566	1382	86,38	V
set 0x2c01 2 to 0x061e	061e	1566	97,88	V
set 0x2c02 1 to 0x0326	0326	806	50,38	V
set 0x2c02 2 to 0x02ec	02ec	748	46,75	V
set 0x2C30 6 to 0x24	24	36	72	V
set 0x4612 1 to 0x0000	0000	0	0,00	V
set 0x4612 3 to 0x02ec	02ec	748	46,75	V
set 0x4612 5 to 0x03d3	03d3	979	61,19	V
set 0x4612 7 to 0x0613	0613	1555	97,19	V
set 0x4612 9 to 0x067a	067a	1658	103,63	V
set 0x4612 11 to 0x067a	067a	1658	103,63	V
set 0x4612 13 to 0x067a	067a	1658	103,63	V
set 0x4612 15 to 0x067a	067a	1658	103,63	V
set 0x4612 17 to 0x067a	067a	1658	103,63	V
set 0x6075 0 to 0x00086470	00086470	550 000	mA	
set 0x4641 2 to 0x0226	0226	550	A	
set 0x4641 12 to 0x0480	0480	1152	72,00	V

Fig. 40. Switch to 72V 550A with the command: "configure_voltage_items 1 72 550".

The parameters at addresses "0x2c00" correspond to the menu "Battery Control", "Battery Nominal Voltage/Overvolt/Undervolt protection".

The parameter at address "0x2c30" corresponds to the menu "Battery Control - BDI Parameters", number of cells of the "Cell count" lead battery, at a rate of 2.00V per cell.

The settings at addresses "0x4612" correspond to the "Torque-Cutback Map Voltage" limitation of the "Battery Control - Voltage Cutback" menu.

The parameter at address "0x6075" corresponds to the maximum controller current in the "Main - Motor - Current Limit" menu. This current corresponds to the nominal current of the GEN4 controller.

The parameter at address "0x4641 sub 2" corresponds to the maximum current in the stator of the "Main - Motor - Motor Data" motor.

The parameter at address "0x4641 sub 2" corresponds to the nominal battery voltage defined in "Main - Motor - Motor Data". This value is identical to the one defined at address "0x2c00 sub 0".

3.3 Loading a "Software DLD" File into the Controller

The DLD file corresponds to the "Software" software of the controller and depends on the type of motor used: synchronous motor or asynchronous motor (induction motor).

The DLD files are provided by SEVCON and are located in the following directory:

C:\SEVCON-GEN4\DLD

There are 2 types of software in the directory:

1) The software named "0703_0017.dld" modified 09/11/2017: this is the latest version of the software for asynchronous motors;
2) The software named "0705_0013.dld" modified 10/08/2018: this is the latest version of the software for synchronous motors.

3.3.1 Saving the Controller Configuration

Before updating the "software" of a controller, it is essential to save its configuration in a DCF file (see 2.6.1 The "Save DCF" Menu). This configuration file will be reused after the update to make the controller operational with its motor.

It is also necessary to make a copy of the file "Master Database.edsdb" in the following directory:

C:\DVTC\common\program\EDS

It may be interesting to delete all the "*.eds" files in order to force the DVTC software to create a new "*.eds" file based on the new "*.edsdb" file.

3.3.2 The "Software" menu

Loading a DLD file into a controller is accessible from the "Helper" script window in the "Software" menu.

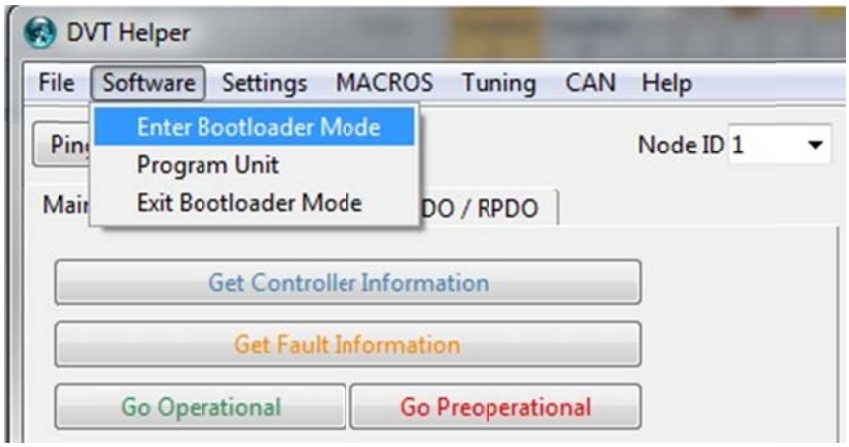

Fig. 41. The "Software" menu to load a "DLD" file.

IMPORTANT: it is necessary to be in the "Preoperationnal" mode (RED button: "Go Preoperational"), so that the motor does not work, to be able to load a new configuration into the controller.

The operation takes a few minutes and is **VERY CRITICAL**: the process must not be interrupted before the end and the power supply to the controller must not be cut off. If there are any problems during transfer, the controller must be returned to the factory and may be unrecoverable.

The operation is carried out in 3 steps.

3.3.3 Switching to the "Bootloader" mode

The first step is to switch to "Bootloader" mode, by using the "Enter Bootloader Mode" command from the "Software" menu (first line).

The controller LED flashes quickly and then goes out.

3.3.4 Programming a New "Software"

The second step consists in selecting the correct DLD file and programming the GEN4 drive with the "Program Unit" command from the "Software" menu (second line).

During the software update, the controller switches to boot loader mode: the green LED flashes quickly.

IMPORTANT: The transfer takes a few minutes and is **VERY CRITICAL**: the process should not be interrupted before the end and the power supply to the controller should not be cut off. In case of problems during transfer, the controller must return to the factory and may be unrecoverable.

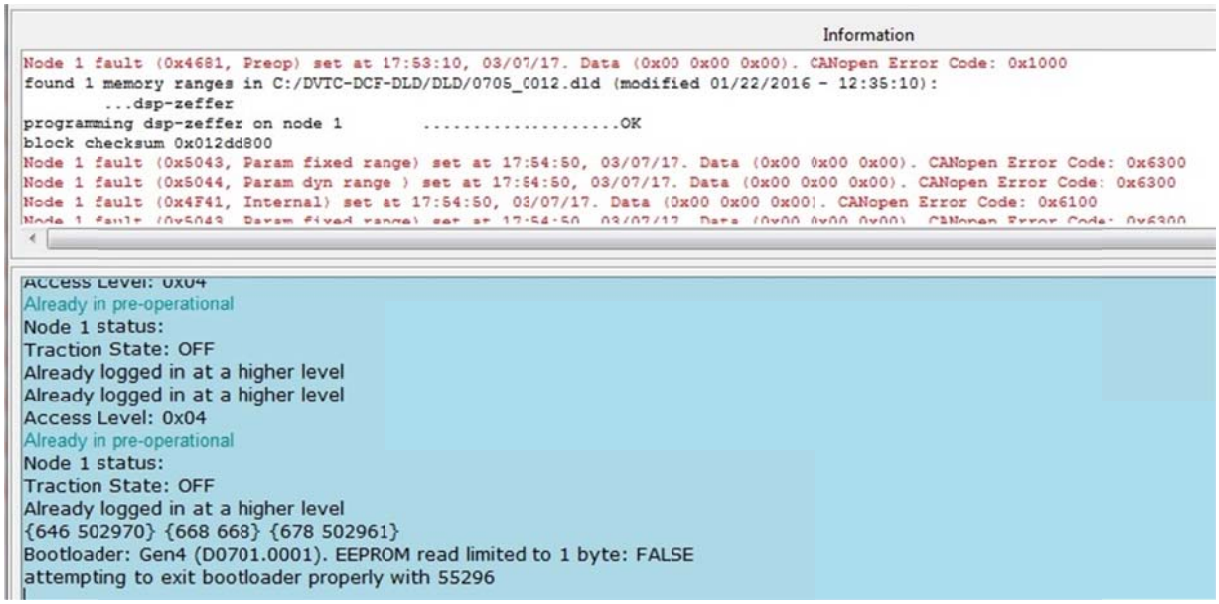

Fig. 42. Transfer of the current software to the "DVT" window.

During the transfer of the new program, a series of dots appears in the "Information" window following the text "programming dsp-zeffer on node 1".

At the end of the transfer, the message "OK" appears in the control window. It is important to exit the "boot loader" mode.

3.3.5 Exiting the "Bootloader" Mode

At the end of the transfer, when the message "OK" appears in the command window, you must exit "boot loader mode" by using the command "Exit Bootloader Mode" from the "Software" menu (third line).

At this point, the green LED on the GEN4 controller starts flashing again. **BE CAREFUL**: the controller is in "Preoperationnal" mode.

It is necessary to cut off the power supply to the controller, wait a few seconds and turn the controller back on "Power Recycle". It is also necessary to close the DVTC software and restart it.

By clicking on the "H" button, the "Helper" script will check the consistency of the EDS file available on the computer's hard disk with the new software and request the creation of a new file if necessary.

3.3.6 In Case of Problems

In case of problems during the transfer, do not exit the "boot loader" mode. It is necessary to cut off the power supply to the controller, turn it back on "Power Recycle" and restart loading the DLD file with the "Program Unit" command from the "Software" menu (second line).

3.3.7 After Updating a New "Software"

Once the new "software" is installed, the new variables that are declared must be correctly initialized. To do this, simply load the "generic" DCF file corresponding to this "Software":

ME0907_0705.0013_G4865_default_configuration_2_start_with.dcf

Then, it is necessary to reload the initial configuration file that was saved BEFORE the update of the "Software".

Note: After each software update step (DLD, DCF) and when the operation has gone well, it is important to remember to disconnect the power supply to the controller and restart it ("Power Recycle") and close and restart the DVTC software.

3.4 The "TPDO/RPDO" Tab

Reference [4] (section 6-4, page 70) gives some explanations about objects communicating via the CAN bus, such as "SDO: Service Data Object" and "PDO: Process Data Object".

PDOs are used by connected nodes (*e.g.*, in a two-drive configuration) to exchange real-time data during operation. PDOs allow up to 8 bytes of data to be transmitted in a CAN message.

They use the producer-consumer communication model, where the producer node creates and transmits the PDO for all connected consumer nodes configured to receive data. The transmitted PDOs are referred to as TPDOs and PDOs received, called RPDOs.

3.4.1 Some References on this Topic

The following documents have not been fully exploited:

- Adding PDOs.pdf
- PDOs training.pdf
- App Note - Controlling AC via CAN.pdf
- App Note - Multi Node Setup.pdf
- App Note - PDO Fundamentals.pdf
- App Note - Vehicle CAN wiring recommendations.pdf
- NT20100501-01 SEVCON – Comment lire les objets CANopen avec un protocole CAN quelconque.pdf
- http://www.canopensolutions.com/english/about_canopen/device_configuration_canopen.shtml
- http://www.canopensolutions.com/english/about_canopen/pdo.shtml

3.4.2 Configuration of "RPDOs"

When using a single controller, the "RPDO" registers are not used and must be empty. If this is not the case, the controller will generate an error message corresponding to waiting for data on the CAN bus and the controller will be in fault.

3.4.3 Configuration of "TPDOs"

5 "TPDO" modules are available on the GEN4 AC controller. They allow real-time data to be transmitted on the CAN bus.

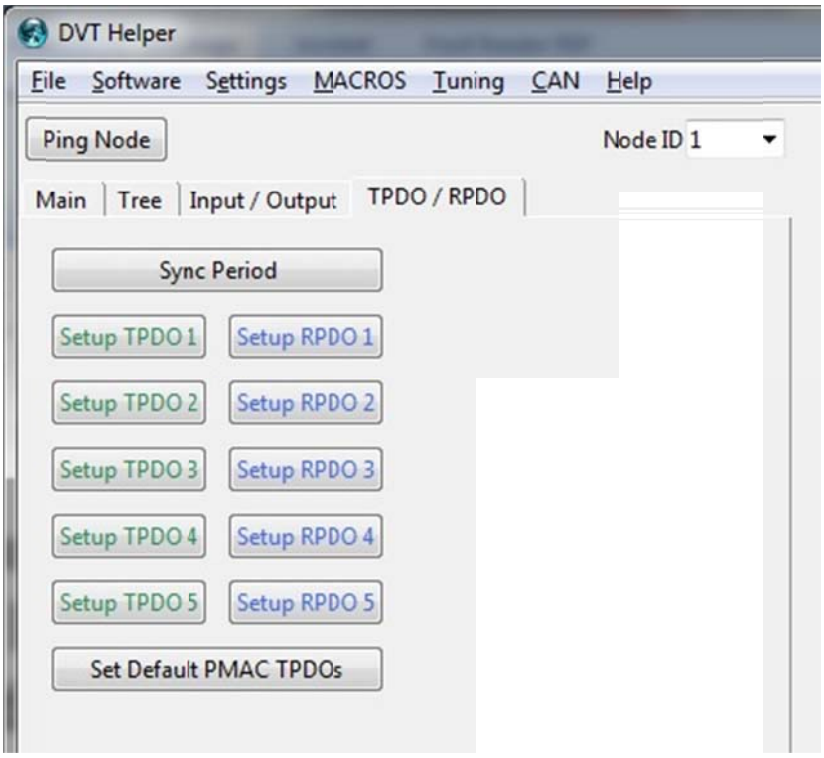

Fig. 43. The "TPDO/RPDO" tab of the "Helper" script.

The default configuration allows data to be sent continuously over the CAN bus.

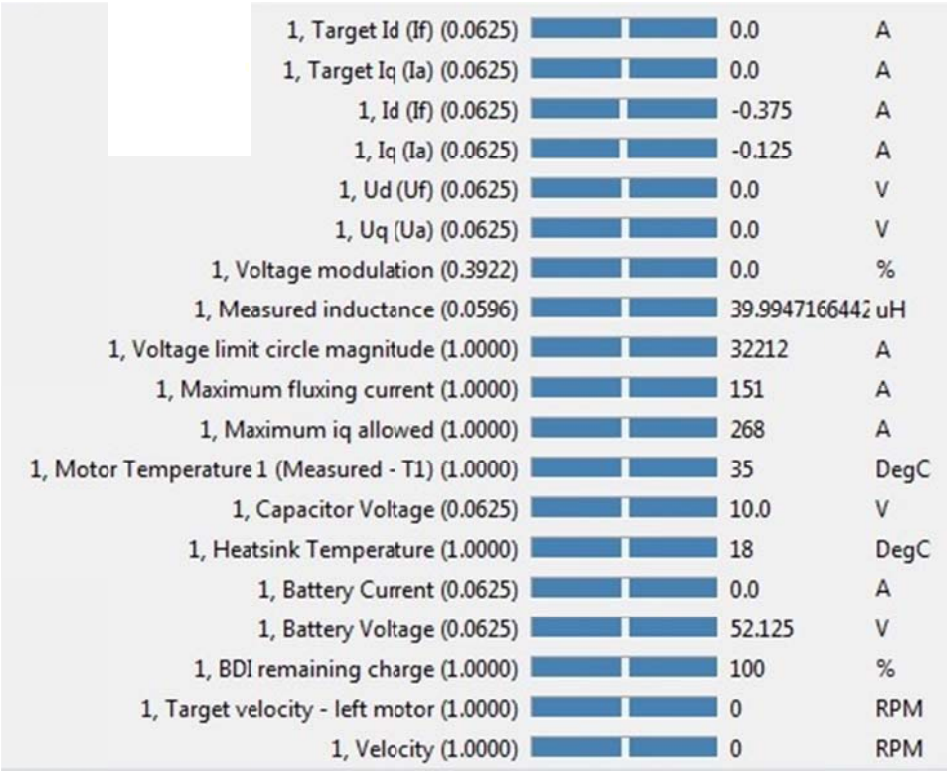

Fig. 44. The data transmitted by the "TPDOs".

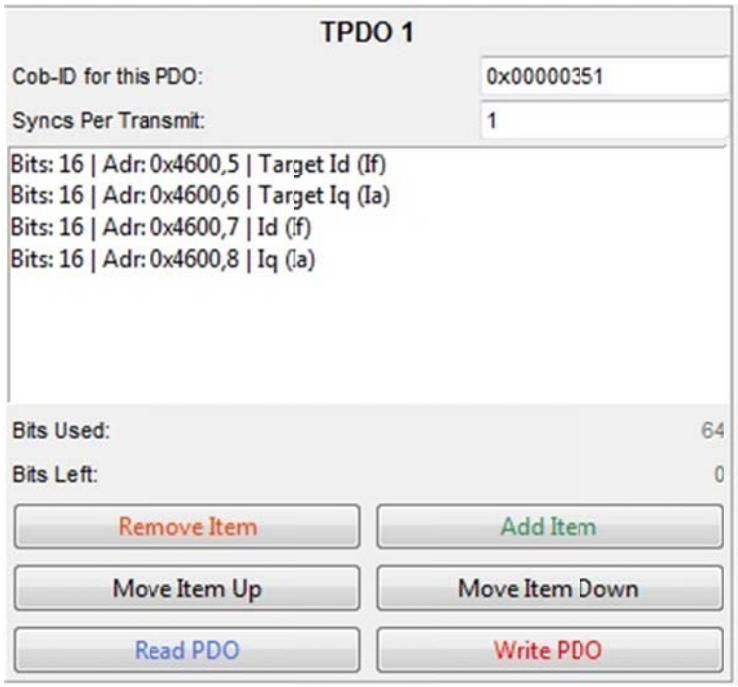

Fig. 45. The data transmitted by the "TPDO1".

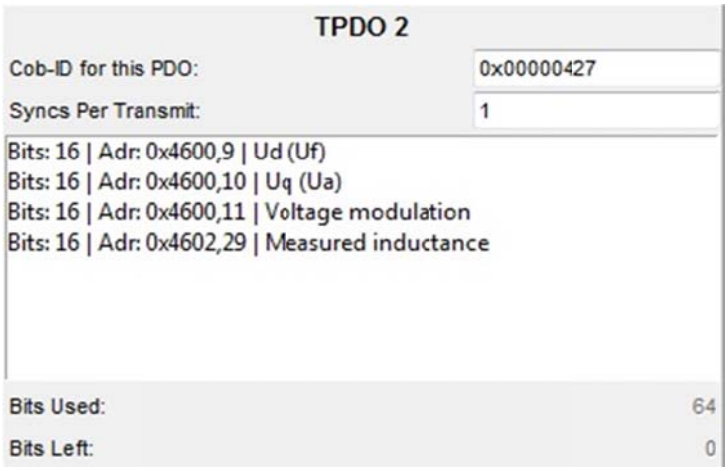

Fig. 46. The data transmitted by the "TPDO2".

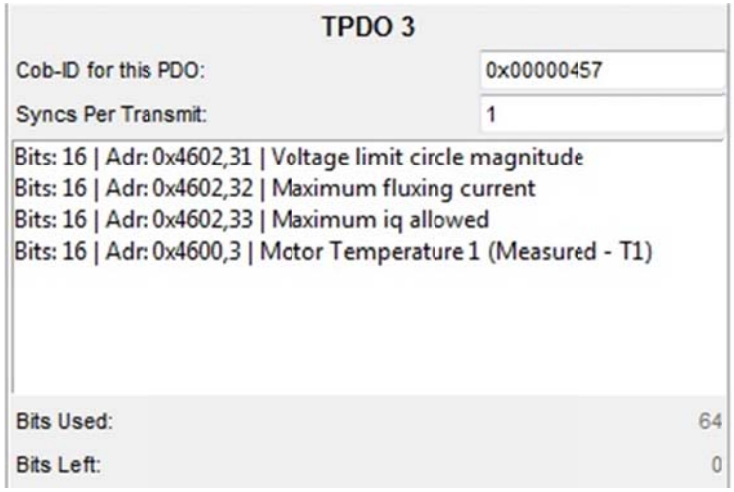

Fig. 47. The data transmitted by the "TPDO3".

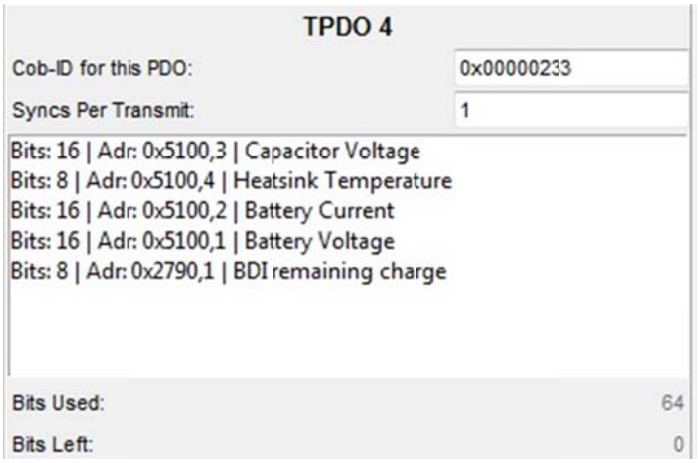

Fig. 48. The data transmitted by the "TPDO4".

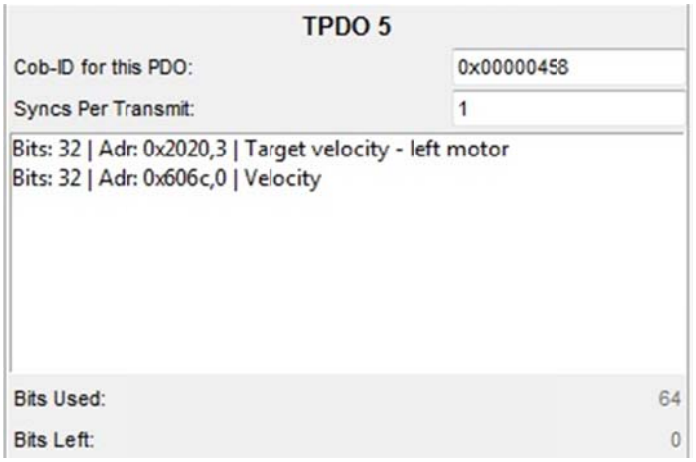

Fig. 49. The data transmitted by the "TPDO5".

3.5 The "Change Baud Rate" Menu

To change the communication speed of the CAN bus:

1- Launch DVT.
2- Open the "Helper" with the menu "H".
3- In the "Helper" script window, click on the "CAN" menu.
4- Then choose "Change Baud Rate" (first line).

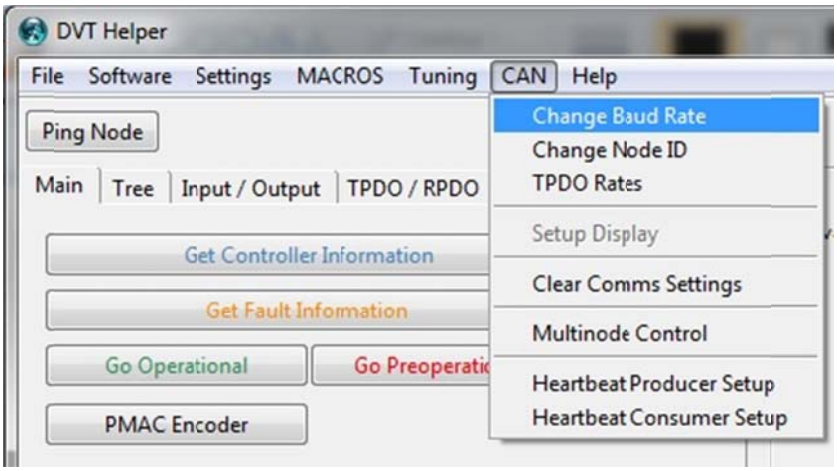

Fig. 50. The "Change Baud Rate" menu from the "DVT Helper".

Then simply select the new communication speed of the CAN bus.

CAUTION 1: It is essential to switch off the controller and recharge it with "Power Recycle" so that the new configuration can be taken into account. Similarly for the "DVT" script, it is necessary to close the software, then re-open it and search for the new communication speed.

CAUTION 2: the controller has entered "Pre Operational" mode. You will need to select "Go Operational" in green to be able to use the controller again.

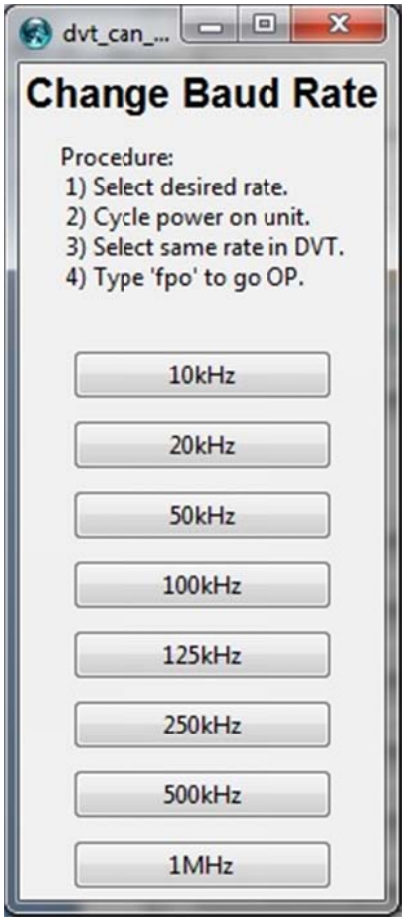

Fig. 51. Changing the speed of the CAN bus, menu "CAN" of the "Helper".

3.6 Definition of the Motor Characteristics

In the "Tree" tab of the "Helper" script, the first "Motor" menu gives access to the various motor parameters in the "Motor Data" submenu.

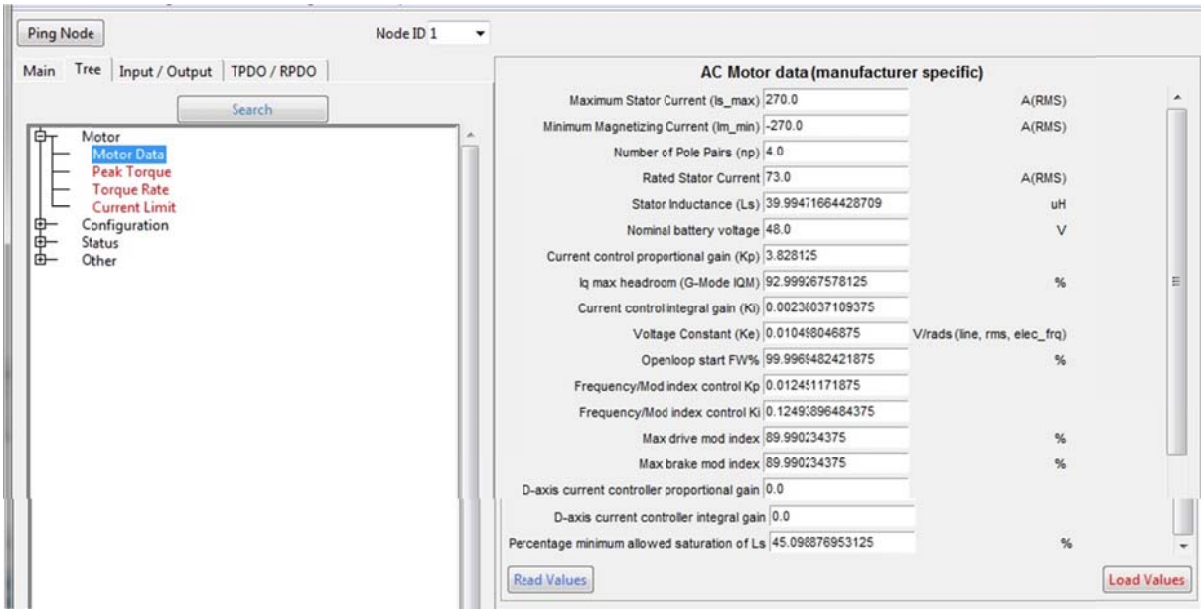

Fig. 52. The motor parameters "AC Motor Data (manufacturer specific).

There are motor specific parameters such as:

- the maximum stator current "Maximum Stator Current Is_max" (often equal to the maximum current of the GEN4 AC controller);
- the minimum magnetizing current "Minimum Magnetizing Current Im_min" (?) ;
- the number of pole pairs;
- the "Rated Stator Current";
- the "Stator Inductance Ls";
- the "Voltage Constant Ke" in V/rad/s. This constant is the ratio between the effective voltage between phases ("line to line rms") and the electric pulse ("elec_frq") $(stator\ rd/s) = 2\pi \cdot f(stator\ Hz)$, *i.e.*:

$$Ke = \frac{U(entre\ phase\ eff)}{\omega(stator\ rd/s)}$$

But there are also controller-specific parameters such as the maximum value of the "Max controller mod index" and the proportional and integral gains of the various control loops.

4 The "Vehicle Interface" Script

4.1 Introduction

The many variables of the controller can be recorded over time using this script [5]. The "Vehicle Interface" script intercepts the data sent by the controller using the "TPDO" and interprets it using the "EDS" object dictionary. The "**CROSS**" button allows the launch of the "Vehicle Interface" script window from the "DVT Customer" window.

Fig. 53. Execution button of the "Vehicle Interface" script.

4.2 Data Display

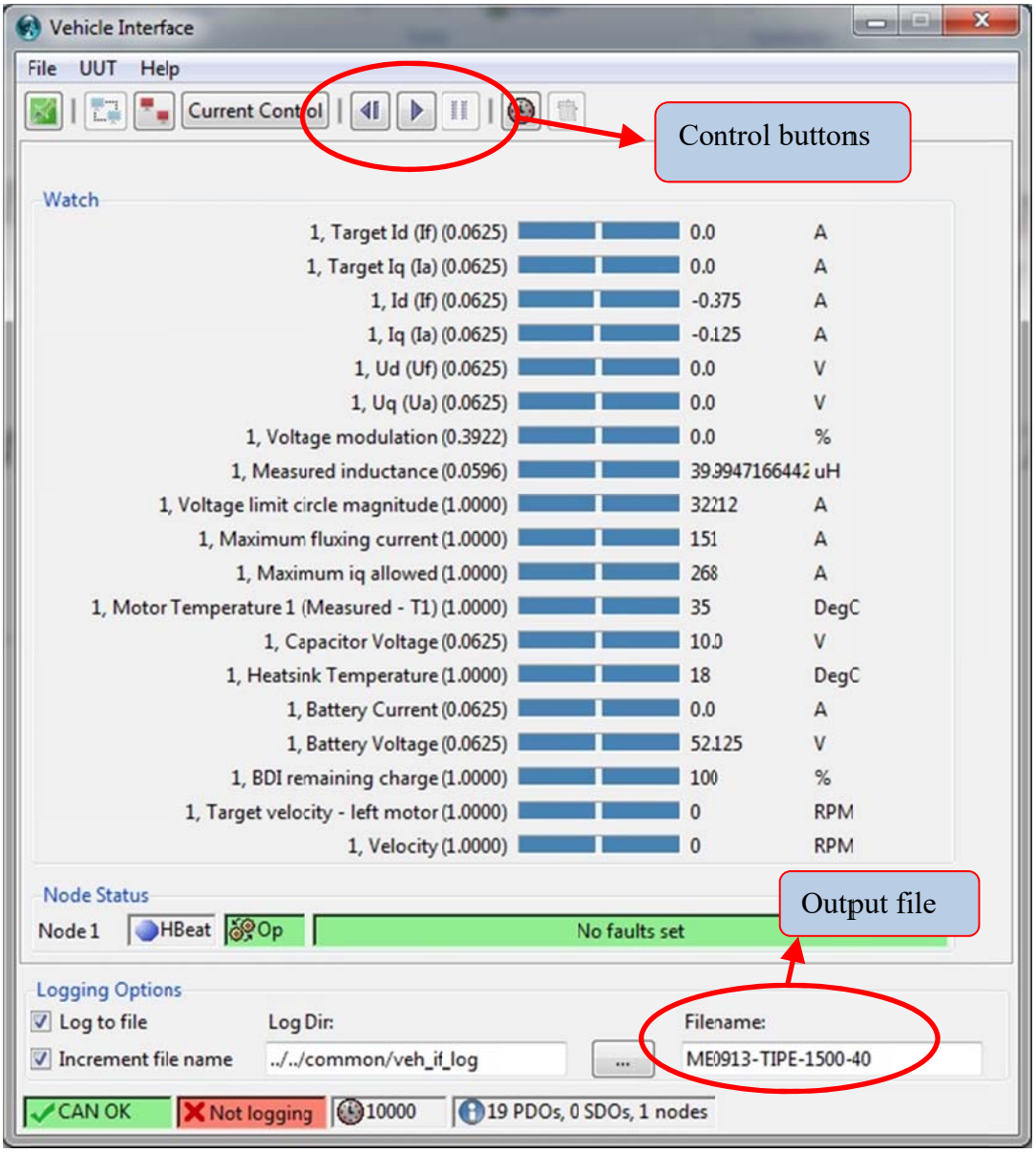

Fig. 54. The "Vehicle Interface" script window.

Note: the current Iq "1. Iq (Ia)" is an image of the motor torque.

4.2.1 The Output File

The "Vehicle interface" script saves the data in a text file in CSV format "Comma Separate Value": the values are separated by commas and the file is "readable" with a spreadsheet program.

The default directory for output files is:

C:\DVTC\common\veh_if_log

Before starting a recording, it is important to define the root of the output file name in the "Filename:" field, such as "PMS100". The "Vehicle interface" script adds the date and time of file creation. The final file will have the full final name:

PMS100_280418_192846.csv

For a field" "Filename = PMS100", dated 28 April 2018, at 19h28min46s.

4.2.2 The Control Buttons

The first button on the left resets the absolute time that will be used in the output file.

The central "Play" button starts the data recording.

The last button on the right "Pause" stops recording and generates the output file.

Fig. 55. The control buttons of the "Vehicle Interface" script.

4.3 Data Processing Using EXCEL

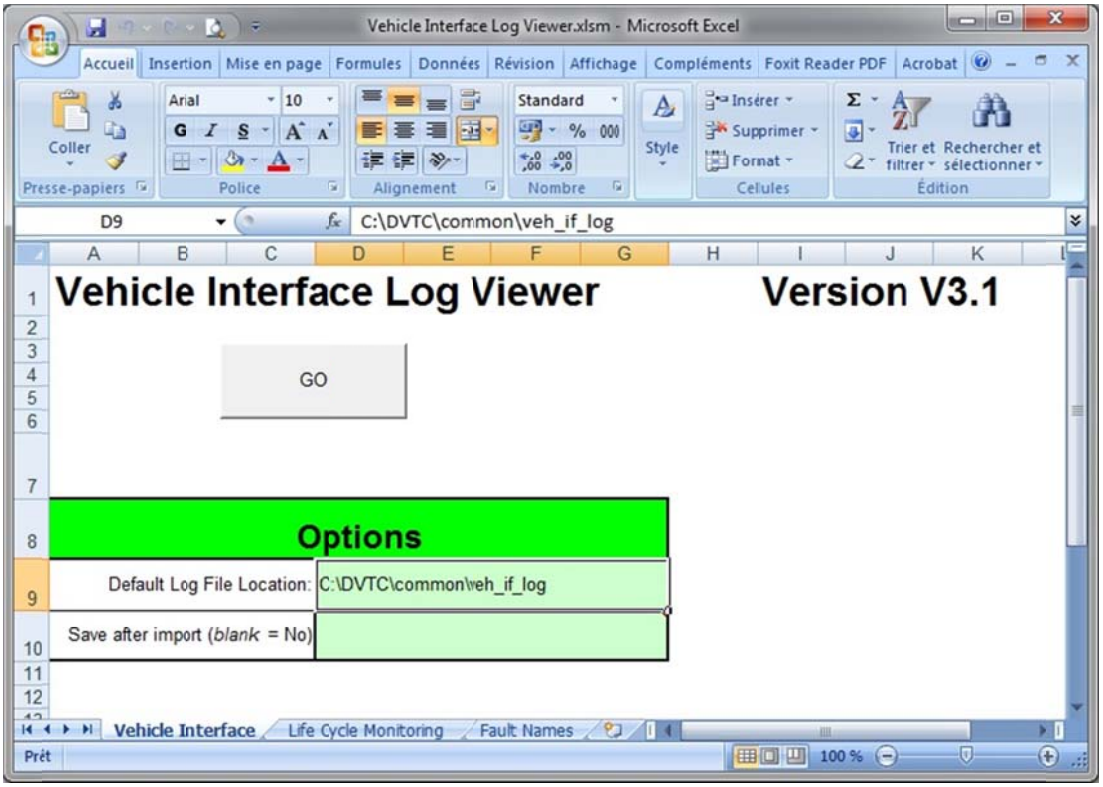

Fig. 56. The Excel macro "Vehicle Interface Log Viewer.xlsm".

Thanks to an Excel macro called "Vehicle Interface Log Viewer.xlsm", the data recorded in CSV format will be put into a spreadsheet and a graph will be generated.

It is necessary to allow the execution of macros on this EXCEL file.

It is interesting to fill in the box "Default Log File Location:" with the directory where the CSV files are saved.

After clicking on the "GO" button and selecting the CSV file you want to use, the macro runs and an error appears: you must then click on "End".

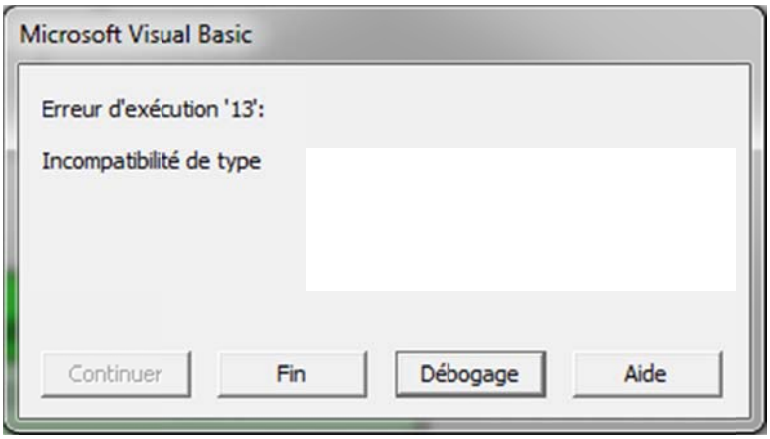

Fig. 57. The Excel macro "Vehicle Interface Log Viewer.xlsm" generates an error...

The proposed graph contains 2 error curves, "Time (s)" and here "BDI remaining charge % (1)", which are not displayed as a function of time in seconds, but as a function of their number of points. Simply select one by one the first 2 curves of the list and delete them.

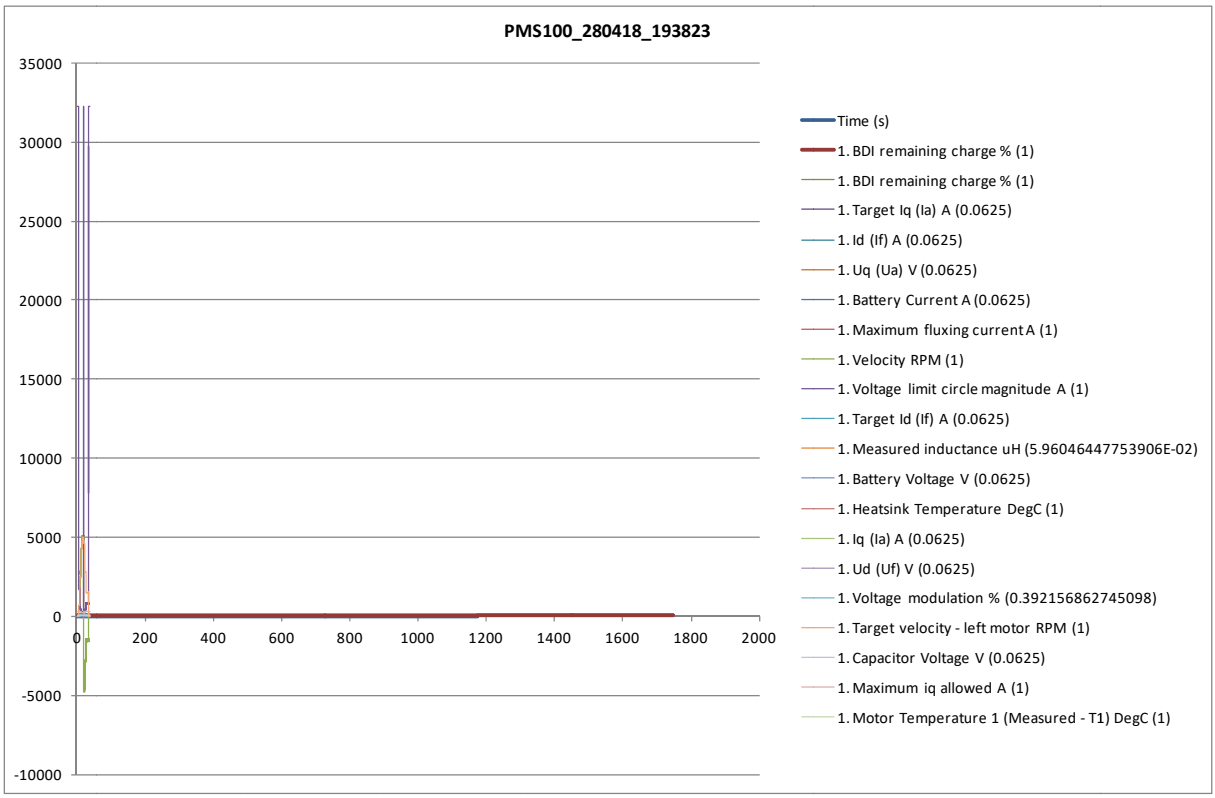

Fig. 58. Result of the Excel macro "Vehicle Interface Log Viewer.xlsm" with 2 error curves.

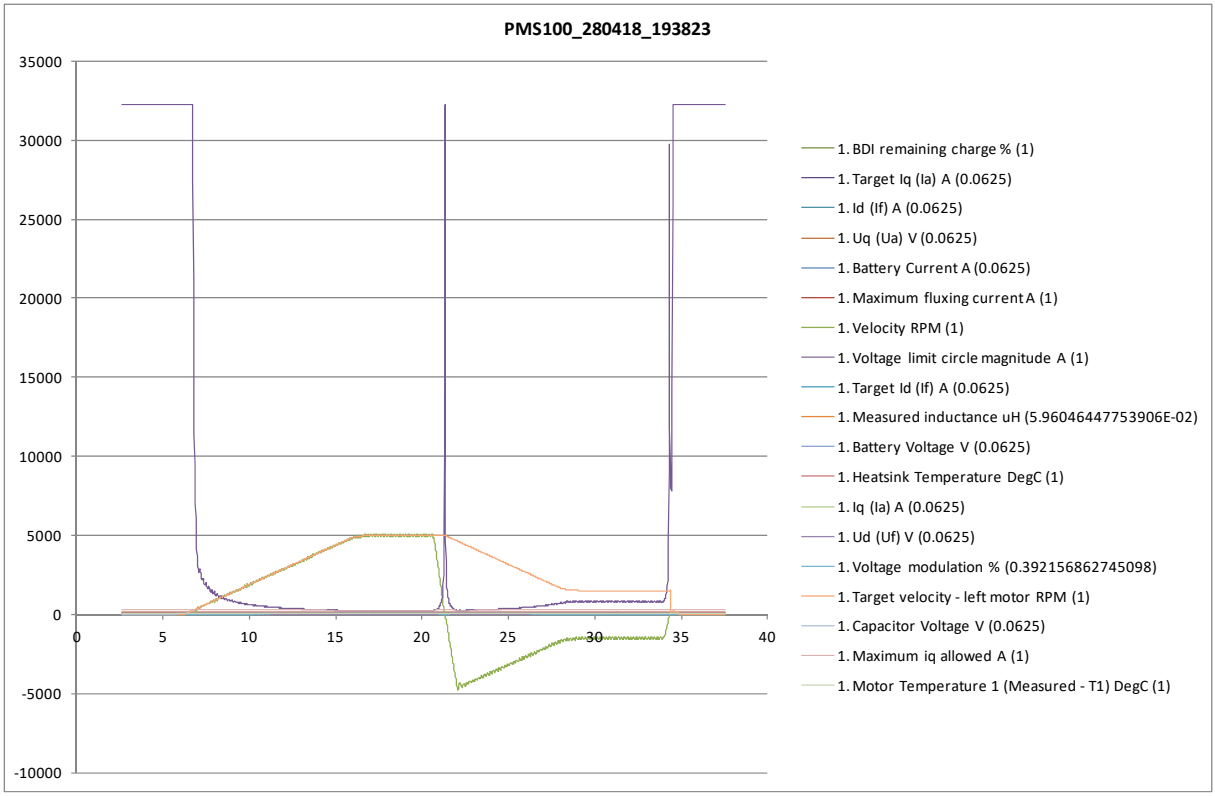

Fig. 59. Result of the Excel macro "Vehicle Interface Log Viewer.xlsm" with the 2 error curves that have been deleted.

All that remains is to "sort" the curves because all the variables are represented with the same scale. For example, there is a data that evolves between +32212 and 0, the speed that evolves between +5000 rpm and -1500 rpm...

While on the curve tab, saving the EXCEL file will propose a modification of the file extension in".xlsx" format:

PMS100_280418_193823.xlsx

5 The "Editor" Script

5.1 Introduction

The "**E**" button allows the launch of the "Editor" script window from the "DVT Customer" window.

The "Editor" script window which is a graphical interface for reading and editing DCF files offline.

Fig. 60. Execution button of the "Editor" script.

After selecting the DCF file you want to study, an empty window appears. In the "Search Object" field, you must then enter the keywords of the variables you want to display. The area under the "Search Object" field contains a list of variables containing the requested keywords. By selecting a variable, the information related to this variable is displayed in the right-hand area.

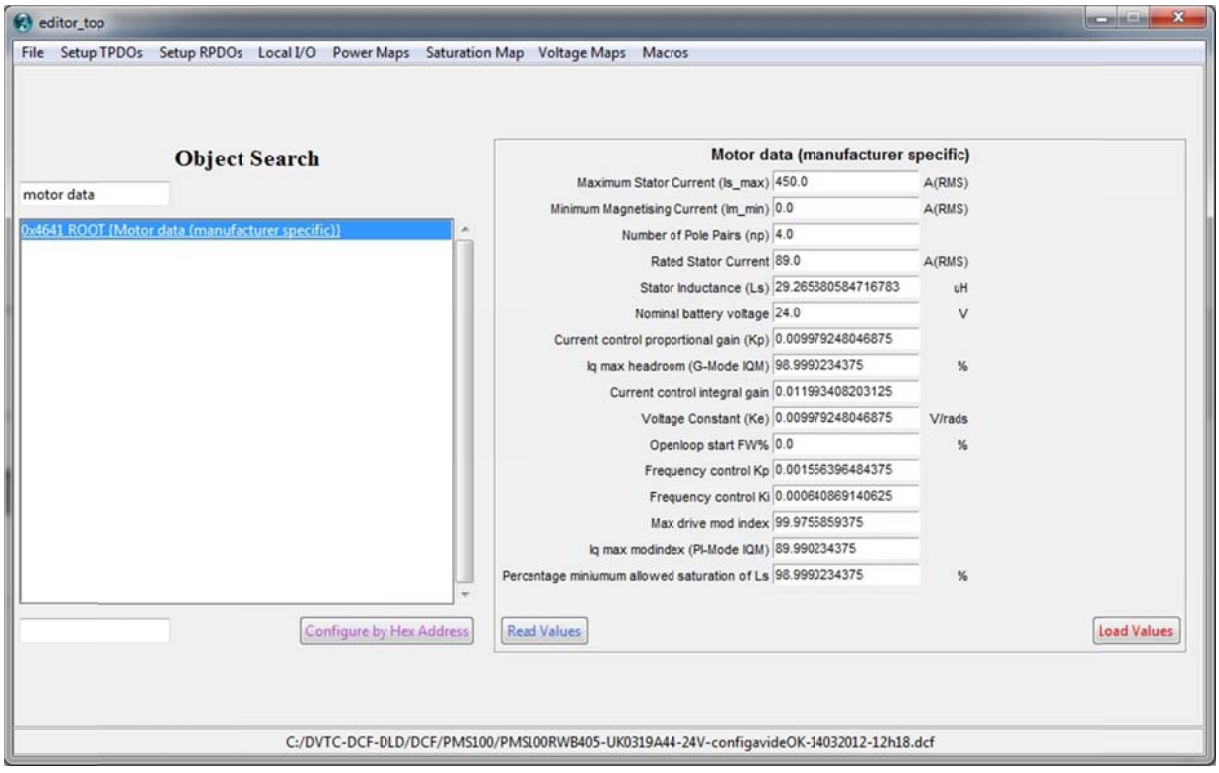

Fig. 61. The "Editor" script window.

It is then possible to modify the values and save them in the DCF file with the "Load Values" button in red and/or to read the values of the DCF file with the "Read Values" button in blue.

Variables can be searched by their address in hexadecimal in the format:

0x4641

and by clicking on "Configure by Hex Address".

6 References

[1] Thierry LEQUEU, « AN-EK015-FR - Installation du logiciel DVT pour les variateurs SEVCON GEN4 », 12 pages, janvier 2013, consulté le 21 septembre 2019 sur : https://www.e-kart.fr/information/tutoriaux/678-an-ek015-fr-installation-du-logiciel-dvt-pour-les-variateurs-sevcon-gen4

[2] P. SHIPLEY, « Application Note – DVT Installation (draft) », December 2nd, 2009, 6 pages.

[3] Site web de la société SEVCON, http://www.sevcon.com/, consulté le 22 avril 2018.

[4] SEVCON, « Gen4 Product Manual », version 3.4, de décembre 2015, 115 pages, 3256 Ko, consulté le 21 septembre 2019 sur : https://www.e-kart.fr/information/notices-techniques/variateurs/1279-sevcon-gen4-product-manual-v3-4

[5] Arnaud SIVERT, « AN-EK005-FR - Didacticiel pour variateur GEN4 SEVCON (moteur AC) V2 », 32 pages, avril 2010, consulté le 21 septembre 2019 sur : https://www.e-kart.fr/information/tutoriaux/187-an-ek005-fr-didacticiel-pour-variateur-gen4-sevcon-moteur-ac-v2

[6] Site web de la société IXXAT, http://www.ixxat.com/, consulté le 21 septembre 2019.

[7] Société SEVCON, « SEVCON DVT Tutorial - Using DVT with Gen4 Systems », 11 pages, consulté le 21 septembre 2019 sur : https://www.e-kart.fr/21-articles-techniques/698-sevcon-dvt-tutorial-using-dvt-with-gen4-systems.htm

[8] Site web de la société ActiveState, http://www.activestate.com/activetcl, consulté le 21 septembre 2019.

[9] H. SLATER, P. SHIPLEY, « SEVCON – Setting up PMAC software », révision 14, du 18 mai 2018, 28 pages, 652 Ko, consulté le 21 septembre 2019 sur : https://www.e-kart.fr/images/stories/technique/SEVCON/sevcon-app-note-pmac.pdf

[10] Thierry LEQUEU, « Exemple de câblage du circuit électrique d'un véhicule », consulté le 21 septembre 2019 sur : https://www.e-kart.fr/information/trucs-astuces/279-exemple-de-cablage-du-circuit-electrique-d-un-kart

7 Appendix 1 – Checks Before the Launch of DVTC

7.1 The Controller Wiring – Power Part

The controller must be powered at its rated voltage and the power source must be able to provide the current required to operate the motor.

The motor power terminals must be connected to the controllers in the order indicated in the parameterization report and/or wiring diagram.

The protections must be installed and in particular the SD300 power relay, which is controlled by the controller. This relay is used to isolate the power section in the event of a fault on the controller. There is no need for a freewheel diode at the terminals of the relay coil because it is integrated in the controller.

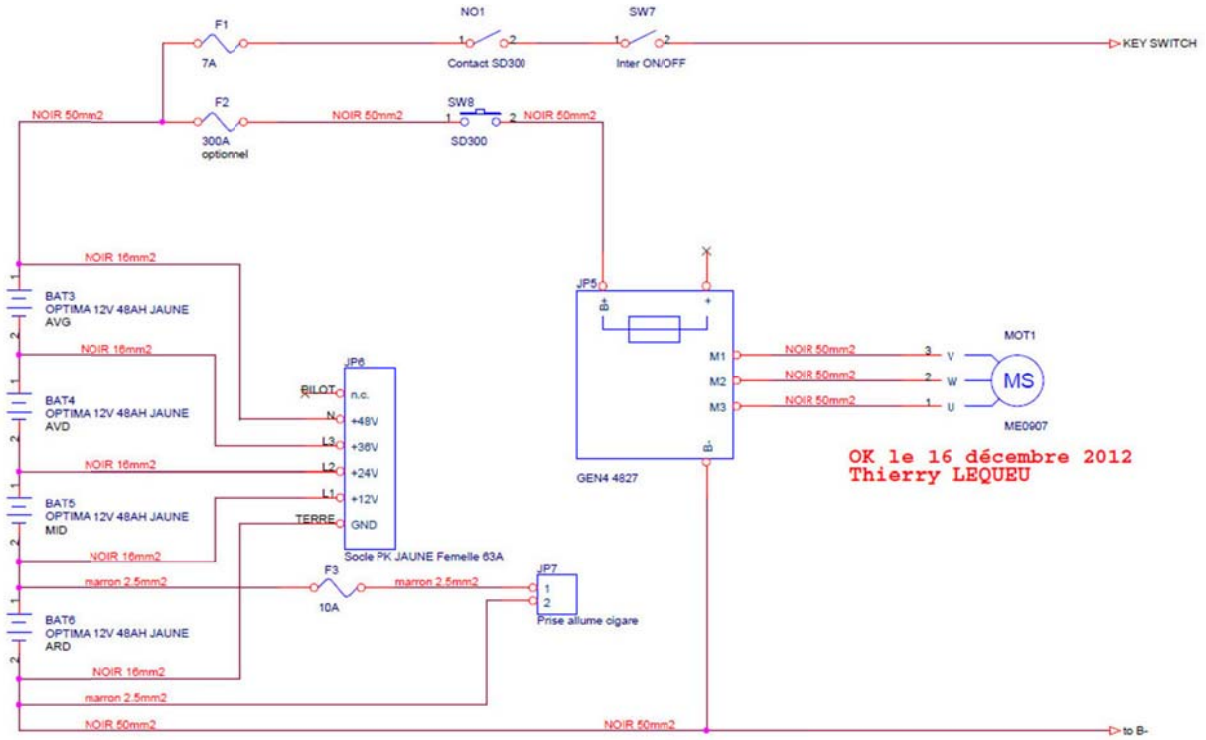

Fig. 62. Example of wiring the power section of a SEVCON GEN4 AC controller [10].

7.2 The Controller Wiring – Control Part

- The power supply to the controller via the 2 pins 1 and 6 must allow the controller to be supplied with a high starting current (a few A). The "I/O init" error occurs when the wiring of the controller power supply limits the voltage rise when the power is switched on (wire cross-section too small, wire length too long, source not powerful enough...).
- The motor position encoder must be connected to the controller, taking into account the isolation of the encoder ground "0V encoder" which is different from the power battery ground "B-" [4].
- A female DB9-pin connector will allow an easier connection of the configuration interface via the CAN bus.
- The green external light reproduces the flashes of the light on the SEVCON controller in the event of an error: it is convenient on the vehicle's dashboard!

➢ The Forward/Stop/Reverse functions, the PB6 accelerator and its FS1 contact are the minimum inputs used with the default controller configuration.

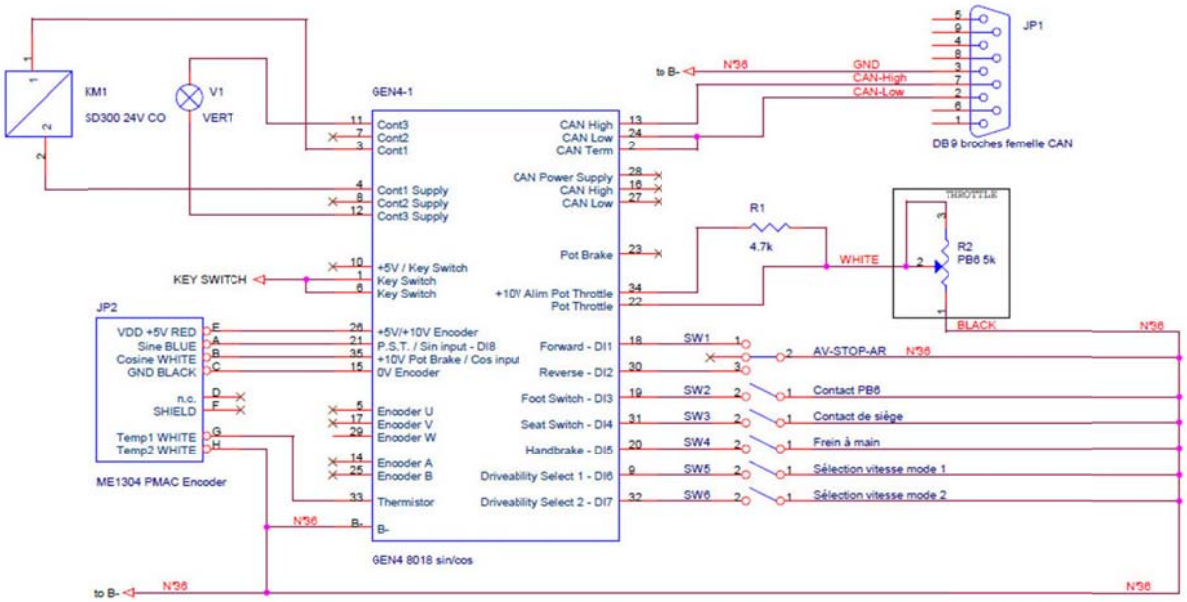

Fig. 63. Example of wiring the control section of a SEVCON GEN4 AC controller [10].

7.3 Checking the USB-to-CAN interface

The IXXAT USB-to-CAN interface has two LEDs, one for the USB bus and the other for the CAN bus. These indicators provide information on the status of the communication.

Fig. 64. The compact USB-to-CAN interface IXXAT [6].

☺ If the USB light is green, communication with the compact USB-to-CAN interface via the USB port is possible.

☹ However, if the USB indicator is red, communication is not possible. In this case it will be necessary to check if you have installed VCI V3 correctly. In case of problems, the latest versions of the USB-to-CAN interface drivers can be downloaded from the IXXAT website at:

https://www.ixxat.com/support/file-and-documents-download/drivers

When the communication via the USB port is effective, you can then launch the "DVTC" software.

BE CAREFUL: The interface may be installed for a particular outlet on the computer and may require a new installation if the USB-to-CAN interface is connected to another USB outlet.

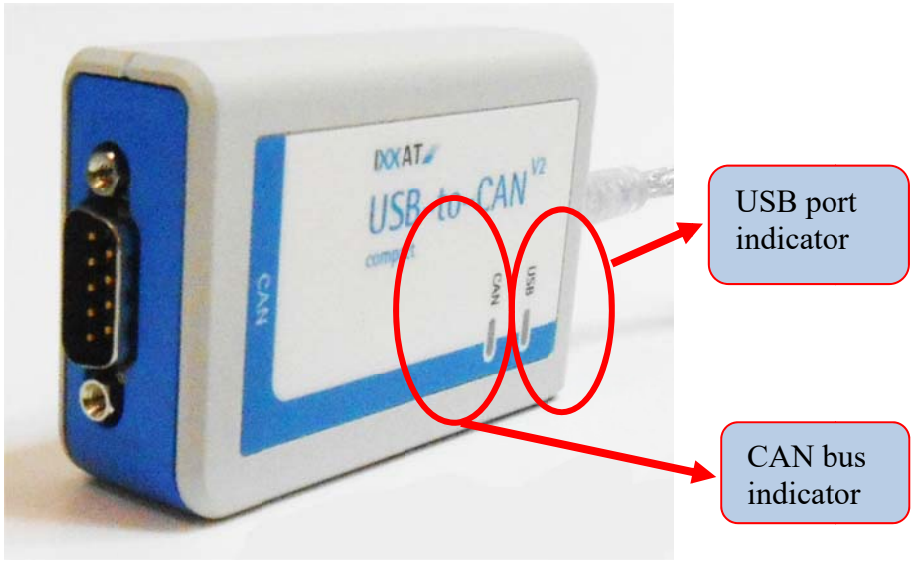

Fig. 65. The USB-to-CAN V2 IXXAT interface [6].

8 Appendix 2 – Numbering of SEVCON GEN4 AC Controllers

8.1 Product identification label

The identification label for SEVCON GEN4 controllers is located on the side of the controller (see Figure 67). It contains the following information:

1) Type: it is a summary of the main characteristics of the controller, here from the GEN4 family, the voltage level (here 36 V/48 V) and the motor current (here 275 A);
2) Part: it is the complete coding of the controller characteristics that is explained in the paragraph §8.2;
3) Serial: This is the unique serial number of the controller. The first 2 digits correspond to the year of manufacture.

Fig. 66. Product Identification Label for SEVCON GEN4 Controllers.

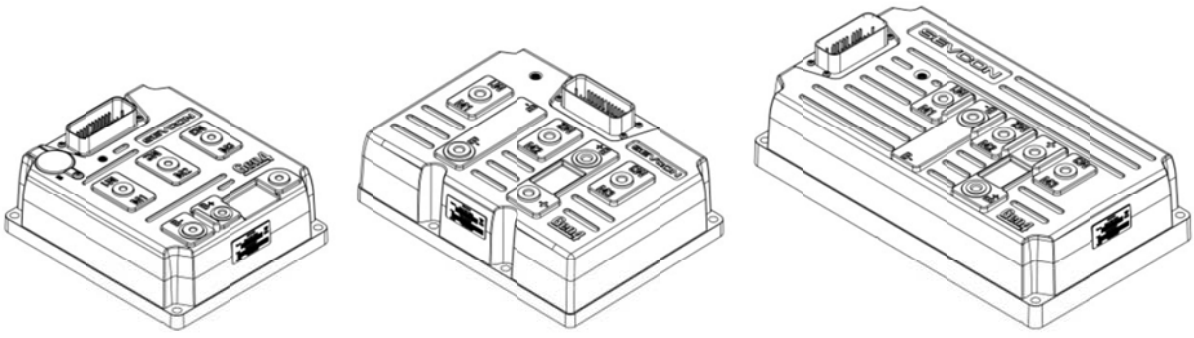

Fig. 67. The 3 different sizes of SEVCON GEN4 AC controllers.

8.2 Numbering of SEVCON GEN4 AC Controllers

- 634A: GEN4 controller?
- 42: ??? size 2 4875
- 44: ??? : size 4 4845
- 101: A/B and U/V/W encoders for MAS asynchronous motor
- 201: A/B and U/V/W/ encoders for MS synchronous motor
- 203: sin/cos encoder for PERM synchronous motor: **BE CAREFUL**: This controller has a special design that modifies the role of the inputs/outputs

8.3 Glossary of Terms

EDS: Electronics Data Sheet: CAN object dictionary (without numerical values)

File name: product code+ revision number:

GEN4_pc0X0705503_rev0x0010010.eds

Explained in the DSP306 eds specification

EDS: configuration parameter file

DCF: Device Configuration File: same as EDS with the values

SDO: Service Data Object

PDO: Process Data Object

CLI: ???

9 Appendix 3 – Online IT Orders

9.1 The Principle of Tcl/Tk Commands

The Tcl/Tk commands can be entered directly in the command prompt window, or written in a text file with the extension" *.tcl" [2], [8].

9.1.1 Displaying a Text

```
puts “Hello World”
```

9.1.2 Comments

```
# The text line after the "#" symbol is ignored
```

9.1.3 Variables

```
set x “Green”
puts “My favourite colour is $x”

set p “10”
puts “The value of p is $p”
```

9.1.4 Calculations

```
expr ( 8 + 12 )
expr ( 5 / 2 )
expr ( 5.0 / 2.0 ) expr ( 0x08 + 0x04 ) expr ( 0x18 | 0x34 )
```

The characters"[et]" must be used to insert commands that will be evaluated before being assigned to the variable.

```
set x [ expr ( 4 + 5 ) ]
puts “The value of x is $x”
puts “Four squared is [ expr ( 4 * 4 ) ]”
```

9.1.5 Calculation loops

```
foreach n { 1 5 10 20 50 100 } {
puts “$n squared is [ expr ( $n * $n ) ]”
}

for { set p 1 } { $p <= 10 } { incr p } {
puts “$p cubed is [ expr ( $p * $p * $p ) ]”
}
```

9.1.6 Declaration of Procedures

```
proc add_four { num } {
set r [ expr ( $num + 4 ) ]
return $r
}
add_four 9
```

9.2 CANopen Commands of SEVCON GEN4 AC Controllers

9.2.1 Manual Loading of a DCF Configuration File

1- Launch the "DVT Customer" script.

2- Choose the right communication speed until the green LED on the IXXAT interface flashes on both sides.

3- In the "DVTC" command window, type the following lines and confirm each by pressing the "ENTER" key:

```
lg 1            # Se connecter sur le nœud CAN N° 1 (« log on node 1 »)
fpo 1 PRE       # Mettre le variateur du nœud 1 en mode « PRE » (opérationnel).
dl_dcf [tk_getOpenFile] 1   # Chargement du fichier « DCF » dans le variateur
                            # du nœud 1 après avoir sélectionner un fichier.
```

4- Select the "DCF" file to load via the Windows interface.

5- Wait a few moments for the file to be loaded into the controller.

6- Cut off the power supply of the controller and replace it ("recycle").

9.2.2 List of "Active Faults"

The "flts" command:

```
dvt(101) % flts + « ENTER »
```

will display the list of faults on the controller of CAN node 1, for example:

```
0: 0x5101 Line Contactor o/c
1: 0x4981 Throttle Fault
2: 0x45c1 BDI Warning
3: 0x45c2 BDI Cutout
```

9.2.3 Manual Loading of a DLD "Software" File

In the online command area of the "DVTC" software window, the GEN4 controller must first be set to "Preoperationnal" mode with the "fpo pre" command.

The online order to switch to boot loader mode is "bts 1".

During the software update, the controller switches to boot loader mode: the green LED flashes quickly and then REMAINS OFF.

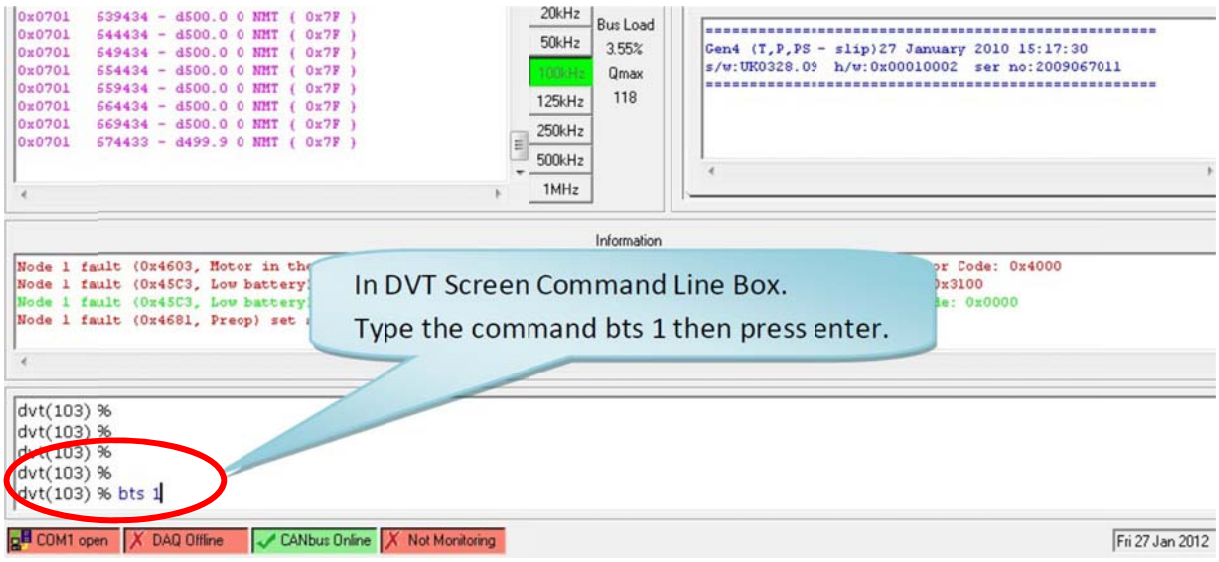

Fig. 68. The command "enter boot loader mode" in the "DVT" window.

To load the file, use the command "load_dld 1": a file selection window opens to choose the DLD file to use.

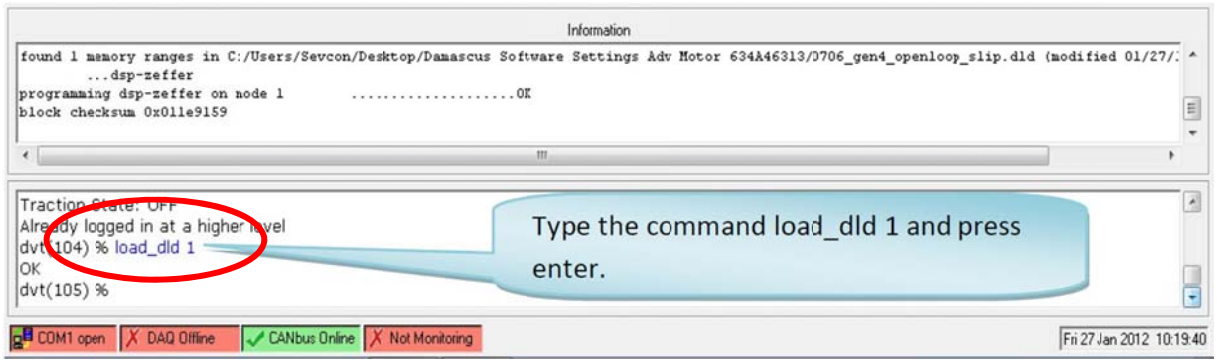

Fig. 69. The command "load_dld 1" in the "DVT" window.

IMPORTANT: The transfer takes a few minutes and is **VERY CRITICAL**: the process should not be interrupted before the end and the power supply of the controller should not be cut off. In case of problems during transfer, the controller must return to the factory and may be unrecoverable!

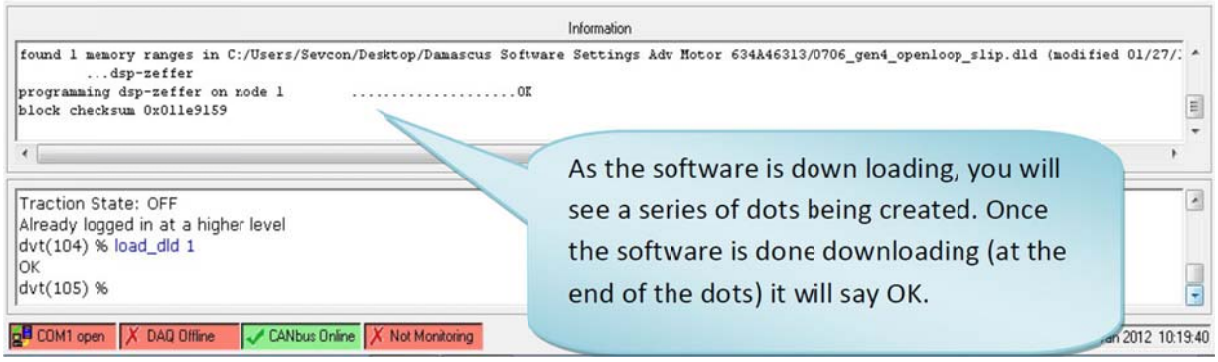

Fig. 70. Transfer of the current software to the "DVT" window.

During the transfer of the new program, a series of dots appears in the "Information" window following the text "programming dsp-zeffer on node 1".

At the end of the transfer, the message "OK" appears in the control window.

It is important to exit the "boot loader" mode with the command "bte 1".

At this point, the green LED on the GEN4 controller starts flashing again. CAUTION: the controller is in "Preoperationnal" mode.

It is necessary to cut off the power supply of the controller, wait a few seconds and turn the controller back on "Power Recycle". It is also necessary to close the DVTC software and restart it.

By clicking on the "H" button, the "Helper" script will check the consistency of the EDS file available on the computer's hard disk with the new software and request the creation of a new file if necessary.

In case of problems during the transfer, do not exit the "boot loader" mode. It is necessary to cut off the power supply of the controller, turn it back on ("**Power recycle**") and restart loading with the command "load_dld 1".

10 Appendix 4 – The Variables of the Motor

10.1 The "Save Partial DCF" Command in the "DVTC Helper"

Saving a partial DCF file is accessible from the menu:

- "Helper" script window;
- "Settings" menu;
- "Save Partial DCF" menu.

It is not necessary to be in the "PreOp" mode to save the controller configuration in a DCF file. The operation takes a few minutes: the process must not be interrupted before the end and the power supply of the controller must not be cut off.

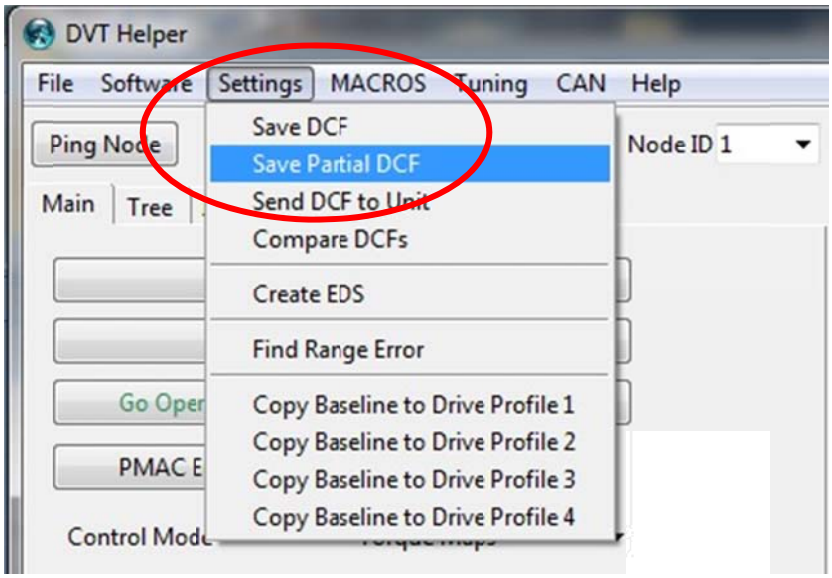

Fig. 71. The "Save Partial DCF" menu in the "Helper" script window.

A new window opens and allows you to select the different variables to be extracted.

The "Add PMAC Motor Items" button allows you to directly select the characteristic variables corresponding to the motor parameters.

Comments: All sub-indexes of the selected variables will be fully saved.

The "Save Selected Items" button is used to generate a partial DCF file containing the variables that have been selected.

Fig. 72. The "Object Search" window of the "Save Partial DCF" menu.

10.2 List of Variables Provided by "Add PMAC Motor Items"

The "Add PMAC Motor Items" button allows you to directly select the characteristic variables corresponding to the motor parameters, *i.e.*:

- 0x4611 Motor power limit map
- 0x4615 Motor power limit map 2
- 0x4617 Programmable User Data
- 0x4620 Motor Temperature 1 (Measured - T1)
- 0x4621 Motor Temperature Setup
- 0x4630 Encoder Configuration
- 0x4640 Motor Nameplate Data
- 0x4641 AC Motor data (manufacturer specific)
- 0x4650 Miscellaneous DSP configuration (Gen4)
- 0x6072 Maximum torque
- 0x6075 Current limit
- 0x6076 Peak torque
- 0x6090 Encoder resolution

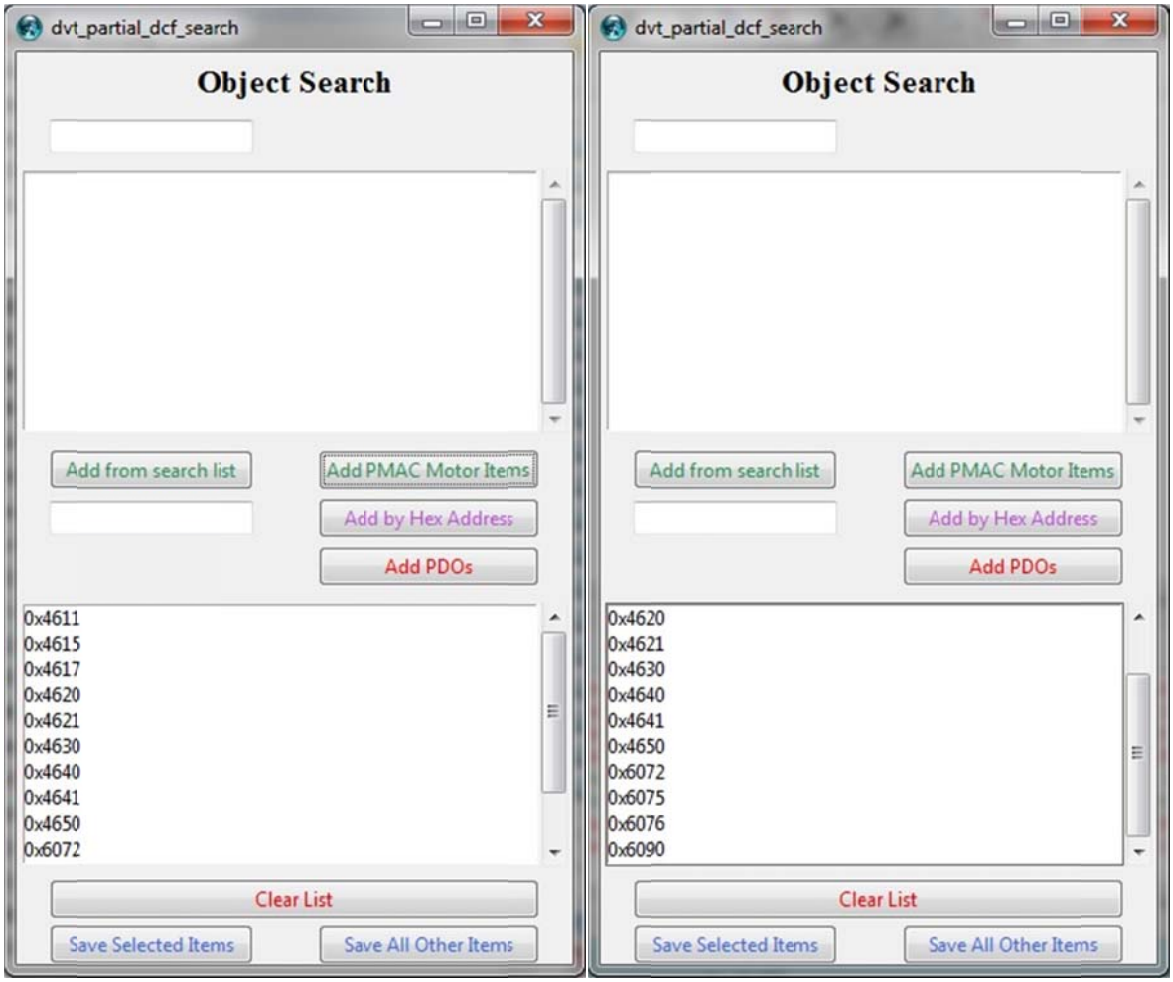

Fig. 73. Result of the "Add PMAC Motor Items" button.

10.2.1 Variable 0x4611 – Motor power limit map

0x4611	Motor power limit map
0x4611 sub 0	Number of entries = 0x12 = 18
0x4611 sub 1	Pt 1 Max Torque
0x4611 sub 2	Pt 1 Speed
…	

10.2.2 Variable 0x4615 – Motor power limit map 2

0x4615	Motor power limit map 2
0x4615 sub 0	Number of entries = 0x12 = 18
0x4615 sub 1	Secondary Pt 1 Max Torque
0x4615 sub 2	Secondary Pt 1 Speed
…	

10.2.3 Variable 0x4617 – Programmable User Data

0x4617	Programmable User Data
0x4617 sub 0	Number of entries = 4
0x4617 sub 1	Data = 0xfffffffffff…
0x4617 sub 2	Description of data
0x4617 sub 3	Version of Data
0x4617 sub 4	Checksum of Data

10.2.4 Variable 0x4620 – Motor Temperature 1 (Measured - T1)

0x4620	Motor Temperature 1 (Measured - T1)
0x4620 sub 0	Number of entries = 7
0x4620 sub 1	Mode = 1
0x4620 sub 2	High Temperature Voltage (PTC)
0x4620 sub 3	Low Temperature Voltage (PTC)
0x4620 sub 4	Switch source
0x4620 sub 5	PTC type
0x4620 sub 6	Failure torque cutback rate
0x4620 sub 7	Failure torque recovery rate

10.2.5 Variable 0x4621 – Motor Temperature Setup

0x4621	Motor Temperature Setup
0x4621 sub 0	Number of entries = 7
0x4621 sub 1	Motor temperature estimate current constant
0x4621 sub 2	Motor temperature estimate discretization
0x4621 sub 3	Maximum allowable motor temperature
0x4621 sub 4	Resistance variation hot temperature
0x4621 sub 5	Resistance variation cold temperature
0x4621 sub 6	Resistance variation hot factor
0x4621 sub 7	Resistance variation cold factor

10.2.6 Variable 0x4620 – Encoder Configuration

0x4630	Encoder Configuration
0x4630 sub 0	Number of entries = 0x15 = 21
0x4630 sub 1	Encoder Pull Up

0x4630 sub 2	Encoder Supply
0x4630 sub 3	Encoder Type
0x4630 sub 4	Encoder Offset
0x4630 sub 5	Sin input minimum (trough) voltage
0x4630 sub 6	Sin input maximum (peak) voltage
0x4630 sub 7	Cos input minimum (trough) voltage
0x4630 sub 8	Cos input maximum (peak) voltage
0x4630 sub 9	Actual sin minimum (trough) voltage
0x4630 sub A	Actual sin maximum (peak) voltage
0x4630 sub B	Actual cos minimum (trough) voltage
0x4630 sub C	Actual cos maximum (peak) voltage
0x4630 sub E	Multipole Sin-cos / Resolver waves per mechanical rotation
0x4630 sub 10	Encoder offset
0x4630 sub 12	Sin-cos/UVW latency select
0x4630 sub 13	Sin-cos/UVW latency fine adjust
0x4630 sub 14	Sin-cos min warning voltage
0x4630 sub 15	Sin-cos max warning voltage

10.2.7 Variable 0x4640 – Motor Nameplate Data

These data are not present in the PMS100 motor DCF...

0x4640	Motor Nameplate Data
0x4640 sub 0	Number of entries
0x4640 sub 1	Rated line voltage
0x4640 sub 2	Rated phase current
0x4640 sub 3	Rated mechanical speed
0x4640 sub 4	Rated frequency
0x4640 sub 5	Rated power
0x4640 sub 6	Power factor

10.2.8 Variable 0x4041 – AC Motor data (manufacturer specific)

0x4641	AC Motor data (manufacturer specific)
0x4641 sub 0	Number of entries = 0x2b = 43
0x4641 sub 1	Commit
0x4641 sub 2	Maximum Stator Current (Is_max)
0x4641 sub 3	Minimum Magnetizing Current (Im_min)
0x4641 sub 4	
0x4641 sub 5	Number of Pole Pairs (np)
0x4641 sub 6	
0x4641 sub 7	Rated Stator Current
0x4641 sub 8	
0x4641 sub 9	
0x4641 sub A	Stator Inductance (Ls)
0x4641 sub B	
0x4641 sub C	Nominal battery voltage
0x4641 sub D	Current control proportional gain (Kp)
0x4641 sub E	Iq max headroom (G-Mode IQM)
0x4641 sub F	Current control integral gain (Ki)
0x4641 sub 10	

0x4641 sub 11	
0x4641 sub 12	Voltage Constant (Ke) V/rads (line, rms, elec_frq)
0x4641 sub 13	
0x4641 sub 14	
0x4641 sub 15	
0x4641 sub 16	Openloop start FW%
0x4641 sub 17	
0x4641 sub 18	
0x4641 sub 19	Frequency/Mod index control Kp
0x4641 sub 1A	Frequency/Mod index control Ki
0x4641 sub 1B	
0x4641 sub 1C	
0x4641 sub 1D	
0x4641 sub 1E	Max drive mod index
0x4641 sub 1F	Max brake mod index
0x4641 sub 20	
0x4641 sub 21	D-axis current controller proportional gain
0x4641 sub 22	D-axis current controller integral gain
0x4641 sub 23	
0x4641 sub 24	
0x4641 sub 25	
0x4641 sub 26	
0x4641 sub 27	
0x4641 sub 28	
0x4641 sub 2A	
0x4641 sub 2B	Percentage minimum allowed saturation of Ls

10.2.9 0x4650 Variable – Miscellaneous DSP Configuration (Gen4)

There are 2 groups of 16 bits of "All or Nothing" information coded on each bit by "0" or "1".

0x4650	Miscellaneous DSP configuration (Gen4)
0x4650 sub 0	Number of entries = 2
0x4650 sub 1	Miscellaneous DSP configuration 1 (Gen4) (16 bits)
0x4650 sub 2	Miscellaneous DSP configuration 2 (Gen4) (16 bits)

10.2.10 0x6072, 0x6075 and 0x6076 Variables

0x6072	Maximum torque
0x6075	Current limit
0x6076	Peak torque

10.2.11 0x6090 Variable – Encoder Resolution

This is the definition of the encoder resolution.

0x6090	Encoder resolution
0x6090 sub 0	Number of entries = 2
0x6090 sub 1	Pulses per revolution
0x6090 sub 2	Motor revolutions per second

11 Appendix 5 – Tips for Adjusting Correctors

11.1 Speed Loop

11.2 Current Loop

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