

# DCmind Soft + CANopen

## User Manual



### Important Notes

- This manual is part of the product.
- Read and follow the instructions in this manual.
- Keep this manual in a safe place.
- Give this manual and any other documents relating to the product to anyone that uses the product.
- We reserve the right to make modifications without prior notification.

## About This Manual

This manual applies to SQ57 SMI21 CANopen DCmind brushless products:

- 80140301
- 80180301
- 80280302

And to SQ75 SMI22 CANopen DCmind brushless products:

- SQ75-1: family 80350
- SQ75-2: family 80360
- SQ75-3: family 80370

*Reference source for manuals*

The manuals can be downloaded from our website at the following address:

<http://www.crouzet-motors.com/>

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## Contents

|        |   |    |
|--------|---|----|
| 1.     | INTRODUCTION .....                            | 7  |
| 1.1.   | Getting Started .....                         | 7  |
| 1.2.   | Communication Interfaces .....                | 7  |
| 1.3.   | Before you begin .....                        | 8  |
| 2.     | DCMIND SOFT + CANOPEN DESKTOP .....           | 9  |
| 2.1.   | DCmind Soft + CANopen workspace display ..... | 9  |
| 2.1.1. | Drive Network window .....                    | 9  |
| 2.1.2. | Configuration window .....                    | 9  |
| 2.1.3. | Alerts window .....                           | 9  |
| 2.1.1. | Drive Faults window .....                     | 9  |
| 2.2.   | DCmind Soft + CANopen toolbar .....           | 10 |
| 2.3.   | DCmind Soft + CANopen Status bar .....        | 11 |
| 2.4.   | Parameters file .....                         | 12 |
| 3.     | WELCOME SCREEN .....                          | 13 |
| 3.1.   | Detected Drives .....                         | 13 |
| 3.2.   | Drive Overview .....                          | 14 |
| 3.2.1. | Configuration overview .....                  | 14 |
| 3.2.2. | Communication parameters .....                | 14 |
| 3.2.3. | Additional drive information .....            | 15 |
| 4.     | MOTION SETTINGS .....                         | 16 |
| 4.1.   | Command Sources .....                         | 17 |
| 4.1.1. | Network .....                                 | 17 |
| 4.1.2. | Analog input .....                            | 17 |
| 4.1.3. | PWM .....                                     | 18 |
| 4.2.   | Limits .....                                  | 19 |
| 4.2.1. | Position Limits .....                         | 19 |
| 4.2.2. | Profiler Limits .....                         | 19 |
| 4.2.3. | Torque Limits .....                           | 19 |
| 4.2.4. | Quick stop .....                              | 20 |
| 4.3.   | Thresholds .....                              | 21 |
| 4.4.   | Profiler .....                                | 23 |
| 4.5.   | Loop control .....                            | 24 |
| 5.     | ACTUATOR SETTINGS .....                       | 26 |
| 5.1.   | Motor .....                                   | 27 |
| 5.1.1. | Foldback .....                                | 28 |
| 5.1.2. | Setting up motor foldback .....               | 28 |
| 5.1.3. | Commutation .....                             | 28 |

|         |                                |    |
|---------|--------------------------------|----|
| 5.2.    | Feedbacks.....                 | 29 |
| 5.2.1.  | Digital encoder.....           | 29 |
| 5.2.2.  | Digital Halls.....             | 30 |
| 5.3.    | Brake.....                     | 31 |
| 6.      | HOMING.....                    | 33 |
| 7.      | ENABLE / DISABLE.....          | 34 |
| 8.      | INPUTS / OUTPUTS.....          | 35 |
| 8.1.    | Analog Inputs.....             | 35 |
| 8.2.    | Digital Inputs.....            | 36 |
| 8.3.    | Digital Outputs.....           | 37 |
| 9.      | PROTECTIONS.....               | 38 |
| 9.1.    | Current protections.....       | 38 |
| 9.2.    | Voltage protections.....       | 38 |
| 9.2.1.  | Voltage warning level.....     | 38 |
| 9.2.2.  | Shunt.....                     | 39 |
| 9.3.    | Temperature protections.....   | 40 |
| 10.     | PDO (Process Data Object)..... | 41 |
| 11.     | DRIVE STATUS.....              | 42 |
| 12.     | PARAMETERS.....                | 43 |
| 13.     | MOTION.....                    | 44 |
| 13.1.   | Homing.....                    | 44 |
| 13.1.   | Open Loop.....                 | 44 |
| 13.2.   | Profile Position.....          | 45 |
| 13.3.   | Profile Velocity.....          | 46 |
| 13.4.   | Profile Torque.....            | 47 |
| 13.5.   | Multi-Point.....               | 48 |
| 14.     | DCMIND PROGRAMS.....           | 49 |
| 14.1.   | Welcome screen.....            | 49 |
| 14.1.1. | Toolbar.....                   | 49 |
| 14.1.2. | Programs description.....      | 50 |
| 14.1.3. | Monitoring window.....         | 50 |
| 14.1.4. | Information bar.....           | 51 |
| 14.1.5. | Stop button.....               | 51 |
| 14.2.   | Application Programs.....      | 52 |
| 14.2.1. | "Valve" Group.....             | 52 |
| 14.2.2. | "Conveyor Belt" Group.....     | 56 |
| 14.2.3. | "Machine" Group.....           | 60 |
| 14.2.4. | "Dosing" Group.....            | 67 |
| 14.3.   | Expert Programs.....           | 69 |
| 14.3.1. | Velocity group.....            | 69 |
| 14.3.2. | Position group.....            | 81 |

|         |                                      |     |
|---------|--------------------------------------|-----|
| 14.3.3. | Torque group .....                   | 95  |
| 15.     | BOOTLOADER.....                      | 99  |
| 15.1.   | Bootloader CAN .....                 | 99  |
| 15.2.   | Bootloader USB .....                 | 100 |
| 16.     | SCOPE .....                          | 101 |
|         | ANNEXE 1 – OBJECT DICTIONARY .....   | 103 |
|         | ANNEXE 2 – LIST OF ERROR CODES ..... | 115 |

## 1. INTRODUCTION

Use DCmind Soft + CANopen to configure and program CROUZET SMI21 or SMI22 CANopen drive.

DCmind Soft + CANopen allows for:

- Detection of compatible drives connected to the software network
- Connection to one or several drives for configuration, tuning, testing and programming.
- Configuration and testing of different motion modes (position, velocity, torque, force, homing, etc.)
- Monitor information with the digital scope

### 1.1. Getting Started

Minimum computer requirements to run DCmind Soft CANopen software are:

- Microsoft Windows OS version XP SP3, Vista, W7, W8 or W10.
- At least 100MB of free disk space.
- USB port for controller USB connection.
- CAN port for CAN connection [optional].
- .NET framework 4.5.2

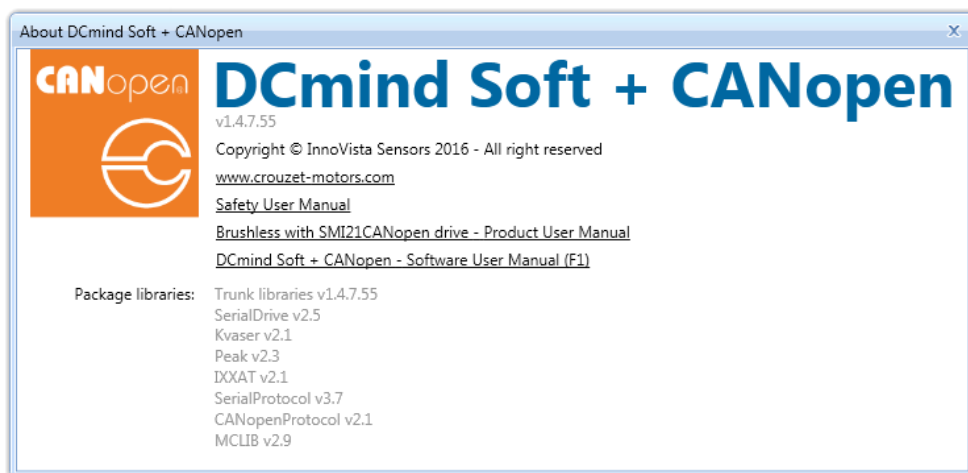
**In order to install and run the DCmind Soft + CANopen software, you must have Administrator privileges (for installation).**

### 1.2. Communication Interfaces

DCmind Soft + CANopen supports the following communication interfaces:

- CAN Peak.
- CAN IXXAT.
- CAN Kvaser.

In the menu of DCmind Soft + CANopen "About", the version of the communication libraries version are displayed.



If the version displayed is "N/A", it could be because of one of the following reasons:

- The dll library was not installed correctly, please try reinstalling DCmind Soft + CANopen.
- The dll library is being used by another program, please close the related software programs and reopen DCmind Soft + CANopen.
- The drivers are not installed in the PC, please download and install the drivers from the vendor website and then reboot the PC.



**WARNING:** The correct drivers must be installed in order to make DCmind Soft + CANopen work with the corresponding communication interface.

### 1.3. Before you begin

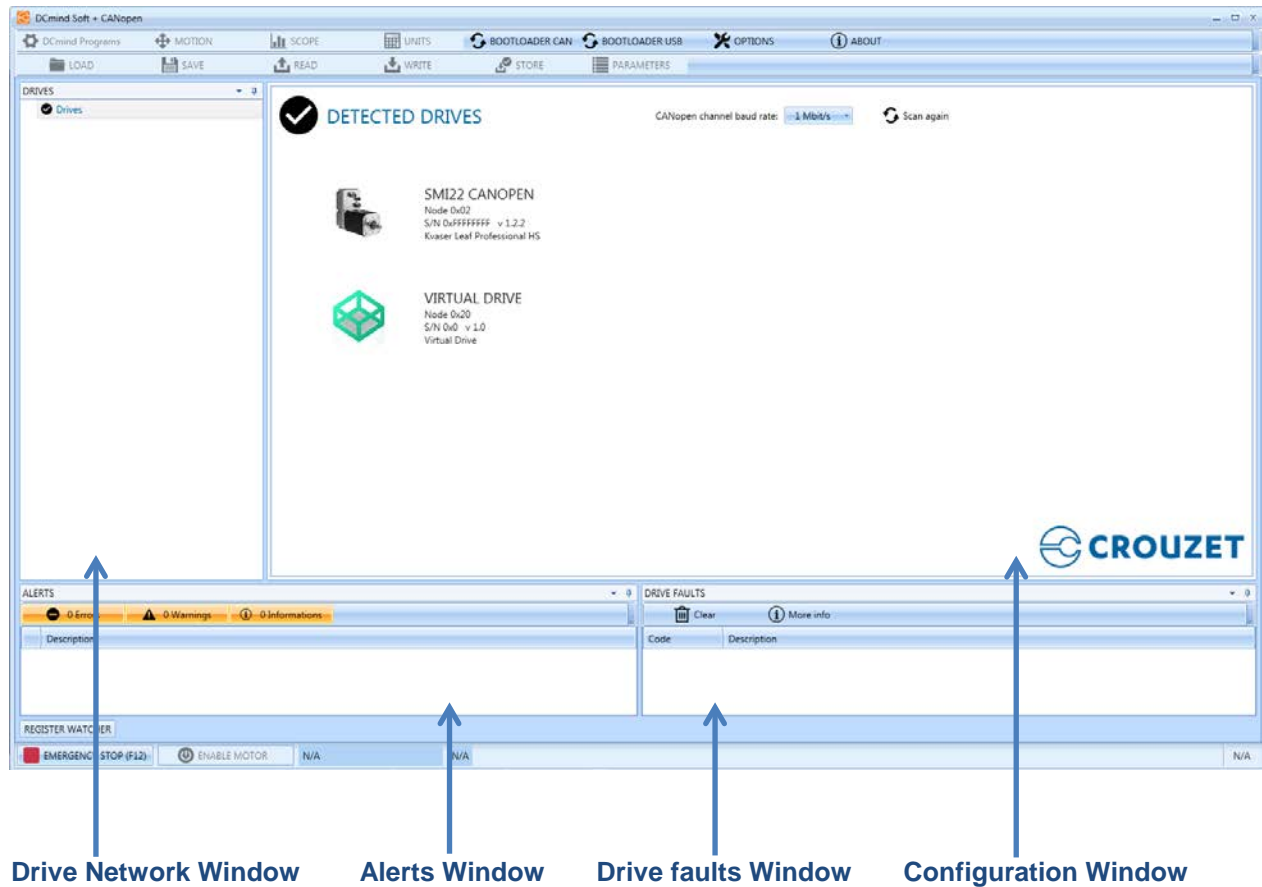
In order to ensure successful drive setup, you should verify that the following conditions are met:

- Read the SMI21 or SMI22 CANopen drive installation manual and the datasheet for the motor.
- Provide electrical power to the motor and connect the communication cable (USB, CAN).



## 2. DCMIND SOFT + CANOPEN DESKTOP

When you first start DCmind Soft + CANopen, click on “SCAN AGAIN” to see the below parts:



### 2.1. DCmind Soft + CANopen workspace display

The following windows provide on-going information as you work in DCmind Soft + CANopen:

#### 2.1.1. Drive Network window

This window displays controllers on the DCmind Soft + CANopen network and its settings.

#### 2.1.2. Configuration window

This is where the configuration of the SMI21 or SMI22 CANopen drive is edited. For example, when a settings group is selected, all the registers within that category are displayed in this area. Several configuration wizards can be accessed from this window.

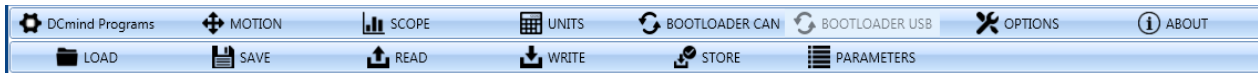
#### 2.1.3. Alerts window

This window displays a list of informations, warnings / errors from the SMI21 or SMI22 CANopen drive.




#### 2.1.1. Drive Faults window


This window displays an history of the errors detected on the SMI21 or SMI22 CANopen drive. You can delete this history by click on the button **Clear**.


## 2.2. DCmind Soft + CANopen toolbar



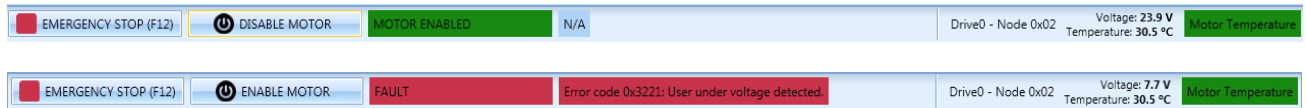
The following table describes the function of each button in the Configuration toolbar (some buttons are available only when a motor is connected and selected).

| Title           | Description   |
|-----------------|---|
| DCmind Programs | Open DCmind soft Programs (V101, P101, P200, C101, conveyor belt, valves...)  |
| MOTION          | Open motion test (velocity, position and torque profile, homing...)   |
| SCOPE           | Open digital scope  |
| UNITS           | Convert values between different units<br> <b>WARNING:</b> Do not dynamically change units during SMI21 or SMI22 CANopen drive configuration and commission process because it rescales the system parameters and causes unusual motion.   |
| BOOTLOADER CAN  | Open CAN bootloader window for firmware updating  |
| BOOTLOADER USB  | Open USB bootloader window for firmware updating  |
| OPTIONS         | Open options window for SMI21 or SMI22 CANopen drive general settings   |
| ABOUT           | Open about window with the following informations: HMI version, online documentation, package libraries...  |
| LOAD            | Load values from File to Parameters list. This will load values from a previous configuration File (.xdc). The parameters are automatically downloaded to the drive<br> <b>WARNING:</b> Do not load a file when the motor is in "ENABLE" mode. The motor needs to click on "DISABLE MOTOR" before the load to avoid bad behavior.  |
| SAVE            | Users can save configurations at any time. This is very useful when a system has been completely set up and you want to store the parameters to download them to other identical systems.<br>To save a configuration, click the <b>SAVE</b> button. The output format for configuration file is an XDC (XML Device Configuration file). User can find further information on that format at section Parameters file of this manual.<br> <b>CAUTION:</b> Make a "STORE" of all parameters before click on the "SAVE" button |
| READ            | Read parameters from SMI21 or SMI22 CANopen drive   |
| WRITE           | Write parameters to SMI21 or SMI22 CANopen drive  |
| STORE           | Store SMI21 or SMI22 CANopen drive parameters to non-volatile memory (NVM)  |
| PARAMETERS      | Show all SMI21 or SMI22 CANopen drive parameters  |

 **CAUTION:** With SMI21 CANopen drive, the BOOTLOADER USB isn't available and the BOOTLOADER CAN can be used only with the baudrate 1 Mb/s.

 **CAUTION:** With SMI22 CANopen drive, the BOOTLOADER USB or BOOTLOADER CAN button should be used with the good motor connection (CANopen or USB). When the HMI is connected to the drive only the good button is available.

### 2.3. DCmind Soft + CANopen Status bar



The status bar on the bottom of the desktop contains information on the SMI21 or SMI22 CANopen drive **connection state**, **FSA current status** (motor enabled, motor disabled, fault...) and **drive error codes**. It also includes an ENABLE/DISABLE button and an EMERGENCY button for safety.

At the right of the status bar, you have the following information:

- Drive name with its Node ID
- Actual bus voltage
- Actual drive temperature
- Motor temperature information




**CAUTION:** With SMI21 CANopen drive, the motor temperature information isn't available

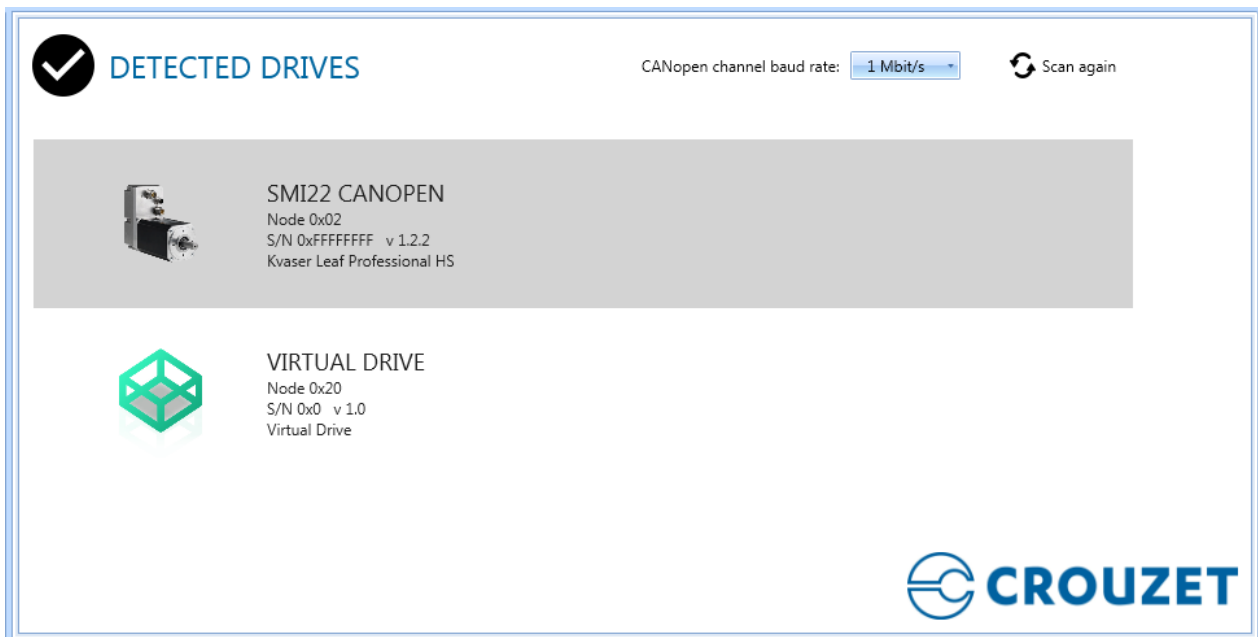
## 2.4. Parameters file

SMI21 and SMI22 CANopen drives are defined according to **CiA311 DSP V1.0.0: CANopen XML-based device description** (.XDD files).


This file contains a list of Drive's Parameters (registers), as well as its names, data type, description, and default value. Each firmware version has always associated an XDD file.

 **WARNING:** If you need to update your firmware version, assure that you also have the corresponding XDD file, in order to avoid possible incompatibility issues.


When connect to a SMI21 or SMI22 CANopen drive in DCmind Soft + CANopen "DETECTED DRIVES", click on "SCAN AGAIN", DCmind Soft + CANopen displays current Firmware version installed in the Drive and loads the corresponding XDD from DCmind Soft + CANopen's installation folder.



If XDD of corresponding version is not found, DCmind Soft + CANopen opens a window showing currently installed XDD files, from which the user can select which is the most appropriate. Note that DCmind Soft + CANopen must be running under administrator permission to do this action.

 **CAUTION:** DCmind Soft + CANopen always checks XDD files into: InstallationFolder\XDD

Each single configuration of a SMI21 or SMI22 CANopen drive can be stored according to **CiA311 in a XML device configuration file** (.XDC).

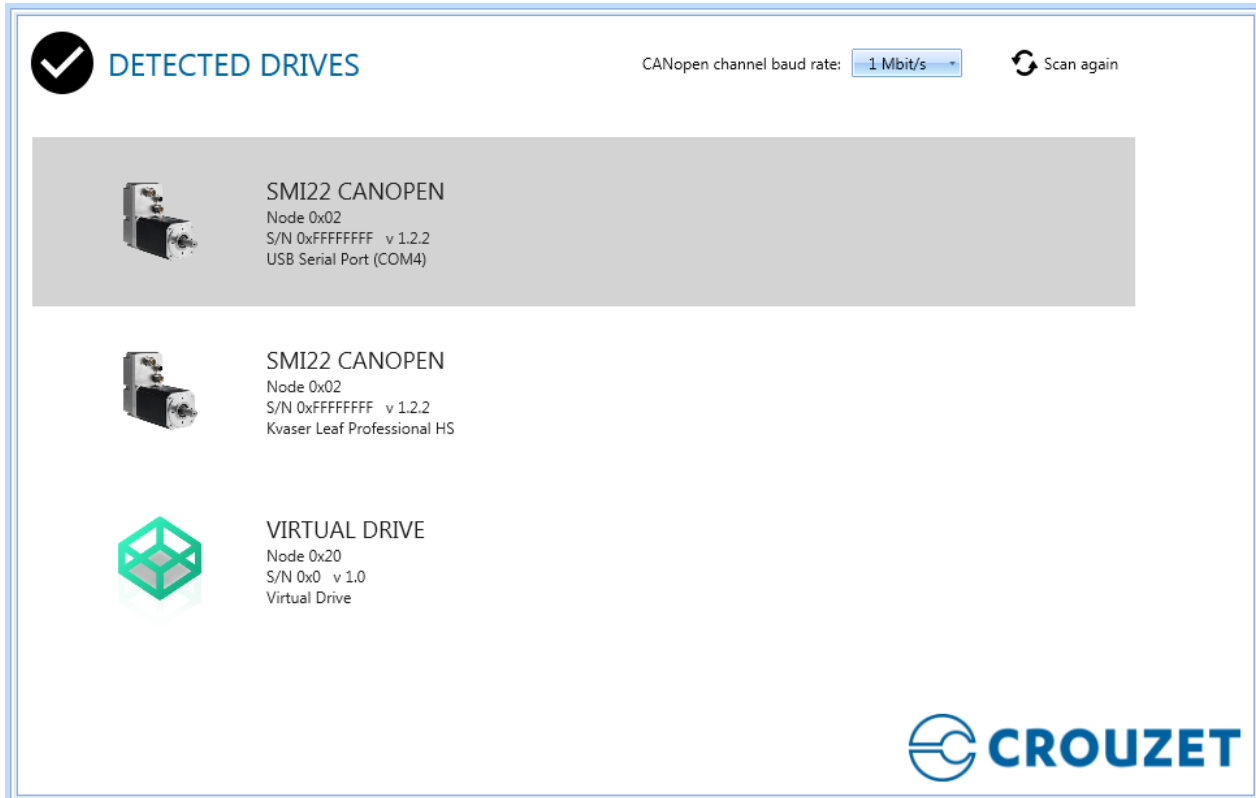
 **CAUTION:** XDC files are the recommended format for saving SMI21 or SMI22 CANopen drive configurations.

Once you are connected to the SMI21 or SMI22 CANopen drive, you can Load/Save an XDC configuration file from the top menu.

### 3. WELCOME SCREEN

This view lets you select which SMI21 or SMI22 CANopen drive (motor) you wish to work with. You can work with a physical drive connected to one of the ports of your PC (online) or a virtual drive (offline) to see all the features of the DCmind Soft + CANopen and create an XDC configuration file without connected motor.

#### 3.1. Detected Drives



The **Drives** screen displays a list of the SMI21 or SMI22 CANopen drives that DCmind Soft + CANopen has found on your local network (CANopen or USB). You can select one of these drives from the list and click on the picture (grey line) to continue. This will connect you to the SMI21 or SMI22 CANopen drive and you will be given the option to use a wizard to setup the drive.

The following fields are available on the displayed list:

| Field   | Description   |
|---------|---|
| Product | Name of product: SMI21 or SMI22 CANOPEN                                   |
| Node ID | ID used for the SMI21 or SMI22 CANopen drive                              |
| Version | Firmware version  |
| Serial  | Unique identifier for each SMI21 or SMI22 CANopen drive                   |
| Port    | Communications port where SMI21 or SMI22 CANopen drive have been detected |



**CAUTION:** Click on the “Scan again” button to rescan the Network looking for available drives at any time.

### 3.2. Drive Overview



#### 3.2.1. Configuration overview

Once your SMI21 or SMI22 CANopen drive is connected, the **Drive Overview** shows a summary of the drive that you are using.

You can view or configure some of the information displayed:

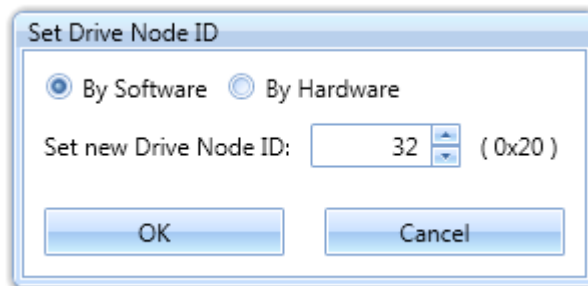
| Field              | Description   |
|--------------------|---|
| Motor type         | Brushless AC (sinusoidal) or Brushless DC (trapezoidal)         |
| Commutation sensor | Digital encoder or digital halls                                |
| Motion mode        | Velocity, Position or Torque profile, homing...                 |
| Velocity feedback  | How is estimated the actual velocity                            |
| Position feedback  | Digital encoder or digital halls                                |
| Command source     | How is drive the motor: network (CANopen or USB), analog or PWM |

#### 3.2.2. Communication parameters

After connecting to your SMI21 or SMI22 CANopen drive, the below parameters are available:

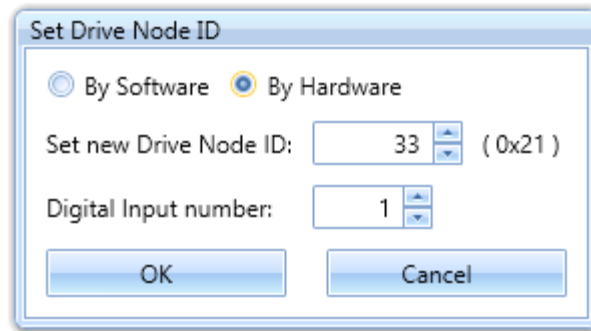
| Field             | Description  | Editable field |
|-------------------|--|----------------|
| Drive Name        | Name assigned to the SMI21 or SMI22 CANopen drive being used | No             |
| Node ID           | CAN Node ID used for the SMI21 or SMI22 CANopen drive        | Yes            |
| CANopen baud rate | Baud rate used in CANopen communications                     | Yes            |

The Node ID can be set by software:




The Node ID can be set from 1 to 127, after that click on "OK" button, disconnect the drive and do an "OFF/ON" on the power supply to enable the Node ID change


The Node ID can also be set by hardware:



The dialog box titled "Set Drive Node ID" contains two radio buttons: "By Software" (unselected) and "By Hardware" (selected). Below the radio buttons are two input fields: "Set new Drive Node ID:" with a value of 33 and "( 0x21 )" next to it, and "Digital Input number:" with a value of 1. At the bottom are "OK" and "Cancel" buttons.

The Node ID is increased of 1 if the selected input is at 1, the Node ID is not increased if the selected input is at 0. The selected input can be 1 to 6.

 CAUTION: If the set Node-ID is 127, the Node-ID is never increased.

 CAUTION: For SMI22 CANopen drive the hardware settings are available only in administrator mode

### 3.2.3. *Additional drive information*

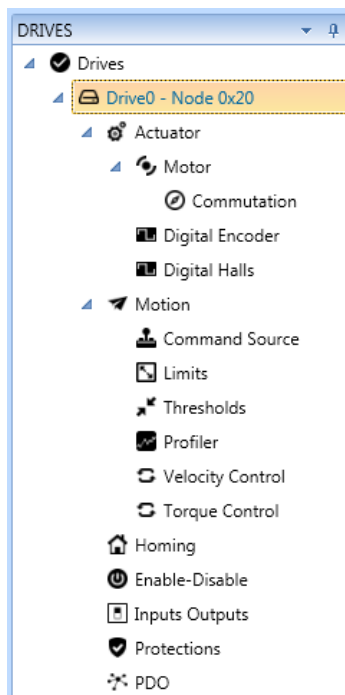
If you click on the button "Additional drive information", the following information is available:


- Product name
- Communication port
- Recommended XDD file
- Used XDD file
- Last loaded XDC configuration file
- Firmware version
- Supported communications
- Serial number
- Motion chip

## 4. MOTION SETTINGS

The Settings menu on the left allows you to configure properly several parameters for your SMI21 or SMI22 CANopen drive based on the requirements of your application. The DCmind Soft + CANopen software provides among others windows for:

- Enter motor parameters
- Configure feedback
- Assign user units of measurement
- Set system limits for temperature, current, voltage, etc.
- Set motion limits for positioning, velocity, torque / force, etc.
- Specify command source
- Adjusts servo loops



 **CAUTION:** By default, only settings applicable to your current SMI21 or SMI22 CANopen drive operation mode, motor, feedbacks and command source will appear in this tree.

Motion settings define the system motion behavior, operation mode, control functions and motion profiler.

### MOTION

Operation Mode:

System Polarity:

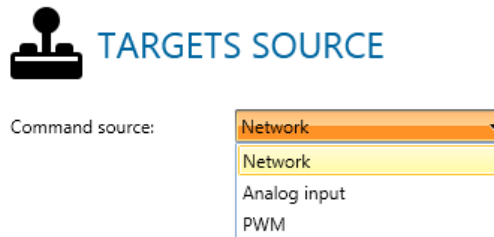
- **Operation mode:** There are up to eight operation modes available in SMI21 or SMI22 CANopen drive (position, velocity, homing, etc.).
- **System polarity** indicates the direction for positive movements and for negative movements. The system polarity is used in all modes. As the direction of torque, velocity and position could be changed it allows reversing the direction of a system without modifying any cabling.



## 4.1. Command Sources

The Command Source option allows selection between any command source supported by the SMI21 or SMI22 CANopen drive hardware and firmware.

After selecting a command source, the available settings for the chosen command will appear below in the same window.



### 4.1.1. Network

Select this option when the SMI21 or SMI22 CANopen drive is being controlled from a PC or remote host. SMI21 or SMI22 CANopen drive can utilize register commands from a network communication (CANopen or USB) as a form of input command.

### 4.1.2. Analog input

Utilize one of the hardware available analog inputs as a form of input command.

Configuration allows the assignment of parameter values for the applicable Analog Input.

- **Analog input used** allows to specify the hardware analog input used.
- **Motion range.** This setting defines the motion range that will correspond to the analog input range. It is also possible to reverse the movement in order to make the motion values evolve towards negative values.
- **Motion offset** allows to move the Motion range up and down depending on its value. A positive offset value will move the range up, and a negative offset value will move the range down.
- **Velocity deadband** parameter allows defining a deadband of values when a velocity mode is used as Operation Mode. This characteristic allows reducing sensitivity at low speeds. It is expressed directly in velocity units, allowing to specify a fixed value independently of the rest of the settings.

The chart on the right represents the final motion movement depending on the analog input value. This allows an easy way to modify the parameters by seeing the effect on the final motion movement



**CAUTION:** The information displayed makes use of the current Operation Mode configured in the Motion setting. Depending on that, the values displayed will be relative to position, velocity, torque or force.

There is a **Quick Test (Offline)** section where the user can see a simulation of the most common values (Maximum, Medium and Minimum) of the Analog Input, to which motion values will correspond. For example, suppose that the Analog Input range is 0 – 10 V, but the signal that will be supplied has a range of 0 – 5V. Then, the range of the slider can be modified to match the real signal range and the most common values for this range will be displayed.

### 4.1.3. PWM

Choose this mode if you would like to use a PWM input as a form of input command. The PWM goes directly into MCU which calculates the appropriate command for the current, velocity or position loop.

There are two main **modes** of working with PWM command source:

- PWM & direction (Dual input mode): It uses two inputs; one to assign the direction of the movement and another to assign the duty. Applying a 0 V to Direction pin will make the system to go in negative directions.
- PWM (Single input mode): It uses one input to control the duty.

The following settings are used to adjust the desired motion based on the PWM duty:

- **Motion range.** This setting defines the motion range that will correspond to the PWM duty. It is also possible to reverse the movement in order to make the motion values evolve towards negative values.
- **Motion offset** allows to move the Motion range up and down depending on its value. A positive offset value will move the range up, and a negative offset value will move the range down.
- **Velocity deadband** parameter allows defining a deadband of values when a velocity mode is used as Operation Mode. This characteristic allows reducing sensitivity at low speeds. It is expressed directly in velocity units, allowing to specify a fixed value independently of the rest of the settings.

The chart on the right represents the final motion movement depending on the PWM duty. This allows an easy way to modify the parameters by seeing the effect on the final motion movement.



**CAUTION:** The information displayed makes use of the current Operation Mode configured in the Motion setting. Depending on that, the values displayed will be relative to position, velocity, torque or force.

There is a **Quick Test (Offline)** section where the user can see a simulation of the most common values (Maximum, Medium and Minimum) of the PWM duty, to which motion values will correspond. For example, suppose that the PWM duty used goes from 30% to 70%. Then, the range of the slider can be modified to match this range and the most common motion values will be displayed.

## 4.2. Limits

This screen enables you to define how your system should behave when it reaches an operational limit.

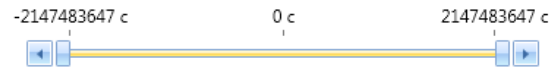


### LIMITS

#### POSITION LIMITS

Minimum absolute position:  c

Maximum absolute position:  c



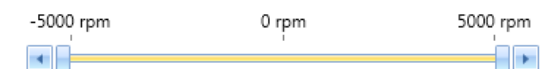
#### PROFILER LIMITS

Maximum profile velocity:  rpm

Maximum motor speed:  rpm 

Maximum profiler acceleration:  rpm/s

Maximum profiler deceleration:  rpm/s



#### TORQUE LIMITS

Minimum torque limit:  mNm

Maximum torque limit:  mNm

Maximum torque @ const speed:  mNm

Maximum motor torque:  mNm 



#### QUICK STOP

Quick Stop Deceleration:  rpm/s

Quick Stop option:

- Slow down on quick stop ramp and stay in quick stop active
- Slow down on quick stop ramp and stay in quick stop active
- Slow down on phase short-circuit and stay in quick stop active

### 4.2.1. Position Limits

**Min/Max absolute position parameters** define the absolute position limits for the target and current position. Every new target position will be checked and adjusted to the limits established by these values.

### 4.2.2. Profiler Limits


**Max profile velocity, acceleration and deceleration** parameters limit the profile velocity / acceleration / deceleration to an acceptable value in order to prevent the motor and the moved mechanics from being destroyed.

### 4.2.3. Torque Limits

**Max torque** parameter indicates the configured maximum permissible torque in the motor.

**Max torque @ const speed** parameter indicates the configured maximum permissible torque in the motor at constant speed (not during acceleration/deceleration paths)


**Min/Max torque limit** indicate the configured maximum positive and negative torque in the motor. This allows user to configure the system with an asymmetrical torque limit window.

 **CAUTION:** Please, note that Max torque, Maximum torque limit value and Minimum torque limit value objects should not limit the peak current.

#### 4.2.4. *Quick stop*

**Quick stop deceleration** parameter indicates the configured deceleration of the motor when we click on the “Quick stop” button, this deceleration is taken into account only if the **Quick stop option** is “Slow down on quick stop ramp and stay in quick stop active”.

**Quick stop option** parameter indicates the configured method of quick stop, “Slow down on quick stop ramp and stay in quick stop active” use the parametrized **Quick stop deceleration**, and “Slow down on short circuit and stay in quick stop active” make a short circuit of the motor phases, with this method the deceleration depends on the load. “Slow down on short circuit and stay in quick stop active” avoid rejection during the deceleration.

 **CAUTION:** Please, note that in V100 expert programs the Quick stop is always “Slow down on short circuit and stay in quick stop active”.

### 4.3. Thresholds

The position, velocity and torque control functions parameters work in conjunction with position, velocity and torque loops. The position and velocity loops are powered from the output of the profiler and from the position/velocity detector or feedback output.

The output of the position/velocity loops will be input to the flux-torque or current loop.

Parameters for *Position control functions* sub-group are:

#### THRESHOLDS

##### POSITION THRESHOLDS

If the actual position is within the position window for a position window time, the target position is set as reached.

Position window:  c  
 Position window time:  ms

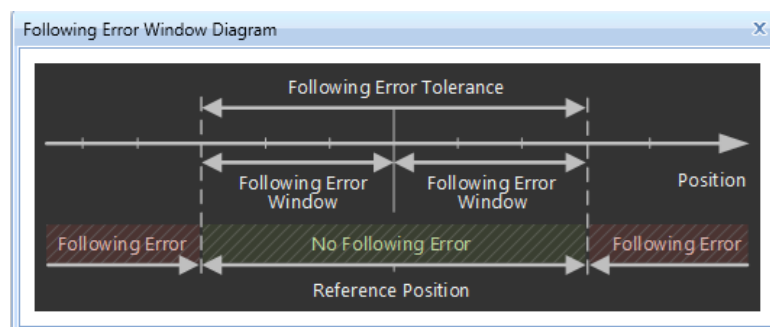
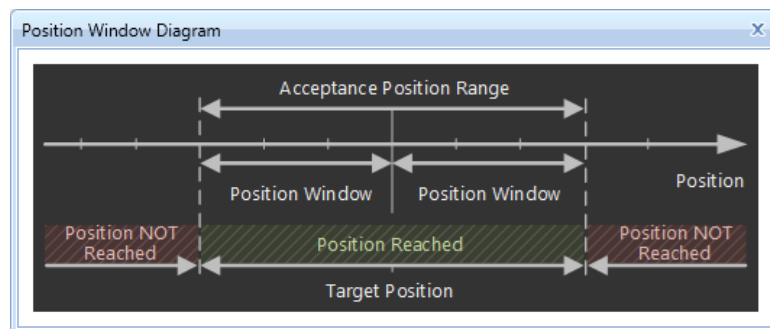
Show Diagram

If the actual position is out of the following error window for a following error timeout time, a following error occurs.

Following error window:  c  
 Following error timeout:  ms

Show Diagram

- **Position window:** this parameter indicates the configured symmetrical range of accepted position relative to the target position. If the actual value of the position encoder is within the position window, this target position shall be regarded as having been reached. As the user mostly prefers to specify the position window in his application in user-defined units, the value is transformed into increments.
- **Position window time:** this parameter indicates the configured time, during which the actual position within the position window is measured.
- **Following error window:** this parameter indicates the configured range of tolerated position values symmetrically to the position demand value.
- **Following error time out:** this parameter indicates the configured time for a following error condition, after that the bit 13 of the *statusword* shall be set to 1.



Parameters for *Velocity control functions* sub-group are:

## THRESHOLDS

### VELOCITY THRESHOLDS

If the actual velocity is within the velocity window for velocity window time, the target velocity is set as reached.

Velocity window:  rpm

Velocity window time:  ms

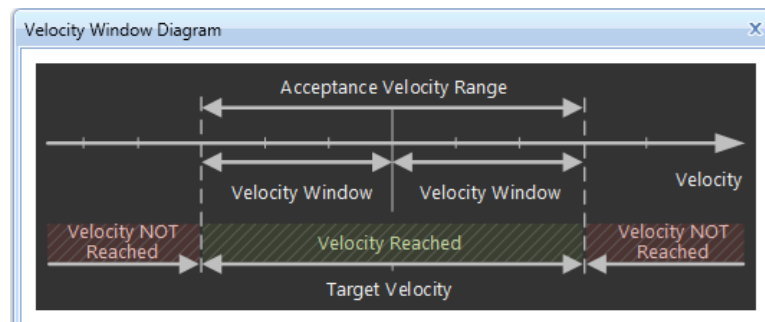
Show Diagram

If the actual velocity is above the velocity threshold longer than velocity threshold time, the motor is considered to be moving.

Velocity threshold:  rpm

Velocity threshold time:  ms

- **Velocity window:** this parameter indicates the configured symmetrical range of accepted velocity relative to the target velocity. If the actual value of the velocity is within the velocity window, this target velocity shall be regarded as having been reached.
- **Velocity window time:** this parameter indicates the configured time, during which the actual velocity within the velocity window is measured.
- **Velocity threshold:** this parameter indicates the configured zero velocity threshold.
- **Velocity threshold time:** this parameter indicates the configured zero velocity threshold time.



Parameters for *Torque control functions* sub-group are:

## THRESHOLDS

### TORQUE THRESHOLDS

If the actual torque/force is within the torque/force window for the window time, the target torque/force is set as reached.

Torque window:  mNm

Torque window time:  ms

- **Torque window:** this parameter indicates the configured symmetrical range of accepted torque/force relative to the target torque/force. If the actual value of the torque/force is within the torque window, this target torque/force shall be regarded as having been reached.
- **Torque window time:** this parameter indicates the configured time, during which the actual torque/force within the torque/force window is measured.

#### 4.4. Profiler

The profiler is in charge of continuously generating the position, velocity or torque references to reach the final target values according to the user specified limits.

These configuration parameters are taken into account as default values to execute a specific mode of operation or motion profile.



### PROFILER

|                      |                                       |       |
|----------------------|---------------------------------------|-------|
| Profile velocity     | <input type="text" value="1 000.00"/> | rpm   |
| Profile acceleration | <input type="text" value="5 000"/>    | rpm/s |
| Profile deceleration | <input type="text" value="5 000"/>    | rpm/s |
| Torque slope         | <input type="text" value="4 770.00"/> | mNm/s |

The available parameters are:

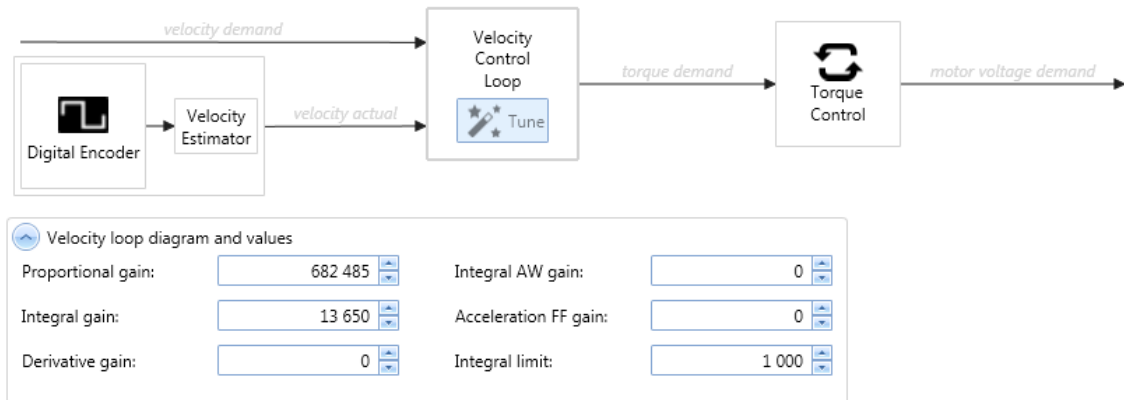
- Profile velocity
- Profile acceleration
- Profile deceleration
- Torque slope

### 4.5. Loop control

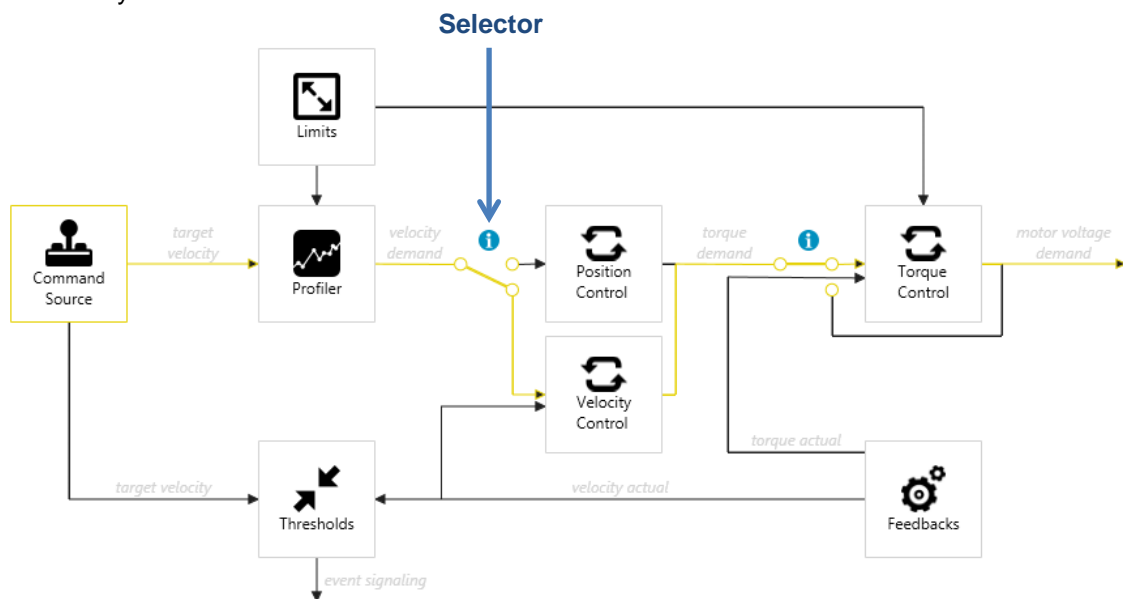
This view allows you to select the configuration for the loops in charge of regulating position, velocity and current (depending the operation mode used):

Parameters for *Velocity control loop* sub-group are:

#### VELOCITY CONTROL



Note that you can set the position loop (or alternatively the velocity loop) for velocity modes such as homing or profile velocity with a selector:



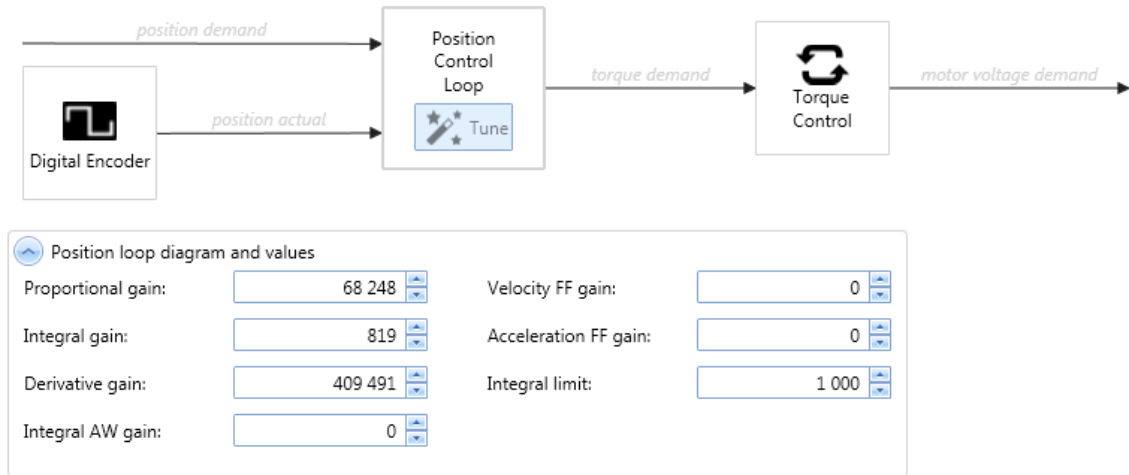
CAUTION: If your system is using a position sensor as a feedback (ex: encoder) it is highly recommended to use position loop for velocity modes.

CAUTION: If your system is going to work at low speeds in velocity modes, it is recommended to use position loop to increase accuracy.



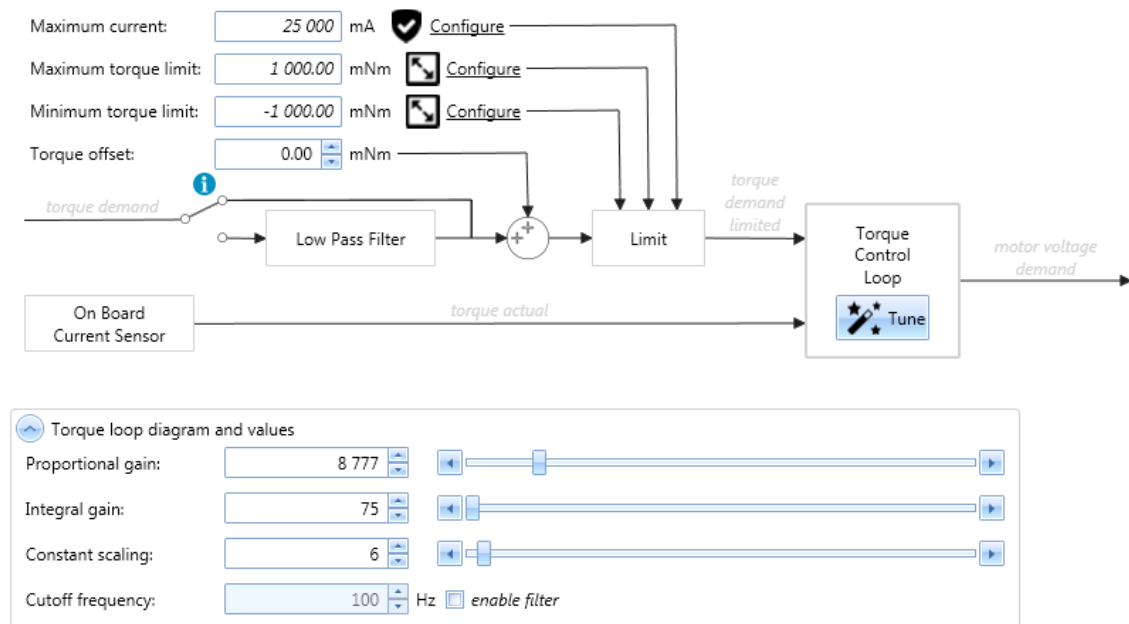
Parameters for *Position control loop* sub-group are:

## POSITION CONTROL



Parameters for *Torque control loop* sub-group are:

## TORQUE CONTROL






**Max current** parameter indicates the maximum permissible current creating torque in the motor.

## 5. ACTUATOR SETTINGS

Each SMI21 or SMI22 CANopen drive requires a unique configuration with parameters that are stored in NVM on the Servo Drive.

### ACTUATOR

|                  |   |  |   |
|------------------|---|--|---|
| Motor type:      | <input type="text" value="Rotary Brushless AC (sinusoidal)"/>       |  <a href="#">Configure</a> |  <a href="#">Configure Commutation</a> |
| Brake available: | <input type="text" value="No"/>                                     |  |   |
| Shunt available: | <input type="text" value="No"/>                                     |  |   |
| Position sensor: | <input type="text" value="Digital Encoder"/>                        |  <a href="#">Configure</a> |   |
| Velocity sensor: | <input type="text" value="Estimate velocity from position sensor"/> |  |   |

The drive supports the following motors:

- Rotary BLAC (for sinusoidal commutation)
- Rotary BLDC (for trapezoidal commutation)

The drive supports the following feedbacks:

- Digital encoder
- Digital halls

In all cases, the actual velocity is estimated from position sensor.



**CAUTION:** there is no brake and no shunt available on SMI21 CANopen motor

## 5.1. Motor

The **Motor** view is used to set up or confirm the parameters of the motor that is connected to the SMI21 or SMI22 CANopen drive.



### MOTOR PARAMETERS

Phase2Phase inductance:  mH

Phase2Phase resistance:  mΩ

Rated torque:  mNm

Torque constant:  mNm/A

Continuous current:  mA

Peak current:  mA

Peak time:  ms

Max permissible speed:  rpm



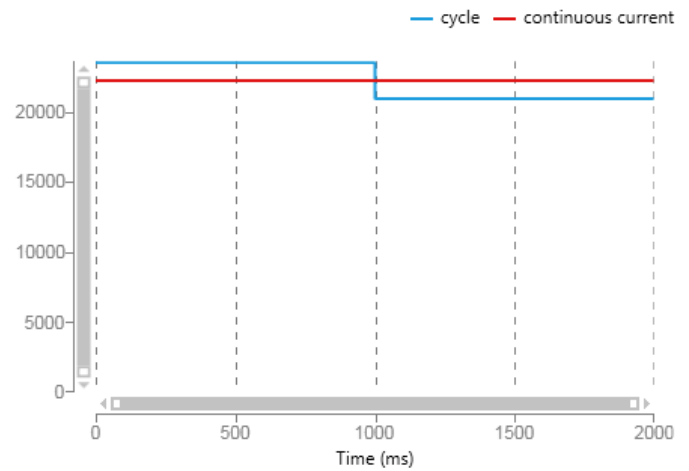
### ROTARY BRUSHLESS MOTOR PARAMETERS

Motor pair poles:

 [Configure Commutation](#)

### FOLDBACK

The foldback feature protects both the motor and the drive from overheating.




Cycle Time:  ms

 **CAUTION:** Motors delivered with SMI21 or SMI22 CANopen are set at the factory with functional parameters.

Depending on the selected **Motor Type** (BLAC or BLDC), the information available for editing will change in the Motor Parameters field. Consult the motor datasheet to determine the appropriate values.

In order to help configuring the parameters, it is possible to link several parameters to calculate automatically one of them according to the following formula:

$$ContinuousCurrent = \frac{RatedTorque}{TorqueConstant}$$

 **CAUTION:** Some of the motor parameters could be used for auto-calculators of other settings so it is recommended to set them accurately.

### 5.1.1. *Foldback*

The foldback feature protects both the motor and the drive from overheating. Two current foldback algorithms run in parallel in the drive: the drive foldback algorithm and the motor foldback algorithm. Each algorithm uses different sets of parameters. Each algorithm has its own foldback current limit. The overall foldback current limit is the minimum of the two at any given moment.



**CAUTION:** Foldback is not the same as current limits. Instantaneous current limits for the drive are set by the Max system current in the system Limits view in DCmind Soft CANopen. The foldback algorithms may reduce the current output to the motor in spite of the current limit settings.

### 5.1.2. *Setting up motor foldback*

The parameter entries required for the drive to apply motor foldback protection properly are Cycle Time, Peak Time, Peak current of the motor and continuous current of the motor. These values are used to setup the algorithm for motor foldback.

### 5.1.3. *Commutation*

This view allows configuration of basic commutation settings. Commutation is the process of switching current in the phases in order to generate motion. The available settings will depend on the type of motor and feedback in use.



## COMMUTATION

Commutation sensor:

Digital Encoder

 [Configure](#)

Initial angle determination method:

Digital halls transition method

**Commutation sensor** allows selecting which sensor is used to compute the rotor position.

If the selected sensor is an incremental sensor or it is not aligned with the rotor it will not be able to give the correct value without an initial rotor determination method. The **initial angle determination method** determines which method to use in order to localize the position of the rotor.

Several methods are proposed:

- **Digital halls transition method:** This method estimates roughly the position of the rotor using Digital Hall sensors and when a Hall transition is detected the position is re-estimated precisely.
- **Initial rotor position known**
- **Non incremental sensor used**
- **Forced alignment method**



**CAUTION:** Digital halls transition method is the only one available

## 5.2. Feedbacks

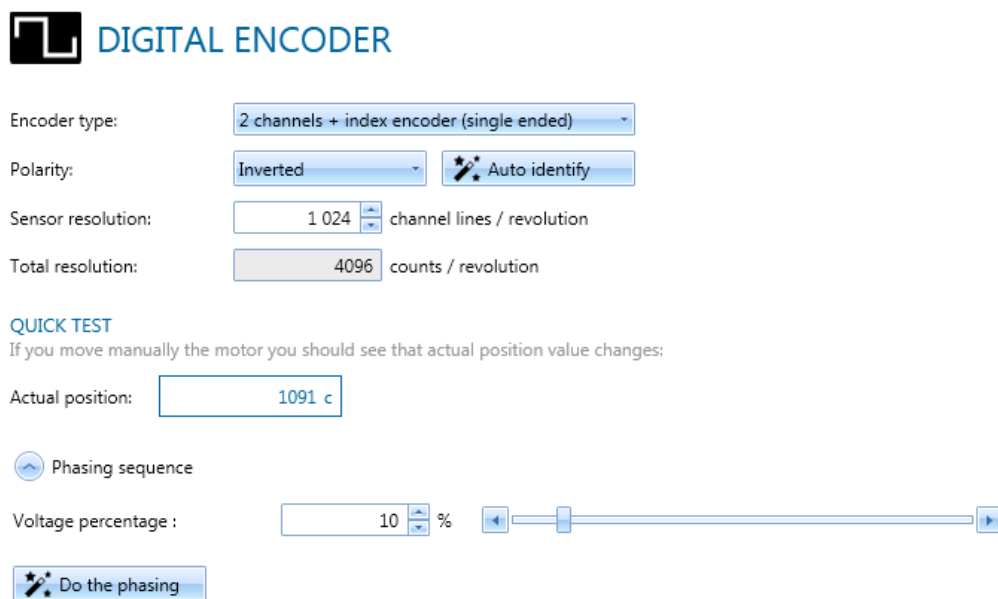
This view allows configuration of feedback sensors used for position and velocity modes. Once the sensor is selected in the Actuator menu, the sensor item will be displayed in the settings navigation tree and from them can be properly configured.

The parameters available for each type of feedback will be dependent on the option selected.

### 5.2.1. Digital encoder

This view allows configuration of digital encoder parameters:

(already set in motors coming from CROUZET factory)



- **Encoder type:** Define whether to use a 2 or 3 channels, differential or single ended encoder.
- **Polarity:** Indicates whether to swap or not swap the channels A and B of the quadrature encoder. For a correct operation of the system the positive sense of movement based on encoder and Hall must match. There is a wizard to detect it automatically.
- **Sensor Resolution:** This is the value that is generally found in the *datasheet*. For rotary motor it is expressed in "channel counts / revolution".
- **Total Resolution:** It is automatically calculated from the parameter above multiplying the Sensor Resolution by 4. For rotary motors it is expressed in "counts / revolution"
- **Voltage percentage:** Percentage of supply voltage use for the phasing


Quick test: This view helps to monitor the actual position value according to actual encoder configuration and user units selected.

Phasing sequence: The phasing is used to configure de SMI22 drive digital encoder, in administrator mode only.



**CAUTION:** SMI21 or SMI22 CANopen drive uses x4 decoding with incremental encoders. So each transition in any of the two main encoder signals (A, B) will be considered to be an increment. As a 1024CPR


(Cycles Per Revolution) encoder is used, the encoder resolution will be 4096 increments per mechanical revolution.

 **CAUTION:** there is no phasing available on SMI21 CANopen drive, and only in administrator mode for SMI22 CANopen drive.


### 5.2.2. Digital Halls

This view allows configuration of digital halls parameters:

**(already set in motors coming from CROUZET factory)**



## DIGITAL HALLS

Polarity: Standard  Auto identify

Halls step offset: 180°

**QUICK TEST**  
If you move manually the motor you should see that actual position value changes:

Actual position: 4096 c

If you move the motor you should see all combinations of HALLS happen.

| Hall 1 | Hall 2 | Hall 3 |
|--------|--------|--------|
| 1      | 0      | 0      |
| 1      | 1      | 0      |
| 0      | 1      | 0      |
| 0      | 1      | 1      |
| 0      | 0      | 1      |
| 1      | 0      | 1      |

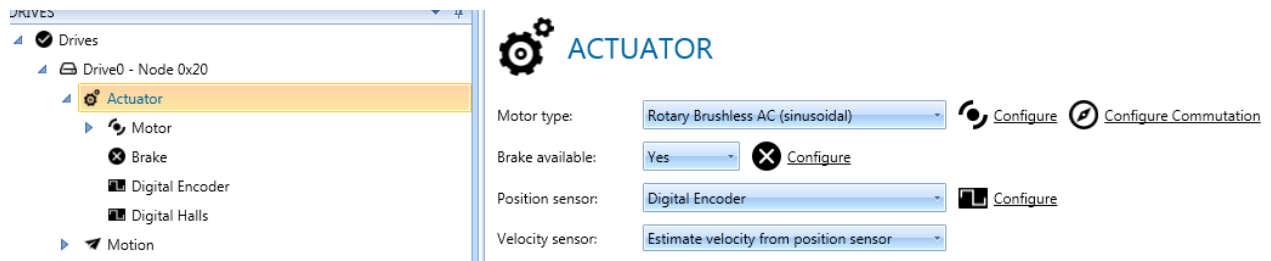
- **Polarity:** Define whether halls are active at high or low logical level.
- **Hall step offset:** Define the angular displacement (expressed in multiples of 60°) between the sequence of values generated by the Hall sensors and its corresponding excitation. This offset only applies when the system is using BLDC motors.

When configured for digital hall feedback, the drive will define 1 count to be equal to 1 hall state change (that is, a 4-poles motor has 12 counts per revolution)

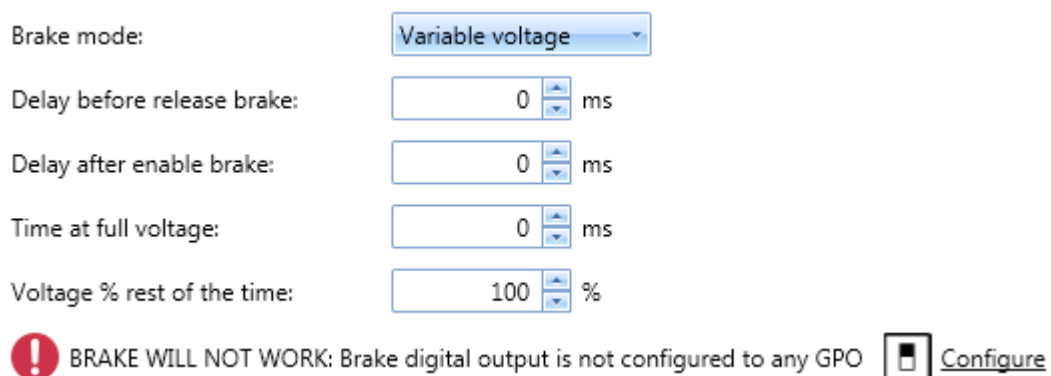
### 5.3. Brake

The **Brake** view is used for configuring an external mechanical brake. If a brake is present and connected to the drive, it can automatically be controlled and activated/deactivated by the system.

First the brake must be set as available in the "ACTUATORS SETTINGS". Then the Brake appears in the menu on the left.



Now the Brake view is accessible:



**Brake mode** allows selecting which voltage is used to supply the brake.

If the selected mode is "Constant voltage" the brake will be supply by a constant voltage and only the two first parameters will be used. If the selected mode is "Variable voltage" the brake will be supply by a PWM signal.

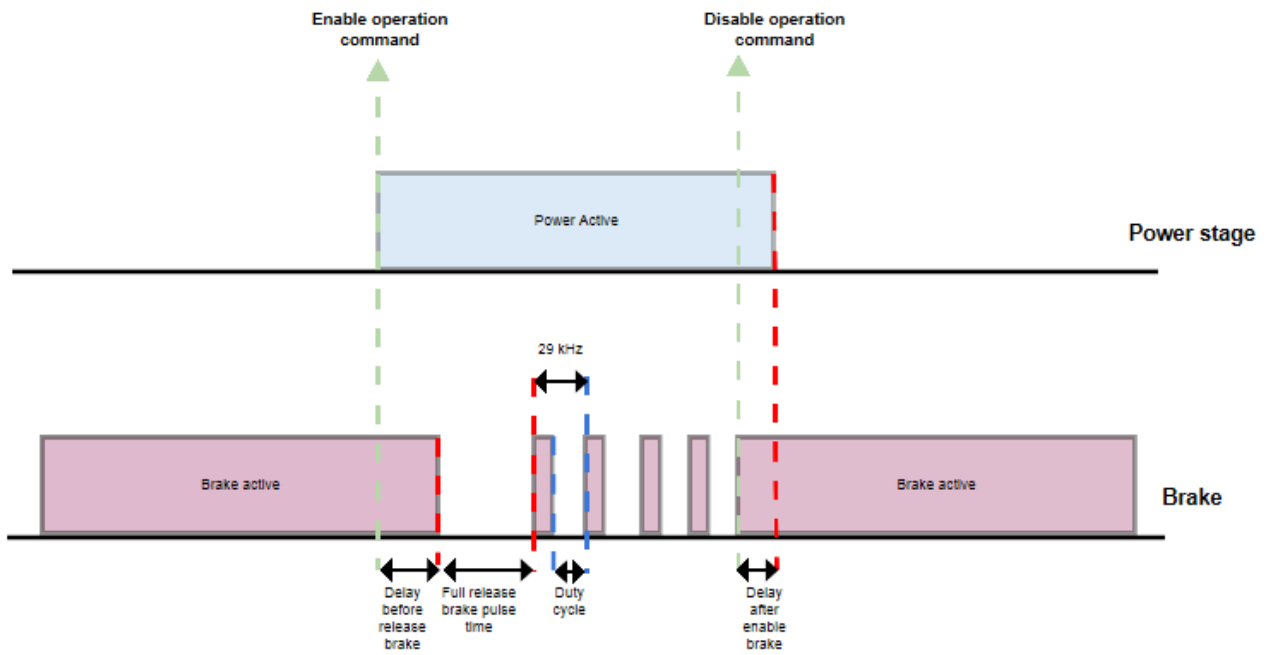
**Delay before release brake** is the delay between release the brake and activation of the power stage (in ms). This delay is designed to prevent loads from falling or coasting when the effects of gravity or other external forces are seen in the system.


**Delay after enable brake** is the delay between deactivation of the power stage and activation of the brake (in ms). This delay is designed to prevent loads from falling or coasting when the effects of gravity or other external forces are seen in the system.


**Time at full voltage:** If the Brake mode is set to voltage variable, this parameter specifies the time (in ms) for full release brake (100% duty cycle).

**Voltage % rest of the time:** If the Brake mode is set to voltage variable, this parameter specifies the % of duty cycle applied to the brake after full voltage time.

Brake operation is as follows:



 **CAUTION:** Brake must be configured to the correct GPO, otherwise it would be like if there were no brake.

 **CAUTION:** Brake isn't available on SMI21 CANopen motor



## 6. HOMING


In positioning systems, it is usually necessary to know the absolute position of the mechanics to assure correct movements. For cost reasons, most of systems do not usually use absolute encoders which provide an absolute reference, and therefore a homing process or search for an absolute reference method is mandatory.


### HOMING


Homing method:


#### Homing parameters


Home offset:  c

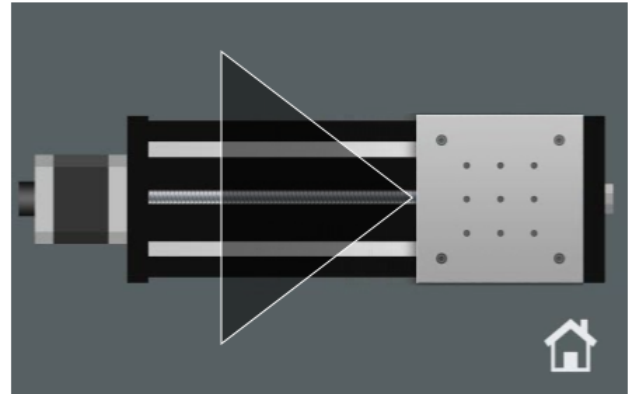
Homing acceleration:  rpm/s 

Homing timeout:  ms 

Speed searching for limit:  rpm 

Speed searching for zero:  rpm 

Torque threshold:  mNm 



Parameters for *homing* are:

- **Homing method:** It indicates the used homing method.
- **Homing acceleration:** It establishes the acceleration used for all accelerations and decelerations in standard homing methods.
- **Homing speeds:** It indicates the speeds used to locate the switch or mechanical limit and the encoder index pulse.
- **Home offset:** It indicates the configured difference between the zero position for the application and the machine home position.
- **Homing timeout:** It indicates the maximum time allowed to complete the whole homing process. If the homing is not completed within this time, the homing process will be aborted, the statusword error bit will be raised, an emergency message will be sent and the system will execute a fault reaction.
- **Torque threshold:** It indicates the level of torque when the mechanical limit is considered to be reached




CAUTION: Some homing parameters could only be available for specific homing methods. Once homing motion has been configured, user can execute it.



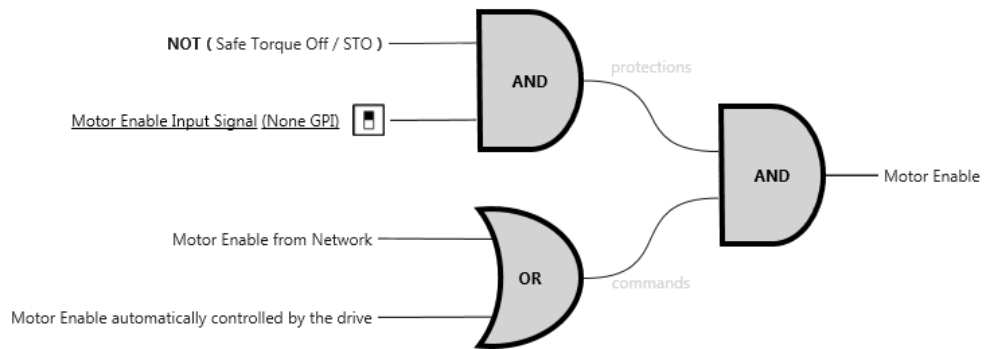
CAUTION: Homings with index are not available with SMI21 CANopen drive.

## 7. ENABLE / DISABLE

### ENABLE-DISABLE

Enable/Disable motor state is automatically controlled by the drive 

#### MOTOR ENABLE DIAGRAM




**Enable/Disable motor state is automatically controlled by the drive** parameter specifies if the motor should be automatically powered on (if possible) after power-up without the needed of user intervention.

**Motor Enable Input Signal** indicates if a general enable signal is available (and it is connected to the GPIx). If this signal is available it will control when the power stage could be activated or deactivated. After the enable signal, the SMI21 or SMI22 CANopen drive will react to motion commands.

## 8. INPUTS / OUTPUTS

The SMI21 or SMI22 CANopen drive has programmable digital/analog inputs and outputs that you can use to initiate motion, control auxiliary devices, or trigger other actions. The inputs and outputs should be wired according to the instructions in the motor datasheet.

Inputs & Outputs monitor enables you to display the current value of I/O and modify the output signals.

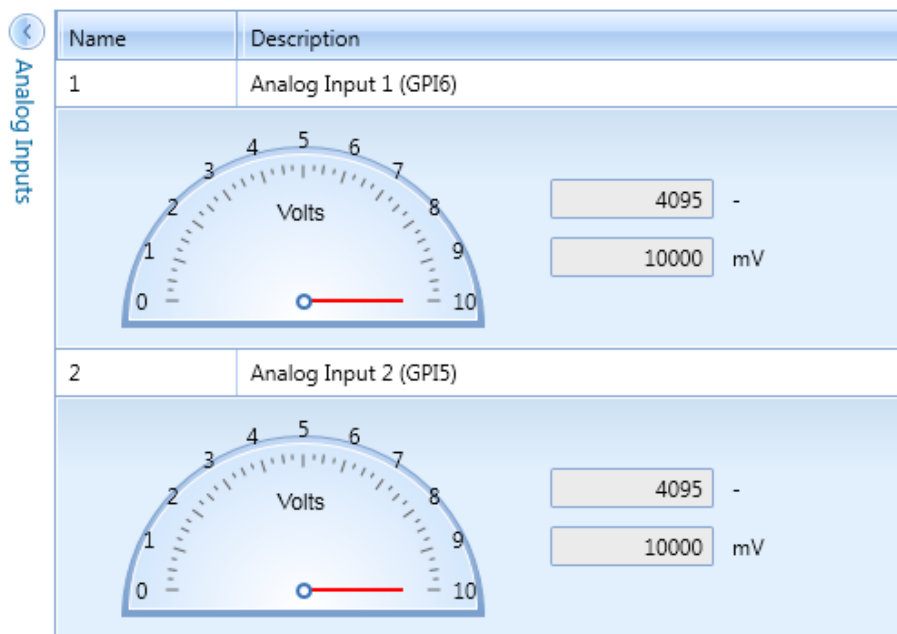
 **CAUTION:** Available inputs and outputs: The specific drive model purchased determines the available physical I/O and the options displayed in DCmind Soft CANopen.


### 8.1. Analog Inputs

All the analog input values are shown graphically and numerically (in ADC counts and mV).



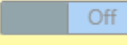


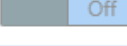
## INPUTS OUTPUTS



 **CAUTION:** Limits: In the semi-circle graphs, it may be observed the voltage working range.

## 8.2. Digital Inputs

All digital inputs appear here. Their states are shown graphically with a switch animation, with the text "On" or "Off".

| Name | Description             | State   | Polarity   | Mode   |
|------|-------------------------|---|--|--|
| GPI1 | General Purpose Input 1 |  Off | <input checked="" type="radio"/> Active High<br><input type="radio"/> Active Low | None<br>None<br>Positive Switch<br>Negative Switch<br>Home Switch<br>Motor Enable<br>Fault Reset |
| GPI2 | General Purpose Input 2 |  Off | <input checked="" type="radio"/> Active High<br><input type="radio"/> Active Low |  |
| GPI3 | General Purpose Input 3 |  Off | <input checked="" type="radio"/> Active High<br><input type="radio"/> Active Low |  |
| GPI4 | General Purpose Input 4 |  Off | <input checked="" type="radio"/> Active High<br><input type="radio"/> Active Low |  |

Two parameters can be configured:

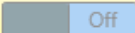



- **Polarity:** Indicates which signal level turns the state to "On".
  - "Active High": High value turns the state to "On".
  - "Active Low": Low value turns the state to "On".
- **Mode:** Relates the digital input to a parameter that may be used to control the motion:
  - "Positive Switch": When activated, Positive Switch signal is detected.
  - "Negative Switch": When activated, Negative Switch signal is detected.
  - "Home Switch": When activated, Home Switch signal is detected.
  - "Motor Enable": When activated, permits the motor to start moving. It has to be previously configured in Enable/Disable menu.
  - "Fault Reset": When activated, the board is unblocked after an error occurs.



**CAUTION:** If an entry is selected to set the Node ID by hardware, it becomes grey and can't be use in another mode.

### 8.3. Digital Outputs

All digital outputs appear here. As in digital inputs, their states are shown graphically with a switch animation, with the text "On" or "Off". Moreover, "auto-update" checkbox permits the state to change in real time, useful when monitoring.

| Name | Description      | State   | Polarity   | Mode  |
|------|------------------|---|--|---|
|      |                  | <input type="checkbox"/> auto-update  |  |   |
| GPO1 | Digital Output 1 |  Off | <input checked="" type="radio"/> Active High<br><input type="radio"/> Active Low | None<br>Brake<br>Health<br>Internal Generator<br>Internal Limit<br>Target Reached |
| GPO2 | Digital Output 2 |  Off | <input checked="" type="radio"/> Active High<br><input type="radio"/> Active Low |   |
| GPO3 | Digital Output 3 |  Off | <input checked="" type="radio"/> Active High<br><input type="radio"/> Active Low |   |
| GPO4 | Digital Output 4 |  Off | <input checked="" type="radio"/> Active High<br><input type="radio"/> Active Low |   |

Two parameters can be configured:

- **Polarity:** Indicates which signal level comes from the state "On".
  - "Active High": "On" state creates a high level signal.
  - "Active Low": "On" state creates a low level signal.
- **Mode:** Relates the digital output to a digital parameter from the drive board:
  - "Brake": Not available on SMI21 CANopen drive, available on SMI22 CANopen drive
  - "Health": It notifies if the drive is in Fault state or not.
  - "Internal Generator": Not available on SMI21 and SMI22 CANopen drive
  - "Internal Limit": It is activated when an internal limit, as a switch, is reached.
  - "Target Reached": In motion control, this signal notifies that target value has been reached.

 CAUTION: Brake isn't available on SMI21 CANopen motor

 CAUTION: Internal Generator isn't available on SMI21 and SMI22 CANopen motor

## 9. PROTECTIONS

### PROTECTIONS

#### CURRENT PROTECTIONS

Maximum system current:  mA  
 Motor peak current:  mA  
 Motor continuous current:  mA



 [Configure](#)

#### VOLTAGE PROTECTIONS

Under voltage warning level:  V  
 Over voltage warning level:  V



#### TEMPERATURE PROTECTIONS

Under temperature fault level:  °C  
 Over temperature fault level:  °C



#### EXTERNAL TEMPERATURE SENSOR

On

Motor Temperature :  °C

### 9.1. Current protections

**Max current** parameter indicates the maximum permissible current creating torque in the motor.

### 9.2. Voltage protections

#### 9.2.1. Voltage warning level

The **actual bus voltage**, the **over voltage warning level** and the **under voltage warning level** can be displayed and adjusted in the Bus Voltage parameters sub-group.



**CAUTION:** The ABSOLUTE bus voltage limits are factory prefixed according to the hardware specifications and cannot be modified. When the actual bus voltage is out of the absolute range an Emergency message is sent and the system executes a Fault reaction.



**WARNING:** Setting maximum user bus voltage below the actual power supply voltage may lead to serious damage of the device. Some drives include internal shunt resistors that would be activated for a long time and cause serious overheating.

### 9.2.2. Shunt

While decelerating a mechanical load (abrupt motion brakes or reversals), the mechanical energy is converted into electrical energy by the motor. This energy is injected into the power supply and could lead to an increase of the supply voltage (depending on the power supply characteristics, especially its output capacitance) and then damage both the controller and the power supply.

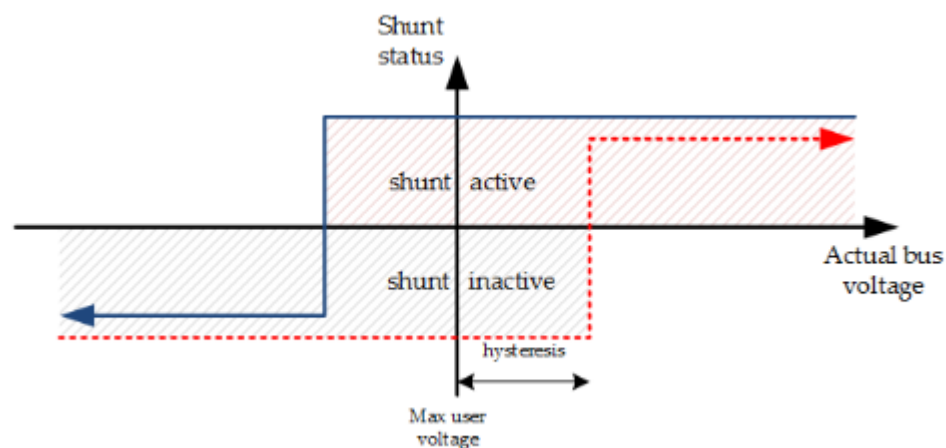
A shunt circuit prevents the bus voltage from rising too high and therefore protects the Drive and the power supply. This shunt is automatically activated when the DC bus voltage exceeds the ballast threshold parametrized by the user.


If a shunt is available (set in the Actuators part), the Shunt menu appears on the right and the user can configure the shunt:



The external shunt will be activated when the actual bus voltage is higher than **Ballast threshold** plus **hysteresis** and will be deactivated when the actual bus voltage is lower than **Ballast threshold** minus **hysteresis**. This **hysteresis** is expressed as percentage of Ballast threshold.

The algorithm used by the shunt is the following:




 CAUTION: The shunt isn't available with SMI21 CANopen motor.

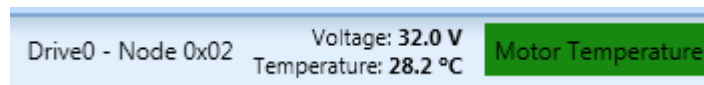
 CAUTION: The voltage applied to the shunt is not modulated.

### 9.3. Temperature protections

The **actual drive temperature**, the **over temperature warning/fault level** and the **under temperature warning/fault level** can be displayed and adjusted in the Temperature parameters sub-group.

 CAUTION: The ABSOLUTE temperature limits are factory prefixed according to the hardware specifications and cannot be modified. When the actual temperature is out of the absolute range an Emergency message is sent and the system executes a Fault reaction.

It's possible to activate an **external temperature sensor** which gives the **actual motor temperature**. When this temperature is over the warning level of 105°C the **motor temperature information** switch from green to red:



 CAUTION: The external temperature sensor isn't available with SMI21 CANopen motor.



## 10. PDO (PROCESS DATA OBJECT)

This page can be used to configure Process Data Objects (PDO). It is possible to configure up to 4 TPDO and 4 RPDO.

### Process Data Object (PDO)

Configure the PDO used in CANopen communications

Select the PDO to configure: **TPDO 1** TPDO 1 configuration Active

Type here to search...

| Index  | SubIndex | Name                                       | Size |
|--------|----------|--|------|
| 0x20c2 | 0x01     | [Driver temperature]<br>Actual temperature | 4    |
| 0x2101 | 0x01     | [Bus voltage]<br>DC link circuit voltage   | 4    |
| 0x2305 | 0x03     | [Commutation]<br>Actual system angle       | 2    |
| 0x2321 | 0x02     | [Digital halls]<br>Value                   | 1    |
| 0x2600 | 0x01     | [Current readings]<br>Current phase A      | 2    |
| 0x2600 | 0x02     | [Current readings]<br>Current phase B      | 2    |
| 0x2600 | 0x03     | [Current readings]<br>Current phase C      | 2    |
| 0x2601 | 0x01     | [Current d-q]<br>Current direct            | 2    |
| 0x2601 | 0x02     | [Current d-q]<br>Current quadrature        | 2    |
| 0x2a03 | 0x01     | [Analog inputs]<br>Analog input 1 value    | 4    |
| 0x2a03 | 0x02     | [Analog inputs]<br>Analog input 2 value    | 4    |
| 0x2a03 | 0x03     | [Analog inputs]                            | 4    |

Mapping capacity: 6/8

| Index  | SubIndex | Name                                     | Size |
|--------|----------|--|------|
| 0x6041 | 0x00     | Statusword                               | 2    |
| 0x2101 | 0x01     | [Bus voltage]<br>DC link circuit voltage | 4    |
|        |          |  |      |
|        |          |  |      |
|        |          |  |      |
|        |          |  |      |
|        |          |  |      |
|        |          |  |      |
|        |          |  |      |

COB-ID:

Transmission type:

Event mode:

Min refresh rate (ms):

In the left part of the screen appear the **mappable objects**, and they can be dragged to the right part of the screen to map them to the current PDO.

The size is measured in bytes. A colored bar helps us to see the mapping capacity of the current PDO.

Several parameters can be configured for each PDO such as COB-ID and Transmission Type.

## 11. DRIVE STATUS

**Drive Status** allows you to view the current status of the drive internal state machine. You have access to this view by passing the mouse on the FSA current status case in the Status bar on the bottom.

Current drive status code:

|                          | brake applied, if present | low-level power applied | high-level power applied | drive function enabled | configuration allowed | shunt control enabled |
|--------------------------|---------------------------|-------------------------|--------------------------|------------------------|-----------------------|-----------------------|
| NOT READY TO SWITCH ON   | ✓                         | ✓                       | ✓                        |                        | ✓                     |                       |
| SWITCH ON DISABLED       | ✓                         | ✓                       | ✓                        |                        | ✓                     |                       |
| READY TO SWITCH ON       | ✓                         | ✓                       | ✓                        |                        | ✓                     |                       |
| SWITCHED ON              | ✓                         | ✓                       | ✓                        |                        | ✓                     |                       |
| <b>OPERATION ENABLED</b> | ✓                         | ✓                       | ✓                        | ✓                      |                       | ✓                     |
| QUICK STOP ACTIVE        | ✓                         | ✓                       | ✓                        | ✓                      |                       | ✓                     |
| FAULT REACTION ACTIVE    | ✓                         | ✓                       | ✓                        | ✓                      |                       | ✓                     |
| FAULT                    | ✓                         | ✓                       | ✓                        |                        | ✓                     |                       |

**MOTOR ENABLED** N/A

The system has a state machine implemented where every state determines which command are accepted or processed. For example, it is only possible to start a movement when the drive is in operation enabled state.

## 12. PARAMETERS

This screen displays a list of both Drive values and Application values of all the parameters that the drive supports.

A search box allows to search them by different criteria: name, index, sub-index, etc. Some of the parameters can be modified from this screen (Access type = ReadWrite or WriteOnly)



| Index  | SubIndex | Name                       | Data Type | Access Type | Drive Value | Application Value |
|--------|----------|----------------------------|-----------|-------------|-------------|-------------------|
| 0x1000 | 0x00     | Device Type                | UInt32    | ReadOnly    | 0x20192     | 0x20192           |
| 0x1001 | 0x00     | Error Register             | UInt8     | ReadOnly    | 0x11        | 0x11              |
| 0x1003 |          | Pre-defined Error Field    |           |             |             |                   |
| 0x1005 | 0x00     | COB-ID SYNC                | UInt32    | ReadWrite   | 0x80        | 0x80              |
| 0x1006 | 0x00     | Cycle Period               | UInt32    | ReadWrite   | 0x0         | 0x0               |
| 0x1007 | 0x00     | Sync Windows Length        | UInt32    | ReadWrite   | 0x0         | 0x0               |
| 0x1008 | 0x00     | Device name                | String    | Const       | emcl        | emcl              |
| 0x1009 | 0x00     | Hardware version           | String    | Const       | See PCB     | See PCB           |
| 0x100a | 0x00     | Software version           | String    | Const       | 1.1.6       | 1.1.6             |
| 0x100c | 0x00     | Guard Time                 | UInt16    | ReadWrite   | 0x0         | 0x0               |
| 0x100d | 0x00     | Life Time Factor           | UInt8     | ReadWrite   | 0x1         | 0x1               |
| 0x1010 |          | Store Parameters           |           |             |             |                   |
| 0x1011 |          | Restore default parameters |           |             |             |                   |
| 0x1014 | 0x00     | COB-ID Emergency message   | UInt32    | ReadWrite   | 0xA0        | 0xA0              |
| 0x1017 | 0x00     | Producer Heartbeat Time    | UInt16    | ReadWrite   | 0x0         | 0x0               |
| 0x1018 |          | Identity Object            |           |             |             |                   |
| 0x1200 |          | SSDO                       |           |             |             |                   |
| 0x1400 |          | RPDO 1                     |           |             |             |                   |
| 0x1401 |          | RPDO 2                     |           |             |             |                   |
| 0x1402 |          | RPDO 3                     |           |             |             |                   |
| 0x1403 |          | RPDO 4                     |           |             |             |                   |
| 0x1600 |          | RPDO 1 mapping parameter   |           |             |             |                   |
| 0x1601 |          | RPDO 2 mapping parameter   |           |             |             |                   |
| 0x1602 |          | RPDO 3 mapping parameter   |           |             |             |                   |
| 0x1603 |          | RPDO 4 mapping parameter   |           |             |             |                   |
| 0x1800 |          | TPDO 1                     |           |             |             |                   |
| 0x1801 |          | TPDO 2                     |           |             |             |                   |
| 0x1802 |          | TPDO 3                     |           |             |             |                   |
| 0x1803 |          | TPDO 4                     |           |             |             |                   |
| 0x1a00 |          | TPDO 1 mapping parameter   |           |             |             |                   |
| 0x1a01 |          | TPDO 2 mapping parameter   |           |             |             |                   |
| 0x1a02 |          | TPDO 3 mapping parameter   |           |             |             |                   |
| 0x1a03 |          | TPDO 4 mapping parameter   |           |             |             |                   |
| 0x2000 |          | Uart configuration         |           |             |             |                   |
| 0x2001 |          | CANopen configuration      |           |             |             |                   |

The following options are available at the top menu:

- READ all parameters from drive: update the parameter table visualized on the screen. User-modified values will be overwritten.
- WRITE all parameters to drive: download all the application parameters to the drive, overwriting the existing ones.
- WRITE modified parameters to drive: only download the application values modified by the user.
- RESTAURE default parameters.

### 13. MOTION

DCmind Soft + CANopen includes a **Motion Test Tool** in the top toolbar to test different motion modes, to perform homing and to verify that the system has been adjusted and works properly or launch a motion profile.

After configuring a specific profile, user can execute it with the **ENABLE/DISABLE MOTOR** button and stop it at any time.

All parameters can be changed during execution and update the motion profile.



**CAUTION:** The following modes will only appear if the connected drive is capable of performing such movements.

#### 13.1. Homing

See HOMING part of this document (section 6)

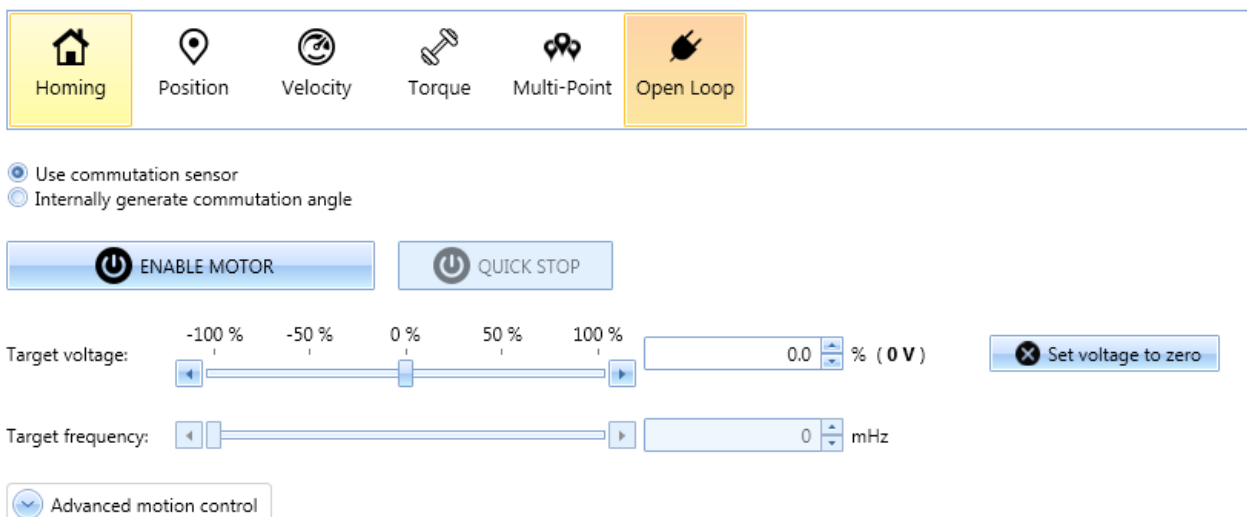
To do it just click on the ENABLE/DISABLE MOTOR button and wait for homing completion.



**WARNING:** It is necessary for a good motion performance to tune the servo loops before executing any homing method.

#### 13.1. Open Loop

Specify target voltage (in %) to reach a target velocity without feedback.



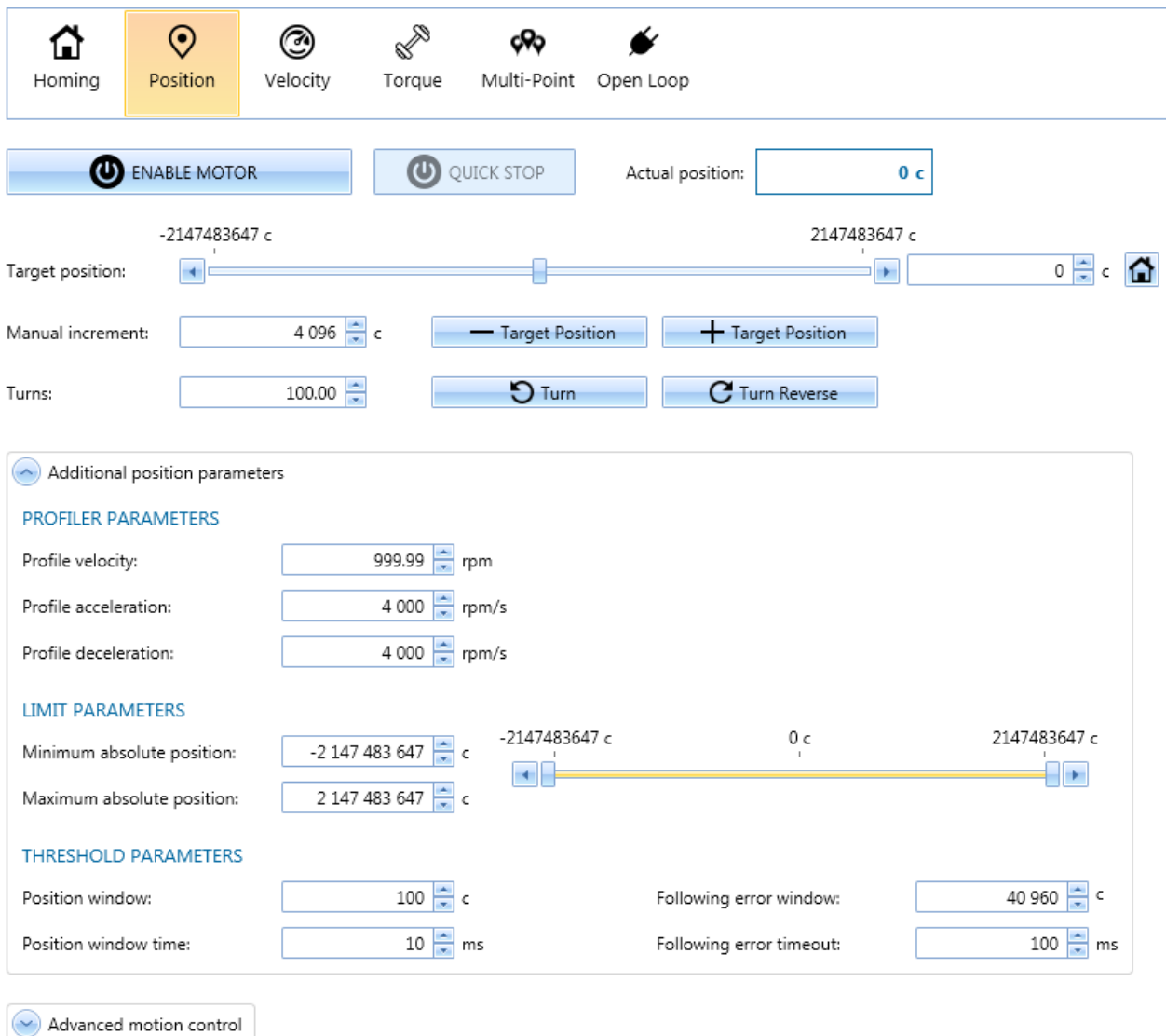
The screenshot shows the DCmind Motion Test Tool interface. At the top, there is a toolbar with six icons: Home, Position, Velocity, Torque, Multi-Point, and Open Loop. The Open Loop icon is highlighted in yellow. Below the toolbar, there are two radio buttons: "Use commutation sensor" (selected) and "Internally generate commutation angle". Below these are two buttons: "ENABLE MOTOR" and "QUICK STOP". Below the buttons, there are two sliders: "Target voltage" (ranging from -100% to 100%, currently set at 0.0%) and "Target frequency" (ranging from 0 to 100 mHz, currently set at 0 mHz). A "Set voltage to zero" button is also present. At the bottom, there is a dropdown menu for "Advanced motion control".



**CAUTION:** Open loop is available only in administrator mode

## 13.2. Profile Position

Specify velocity and acceleration to reach a given position.



The interface shows a navigation bar with icons for Homing, Position (selected), Velocity, Torque, Multi-Point, and Open Loop. Below this are buttons for 'ENABLE MOTOR' and 'QUICK STOP', and a display for 'Actual position: 0 c'. A slider for 'Target position' ranges from -2147483647 c to 2147483647 c, with a current value of 0 c. Below the slider are controls for 'Manual increment' (4 096 c), 'Turns' (100.00), and buttons for 'Target Position' (+/-) and 'Turn' (forward/reverse). A section titled 'Additional position parameters' includes 'PROFILER PARAMETERS' (Profile velocity: 999.99 rpm, Profile acceleration: 4 000 rpm/s, Profile deceleration: 4 000 rpm/s), 'LIMIT PARAMETERS' (Minimum absolute position: -2 147 483 647 c, Maximum absolute position: 2 147 483 647 c), and 'THRESHOLD PARAMETERS' (Position window: 100 c, Position window time: 10 ms, Following error window: 40 960 c, Following error timeout: 100 ms). An 'Advanced motion control' button is at the bottom.


Parameters for *Profile position* are:


- **Velocity:** It indicates the velocity applied to the profile.
- **Acceleration / Deceleration:** Acc/ decel applied to the displacement.
- **Target position:** Displacement in counts or user units.


The **House** icon (Go Home button) allows for commanding position zero to servo drive.


### 13.3. Profile Velocity


Specify acceleration and deceleration to reach a target speed.


  
Homing


  
Position


  
Velocity

  
Torque

  
Multi-Point

  
Open Loop


 ENABLE MOTOR

 QUICK STOP

Actual velocity: 0 rpm

Target velocity: 
-5000 rpm
0 rpm
5000 rpm
 0.00 rpm

Manual increment: 2.93 rpm
- Target Velocity
+ Target Velocity

 Additional velocity parameters

**PROFILER PARAMETERS**

Profile acceleration: 4 000 rpm/s

Profile deceleration: 4 000 rpm/s

**LIMIT PARAMETERS**


Maximum profile velocity: 5 000.00 rpm

-5000 rpm
0 rpm
5000 rpm

**THRESHOLD PARAMETERS**

Velocity window: 49.98 rpm
Velocity threshold: 49.98 rpm

Velocity window time: 10 ms
Velocity threshold time: 100 ms

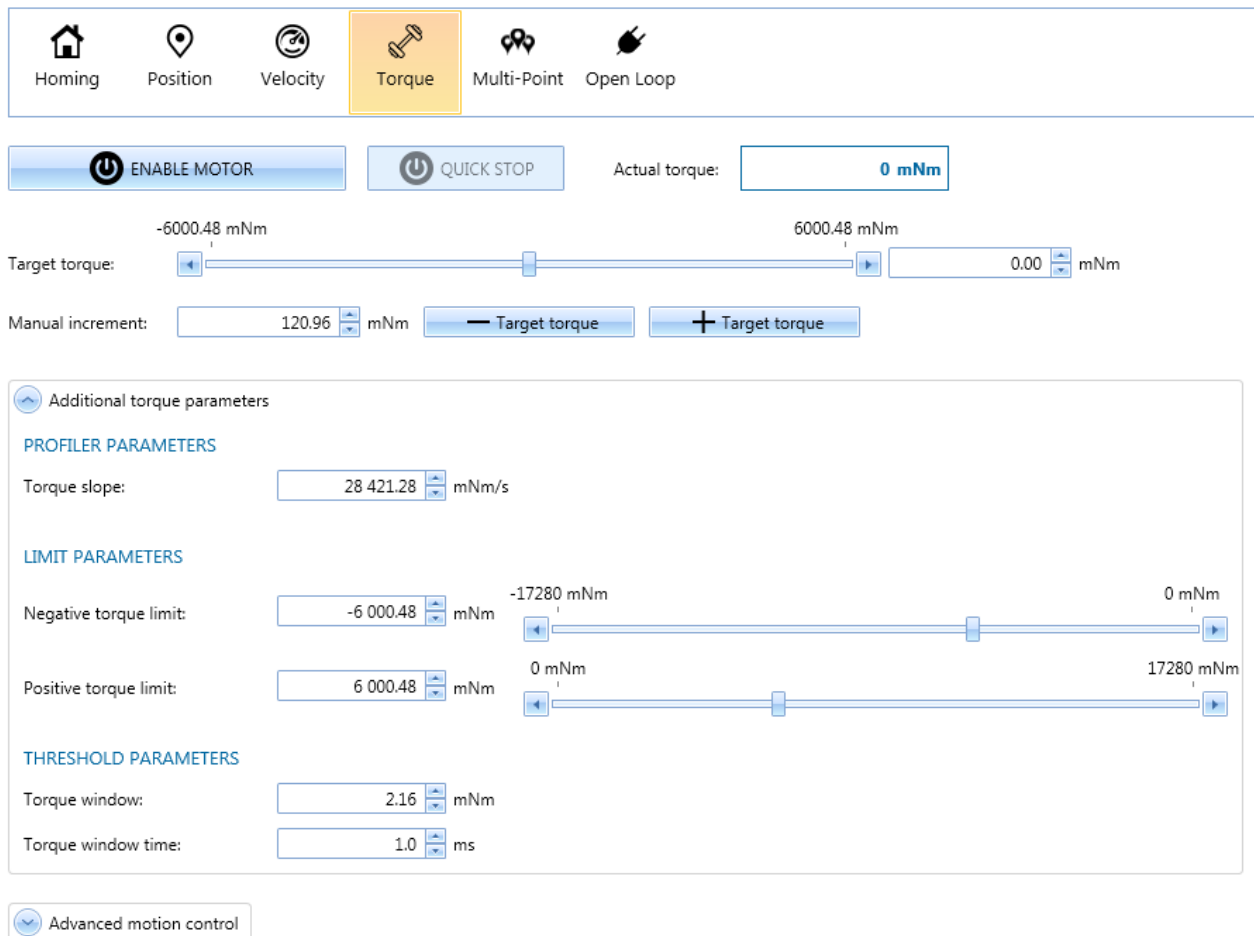
 Advanced motion control

Parameters for *Profile Velocity* are:

- **Acceleration / Deceleration:** Acc/ decel applied to reach target velocity.
- **Target velocity:** Velocity in counts/s or user units.

### 13.4. Profile Torque

In Torque Mode, the motor moves in one direction or another (depending on force value sign) trying to reach the torque setpoint.



Homeing Position Velocity **Torque** Multi-Point Open Loop

ENABLE MOTOR QUICK STOP Actual torque: **0 mNm**

Target torque: -6000.48 mNm 6000.48 mNm 0.00 mNm

Manual increment: 120.96 mNm - Target torque + Target torque

Additional torque parameters

**PROFILER PARAMETERS**  
 Torque slope: 28 421.28 mNm/s

**LIMIT PARAMETERS**  
 Negative torque limit: -6 000.48 mNm -17280 mNm 0 mNm  
 Positive torque limit: 6 000.48 mNm 0 mNm 17280 mNm

**THRESHOLD PARAMETERS**  
 Torque window: 2.16 mNm  
 Torque window time: 1.0 ms

Advanced motion control

Parameters for *Profile force* are:

- **Torque slope:** It sets how torque will increase.
- **Target torque:** Setpoint in mNm.

**CAUTION:** This test requires to apply some mechanical opposition to the movement. Try to hold the shaft otherwise it will rotate or move continuously. Test different values always under safety conditions using low values.

**CAUTION:** Notice that some configuration parameters are populated by default with the values entered under Profiler.

## 13.5. Multi-Point

Specify velocity and acceleration to reach several given positions (up to 15 positions).

Homing
 Position
 Velocity
 Torque
 Multi-Point
 Open Loop

ENABLE MOTOR
 QUICK STOP

Actual position:

| Position | Action                                       |
|----------|--|
| 0        | <span>+ Capture</span> <span>- Delete</span> |
| -10000   | <span>+ Capture</span> <span>- Delete</span> |
| 10000    | <span>+ Capture</span> <span>- Delete</span> |
| -20000   | <span>+ Capture</span> <span>- Delete</span> |
| 20000    | <span>+ Capture</span> <span>- Delete</span> |
| -30000   | <span>+ Capture</span> <span>- Delete</span> |
| 30000    | <span>+ Capture</span> <span>- Delete</span> |
| -40000   | <span>+ Capture</span> <span>- Delete</span> |
| 40000    | <span>+ Capture</span> <span>- Delete</span> |
| -50000   | <span>+ Capture</span> <span>- Delete</span> |
| 50000    | <span>+ Capture</span> <span>- Delete</span> |
| 0        | <span>+ Capture</span> <span>- Delete</span> |
|          | <span>+ Capture</span> <span>- Delete</span> |
|          | <span>+ Capture</span> <span>- Delete</span> |
|          | <span>+ Capture</span> <span>- Delete</span> |

Repeat sequence:

Pause before repeating:  ms

Additional position parameters

**PROFILER PARAMETERS**

Profile velocity:  rpm

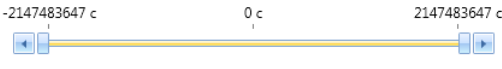
Profile acceleration:  rpm/s

Profile deceleration:  rpm/s

**LIMIT PARAMETERS**

Minimum absolute position:  c

Maximum absolute position:  c



**THRESHOLD PARAMETERS**

Position window:  c

Position window time:  ms

Following error window:  c

Following error timeout:  ms

Advanced motion control

Parameters for *Profile position* are:

- **Velocity:** It indicates the velocity applied to the profile.
- **Acceleration / Deceleration:** Acc/ decel applied to the displacement.
- **Target positions:** Displacement in counts or user units.

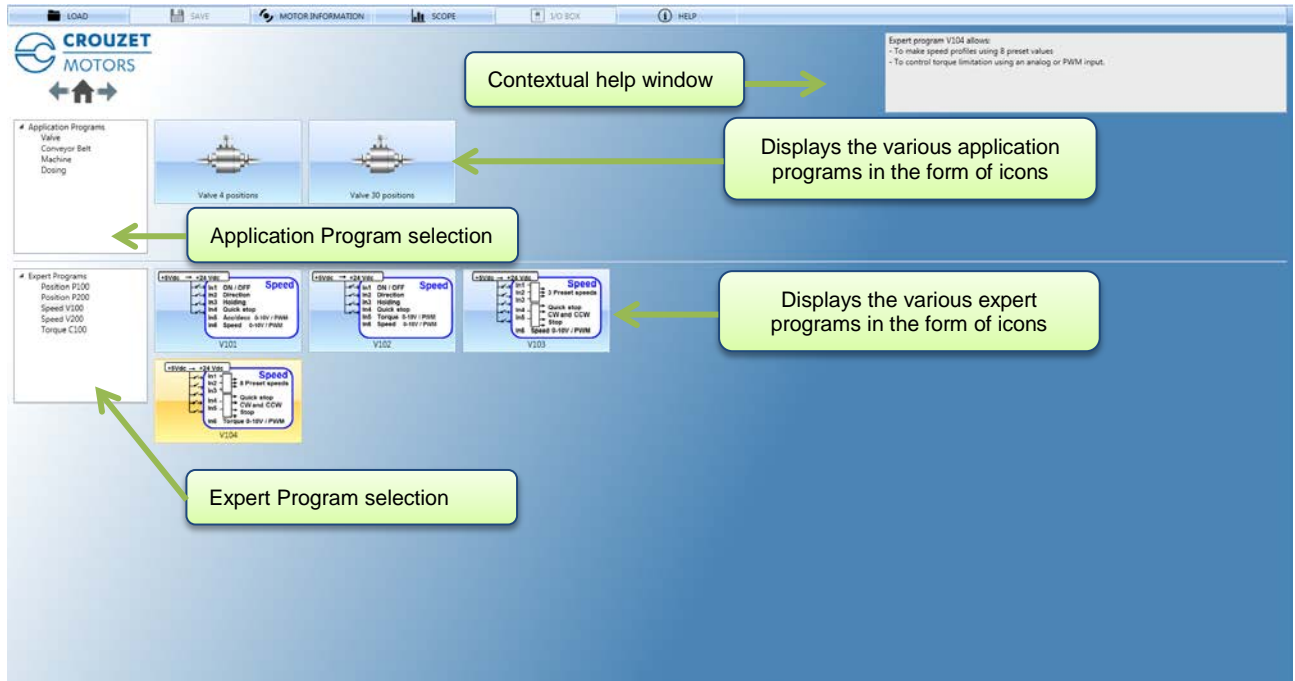
You have the possibility to make periodically this sequence by check the Repeat sequence case and set the time between 2 sequences.



## 14. DCMIND PROGRAMS

DCmind Soft CANopen includes also a **Specific Motion Test** named “**DCmind Programs**” in the top toolbar to test different specific programs, to perform homing and to verify that the system has been adjusted and works properly or launch a motion profile (velocity, position and torque).

### 14.1. Welcome screen



#### 14.1.1. Toolbar

The following table describes the function of each button in the Configuration toolbar (some buttons are available only when a motor is connected and selected).

| Title              | Description   |
|--------------------|---|
| LOAD               | Load values from File to Parameters list. This will load values from a previous configuration File (.xml). The parameters are automatically downloaded to the drive   |
| SAVE               | Users can save configurations at any time. This is very useful when a system has been completely set up and you want to store the parameters to download them to other identical systems.<br>To save a configuration, click the <b>SAVE</b> button. The output format for configuration file is an XML. User can find further information on that format at section Parameters file of this manual. |
| MOTOR INFORMATIONS | Open a window with the following informations: motor reference, coil reference, manufacturing date, firmware, bootloader, hardware and HMI version.   |
| SCOPE              | Open digital scope.   |
| I/O BOX            | Digital Inputs / Outputs simulator. Not implemented yet.  |
| HELP               | Open the online documentation   |

### 14.1.2. Programs description

#### Application programs:

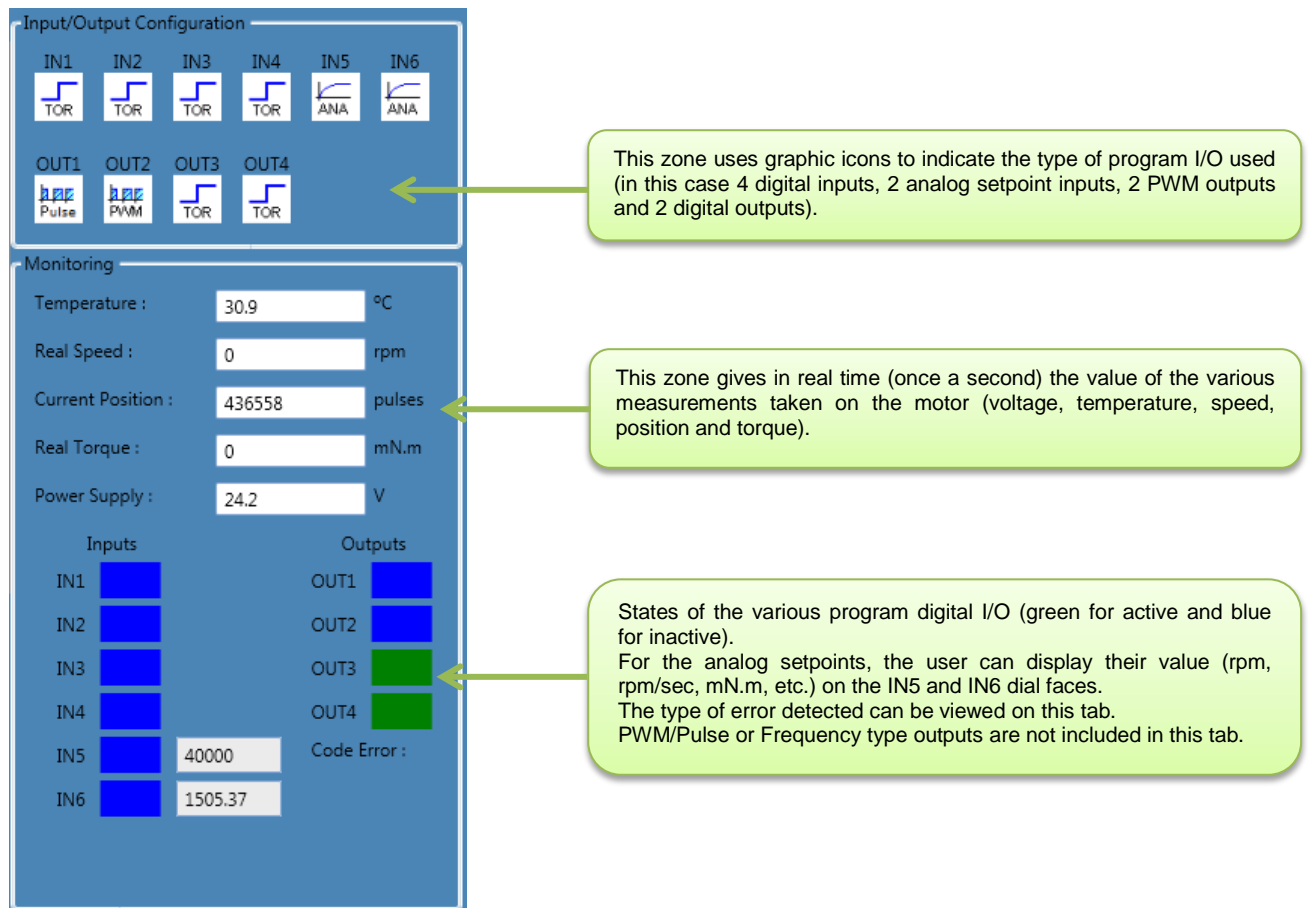
- The application programs are grouped together with similar applications (valve, conveyor belt, machine, etc.).
- They enable quick start-up with completion of just a few key application values.
- Each application program is based on a preconfigured expert program. After testing the motor a few times in the application, the user can refine the motor operation by accessing all the adjustment parameters via the expert program linked to the application program and changing the pre-filled values.

#### Expert programs:

- The expert programs are grouped together with similar programs (P1xx, P2xx, etc position control, V1xx, V2xx velocity control, C1xx, C2xx torque control).
- These are generic programs, not specific to any application. They can be used to access all the options and settings.
- They can be used directly, without going via the "application program" step and they offer a wider choice of uses.

### 14.1.3. Monitoring window

The monitoring part of the HMI is common to all the expert and application program tabs.



The screenshot displays the HMI monitoring window, divided into two main sections: "Input/Output Configuration" and "Monitoring".

**Input/Output Configuration:** This section shows the configuration for six inputs (IN1 to IN6) and four outputs (OUT1 to OUT4). Each input and output is represented by a graphic icon indicating its type: TOR (Tactile Output Relay), ANA (Analog), Pulse, or PWM.

**Monitoring:** This section displays real-time motor data in a table-like format:

|                    |        |        |
|--------------------|--------|--------|
| Temperature :      | 30.9   | °C     |
| Real Speed :       | 0      | rpm    |
| Current Position : | 436558 | pulses |
| Real Torque :      | 0      | mN.m   |
| Power Supply :     | 24.2   | V      |

Below the monitoring data, there are two columns of digital I/O status indicators:

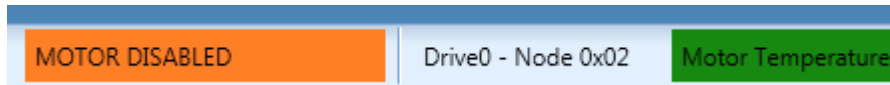
| Inputs             | Outputs      |
|--------------------|--------------|
| IN1 [Blue]         | OUT1 [Blue]  |
| IN2 [Blue]         | OUT2 [Blue]  |
| IN3 [Blue]         | OUT3 [Green] |
| IN4 [Blue]         | OUT4 [Green] |
| IN5 [Blue] 40000   | Code Error : |
| IN6 [Blue] 1505.37 |              |

Three callout boxes provide additional information:

- Callout 1:** This zone uses graphic icons to indicate the type of program I/O used (in this case 4 digital inputs, 2 analog setpoint inputs, 2 PWM outputs and 2 digital outputs).
- Callout 2:** This zone gives in real time (once a second) the value of the various measurements taken on the motor (voltage, temperature, speed, position and torque).
- Callout 3:** States of the various program digital I/O (green for active and blue for inactive). For the analog setpoints, the user can display their value (rpm, rpm/sec, mN.m, etc.) on the IN5 and IN6 dial faces. The type of error detected can be viewed on this tab. PWM/Pulse or Frequency type outputs are not included in this tab.

#### 14.1.4. Information bar

The monitoring information bar is common to all the expert and application program tabs.



The following information is present:

- **The motor status** : Enable, Disable or Fault (the error code is displayed in the monitoring part)
- **The node ID** of the drive
- **The Motor temperature information** is the external temperature sensor is selected.



CAUTION: The external temperature sensor isn't available with SMI21 CANopen motor.

#### 14.1.5. Stop button

The stop button is common to all the expert and application program tabs.



Click on this button will:

- **Stop the motor**: motor in disable state
- **Reset the actual application**: no application in the drive (index 0x2C10 sub-index 0x1 set at 0)
- **Reset the restart application**: after a power on the motor will be in standby (index 0x2C10 sub-index 0x3 set at 0).



WARNING: To go from DCmind programs to Motion standard profile, it's mandatory to click on the stop button (not only on the red cross), otherwise the drive can have an undesirable behavior.



WARNING: If you forgot to click on this button, you can directly change the register values (0x2C10: 0x1 = 0 and 0x2C10: 0x3 = 0).

## 14.2. Application Programs

### 14.2.1. "Valve" Group

#### 14.2.1.1. "Valve 4 positions"

The "Valve 4 positions" application program invokes the P101 expert program.

The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.

The values preset in application mode will be loaded directly in expert mode.

It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly.

To restart the motor, the program needs to be reloaded.

Once the settings are complete, press the "Load Program" button to configure the motor.

**Note:** Each time you power ON the power supply or a program is loaded, it is necessary to perform the homing sequence.

#### 14.2.1.1.1. Inputs/Outputs Configuration

##### Inputs:

- IN1: If 0 → No position setpoint, if 1 → Setpoint = "Position 1" Parameter
- IN2: If 0 → No position setpoint, if 1 → Setpoint = "Position 2" Parameter
- IN3: If 0 → No position setpoint, if 1 → Setpoint = "Position 3" Parameter
- IN4: If 0 → No position setpoint, if 1 → Setpoint = "Position 4" Parameter
- IN5: If 0 → No action, if 1 → Launch homing phase
- IN6: If 0 → Stop, if 1 → Run

N.B.: if more than 1 input IN1 to IN4 is activated at the same time, the motor switches to stop mode.

Outputs: Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: If 0 → position setpoint not reached, if 1 → position setpoint reached.
- OUT2: If 0 → homing phase complete, if 1 → homing phase in progress or not performed.
- OUT3: If 0 → motor stopped, if 1 → motor running.
- OUT4: If 0 → no error, if 1 → error detected.

#### 14.2.1.1.2. Application Settings

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default.
- The "Number of rotation(s) to close the valve" and "Mechanical ratio between the motor and the valve" parameters are used to calculate the application total stroke in number of motor revolutions:

$$Total\ course\ [Rotation\ motor] = Nb\ of\ rotationr_{closing\ valve} \times \eta_{Vaves\ vs\ Motor}$$

- The "Time to realize the total stroke" parameter is used to calculate the motor speed of rotation during the positioning phases:

$$Motor\ speed\ [RPM] = \frac{Total\ course\ [Rotation_{motor}] \times 60}{Time_{total\ course}\ [sec]}$$

The calculated value is given for information in the grayed-out box.

- The motor speed of rotation during the mechanical stop search phase (homing) is determined as follows:

$$Homing\ speed\ [RPM] = \frac{Motor\ speed\ [RPM]}{5}$$

#### 14.2.1.1.3. Motor Configuration

- Used to configure the mechanical stop search phase (homing) by setting the "Homing torque" and the direction of valve closing.
- The nominal and maximum torques **in the motor** are determined from the "Homing torque" value as follows:

$$Nominal\ torque = Homing\ torque$$

$$Torque\ Maxi = 2 \times Homing\ torque$$

- For information, the maximum torque value **seen by the valve** during operation is given in the grayed-out box.

#### 14.2.1.1.4. Valve Positioning

- The user has the option of setting 4 position setpoints parameters as a percentage of valve opening.
- By default, position 1 corresponds to detection of the mechanical stop (valve closed). If the user wishes to add an offset to avoid mechanical shocks during valve closing, he should change the "Position 1" parameter accordingly.
- By default, position 4 corresponds to the application total stroke (valve open).

For information, all 4 positions are given in number of pulses (4096 pulses per motor revolution) in the grayed-out boxes.

### 14.2.1.2. "Valve 30 positions" with 1 Mechanical Stop

Information: this is the speed of the motor to go from one position to another with the values defined by the user = total stroke x 60/(time x ratio)

**Application settings**

Project name : P111

Number of rotation(s) to close the valve : 0.25 turn(s)

Time to realize the total stroke (to close the valve): 1 second(s)

Mechanical ratio between the motor and the valve: 50.00

--> Maximum speed : 750 rpm

**Motor settings**

-Homing torque : 100 mN.m

Valve torque : --> 10 N.m

-Direction to close the valve:  Change the direction of rotation

**Inputs / Outputs configuration**

+5Vdc → +24 Vdc

In1 On / Off Homing Positions

In2

In3

In4

In5

In6 - Not Used

30 Positions

Target Homing (done = 0)

Running Error

Output = + Vcc supply (PNP open collector)

Out1

Out2

Out3

Out4

4.7 KΩ

4.7 KΩ

4.7 KΩ

**Monitoring**

Temperature : 35.6 °C

Real Speed : 0 rpm

Current Position : 0 pulses

Real Torque : 0 mN.m

Power Supply : 24.2 V

**Inputs**

IN1

IN2

IN3

IN4

IN5

IN6

**Outputs**

OUT1

OUT2

OUT3

OUT4

Code Error :

Load program

Expert mode

STOP

Input connections

Output connections

The "Valve 30 positions" application program invokes the P111 expert program.

The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.

The values preset in application mode will be loaded directly in expert mode.

It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly.

To restart the motor, the program needs to be reloaded.

Once the settings are complete, press the "Load Program" button to configure the motor.

**Note:** Each time you power ON the power supply or a program is loaded, it is necessary to perform the homing sequence.

#### 14.2.1.2.1. Inputs/Outputs Configuration

##### Inputs:

- IN1 to IN5: 32 possible combinations:
  - IN1 = IN2 = IN3 = IN4 = IN5 = 0 → Stop.
  - IN1 = 1, all 4 others = 0 → Launch homing phase.
  - The other 30 combinations correspond to the 30 position setpoints.
- IN6: Not used.

Outputs: Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: If 0 → position setpoint not reached,                      if 1 → position setpoint reached.
- OUT2: If 0 → homing phase complete,                                      if 1 → homing phase in progress or not performed.
- OUT3: If 0 → motor stopped,    if 1 → motor running.
- OUT4: If 0 → no error,    if 1 → error detected.

#### 14.2.1.2.2. Application Settings

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default.
- The "Number of rotation(s) to close the valve" and "Mechanical ratio between the motor and the valve" parameters are used to calculate the application total stroke in number of motor revolutions:

$$Totale\ course\ [Rotation_{motor}] = Nb\ rotation_{closing\ valve} \times \eta_{Valve\ vs\ Motor}$$

- The "Time to realize the total stroke" parameter is used to calculate the motor speed of rotation during the positioning phases:

$$Motor\ speed\ [RPM] = \frac{Totale\ course[rotation_{motor}] \times 60}{Time_{Totale\ course}\ [sec]}$$

The calculated value is given for information in the grayed-out box.

- The motor speed of rotation during the mechanical stop search phase (homing) is determined as follows:

$$Homing\ speed[RPM] = \frac{Motor\ speed\ [RPM]}{5}$$

#### 14.2.1.2.3. Motor Configuration

- Used to configure the mechanical stop search phase (homing) by setting the "Homing torque" and the direction of valve closing.
- The nominal and maximum torques **in the motor** should be determined from the "Homing torque" value as follows:

$$Nominal\ torque = Homing\ torque$$

$$Maxi\ torque = 2 \times Homing\ torque$$

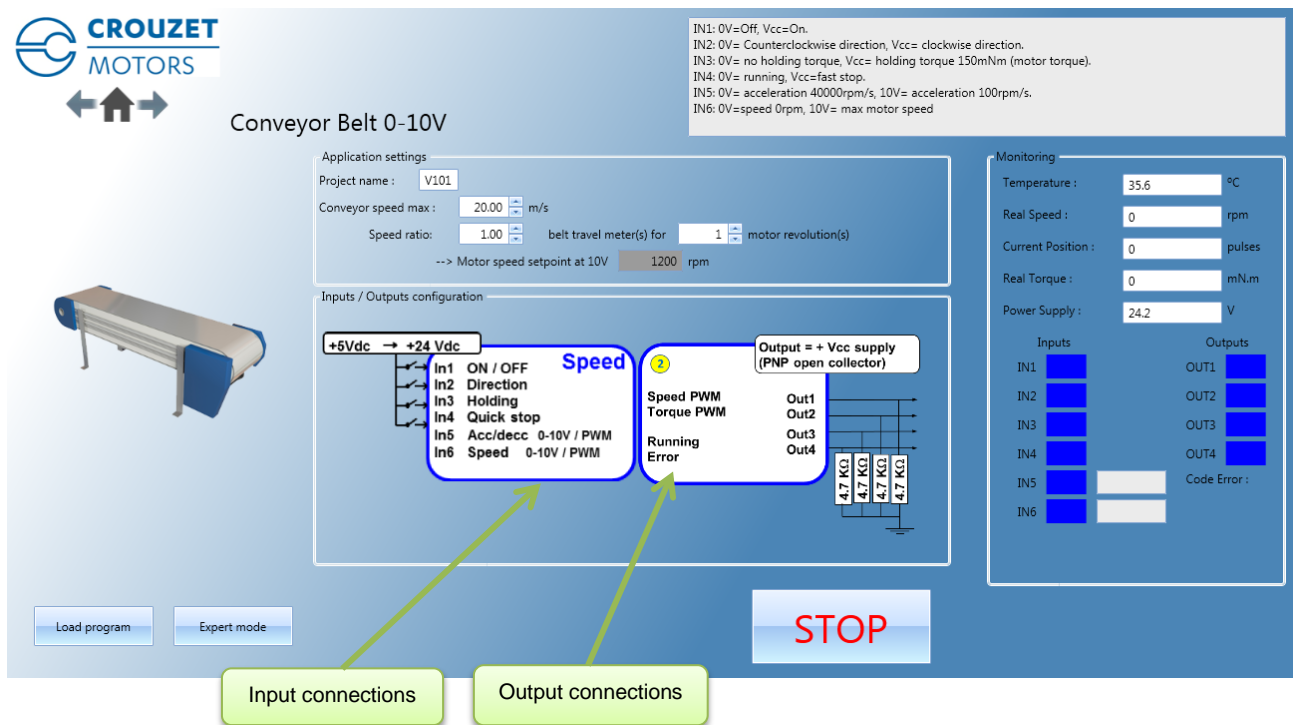
- For information, the maximum torque value **seen by the valve** during operation is given in the grayed-out box.

#### 14.2.1.2.4. Position Table

- The user is not able to change the position setpoints, they will automatically be defined with between 2 and 30 equal positions, according to the defined total stroke and the "Number of positions" parameter. To change them, you need to change to "Expert Mode".
- By default, position 1 corresponds to detection of the mechanical stop (valve closed).
- By default, the last position corresponds to the application total stroke (valve open).
- For information, the position setpoints are given in number of valve rotations and number of pulses (4096 pulses per motor revolution).

## 14.2.2. "Conveyor Belt" Group

### 14.2.2.1. "Conveyor Belt 0-10V"



The "Conveyor Belt 0-10V" application program invokes the V101 expert program.

The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.

The values preset in application mode will be loaded directly in expert mode.

It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly.

To restart the motor, the program needs to be reloaded.

Once the settings are complete, press the "Load Program" button to configure the motor.

#### 14.2.2.1.1. Inputs/Outputs Configuration

##### Inputs:

- IN1: If 0 → Stop, if 1 → Run
- IN2: If 0 → motor running in reverse (CCW), if 1 → motor running forward (CW)
- IN3: If IN3 = 1 and IN1 = 1 and IN6 = 0, application of a 150 mNm holding torque.
- IN4: If 0 → no action, if 1 → Quick start by short-circuiting the coils. This action takes priority over the other commands.
- IN5: 0-10 V control. Sets the motor acceleration and deceleration. 40,000 rpm/sec for 0 V (maximum acceleration) and 100 rpm/sec for 10 V.
- IN6: 0-10 V control. Sets the speed setpoint. 0 V for 0 rpm and 10 V for the maximum motor speed defined by the user.



Outputs: Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: Provides information on the motor speed value in PWM.  
Cyclical ratio = 0% → speed = 0 rpm  
Cyclical ratio = 100% → speed = maximum speed.
- OUT2: Provides information on the real torque value in PWM.  
Cyclical ratio = 0% → torque = 0 mNm  
Cyclical ratio = 100% → torque = 1 Nm.
- OUT3: If 0 → motor running, if 1 → motor stopped.
- OUT4: If 0 → error detected, if 1 → no error.

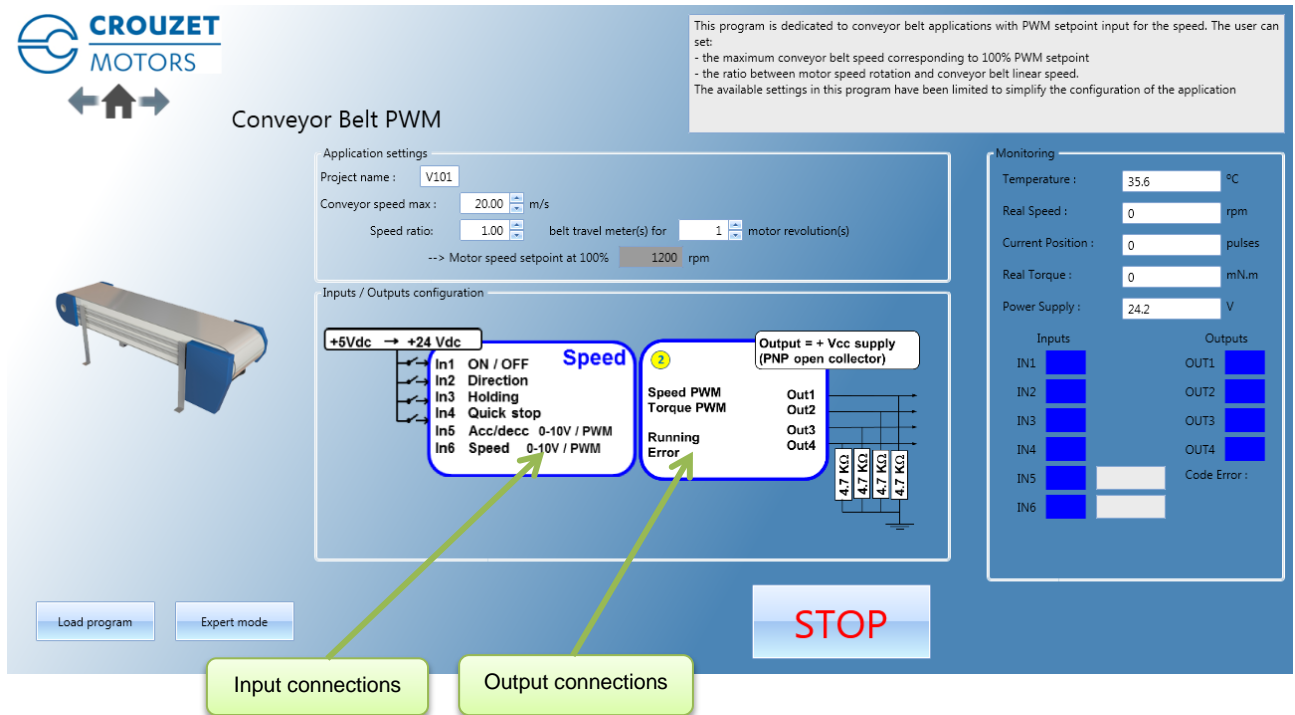
#### 14.2.2.1.2. Application Settings

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default.
- The maximum motor speed corresponding to a voltage of 10 V is calculated as follows:

$$\text{Setpoint motor speed}_{10V}[\text{RPM}] = \frac{\text{Max speed Tapis [m. s}^{-1}] \times 60}{\text{Speed step [m. tr}^{-1}]}$$

The calculated value is given for information in the grayed-out box.

### 14.2.2.2. "Conveyor Belt PWM"



The "Conveyor Belt PWM" application program invokes the V101 expert program. The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button. The values preset in application mode will be loaded directly in expert mode. It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly. To restart the motor, the program needs to be reloaded.

Once the settings are complete, press the "Load Program" button to configure the motor.

#### 14.2.2.2.1. Inputs/Outputs Configuration

##### Inputs:

- IN1: If 0 → Stop, if 1 → Run
- IN2: If 0 → motor running in reverse (CCW), if 1 → motor running forward (CW)
- IN3: If IN3 = 1 and IN1 = 1 and IN6 = 0, application of a 150 mNm holding torque.
- IN4: If 0 → no action, if 1 → Quick start by short-circuiting the coils. This action takes priority over the other commands.
- IN5: PWM control. Sets the motor acceleration and deceleration. 40,000 rpm/sec for 0% PWM (maximum acceleration) and 100 rpm/sec for 100% PWM.
- IN6: PWM control. Sets the speed setpoint. 0% PWM for 0 rpm and 100% PWM for the maximum motor speed defined by the user.

Outputs: Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: Provides information on the motor speed value in PWM.  
Cyclical ratio = 0% → speed = 0 rpm  
Cyclical ratio = 100% → speed = maximum speed.
- OUT2: Provides information on the real torque value in PWM.  
Cyclical ratio = 0% → torque = 0 mNm  
Cyclical ratio = 100% → torque = 1 Nm.
- OUT3: If 0 → motor running, if 1 → motor stopped.
- OUT4: If 0 → error detected, if 1 → no error.

#### 14.2.2.2.2. Application Settings

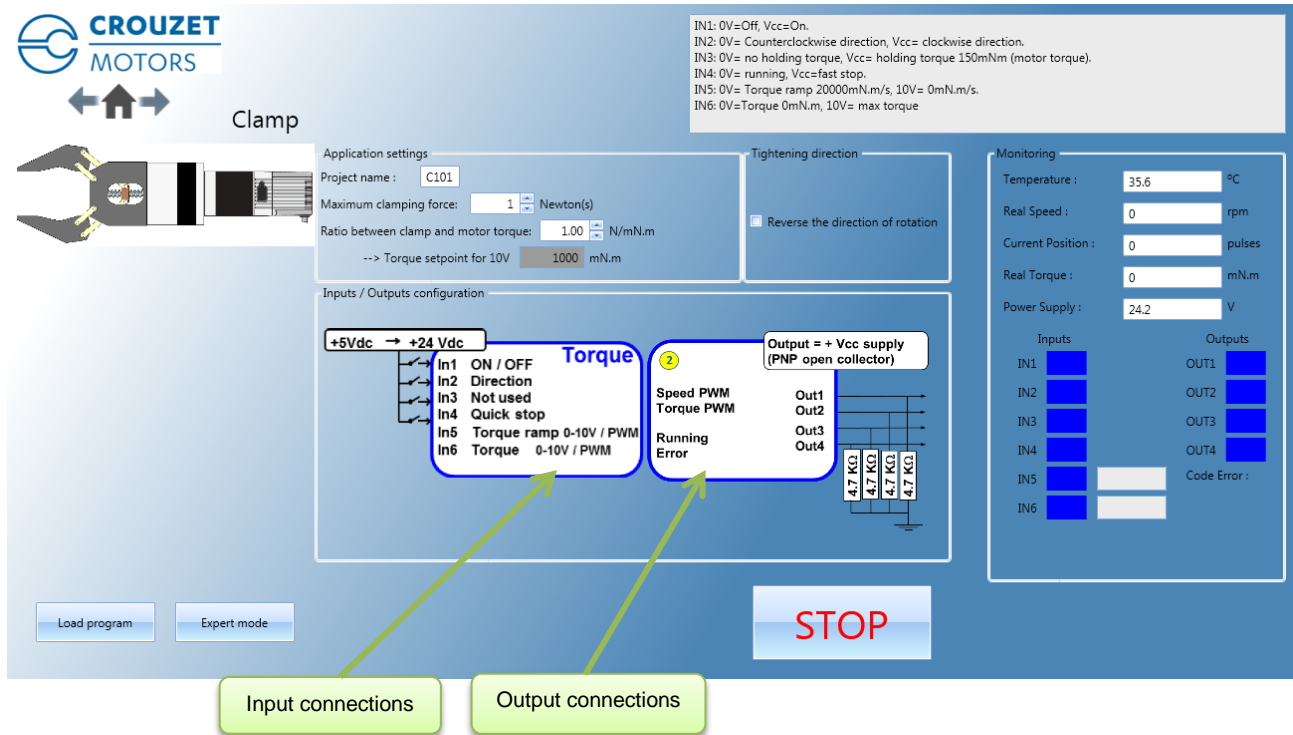
- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default.
- The maximum motor speed corresponding to a PWM signal with 100% cyclical ratio is calculated as follows:

$$\text{Setpoint motor speed}_{100\% PWM} [RPM] = \frac{\text{Max speed } [m.s^{-1}] \times 60}{\text{Speed step } [m.tr^{-1}]}$$

The calculated value is given for information in the grayed-out box.

### 14.2.3. "Machine" Group

#### 14.2.3.1. "Clamp"



The screenshot shows the 'Clamp' application settings. Key sections include:

- Application settings:** Project name: C101, Maximum clamping force: 1 Newton(s), Ratio between clamp and motor torque: 1.00 N/mNm.
- Inputs / Outputs configuration:** Shows connections for In1 (ON/OFF), In2 (Direction), In3 (Not used), In4 (Quick stop), In5 (Torque ramp), and In6 (Torque). It also shows output connections for Out1-4 and a code error field.
- Monitoring:** Displays Temperature (35.6 °C), Real Speed (0 rpm), Current Position (0 pulses), Real Torque (0 mNm), and Power Supply (24.2 V).

The "Clamp" application program invokes the C101 expert program.

The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.

The values preset in application mode will be loaded directly in expert mode.

It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly.

To restart the motor, the program needs to be reloaded.

Once the settings are complete, press the "Load Program" button to configure the motor.

#### 14.2.3.1.1. Inputs/Outputs Configuration

##### Inputs:

- IN1: If 0 → Stop, if 1 → Run
- IN2: If 0 → motor running in reverse (CCW), if 1 → motor running forward (CW)
- IN3: Not used.
- IN4: If 0 → no action, if 1 → Quick start by short-circuiting the coils. This action takes priority over the other commands.
- IN5: 0-10 V control. Sets the motor torque ramp. 20,000 mNm/sec for 0 V (maximum ramp) and 100 mNm/sec for 10 V.
- IN6: 0-10 V control. Sets the torque setpoint. 0V for 0 mNm and 10V for the maximum motor torque defined by the user (value in the greyed-out box).

Outputs: Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: Provides information on the motor speed value in PWM.  
Cyclical ratio = 0% → speed = 0 rpm  
Cyclical ratio = 100% → speed = 4000 rpm.
- OUT2: Provides information on the real torque value in PWM.  
Cyclical ratio = 0% → torque = 0 mNm  
Cyclical ratio = 100% → torque = maximum torque.
- OUT3: If 0 → motor running, if 1 → motor stopped.
- OUT4: If 0 → error detected, if 1 → no error.

#### 14.2.3.1.2. Application Settings

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default.
- The maximum motor torque corresponding to a voltage of 10 V is calculated as follows:

$$\text{Consigne Couple Moteur}_{10V} [mNm] = \frac{\text{Force Maxi Serrage} [N]}{\text{Rapport}_{\text{Pince/Moteur}} [N/mNm]}$$

The calculated value is given for information in the grayed-out box.

### 14.2.3.2. "Worm Gear"

This program is dedicated to positioning worm gear applications. The application can be made with either the motor alone or the motor associated with an adjustable reduction system (belt / pulley, gear). The user can set the homing phase (type of stop, search direction, offset between software zero and mechanical zero), mechanical design (total stroke, step of the screw, reduction ratio, yield) and physical limitations (linear).

**Mechanical setting**  
 Total stroke length : 300 mm  
 Step of the screw : 5.00 mm/tour  
 Mechanical ratio between the motor and the screw (belt/pulley, gearbox, included) : 20 / 1  
 Mechanical system efficiency : 100 %

**Application limits**  
 Maximum linear speed : 10 mm/s  
 Maximum force : 1 000 N  
 Speed max : 2400 rpm  
 Torque max : 80 mN.m

**Homing phase**  
 - Project name : P111  
 - Type of stop :  Mécanique  Switch  
 - Direction of rotation (to go to the stop) :  
 Clockwise direction (direction 1)  
 Counter clockwise direction (direction 2)  
 - Offset between position 1 and stop : 10 mm

**Monitoring**  
 Temperature : 35.6 °C  
 Real Speed : 0 rpm  
 Current Position : 0 pulses  
 Real Torque : 0 mN.m  
 Power Supply : 24.2 V

**Positions Table**  
 Number of positions : 30

| IN1 | IN2 | IN3 | IN4 | IN5 | Position (mm) |
|-----|-----|-----|-----|-----|---------------|
| 0   | 1   | 0   | 0   | 0   | 0             |
| 1   | 1   | 0   | 0   | 0   | 10.345        |
| 0   | 0   | 1   | 0   | 0   | 20.69         |
| 1   | 0   | 1   | 0   | 0   | 31.034        |
| 0   | 1   | 1   | 0   | 0   | 41.379        |
| 1   | 1   | 1   | 0   | 0   | 51.724        |
| 0   | 0   | 0   | 1   | 0   | 62.069        |
| 1   | 0   | 0   | 1   | 0   | 72.414        |
| 0   | 1   | 0   | 1   | 0   | 82.759        |
| 1   | 1   | 0   | 1   | 0   | 93.103        |
| 0   | 0   | 1   | 1   | 0   | 103.448       |
| 1   | 0   | 1   | 1   | 0   | 113.793       |
| 0   | 1   | 1   | 1   | 0   | 124.138       |

**Inputs / Outputs configuration**  
 Inputs: IN1 (On / Off), IN2 (Homing), IN3 (Positions), IN4 (Positions), IN5 (Positions), IN6 (Switch 1)  
 Outputs: Out1 (Target Homing done = 0), Out2 (Running Error), Out3 (PNP open collector), Out4 (PNP open collector)

**STOP**

Input connections: IN1, IN2, IN3, IN4, IN5, IN6

Output connections: Out1, Out2, Out3, Out4

The "Worm Gear" application program invokes the P111 expert program. The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.

The values preset in application mode will be loaded directly in expert mode. It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly. To restart the motor, the program needs to be reloaded.

Once the settings are complete, press the "Load Program" button to configure the motor.

**Note:** Each time you power ON the power supply or a program is loaded, it is necessary to perform the homing sequence.

#### 14.2.3.2.1. Inputs/Outputs Configuration

##### Inputs:

- IN1 to IN5: 32 possible combinations:
  - IN1 = IN2 = IN3 = IN4 = IN5 = 0 → Stop
  - IN1 = 1, all 4 others = 0 → Launch homing phase
  - The other 30 combinations correspond to the 30 position setpoints
- IN6: Switch limit input if « switch » is selected as "type of stop"

##### Outputs:

Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: If 0 → position setpoint not reached, if 1 → position setpoint reached.
- OUT2: If 0 → homing phase complete, if 1 → homing phase in progress or not performed.
- OUT3: If 0 → motor stopped, if 1 → motor running.
- OUT4: If 0 → no error, if 1 → error detected.

#### 14.2.3.2.2. Initialization Phase

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default.
- Select the type of stop, either "Mechanical" if the stop is achieved by detection of an obstacle on the application, or "Switch" if a limit switch is used in the application.
- Define the motor direction of rotation used to reach the stop selected above (forward (CW) rotation by default).
- To protect the application and prevent the mechanical stop being reached each time it returns to position zero, a position offset (in mm) can be set between the mechanical stop and position 1 corresponding to the application reference.

#### 14.2.3.2.3. Application Settings

- To determine the maximum operating speed during the positioning phases, the user should enter the maximum linear speed in mm/s and the "Step of the screw" and "Mechanical ratio between the motor and the screw" adjustment parameters are used to obtain a motor speed of rotation according to the formula below:

$$Motor\ speed\ [RPM] = \frac{Linear\ speed\ [mm/s] \times step_{Reduction} \times 60}{Step_{screw}\ [mm/rotation]}$$

- The motor speed of rotation during the mechanical stop search phase (homing) is determined as follows:

$$Homing\ speed\ [RPM] = \frac{Motor\ speed\ [RPM]}{5}$$

#### 14.2.3.2.4. Motor Configuration

- To determine the nominal torque during operation, the user should enter the maximum thrust for his application in Newtons and the "Step of the screw" and "Mechanical ratio between the motor and the screw" adjustment parameters are used to obtain a nominal motor torque using the following formula:

$$Motor\ torque\ [mN.m] = \frac{1}{2\pi} \times \frac{Pushing\ [N] \times Step_{screw}\ [mm/tour]}{Step_{Reduction}}$$

- The homing and maximum torques for detecting the mechanical stop **in the motor** are determined from the "Motor Torque" value defined above as follows:

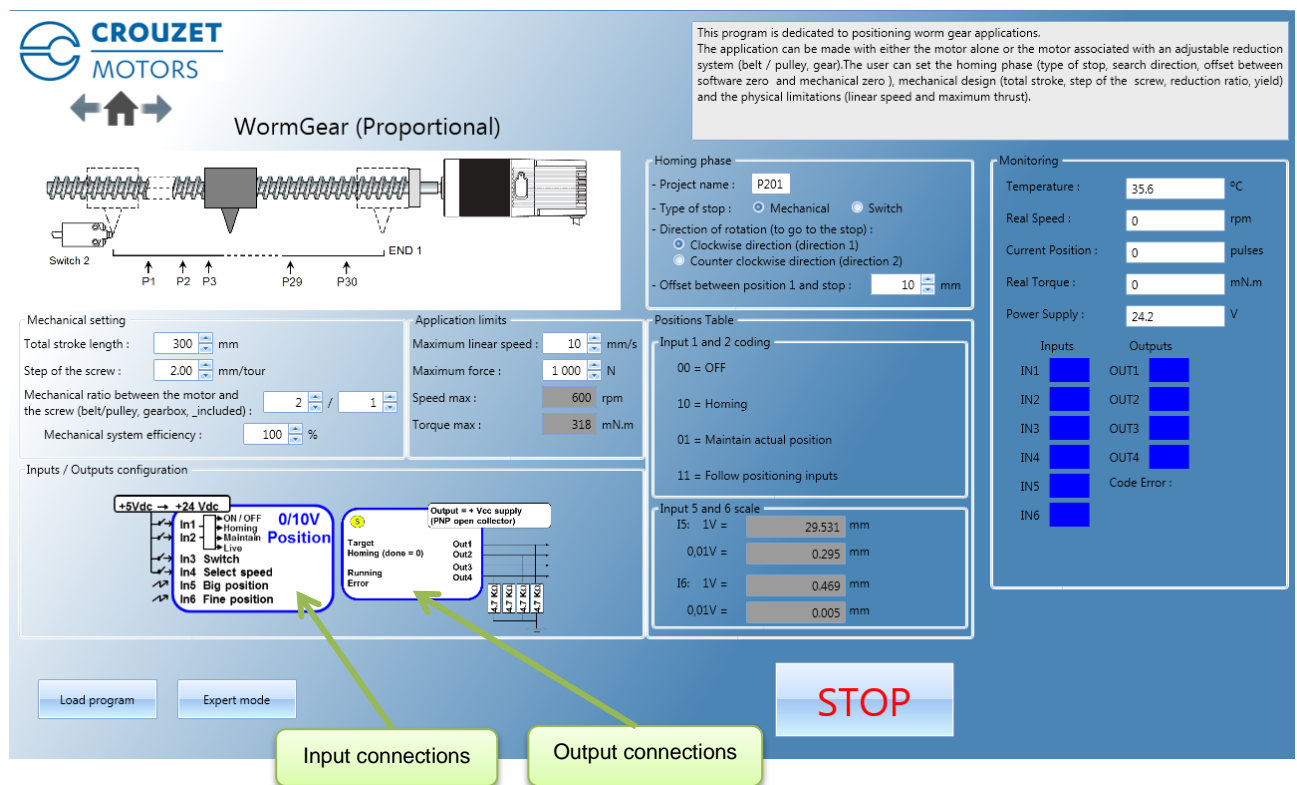
$$Homing\ torque = Motor\ torque$$

$$Maxi\ torque = 2 \times Motor\ torque$$

#### 14.2.3.2.5. Position Table

- The user is not able to enter the 2 to 30 position setpoints himself, they are automatically defined with between 2 and 30 equidistant positions, according to the defined total stroke "Total stroke length" and the "Number of positions" parameter.
- Position 1 corresponds to detection of the mechanical stop (as close as possible to the offset).
- The last position corresponds to the application total stroke.
- In the table, the position setpoints are given in mm.

### 14.2.3.3. "Worm Gear Proportional"



The "Worm Gear (Proportional)" application program uses the P201 expert program.

The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.

The values preset in application mode will be loaded directly in expert mode.

It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly.

To restart the motor, the program needs to be reloaded.

Once the settings are complete, press the "Load Program" button to configure the motor.

**Note:** Each time you power ON the power supply or a program is loaded, it is necessary to perform the homing sequence

#### 14.2.3.3.1. Inputs/Outputs Configuration

##### Inputs:

- IN1 and IN2: 4 possible combinations:
  - [IN1-IN2] = [00] → Stop and error reset
  - [IN1-IN2] = [10] → Homing phase
  - [IN1-IN2] = [01] → Maintain actual position
  - [IN1-IN2] = [11] → Go to required position
- IN3: Switch limit input if « switch » is selected as "type of stop"
- IN4: High speed (if 0) or low speed (if 1) selection
- IN5: Proportional position setting – Coarse tuning
- IN6: Proportional position setting – Thin tuning



Outputs: Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: Provides information on the motor speed value in PWM.  
Cyclical ratio = 0% → speed = 0 rpm  
Cyclical ratio = 100% → speed = 4000 rpm.
- OUT2: Provides information on the real torque value in PWM.  
Cyclical ratio = 0% → torque = 0 mNm  
Cyclical ratio = 100% → torque = maximum torque.
- OUT3: If 0 → motor running, if 1 → motor stopped.
- OUT4: If 0 → error detected, if 1 → no error.

#### 14.2.3.3.2. Initialization Phase

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default. For more details, see the "Saving Parameters" paragraph.
- Select the type of stop, either "Mechanical" if the stop is achieved by detection of an obstacle on the application, or "Switch" if a limit switch is used in the application.
- Define the motor direction of rotation used to reach the stop selected above (forward (CW) rotation by default).
- To protect the application and prevent the mechanical stop being reached each time it returns to position zero, a position offset (in mm) can be set between the mechanical stop and position 1 corresponding to the application reference.

#### 14.2.3.3.3. Application Settings

- To determine the maximum operating speed during the positioning phases, the user should enter the maximum linear speed in mm/s and the "Step of the screw" and "Mechanical ratio between the motor and the screw" adjustment parameters are used to obtain a motor speed of rotation according to the formula below:

$$\text{Maximum speed [RPM]} = \frac{\text{Maximum linear speed [mm/s]} \times \text{step}_{\text{Reduction}} \times 60}{\text{Step}_{\text{screw}} [\text{mm/rotation}]}$$

- By activating the digital input 4 (IN4 = 1), the user selects the low speed profile:

$$\text{Low speed [RPM]} = \frac{\text{Maximum speed [RPM]}}{5}$$

- The motor speed of rotation during the mechanical stop search phase (homing) is determined as follows:

$$\text{Homing speed [RPM]} = \frac{\text{Maximum speed [RPM]}}{5}$$

**NB:** Motor speed is restricted to max. 4000 rpm in this program. If this value is exceeded, the writing becomes red colored and the loading of the parameters becomes impossible. It is strongly advised to check motor specifications before to configuring the application.

#### 14.2.3.3.4. Motor Configuration

- To determine the maximum torque during operation, the user should enter the maximum thrust for his application in Newtons and the "Step of the screw" and "Mechanical ratio between the motor and the screw" and "Mechanical system efficiency" adjustment parameters are used to obtain a maximum motor torque using the following formula:

$$\text{Maximum torque [mN.m]} = \frac{1}{2\pi} \times \frac{\text{Pushing [N]} \times \text{Step}_{\text{screw}} [\text{mm/tour}]}{\text{Step}_{\text{Reduction}}} \times 2$$

$$\text{Nominal torque} = \frac{\text{Maximum torque}}{2}$$

- To detect the mechanical end stop, the homing torque is automatically set to be equal to nominal torque.

**NB:** The max. torque has to don't be higher than 1000 mNm. If this value is exceeded, the writing becomes red colored and the loading of the parameters becomes impossible.

The real maximum torque value is limited per motor characteristics. It is strongly advised to check motor specifications before to configuring the application.

#### 14.2.3.3.5. Position setpoint

- The user indicates the total stroke in mm of the application: parameter « Total stroke length ». The full stroke is achieved when both setpoints (IN5 and IN6) are at 10V. To travel this distance, the settings are distributed as follows:
  - Coarse setting: Input IN5 allows to travel 63/64th of the « total stroke length »
  - Thin setting: Input IN6 allows to travel 1/64th of the « total stroke length »
- The resolution of each of the two inputs IN5 and IN6 is given as an indication in the gray boxes in the « Position table – Input 5 and input 6 scale » zone:
  - Distance equivalent to an applied voltage of 1V
  - Distance equivalent to an applied voltage of 0,01V (resolution of the system)

**Example:** For a «Total stroke length » = 300 mm:

→ Input IN5 allows to travel:  $\text{Stroke}_{E5} = \frac{63}{64} \times 300\text{mm} = 295,3125\text{mm}$  (for 10V applied)

Meaning 29,53125 mm for 1V

Meaning 0,2953125 mm for 0,01V

→ Input IN6 allows to travel:  $\text{Stroke}_{E6} = \frac{1}{64} \times 300\text{mm} = 4,6875\text{mm}$  (for 10V applied)

Meaning 0,46875 mm for 1V

Meaning 0,0046875 mm for 0,01V

## 14.2.4. "Dosing" Group

### 14.2.4.1. "Peristaltic pump"

**Peristaltic Pump**

This program is dedicated to dosing applications (flow or fix doses). The user can set:

- Fix quantity: 3 preset doses and 1 adjustable dose (0/10V input)
- Continuous flow: 4 preset speed ranges and speed set per analog 0/10V input into the selected speed range.

**Application settings**

Project name: P201  
 Flow: 20.00 ml/rotation Mechanical Ratio: 1.00

**Dose setting and coding**

|              | IN 4 | IN 5 | Dose        | Time    | Speed Motor |
|--------------|------|------|-------------|---------|-------------|
| Dose 1       | 1    | 0    | 100.00 ml   | 60.00 s | 5 rpm       |
| Dose 1       | 0    | 1    | 100.00 ml   | 10.00 s | 90 rpm      |
| Dose 1       | 1    | 1    | 1 000.00 ml | 60.00 s | 50 rpm      |
| Dose 4 (10V) | 0    | 0    | 4 000.00 ml | 60.00 s | 200 rpm     |

**Monitoring**

Temperature: 35.6 °C  
 Real Speed: 0 rpm  
 Current Position: 0 pulses  
 Real Torque: 0 mN.m  
 Power Supply: 24.2 V

**Inputs / Outputs configuration**

**Coding Speed Range**

| IN1 | IN2 | MinSpeed | MaxSpeed | MinFlow | MaxFlow |
|-----|-----|----------|----------|---------|---------|
| 0   | 0   | 0        | 3000     | 0       | 60      |
| 1   | 0   | 0        | 1000     | 0       | 20      |
| 0   | 1   | 900      | 2000     | 18      | 40      |
| 1   | 1   | 1800     | 3000     | 36      | 60      |

**Input connections** and **Output connections** are shown in the diagram.

**STOP** button is visible at the bottom.

The "Peristaltic pump" application program uses a preset V201 expert program. The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.

The values preset in application mode will be loaded directly in expert mode. It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly.

To restart the motor, the program needs to be reloaded.

Once the settings are complete, press the "Load Program" button to configure the motor.

#### 14.2.4.1.1. Inputs/Outputs Configuration

##### Inputs:

- IN1: ON/OFF      0 → Stop      1 → ON
- IN2: Mode      0 → Dosing mode      1 → Flow mode (speed)
- IN3: Direction / Go
  - In flow mode:      0 → Motor turns CCW      1 → Motor turns CW
  - In Dosing mode:      0 → No new dosing      1 → launches a new dose

**Note:** When Dosing mode is selected, the IN3 signal has to be available during more than 15ms before to be taken in count.
- IN4 + IN 5: Coding      Codes speed range or dose values depending on selected mode.
- IN6: Flow / Dose      0/10V analog input.
  - In Flow mode: Adjusts the flow value depending on the flow range selected (IN4 and I N5 coding).
  - In Dosing mode: Adjusts D4, the dose to deliver (IN4=IN5=1)

**Outputs:** Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: Mode
  - 0: Dosing mode
  - 1: Flow mode
- OUT2: Direction of rotation
  - 0: CCW
  - 1: CW
- OUT3: Target
  - In Dosing mode:    0 → Dose not completely delivered,    1 → Dose completed
  - In Flow mode:        0 → Motor is running                                    1 → Motor doesn't move
- OUT4: Error
  - 0 → No error detected
  - 1 → Error detected

#### 14.2.4.1.2. Application configuration

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default. For more details, see the "Saving Parameters" paragraph.
- « Dose », « Time » and « ratio » parameters allow to calculate the motor parameters for each dose (IN4 + IN5) the position to move, speed to deliver the dose. Calculation is as following:

$$Position\ setting\ [Pulses] = \frac{Dose\ [ml] \times 4096}{Flow\ [m.tr^{-1}]} \times Ratio$$

$$Speed\ setting\ [RPM] = \frac{Dose\ [ml]}{Flow\ [m.tr^{-1}]} \times \frac{60}{Time\ [sec]} \times Ratio$$

For information, for each dose, the calculated speed is in grey boxes.

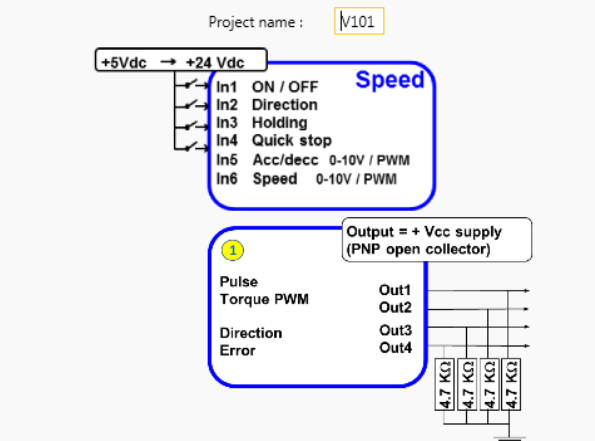
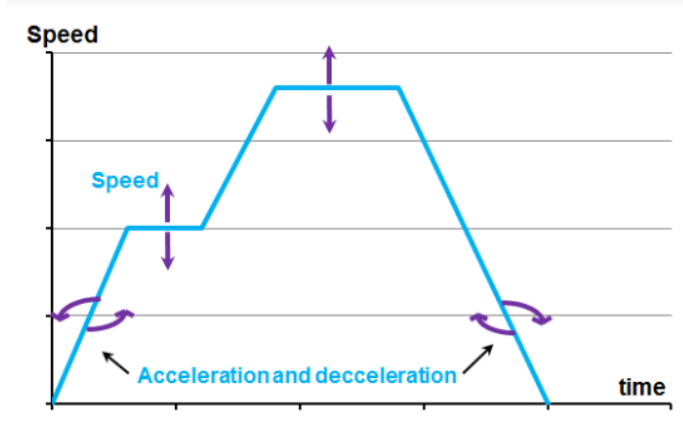
- For this program, speed ranges are fixed. You could modify them in going in "Expert mode".

| IN 4 | IN 5 | Min. motor speed (rpm) | Max. motor speed (rpm) |
|------|------|------------------------|------------------------|
| 0    | 0    | 0                      | 3000                   |
| 1    | 0    | 0                      | 1000                   |
| 0    | 1    | 900                    | 2000                   |
| 1    | 1    | 1800                   | 3000                   |

### 14.3. Expert Programs

#### 14.3.1. Velocity group

##### 14.3.1.1. "V101"



Expert program V101 is used to:

- Create speed profiles with analog or PWM control.
- Set the acceleration/deceleration phases with analog or PWM control.
- Set the nominal and maximum torque parameters for the application safety via the HMI.

##### 14.3.1.1.1. "Inputs" tab parameters

|  |   |
|--|---|
| <p>Input 1 - DIGITAL - ON / OFF</p> <p><input checked="" type="radio"/> On = 1 / Off = 0    <input type="radio"/> On = 0 / Off = 1</p>   | <p>Input 2 - DIGITAL - Direction of Rotation</p> <p><input checked="" type="radio"/> CW = 1 / CCW = 0    <input type="radio"/> CW = 0 / CCW = 1</p>   |
| <p>Input 3 - DIGITAL - Holding at stop</p> <p><input checked="" type="radio"/> High state active    Holding Torque : <input type="text" value="150"/> nM.m</p> <p><input type="radio"/> Low state active</p>   | <p>Input 4 - DIGITAL - Fast Stop</p> <p><input checked="" type="radio"/> High state active    <input type="radio"/> Low state active</p>  |
| <p>Input 5 - Proportional setpoint : Acceleration/Deceleration</p> <p><input checked="" type="radio"/> 0-10V    <input type="radio"/> 0-5V    <input type="radio"/> PWM</p> <p>10V <input type="text" value="100"/> rpm/s</p> <p>40 000 <input type="text" value="0"/> rpm/s</p> <p>0V</p> | <p>Input 6 - Proportional setpoint : Speed</p> <p><input checked="" type="radio"/> 0-10V    <input type="radio"/> 0-5V    <input type="radio"/> PWM</p> <p>10V <input type="text" value="4 000"/> rpm</p> <p><input type="text" value="0"/> rpm</p> <p>0V</p> |

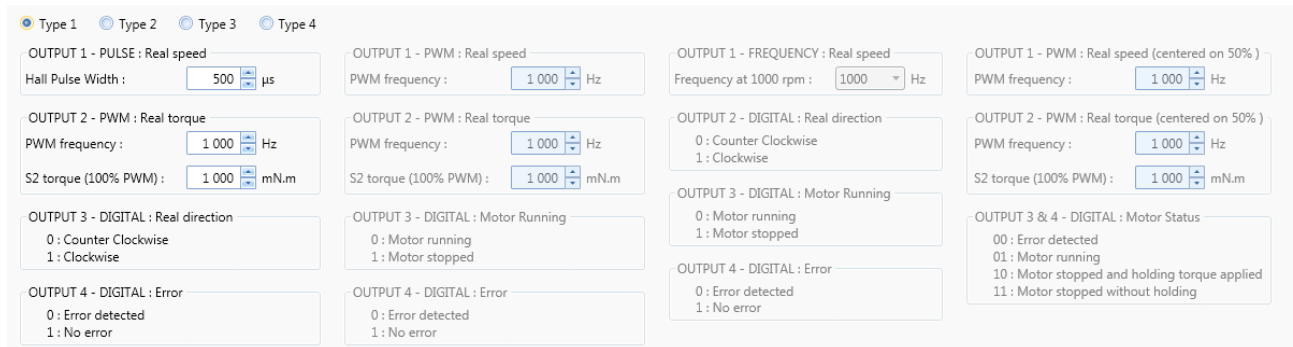
- Digital input 1: Used to set the "On/Off" input polarity.
- Digital input 2: Used to set the "Direction of rotation" input polarity.
- Digital input 3: Used to set the "Holding at stop" input polarity and set the Holding Torque value.
- Digital input 4: Used to set the "Fast stop" input polarity.

This input is used to stop the motor as quickly as possible, ignoring the setpoints applied to the other inputs.

- Setpoint input 5: Used to select the control type for the acceleration/deceleration setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

- Setpoint input 6: Used to select the control type for the speed setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

### 14.3.1.1.2. "Outputs" tab parameters



#### a) Type 1

- Setting the parameter of Pulse output 1 "Real speed": A Hall pulse with configurable width (100 to 800 µs) is generated each time one of the 3 motor Hall sensors changes state.

80140\_SMI21 and 80180\_SMI21 motors have 12 Hall pulses per revolution (2 pairs of poles).  
80280\_SMI21 and all SMI22 motors have 24 Hall pulses per revolution (4 pairs of poles).

- Setting the parameters of PWM output 2 "Real Torque": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Torque supplied = 0 mNm.  
If cyclical ratio = 100% → Torque supplied = "S2 torque".

- State of digital output 3 "Real direction": Used to find out the motor direction of rotation.

- State of digital output 4 "Error": Used to find out whether an error has been detected.

#### b) Type 2

- Setting the parameter of PWM output 1 "Real Speed": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Real speed = 0 rpm.  
If cyclical ratio = 100% → Real speed = maximum speed setpoint defined in In6.

- Setting the parameters of PWM output 2 "Real Torque": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Torque supplied = 0 mNm.  
If cyclical ratio = 100% → Torque supplied = "S2 torque".

- State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

- State of digital output 4 "Error": Used to find out whether an error has been detected.

#### c) Type 3

- Setting the parameter of frequency output 1 "Real speed": The parameters can be set for the signal frequency of this output for which the motor runs at 1000 RPM (200, 500 or 1000 Hz).

- State of digital output 2 "Real direction": Used to find out the motor direction of rotation.

- State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

- State of digital output 4 "Error": Used to find out whether an error has been detected.

d) Type 4

- Setting the parameters of PWM output 1: "Real speed (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

- If cyclical ratio = 0% → Motor running forward (CW) at maximum speed setpoint defined in In6.
- If cyclical ratio = 50% → Real speed = 0 rpm.
- If cyclical ratio = 100% → Motor running in reverse (CCW) at maximum speed setpoint defined in In6.

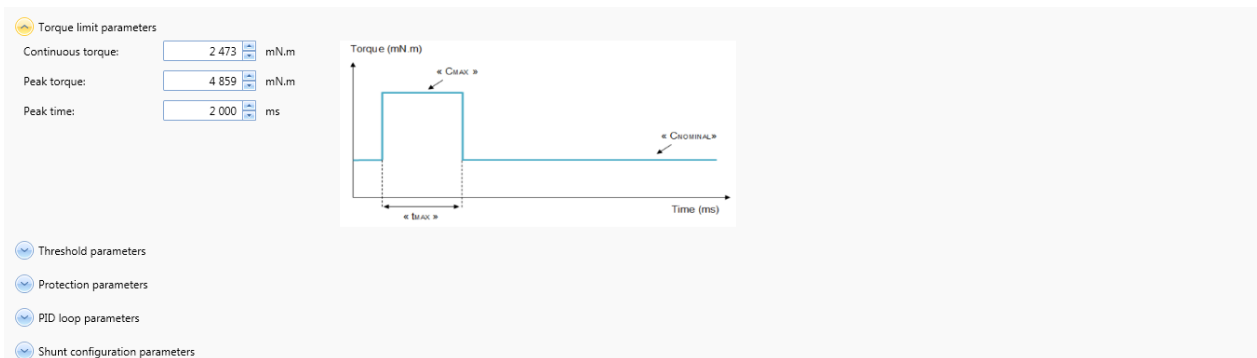
- Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

- If cyclical ratio = 0% → Braking torque supplied = "S2 torque".
- If cyclical ratio = 50% → Torque supplied = 0 mNm.
- If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

- Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

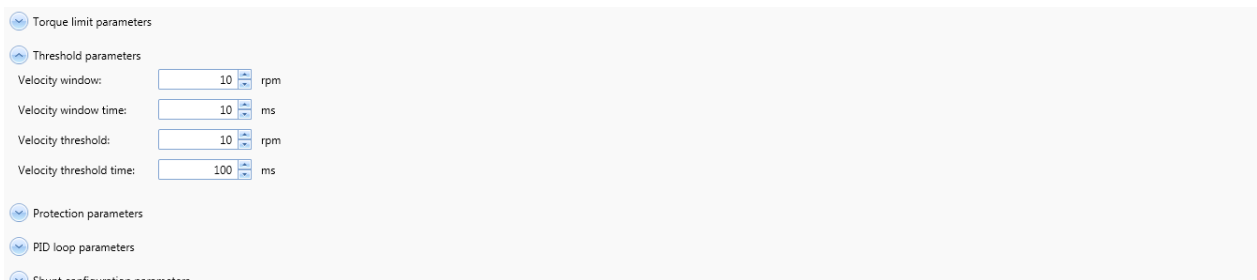
### 14.3.1.1.3. "Settings" tab parameters

#### a) Torque limit parameters



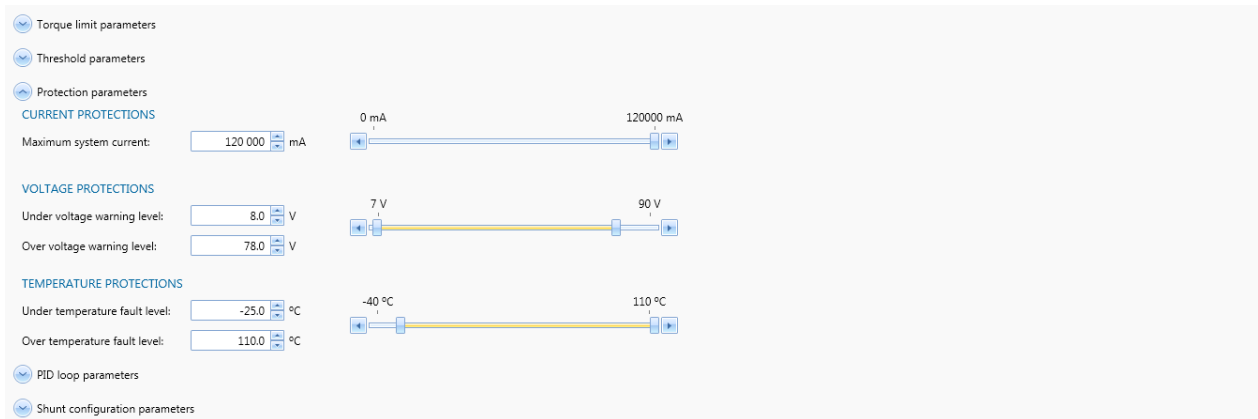
- Setting the various torque parameters: When the application torque exceeds the torque " $C_{NOMINAL}$ " (Continuous torque), the motor can provide torque up to the value " $C_{MAX}$ " (Peak torque) for the maximum duration " $t_{MAX}$ " (Peak time). Thereafter, if the application torque is still higher than " $C_{NOMINAL}$ " (Continuous torque), the motor torque is limited to the value " $C_{NOMINAL}$ " (Continuous torque), until the application torque falls back below this value.

#### b) Threshold parameters



See part "4. MOTION SETTINGS / 4.3. Thresholds" of this user manual.

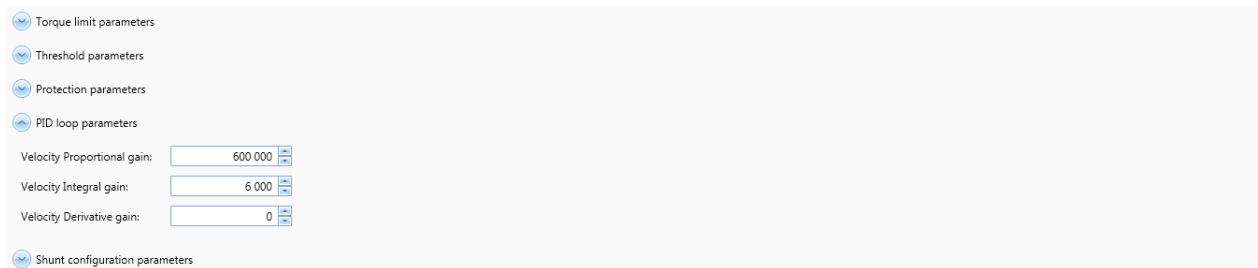
### c) Protection parameters



See part "[9. PROTECTIONS](#)" of this user manual.

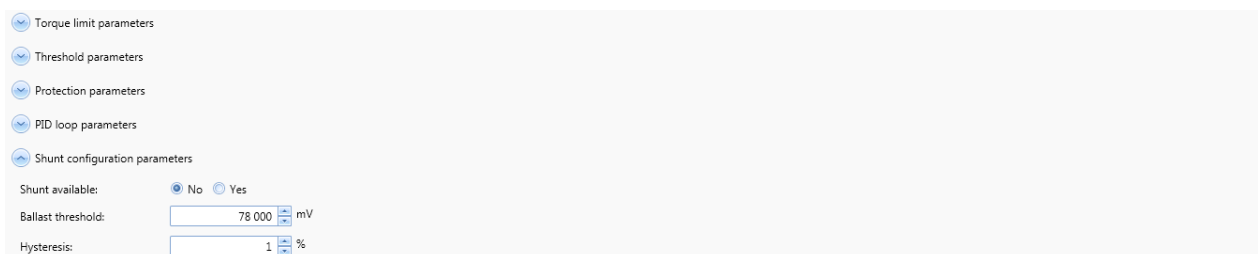
If one of these protection parameters is exceeded, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).

### d) PID loop parameters



Set the PID controller factors in the speed control loop (this function is reserved for advanced users). The values given in the example below ensure correct product operation in the majority of cases.

### e) Shunt configuration parameters

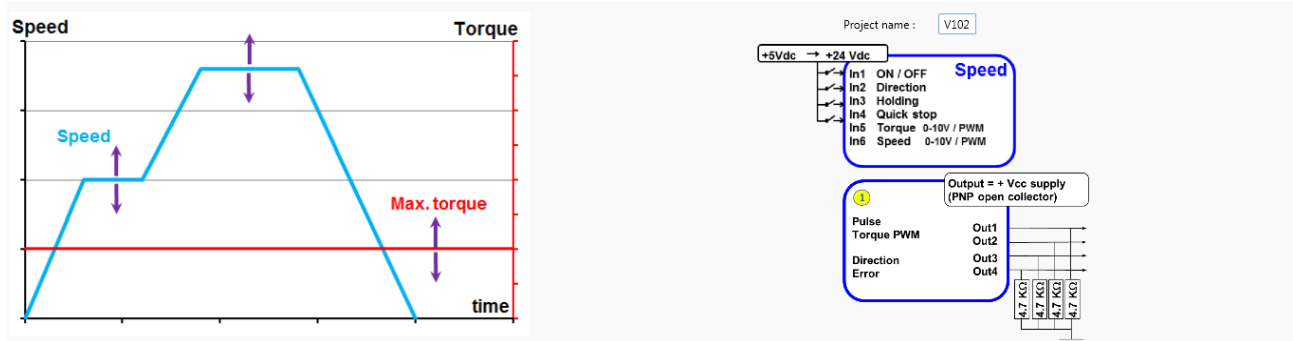


See part "[9. PROTECTIONS/ 9.2. Voltage protections/ 9.2.2. Shunt](#)" of this user manual.

If the ballast threshold plus hysteresis is exceeded, the shunt is activated.



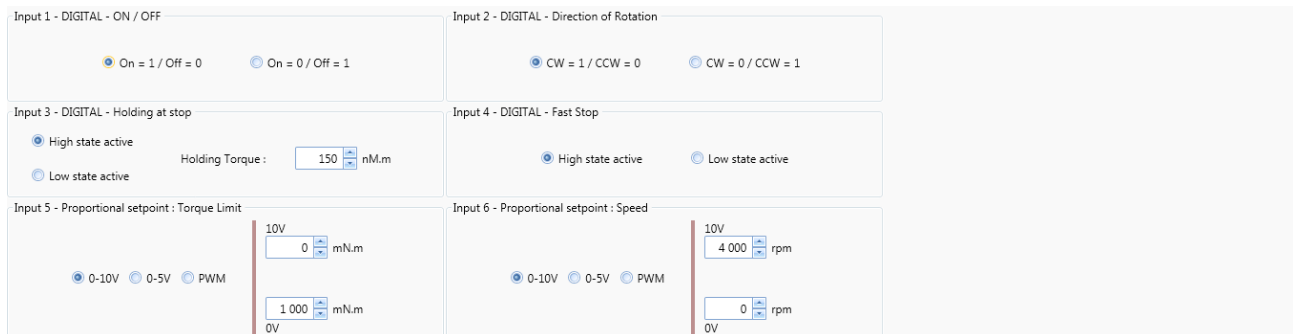
### 14.3.1.2. "V102"



Expert program V102 is used to:

- Create speed profiles with analog or PWM control.
- Set torque limiting with analog or PWM control.

#### 14.3.1.2.1. "Inputs" tab parameters



- Digital input 1: Used to set the "On/Off" input polarity.
- Digital input 2: Used to set the "Direction of rotation" input polarity.
- Digital input 3: Used to set the "Holding at stop" input polarity and set the Holding Torque value.
- Digital input 4: Used to set the "Fast stop" input polarity.

This input is used to stop the motor as quickly as possible, ignoring the setpoints applied to the other inputs.

- Setpoint input 5: Used to select the control type for the torque limiting setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.
- Setpoint input 6: Used to select the control type for the speed setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

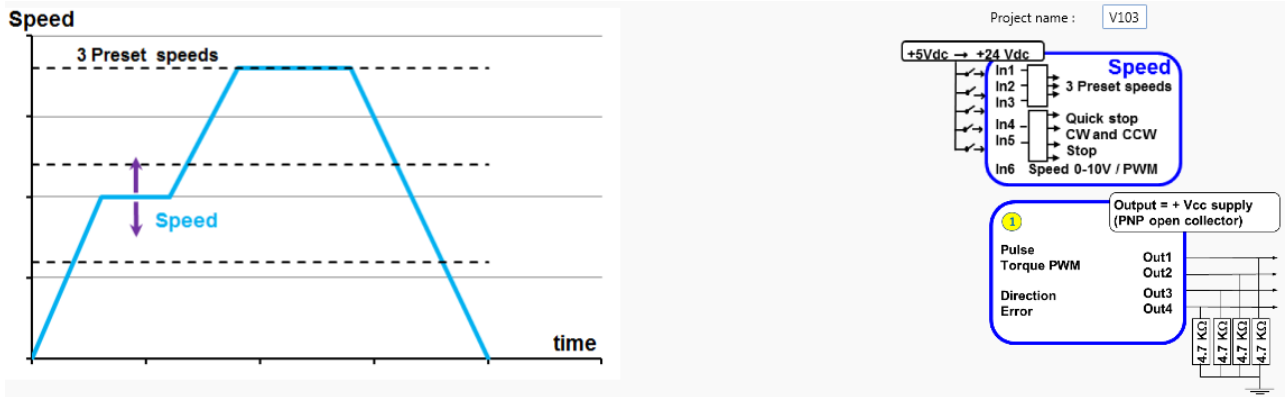
#### 14.3.1.2.2. "Outputs" tab parameters

See part "[14.3.1.1. "V101" / 14.3.1.1.2 "Outputs" tab parameters](#)" of this user manual.

#### 14.3.1.2.3. "Settings" tab parameters

See part "[14.3.1.1. "V101" / 14.3.1.1.3 "Settings" tab parameters](#)" of this user manual (note that you don't have access to the "torque limit parameters", you must use the setpoint input 5 for that).

### 14.3.1.3. "V103"



Expert program V103 is used to:

- Create speed profiles with analog or PWM control.
- Force speed control to one of the 3 preprogrammed speeds.
- Set the acceleration/deceleration phase parameters via the HMI.

#### 14.3.1.3.1. "Inputs" Tab Parameters

Inputs 1, 2, 3 - DIGITAL : Choose speed setpoint

| IN1 | IN2 | IN3 |                        |
|-----|-----|-----|------------------------|
| 0   | 0   | 0   | Speed setpoint Input 6 |
| 1   | 0   | 0   | Speed n°1 1 000 rpm    |
| 0   | 1   | 0   | Speed n°2 2 000 rpm    |
| 0   | 0   | 1   | Speed n°3 3 000 rpm    |

Inputs 4, 5 - DIGITAL : Choose motion

| IN4 | IN5 |                       |
|-----|-----|-----------------------|
| 0   | 0   | Fast stop             |
| 1   | 0   | CCW direction         |
| 0   | 1   | CW direction          |
| 1   | 1   | Stop and remove error |

Input 6 - Proportional setpoint : Speed

0-10V  
  0-5V  
  PWM

10V  
 rpm  
 0V  
 rpm

Acceleration and deceleration

Rate of acceleration  rpm/s  
 Rate of deceleration  rpm/s

- Combinations of digital inputs 1 to 3: Used to choose the type of speed setpoint applied at the motor input:

- If no input is active, the setpoint will be that applied to input 6.
- If one of these 3 inputs is active, the setpoint will be the priority speed associated with this input.

N.B.: If more than 1 input In1 to In3 is active, the setpoint taken into account will be that for input 6.

- Combinations of digital inputs 4 and 5: Used to choose the motion to be performed from the 4 actions indicated below.

- Setpoint input 6: Used to select the control type for the speed setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

- Setting the acceleration and braking ramps: These values are fixed via the HMI and cannot be changed by inputs while the motor is running. By default, the rates are fixed at 40,000 RPM/sec.

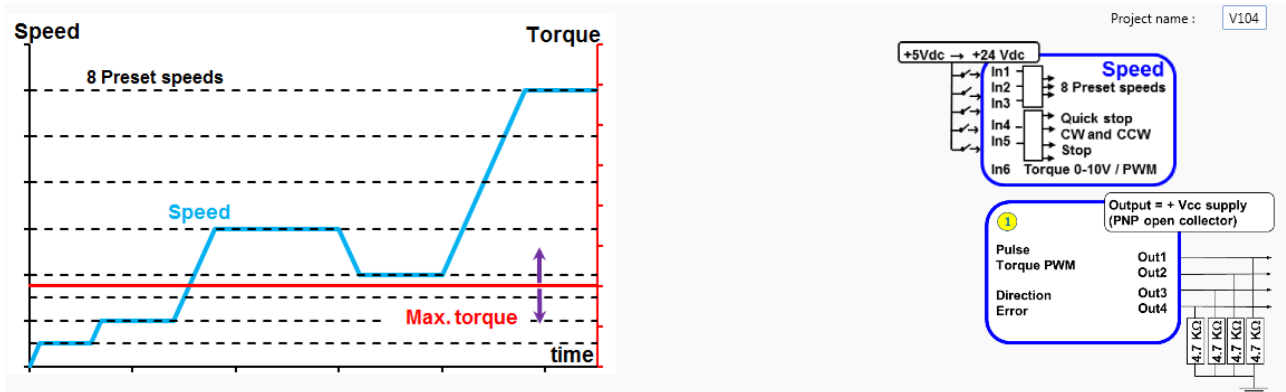
#### 14.3.1.3.2. “Outputs” tab parameters

See part “[14.3.1.1. “V101” / 14.3.1.1.2 “Outputs” tab parameters](#)” of this user manual.

#### 14.3.1.3.3. “Settings” tab parameters

See part “[14.3.1.1. “V101” / 14.3.1.1.3 “Settings” tab parameters](#)” of this user manual.

### 14.3.1.4. "V104"



Expert program V104 is used to:

- Create speed profiles with a choice of 8 preconfigured values.
- Set torque limiting with analog or PWM control.
- Set the acceleration/deceleration phase parameters via the HMI.

#### 14.3.1.4.1. "Inputs" Tab Parameters

The screenshot shows the 'Inputs' tab parameters for the V104 motor control. It is divided into three main sections:

- Inputs 1, 2, 3 - DIGITAL : Choose speed setpoint**: A table with 8 rows of digital input combinations (IN1, IN2, IN3) and corresponding speed setpoints in rpm.
 

| IN1 | IN2 | IN3 | Speed (rpm) |
|-----|-----|-----|-------------|
| 0   | 0   | 0   | 0           |
| 1   | 0   | 0   | 500         |
| 0   | 1   | 0   | 1 000       |
| 1   | 1   | 0   | 1 500       |
| 0   | 0   | 1   | 2 000       |
| 1   | 0   | 1   | 2 500       |
| 0   | 1   | 1   | 3 000       |
| 1   | 1   | 1   | 3 500       |
- Inputs 4, 5 - DIGITAL : Select motion**: A table with 4 rows of digital input combinations (Input 4, Input 5) and corresponding motion actions.
 

| Input 4 | Input 5 | Action                |
|---------|---------|-----------------------|
| 0       | 0       | Fast stop             |
| 1       | 0       | CCW direction         |
| 0       | 1       | CW direction          |
| 1       | 1       | Stop and remove error |
- Acceleration and deceleration**: Two input fields for 'Rate of acceleration' and 'Rate of deceleration', both set to 40 000 rpm/s.
- Input 6 - Proportional setpoint : Torque Limit**: A section with radio buttons for '0-10V', '0-5V', and 'PWM'. Below it are two input fields for torque limits: a minimum limit set to 0 mN.m and a maximum limit set to 1 000 mN.m.

- Combinations of digital inputs 1 to 3: Used to select the type of speed setpoint applied at the motor input: 8 possible combinations:
- Combinations of digital inputs 4 and 5: Used to select the motion to be performed from the 4 actions indicated below.
- Setpoint input 6: Used to select the control type for the torque limiting setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.
- Setting the acceleration and braking ramps: These values are fixed via the HMI and cannot be changed by inputs while the motor is running. By default, the rates are fixed at 40,000 RPM/sec.

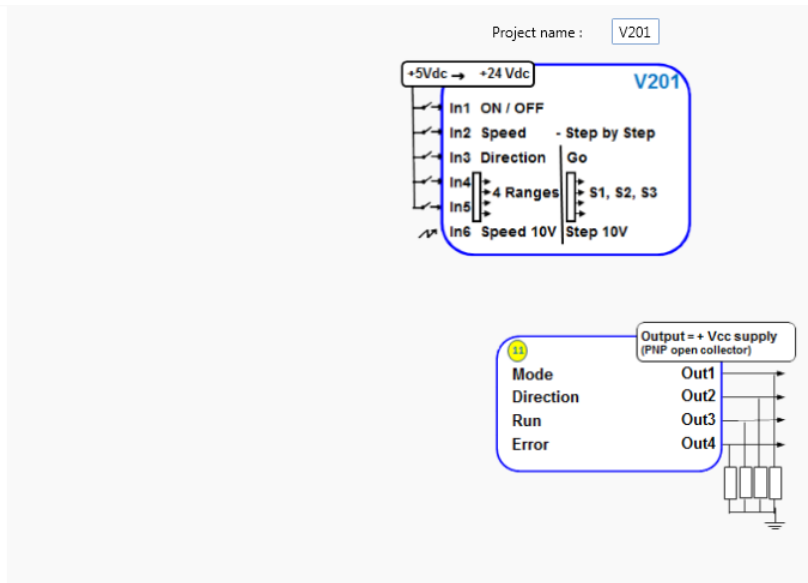
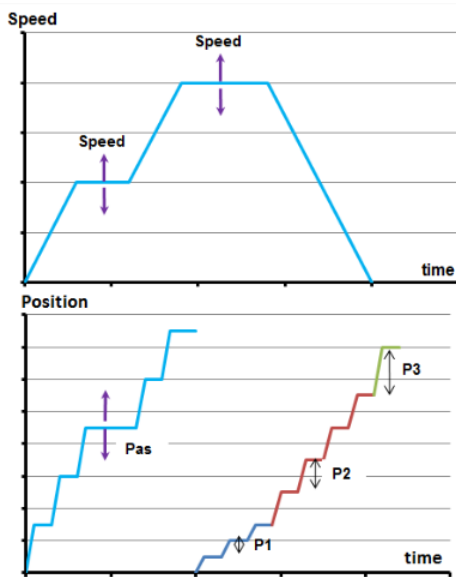
#### 14.3.1.4.2. “Outputs” tab parameters

See part “[14.3.1.1. “V101” / 14.3.1.1.2 “Outputs” tab parameters](#)” of this user manual.

#### 14.3.1.4.3. “Settings” tab parameters

See part “[14.3.1.1. “V101” / 14.3.1.1.3 “Settings” tab parameters](#)” of this user manual (note that you don’t have access to the “torque limit parameters”, you must use the setpoint input 6 for that).

### 14.3.1.5. V201



V201 expert program allows to:

- Set a speed using an analog input 0/10V or 0/5V or PWM. The speed regulation is based on the “moving target” principle which allows to reach very low speed (down to 1 rpm).
- Or to set a relative position using the same analog input (0/10V or 0/5V or PWM).
- Switch between speed mode and position mode.

#### 14.3.1.5.1. "Inputs" Tab Parameters

**Input 1 - DIGITAL - ON / OFF**

On = 1 / Off = 0     On = 0 / Off = 1

---

**Speed Mode**

**Input 3 - DIGITAL - Direction of Rotation**

CW = 1 / CCW = 0     CW = 0 / CCW = 1

**Input 4, 5 - TOR : Speed Range Selection**

| E4 | E5 | Min (rpm) | Max (rpm) | Acceleration (rpm/s) | Deceleration (rpm/s) |
|----|----|-----------|-----------|----------------------|----------------------|
| 0  | 0  | 1         | 1 000     | 4 000                | 4 000                |
| 1  | 0  | 1 000     | 2 000     | 4 000                | 4 000                |
| 0  | 1  | 2 000     | 3 000     | 4 000                | 4 000                |
| 1  | 1  | 3 000     | 3 500     | 4 000                | 4 000                |

**Input 6 - Proportional setpoint : Speed**

0-10V     0-5V     PWM

Max (rpm): 10V  
Min (rpm): 0V

**Input 2 - DIGITAL - Mode**

Speed Mode = 1 / PositionMode = 0     Speed Mode = 0 / Position Mode = 1

---

**Relative Position Mode**

**Input 3 - DIGITAL**

Pulse Time Min: 15 ms

**Input 4, 5 - TOR : Position Selection**

| E4 | E5 | Pulses  | Speed (rpm) | Acceleration (rpm/s) | Deceleration (rpm/s) |
|----|----|---------|-------------|----------------------|----------------------|
| 1  | 0  | 1 000   | 1 000       | 4 000                | 4 000                |
| 0  | 1  | 2 000   | 1 000       | 4 000                | 4 000                |
| 1  | 1  | 3 000   | 1 000       | 4 000                | 4 000                |
| 0  | 0  | Input 6 | 1 000       | 4 000                | 4 000                |

**Input 6 - Proportional setpoint : Position**

0-10V     0-5V     PWM

Max (counts): 10V → 4 096  
Min (counts): 0V → 0

- Digital input 1: « On/Off »: This input is to start or stop the motor. The input polarity is adjustable.
- Digital input 2: « Mode »: This input is to select the speed or position mode. The input polarity is adjustable.

- Digital input 3 (in speed mode): « Direction »: This input is to select motor direction. The input polarity is adjustable.
- Digital input 3 (in position mode): « Go »: This input gives the start to go to a new position. This input is taken in count only after that the last positioning was completed.  
The "Pulse time min." works as a filter. The « Go » signal could not be taken in count if its duration is lower than the set value.
- Digital inputs 4 and 5 (in speed mode): « speed coding »: They allow to select the speed range for the IN6 input. For each range, the min and max speed, the acceleration and deceleration can be set.
- Digital inputs 4 and 5 (in position mode): "Position coding": They allow to select the relative position to reach (the step value to do). For each of the positions, the number of pulses (4096 pulses → 1 motor turn), the max speed, the acceleration and deceleration can be set. The last position is adjustable by IN6 analog input (IN4 = IN5 = 0).
- Analog input 6 (In speed mode): « Speed »: This input adjusts motor speed using an analog 0/10V or 0/5V or PWM signal. Speed range is given per IN4 + IN5 coding.

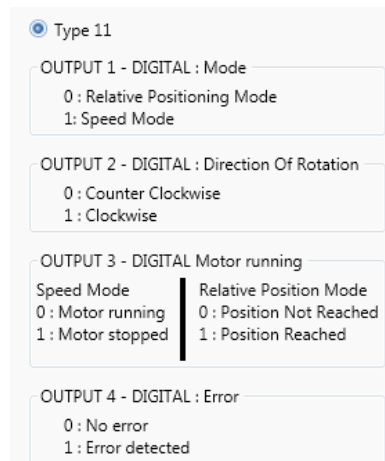
The setting parameter is analog or PWM signal type.

- Analog input 6 (In position mode): « Step »: This input adjusts the value of the step to do (relative position) when IN4=IN5=0, using an analog 0/10V or 0/5V or PWM signal.

The setting parameters are

- o Minimum of pulses (4096 pulses → 1 motor turn)
- o Maximum of pulses (4096 pulses → 1 motor turn)
- o Analog or PWM signal type.

#### 14.3.1.5.2. "Outputs" tab parameters



Type 11

OUTPUT 1 - DIGITAL : Mode  
0 : Relative Positioning Mode  
1 : Speed Mode

OUTPUT 2 - DIGITAL : Direction Of Rotation  
0 : Counter Clockwise  
1 : Clockwise

OUTPUT 3 - DIGITAL Motor running

| Speed Mode        | Relative Position Mode   |
|-------------------|--------------------------|
| 0 : Motor running | 0 : Position Not Reached |
| 1 : Motor stopped | 1 : Position Reached     |

OUTPUT 4 - DIGITAL : Error  
0 : No error  
1 : Error detected

- State of digital output 1: "Mode": Gives mode used.
- State of digital output 2: "Direction" Used to find out the motor direction of rotation.
- State of digital output 3 (speed mode): "Motor running": Used to find out whether the motor is stopped or running.
- State of digital output 3 (position mode): "Target": Used to find out if the position is reached.
- State of digital output 4: "Error": Used to find out whether an error has been detected.

#### 14.3.1.5.3. “Settings” tab parameters

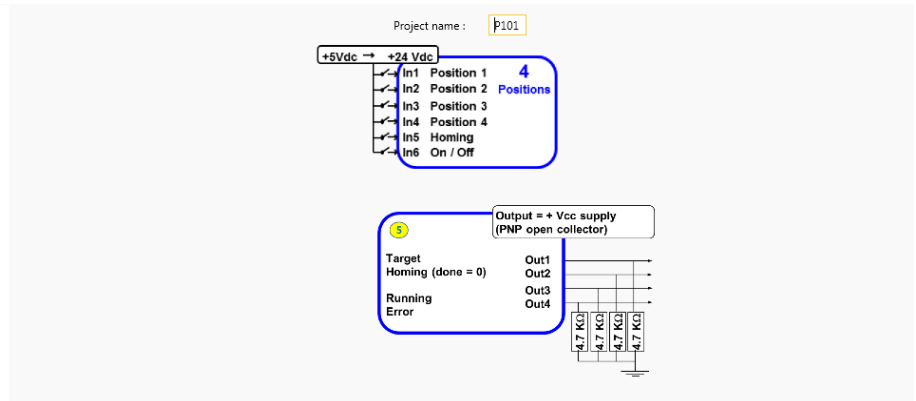
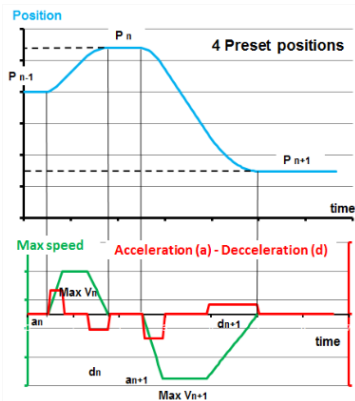
See part “[14.3.1.1. “V101” / 14.3.1.1.3 “Settings” tab parameters](#)” of this user manual.

Note that there is only one additional parameter for expert program P202: “Analog input hysteresis”: use this parameter when the stroke is important to minimize the oscillation of the analog target position (in pulse encoder).



## 14.3.2. Position group

### 14.3.2.1. "P101"



Expert program P101 is used to:

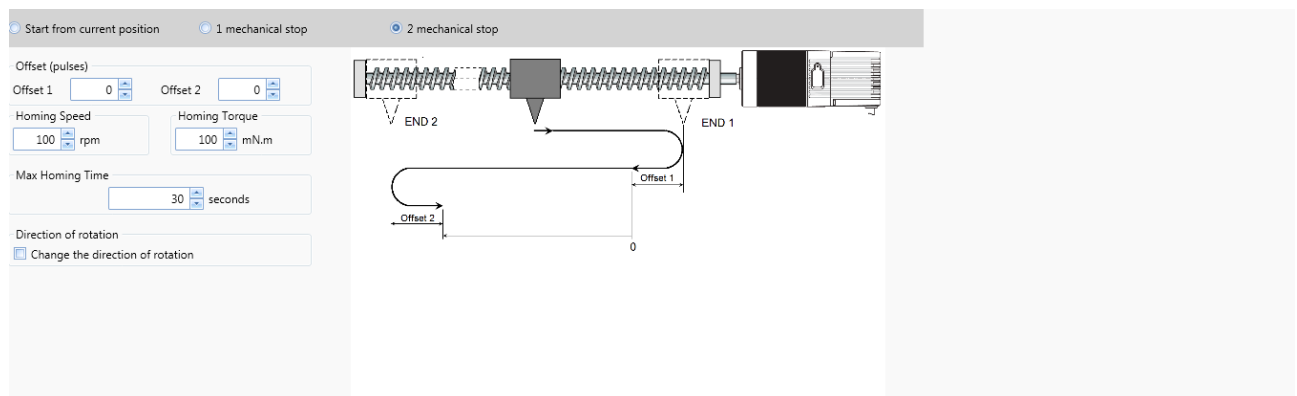
- Perform a homing phase to initialize the system with detection of the stroke ends.
- Perform various positionings using 4 preset position setpoints, each corresponding to one of the digital inputs "In1" to "In4".
- Set the acceleration/deceleration phases and the maximum speed that must not be exceeded between each point via the HMI.

#### 14.3.2.1.1. "Homing" tab parameters

The homing sequence is an initialization phase that helps the motor estimate the application position reference by searching for mechanical stops. These stops can be detected in one of 2 ways:

- With 1 limit switch by retrieving information from one of the inputs.
- By detecting overtorque when the motor is at a mechanical stop.

**N.B.:** The default motor direction of rotation is forward (CW).



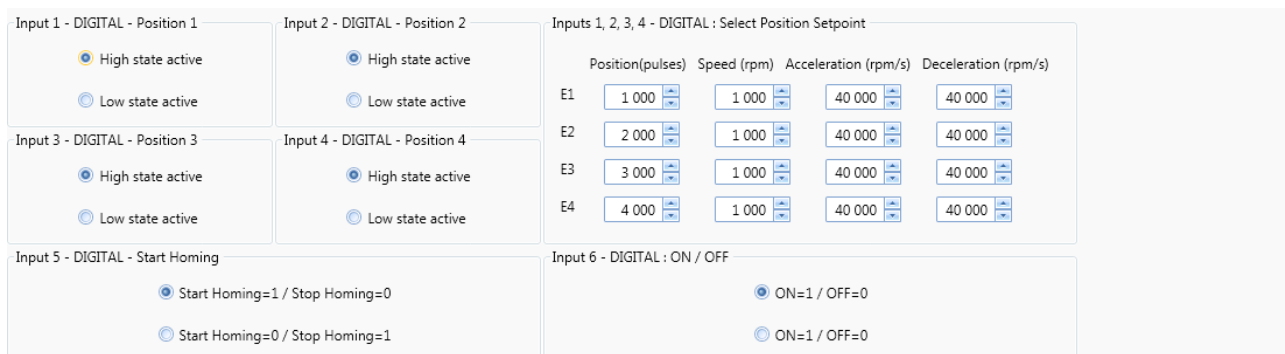
- choose the homing method: current position, with 1 or 2 mechanical stop.

- Offset: Set the difference in position (in pulses) between the mechanical stops and the application total stroke limits: stop 1 (END1) represents the stroke start, stop 2 (END2) represents the stroke end.

Note: Where there is only one mechanical stop, the "Offset 2" parameter is not available.

- Homing speed: Set the search speed for stops during the homing phase.
  - Homing torque: Set the homing torque that allows the mechanical stop to be found by detection of overtorque.
  - Max Homing Time: Set the maximum permitted time for the homing phase. If this value is exceeded, an error will be generated. Time limited to 300 seconds.
  - Direction of rotation: Set the direction of rotation for the first stop search (END1).
- N.B.: By default, the motor runs forward (CW).

### 14.3.2.1.2. "Inputs" tab parameters



| Input 1 - DIGITAL - Position 1                                  |   | Input 2 - DIGITAL - Position 2                     |   | Inputs 1, 2, 3, 4 - DIGITAL : Select Position Setpoint |             |                      |                      |
|---|---|--|---|--|-------------|----------------------|----------------------|
| <input checked="" type="radio"/> High state active              | <input type="radio"/> Low state active            | <input checked="" type="radio"/> High state active | <input type="radio"/> Low state active            | Position(pulses)                                       | Speed (rpm) | Acceleration (rpm/s) | Deceleration (rpm/s) |
| <input type="radio"/> High state active                         | <input checked="" type="radio"/> Low state active | <input type="radio"/> High state active            | <input checked="" type="radio"/> Low state active | E1: 1 000  | 1 000       | 40 000               | 40 000               |
| <input checked="" type="radio"/> High state active              | <input type="radio"/> Low state active            | <input checked="" type="radio"/> High state active | <input type="radio"/> Low state active            | E2: 2 000  | 1 000       | 40 000               | 40 000               |
| <input type="radio"/> High state active                         | <input checked="" type="radio"/> Low state active | <input type="radio"/> High state active            | <input checked="" type="radio"/> Low state active | E3: 3 000  | 1 000       | 40 000               | 40 000               |
| Input 5 - DIGITAL - Start Homing                                |   |  |   | Input 6 - DIGITAL : ON / OFF                           |             |                      |                      |
| <input checked="" type="radio"/> Start Homing=1 / Stop Homing=0 |   |  |   | <input checked="" type="radio"/> ON=1 / OFF=0          |             |                      |                      |
| <input type="radio"/> Start Homing=0 / Stop Homing=1            |   |  |   | <input type="radio"/> ON=1 / OFF=0                     |             |                      |                      |

- Digital input 1: Used to set the "Position 1" input polarity.
- Digital input 2: Used to set the "Position 2" input polarity.
- Digital input 3: Used to set the "Position 3" input polarity.
- Digital input 4: Used to set the "Position 4" input polarity.
- Digital Inputs 1, 2, 3, 4: Set the 4 position setpoints and the speed profiles to be followed (acceleration ramp, speed step and deceleration ramp: trapezoidal profile).
- Digital input 5: Used to set the "Start Homing" input polarity.
- Digital input 6: Used to set the "On/Off" input polarity.

### 14.3.2.1.3. "Outputs" tab parameters

Type 5  
  Type 6  
  Type 7  
  Type 8  
  Type 9

|  |  |  |
|--|--|--|
| <b>OUTPUT 1 - DIGITAL : Target Reached Flag</b><br>0 : Position target not reached<br>1 : Position target reached      | <b>OUTPUT 1 - DIGITAL : Target Reached Flag</b><br>0 : Position target not reached<br>1 : Position target reached      | <b>OUTPUT 1 - DIGITAL : Target Reached Flag</b><br>0 : Position target not reached<br>1 : Position target reached  |
| <b>OUTPUT 2 - DIGITAL : Homing Sequence Information</b><br>0 : Homing completed<br>1 : Homing in progress or no homing | <b>OUTPUT 2 - DIGITAL : Homing Sequence Information</b><br>0 : Homing in progress or no homing<br>1 : Homing completed | <b>OUTPUT 2 - PWM : Real torque (centered on 50%)</b><br>PWM frequency : <input type="text" value="1 000"/> Hz<br>S2 torque (100% PWM) : <input type="text" value="1 000"/> mN.m   |
| <b>OUTPUT 3 - DIGITAL : Motor Running</b><br>0 : Motor stopped<br>1 : Motor running                                    | <b>OUTPUT 3 - DIGITAL : Motor Running</b><br>0 : Motor running<br>1 : Motor stopped                                    | <b>OUTPUT 3 &amp; 4 - DIGITAL : Motor status</b><br>00 : Error detected<br>01 : Homing in progress OR no homing<br>10 : Homing completed AND motor stopped<br>11 : Motor running *<br>* including motor in positioning mode or motor driven by a load. |
| <b>OUTPUT 4 - DIGITAL : Error</b><br>0 : No error<br>1 : Error detected  | <b>OUTPUT 4 - DIGITAL : Error</b><br>0 : Error detected<br>1 : No error  |  |

|  |   |
|--|---|
| <b>OUTPUT 1 - DIGITAL : Target Reached Flag</b><br>0 : Position target not reached<br>1 : Position target reached  | <b>OUTPUT 1 - Pulse : Real speed</b><br>Hall pulse width : <input type="text" value="500"/> $\mu$ s |
| <b>OUTPUT 2 - PWM : Real torque (centered on 50%)</b><br>PWM frequency : <input type="text" value="1 000"/> Hz<br>S2 torque (100% PWM) : <input type="text" value="1 000"/> mN.m   | <b>OUTPUT 2 - DIGITAL : Real direction</b><br>0 : Counter Clockwise<br>1 : Clockwise                |
| <b>OUTPUT 3 &amp; 4 - DIGITAL : Motor status</b><br>00 : Error detected OR motor in stop mode *<br>01 : Not used<br>10 : Motor stopped AND target reached **<br>11 : Motor running ***<br>* motor running in OFF mode : driven by a load :<br>in this case, the motor is free on the shaft.<br>** in this case the motor is always stopped : in disabled mode,<br>blocked by an obstacle, position loop before homing,<br>position loop after homing.<br>*** including motor in positioning mode or motor driven<br>by a load or homing in progress. |   |

#### a) Type 5

- State of digital output 1 "Target Reached Flag": Used to find out whether the position setpoint has been reached.
- State of digital output 2 "Homing Sequence Information": Used to find out how the homing phase is progressing: completed, in progress or not performed.
- State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.
- State of digital output 4 "Error": Used to find out whether an error has been detected.

#### b) Type 6

- State of digital output 1 "Target Reached Flag": Used to find out whether the position setpoint has been reached.
- State of digital output 2 "Homing Sequence Information": Used to find out how the homing phase is progressing: completed, in progress or not performed.
- State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.
- State of digital output 4 "Error": Used to find out whether an error has been detected.

## c) Type 7

- State of digital output 1 "Target Reached Flag": Used to find out whether the position setpoint has been reached.

- Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Braking torque supplied = "S2 torque".

If cyclical ratio = 50% → Torque supplied = 0 mNm.

If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

- Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

## d) Type 8

- State of digital output 1 "Target Reached Flag": Used to find out whether the position setpoint has been reached.

- Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Braking torque supplied = "S2 torque".

If cyclical ratio = 50% → Torque supplied = 0 mNm.

If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

- Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

## e) Type 9

- Setting the parameter of Pulse output 1 "Real speed": A Hall pulse with configurable width (100 to 800  $\mu$ s) is generated each time one of the 3 motor Hall sensors changes state.

80140\_SMI21 and 80180\_SMI21 motors have 12 Hall pulses per revolution (2 pairs of poles).

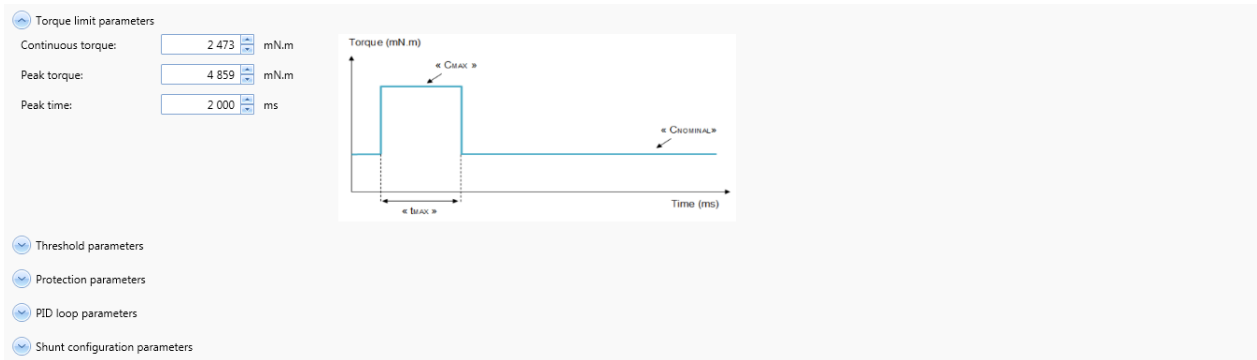
80280\_SMI21 and all SMI22 motors have 24 Hall pulses per revolution (4 pairs of poles).

- State of digital output 2 "Real direction": Used to find out the motor direction of rotation.

- Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

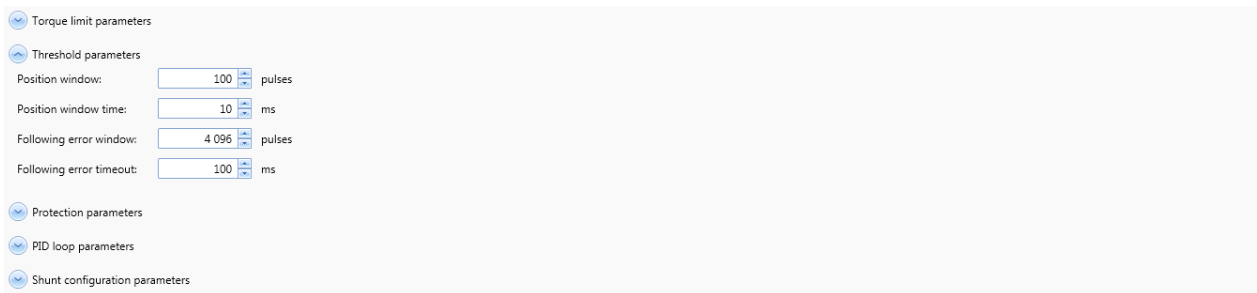
### 14.3.2.1.4. "Settings" tab parameters

#### a) Torque limit parameters



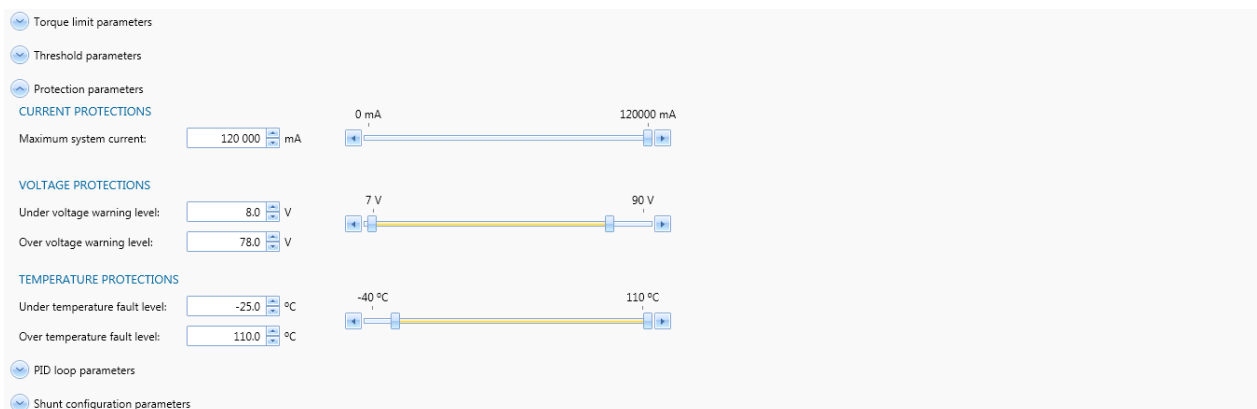
- Setting the various torque parameters: When the application torque exceeds the torque " $C_{NOMINAL}$ " (Continuous torque), the motor can provide torque up to the value " $C_{MAX}$ " (Peak torque) for the maximum duration " $t_{MAX}$ " (Peak time). Thereafter, if the application torque is still higher than " $C_{NOMINAL}$ " (Continuous torque), the motor torque is limited to the value " $C_{NOMINAL}$ " (Continuous torque), until the application torque falls back below this value.

#### b) Threshold parameters



See part "4. MOTION SETTINGS / 4.3. Thresholds" of this user manual.

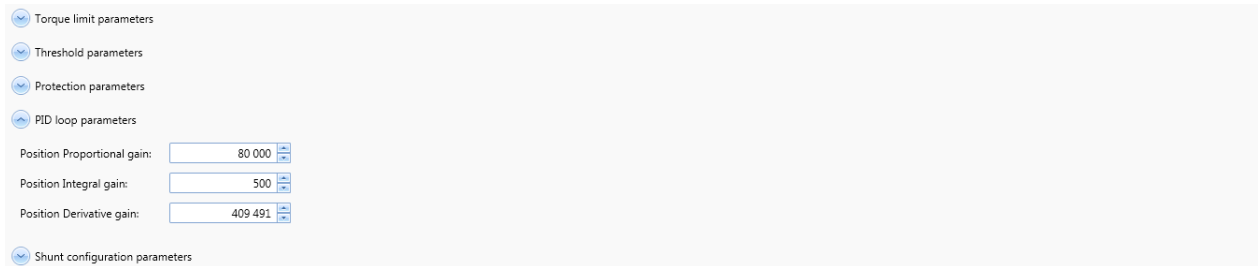
#### c) Protection parameters



See part "9. PROTECTIONS" of this user manual.

If one of these protection parameters is exceeded, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).

#### d) PID loop parameters



The screenshot shows a configuration menu with the following items:

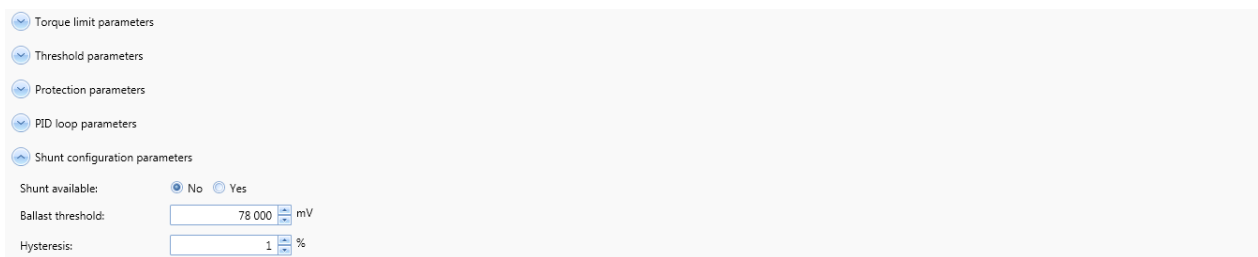
- Torque limit parameters
- Threshold parameters
- Protection parameters
- PID loop parameters** (selected)
- Shunt configuration parameters

Under the selected 'PID loop parameters' section, the following values are displayed in input fields:

- Position Proportional gain: 80 000
- Position Integral gain: 500
- Position Derivative gain: 409 491

Set the PID controller factors in the position control loop (this function is reserved for advanced users). The values given in the example below ensure correct product operation in the majority of cases.

#### e) Shunt configuration parameters



The screenshot shows a configuration menu with the following items:

- Torque limit parameters
- Threshold parameters
- Protection parameters
- PID loop parameters
- Shunt configuration parameters** (selected)

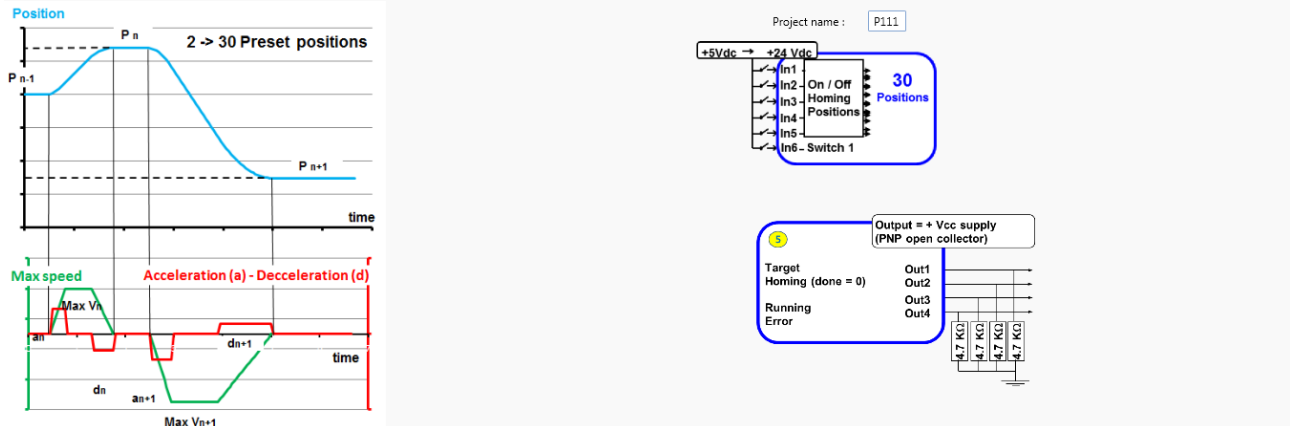
Under the selected 'Shunt configuration parameters' section, the following values are displayed:

- Shunt available:  No  Yes
- Ballast threshold: 78 000 mV
- Hysteresis: 1 %

See part "[9. PROTECTIONS/ 9.2. Voltage protections/ 9.2.2. Shunt](#)" of this user manual.

If the ballast threshold plus hysteresis is exceeded, the shunt is activated.

### 14.3.2.2. "P111"



Expert program P111 is used to:

- Perform a homing phase to initialize the system with detection of the limit switches (switch or mechanical type). A single switch type contact is managed in this program.
- Perform various positionings using 1 to 30 preset position setpoints, each corresponding to a specific combination of digital inputs "In1" to "In5".
- Set the acceleration/deceleration phases and the maximum speed that must not be exceeded between each point via the HMI.

#### 14.3.2.2.1. "Homing" tab parameters

- choose the homing method: current position, with 1 or 2 mechanical stop, with 1 switch, with 1 mechanical stop + 1 switch.

Switch status: Set the polarity of the switch wired on digital input "In6":

- Offset: Set the difference in position (in pulses) between the mechanical stops and the application total stroke limits: stop 1 (END1) represents the stroke start, stop 2 (END2) represents the stroke end.

Note: Where there is only one mechanical stop, the "Offset 2" parameter is not available.

- Homing speed: Set the search speed for stops during the homing phase.

- Approach speed: Set the search speed for zero during the homing phase (only available with 1 switch).
- Homing torque: Set the homing torque that allows the mechanical stop to be found by detection of overtorque.
- Max Homing Time: Set the maximum permitted time for the homing phase. If this value is exceeded, an error will be generated. Time limited to 300 seconds.
- Direction of rotation: Set the direction of rotation for the first stop search (END1).

N.B.: By default, the motor runs forward (CW).

### 14.3.2.2.2. “Inputs” tab parameters

Input 6 - DIGITAL - Switch

High state active

Low state active

Number of position setpoints:

30

| Position Index | IN1 | IN2 | IN3 | IN4 | IN5 | Position (pulses) | Speed (rpm) | Acceleration (rpm/s) | Deceleration (rpm/s) |
|----------------|-----|-----|-----|-----|-----|-------------------|-------------|----------------------|----------------------|
| Stop           | 0   | 0   | 0   | 0   | 0   |                   |             |                      |                      |
| Start Homing   | 1   | 0   | 0   | 0   | 0   |                   |             |                      |                      |
| Position 1     | 1   | 1   | 0   | 0   | 0   | 1000              | 1000        | 40000                | 40000                |
| Position 2     | 0   | 0   | 1   | 0   | 0   | 2000              | 1000        | 40000                | 40000                |
| Position 3     | 1   | 0   | 1   | 0   | 0   | 3000              | 1000        | 40000                | 40000                |
| Position 4     | 0   | 1   | 1   | 0   | 0   | 4000              | 1000        | 40000                | 40000                |
| Position 5     | 1   | 1   | 1   | 0   | 0   | 5000              | 1000        | 40000                | 40000                |
| Position 6     | 0   | 0   | 0   | 1   | 0   | 6000              | 1000        | 40000                | 40000                |
| Position 7     | 1   | 0   | 0   | 1   | 0   | 7000              | 1000        | 40000                | 40000                |
| Position 8     | 0   | 1   | 0   | 1   | 0   | 8000              | 1000        | 40000                | 40000                |
| Position 9     | 1   | 1   | 0   | 1   | 0   | 9000              | 1000        | 40000                | 40000                |
| Position 10    | 0   | 0   | 1   | 1   | 0   | 10000             | 1000        | 40000                | 40000                |
| Position 11    | 1   | 0   | 1   | 1   | 0   | 11000             | 1000        | 40000                | 40000                |
| Position 12    | 0   | 1   | 1   | 1   | 0   | 12000             | 1000        | 40000                | 40000                |
| Position 13    | 1   | 1   | 1   | 1   | 0   | 13000             | 1000        | 40000                | 40000                |
| Position 14    | 0   | 0   | 0   | 0   | 1   | 14000             | 1000        | 40000                | 40000                |
| Position 15    | 1   | 0   | 0   | 0   | 1   | 15000             | 1000        | 40000                | 40000                |
| Position 16    | 0   | 1   | 0   | 0   | 1   | 16000             | 1000        | 40000                | 40000                |
| Position 17    | 1   | 1   | 0   | 0   | 1   | 17000             | 1000        | 40000                | 40000                |
| Position 18    | 0   | 0   | 1   | 0   | 1   | 18000             | 1000        | 40000                | 40000                |

- Digital input 6: Information concerning the polarity of the switch wired on digital input 6. This polarity is selected in the "Homing" tab (see above).
- Select the number of position setpoints to be preset (see table above).

### 14.3.2.2.3. “Outputs” tab parameters

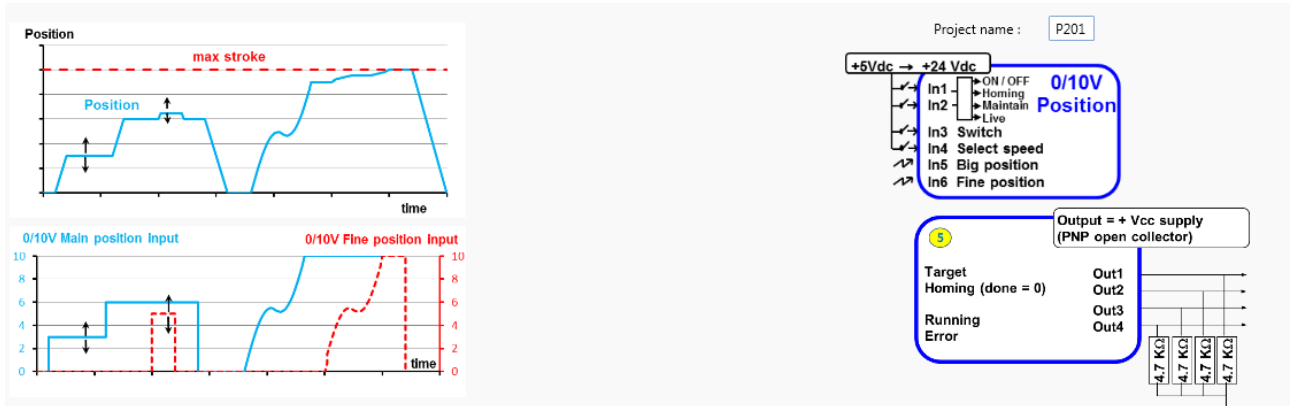
See part “[14.3.2.1. “P101”](#) / [14.3.2.1.3 “Outputs” tab parameters](#)” of this user manual.

### 14.3.2.2.4. “Settings” tab parameters

See part “[14.3.2.1. “P101”](#) / [14.3.2.1.4 “Settings” tab parameters](#)” of this user manual.



### 14.3.2.3. "P201"



P201 expert program allows to:

- Perform a homing phase to initialize the system with detection of the stroke ends (mechanical stop or switch limit).
- Perform positioning in using two 0/10V analog inputs: One for coarse tuning and second for thin tuning. The total stroke (which has to be set per the user in this program) can be cut up to 65536 positions. The targeted position follows in live the 2 inputs.
- Select a speed profile (choice between 2 profiles) to go from a position to another position. A speed profile contains acceleration, deceleration and maximum allowed speed values.

#### 14.3.2.3.1. "Homing" tab parameters

See part "[14.3.2.2. "P111" / 14.3.2.2.1 "Homing" tab parameters](#)" of this user manual (note that the input connected to the switch is the input 3)

#### 14.3.2.3.2. "Inputs" tab parameters

Combinations of digital inputs 1 and 2: Used to choose the motion to be performed from the 4 actions indicated below.

| Input 1 and 2 - Digital: move selection |    |                                     |
|---|----|-------------------------------------|
| I1                                      | I2 |                                     |
| 0                                       | 0  | Stop and error cancelation          |
| 1                                       | 0  | Do homing phase                     |
| 0                                       | 1  | Target actual position              |
| 1                                       | 1  | Target position from inputs 5 and 6 |

Information concerning the polarity of the switch wired on digital input 3. This polarity is selected in the "Homing" tab (see above).

Input 3 - DIGITAL - Switch

High state active

Low state active

Digital input 4 - IN4: Used to select one of the two speed profile.

To go from a position to a new position, motor follows a trapezoidal trajectory. This trajectory uses the maximum speed, acceleration and deceleration which are set in the « Digital speed profile selection » zone.

Input 4 - Digital: speed profile selection

|            | Speed (rpm) | Acceleration (rpm/s) | Deceleration (rpm/s) |
|------------|-------------|----------------------|----------------------|
| Profile 1: | 500         | 50                   | 50                   |
| Profile 2: | 2500        | 1000                 | 1000                 |

**NB:** If the user needs to change its velocity profile during a positioning phase, it is strongly recommended to use the same deceleration slope for both velocity profiles to avoid overruns targets.

Input IN5 and IN6 setpoints: To do the position setting using the two 0-10V analog inputs.

Parameter « total stroke length » is the number of encoder pulses corresponding to the stroke when IN5 and IN6 are at 10V.

Parameter "resolution coefficient" allows to cut the « total stroke length » in 2,048 or 4,096 or 8,192 or 16,384 or 32,768 or 65,536 positions.

The distribution of the « Total stroke length » on the two analog setpoint inputs is carried out according to the rules below.

- On IN5:  $[0 - 10V] \equiv [0 ; Stroke_{total\_application} \times \frac{Coefficient\_resolution - 1}{Coefficient\_resolution}]$  coded on 1024 points (coarse setting)
- On IN6:  $[0 - 10V] \equiv [0 ; Course_{totale\_application} \times \frac{1}{Coefficient\_résolution}]$  coded on 1024 points (thin setting)

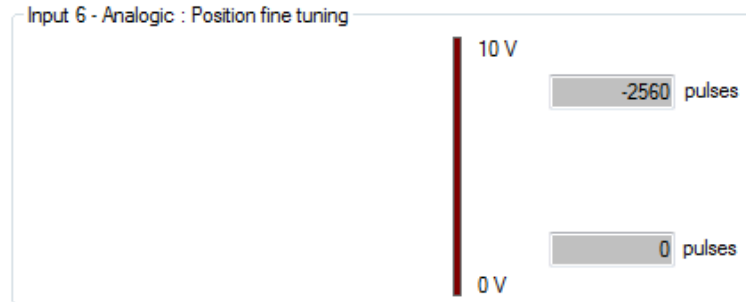
Input 5 - Analogic : Position big tuning

Total application stroke: 40960 pulses

Resolution coefficient: 16

10 V: -38400 pulses

0 V: 0 pulses



The motor position setpoint is the addition of position setpoint of IN5 and of position setpoint of IN6.

In above example:

- On IN5:  $[0 - 10V] \equiv \left[0 ; 40960 \times \frac{16-1}{16}\right] = [0 ; 38400]$  coded on 1,024 points (coarse setting)
- On IN6:  $[0 - 10V] \equiv \left[0 ; 40960 \times \frac{1}{16}\right] = [0 ; 2560]$  coded on 1,024 points (thin setting)

Note: The sign (-) at the 10V setpoint depends from the direction of rotation during the homing sequence.

#### 14.3.2.3.3. “Outputs” tab parameters

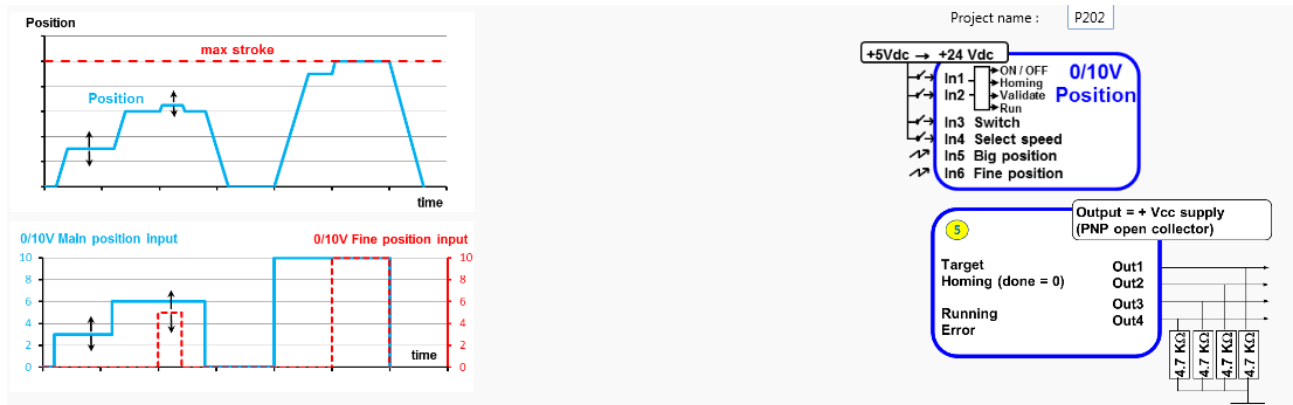
See part “[14.3.2.1. “P101” / 14.3.2.1.3 “Outputs” tab parameters](#)” of this user manual.

#### 14.3.2.3.4. “Settings” tab parameters

See part “[14.3.2.1. “P101” / 14.3.2.1.4 “Settings” tab parameters](#)” of this user manual.

Note that there is only one additional parameter for expert program P201: “Analog input hysteresis”: use this parameter when the stroke is important to minimize the oscillation of the analog target position (in pulse encoder).

### 14.3.2.4. "P202"



P202 expert program allows to:

- Perform a homing phase to initialize the system with detection of the stroke ends (mechanical stop or switch limit).
- Define a position setpoint in using two 0/10V analog inputs: One for coarse tuning and second for thin tuning. The total stroke (which has to be set per the user in this program) can be cut up to 65536 positions.
- Memorize the new position setpoint
- Go to the new position target
- Select a speed profile (choice between 2 profiles) to go from a position to another position. A speed profile contains acceleration, deceleration and maximum allowed speed values.

#### 14.3.2.4.1. "Homing" tab parameters

See part "[14.3.2.3."P201"](#) / [14.3.2.3.1 "Homing" tab parameters](#)" of this user manual.

#### 14.3.2.4.2. "Inputs" tab parameters

Combinations of digital inputs 1 and 2: Used to choose the motion to be performed from the 4 actions indicated below.

| Input 1 and 2 - Digital: move selection |    |  |
|---|----|--|
| I1                                      | I2 |  |
| 0                                       | 0  | Stop and error cancelation                   |
| 1                                       | 0  | Do homing phase                              |
| 0                                       | 1  | Validate and memorize new requested position |
| 1                                       | 1  | Go to memorized position                     |

Information concerning the polarity of the switch wired on digital input 3. This polarity is selected in the "Homing" tab (see above).

Input 3 - DIGITAL - Switch

High state active

Low state active

Digital input 4 - IN4: Used to select one of the two speed profile.

To go from a position to a new position, motor follows a trapezoidal trajectory. This trajectory uses the maximum speed, acceleration and deceleration which are set in the « Digital speed profile selection » zone.

Input 4 - Digital: speed profile selection

|            | Speed (rpm) | Acceleration (rpm/s) | Deceleration (rpm/s) |
|------------|-------------|----------------------|----------------------|
| Profile 1: | 500         | 50                   | 50                   |
| Profile 2: | 2500        | 1000                 | 1000                 |

**NB:** If the user needs to change its velocity profile during a positioning phase, it is strongly recommended to use the same deceleration slope for both velocity profiles to avoid overruns targets.

Input IN5 and IN6 setpoints: To do the position setting using the two 0-10V analog inputs.

Parameter « total stroke length » is the number of encoder pulses corresponding to the stroke when IN5 and IN6 are at 10V.

Parameter "resolution coefficient" allows to cut the « total stroke length » in 2,048 or 4,096 or 8,192 or 16,384 or 32,768 or 65,536 positions.

The distribution of the « Total stroke length » on the two analog setpoint inputs is carried out according to the rules below.

- On IN5:  $[0 - 10V] \equiv [0 ; Stroke_{total\_application} \times \frac{Coefficient\_resolution - 1}{Coefficient\_resolution}]$  coded on 1024 points (coarse setting)
- On IN6:  $[0 - 10V] \equiv [0 ; Course_{totale\_application} \times \frac{1}{Coefficient\_résolution}]$  coded on 1024 points (thin setting)

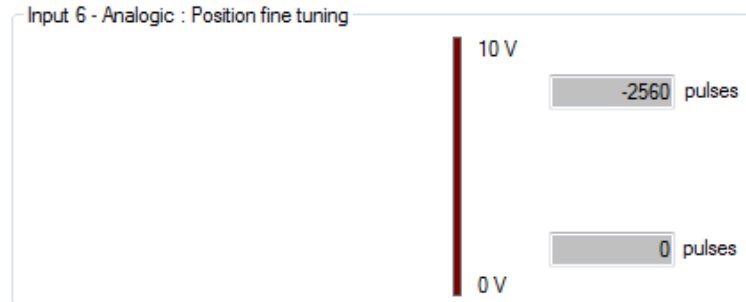
Input 5 - Analogic : Position big tuning

Total application stroke: 40960 pulses

Resolution coefficient: 16

10 V: -38400 pulses

0 V: 0 pulses



The motor position setpoint is the addition of position setpoint of IN5 and of position setpoint of IN6.

In above example:

- On IN5:  $[0 - 10V] \equiv \left[0 ; 40960 \times \frac{16-1}{16}\right] = [0 ; 38400]$  coded on 1,024 points (coarse setting)
- On IN6:  $[0 - 10V] \equiv \left[0 ; 40960 \times \frac{1}{16}\right] = [0 ; 2560]$  coded on 1,024 points (thin setting)

Note: The sign (-) at the 10V setpoint depends from the direction of rotation during the homing sequence.

#### 14.3.2.4.3. “Outputs” tab parameters

See part “[14.3.2.1. “P101” / 14.3.2.1.3 “Outputs” tab parameters](#)” of this user manual.

#### 14.3.2.4.4. “Settings” tab parameters

See part “[14.3.2.1. “P101” / 14.3.2.1.4 “Settings” tab parameters](#)” of this user manual.

Note that there is only one additional parameter for expert program P202: “Analog input hysteresis”: use this parameter when the stroke is important to minimize the oscillation of the analog target position (in pulse encoder).

### 14.3.3. Torque group

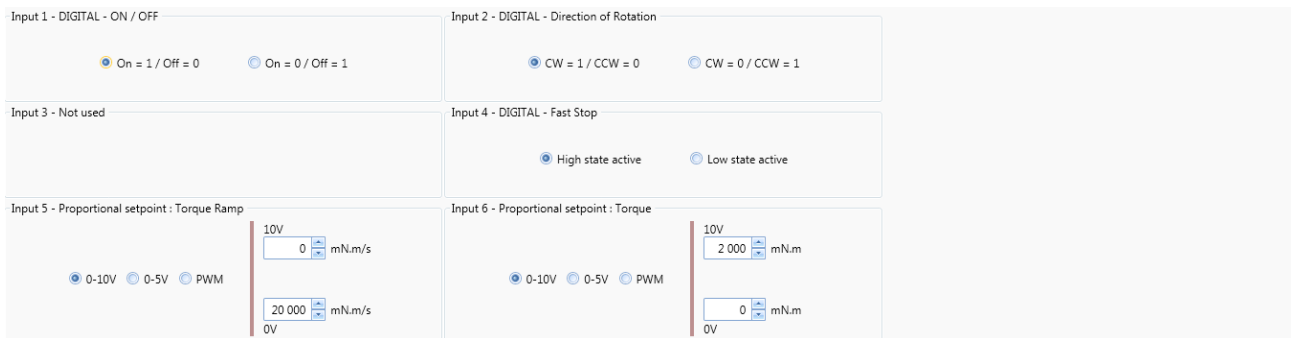
#### 14.3.3.1. "C101"



Expert program C101 is used to:

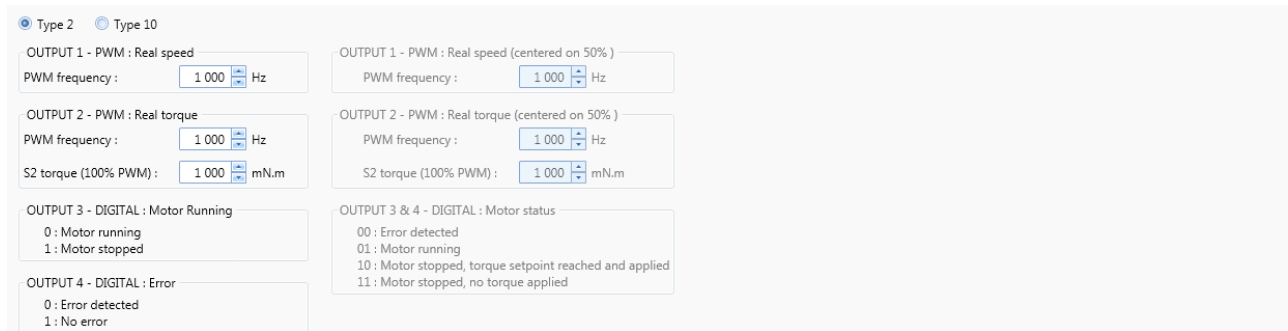
- Create torque profiles with analog or PWM control.
- Set the torque up and down ramps with analog or PWM control.

#### 14.3.3.1.1. "Inputs" tab parameters



- Digital input 1: Used to set the "On/Off" input polarity.
- Digital input 2: Used to set the "Direction of Rotation" input polarity.
- Digital input 3: Not used
- Digital input 4: Used to set the "Fast stop" input polarity.  
This input is used to stop the motor as quickly as possible, ignoring the setpoints applied to the other inputs.
- Setpoint input 5: Used to select the control type for the torque ramp setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.
- Setpoint input 6: Used to select the control type for the torque setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

### 14.3.3.1.2. "Outputs" tab parameters



#### a) Type 2

- Setting the parameter of PWM output 1 "Real Speed": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Real speed = 0 rpm.

If cyclical ratio = 100% → Real speed = maximum speed setpoint defined in In6.

- Setting the parameters of PWM output 2 "Real Torque": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Torque supplied = 0 mNm.

If cyclical ratio = 100% → Torque supplied = "S2 torque".

- State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

- State of digital output 4 "Error": Used to find out whether an error has been detected.

#### b) Type 10

- Setting the parameter of PWM output 1: "Real speed (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Motor running forward (CW) at maximum speed setpoint defined in In6.

If cyclical ratio = 50% → Real speed = 0 rpm.

If cyclical ratio = 100% → Motor running in reverse (CCW) at maximum speed setpoint defined in In6.

- Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Braking torque supplied = "S2 torque".

If cyclical ratio = 50% → Torque supplied = 0 mNm.

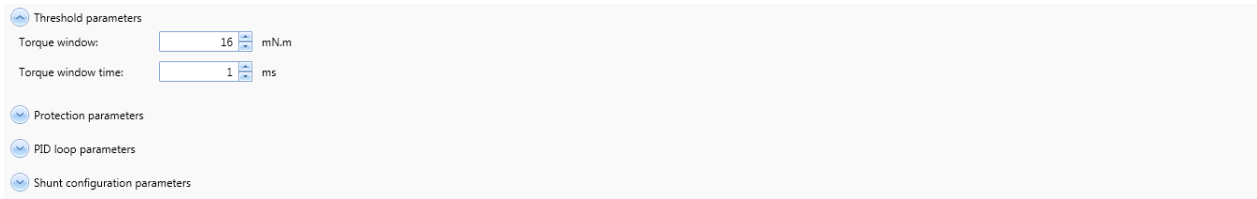
If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

- Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.



### 14.3.3.1.3. “Settings” tab parameters

#### a) Threshold parameters



See part “[4. MOTION SETTINGS / 4.3. Thresholds](#)” of this user manual.

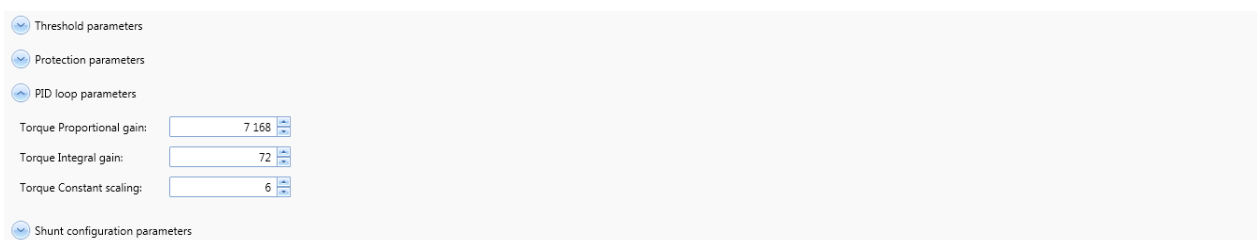
#### b) Protection parameters



See part “[9. PROTECTIONS](#)” of this user manual.

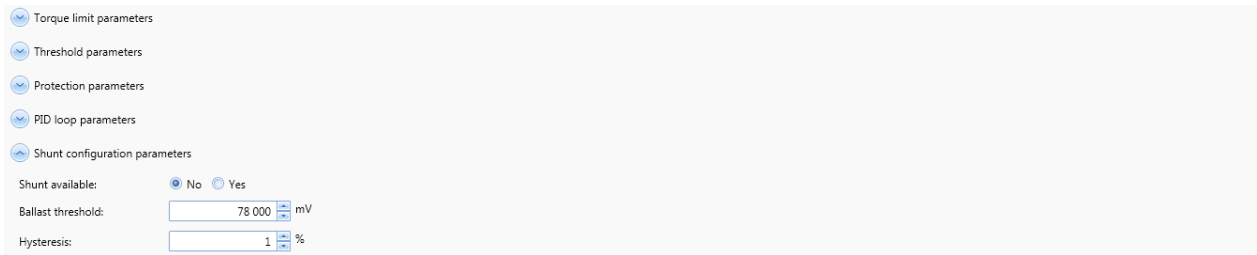
If one of these protection parameters is exceeded, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).

#### c) PID loop parameters



Set the PID controller factors in the torque control loop (this function is reserved for advanced users). The values given in the example below ensure correct product operation in the majority of cases.

#### d) Shunt configuration parameters



The screenshot shows a software interface for configuring motor parameters. A list of categories is displayed on the left, with 'Shunt configuration parameters' selected. Below the list, there are three configuration options:

- Shunt available:  No  Yes
- Ballast threshold:  mV
- Hysteresis:  %

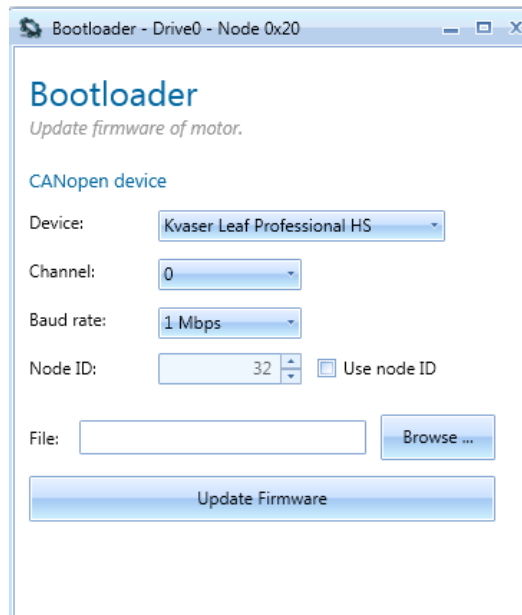
See part "[9. PROTECTIONS/ 9.2. Voltage protections/ 9.2.2. Shunt](#)" of this user manual.

If the ballast threshold plus hysteresis is exceeded, the shunt is activated.

## 15. BOOTLOADER

### 15.1. Bootloader CAN

The CAN Bootloader button on the top toolbar allows you to update the firmware inside the SMI21 or SMI22 CANopen drive.



Select the .hex file that you want to load inside the SMI21 or SMI22 CANopen drive by click on the “Browse” button and after click on the “Update Firmware” button to launch the bootloader sequence.

When the bootloader sequence is finished, the following green message appears: **“Firmware update successful”**.



**WARNING:** Bootloader sequence is an expert procedure to update the firmware. If there is a problem during the firmware update, you can permanently lose the communication with the motor.



**WARNING:** During bootloader sequence (firmware update), you must never disconnect the power cable (or power supply) or the CAN communication cable before the end of the downloading, you can permanently lose the communication with the motor and be not able to use it. If it happens, send motor to Crouzet After sales department to reset completely the motor. Your parameters could not be saved, you should reset the motor after the repair. This repair is not covered by the warranty.



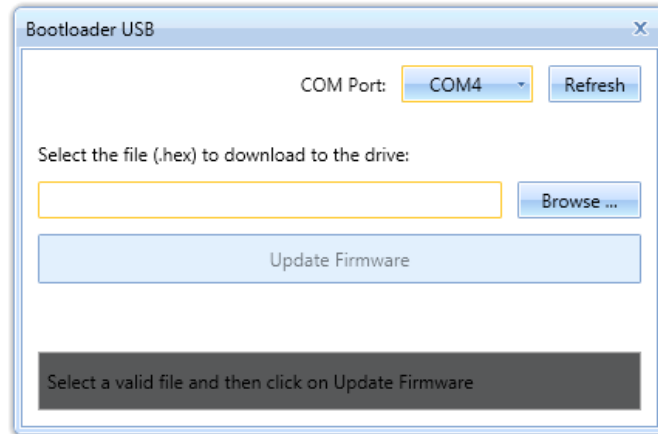
**CAUTION:** With SMI21 CANopen drive, the BOOTLOADER CAN can be used only with the baudrate 1 Mb/s.



**CAUTION:** The chosen baudrate in the bootloader should be the same than the one configured in the motor.

## 15.2. Bootloader USB

The USB Bootloader button on the top toolbar allows you to update the firmware inside the SMI22 CANopen drive.



Click on Refresh and chose the COM Port of the drive.

Select the .hex file that you want to load inside the SMI22 CANopen drive by click on the “Browse” button and after click on the “Update Firmware” button to launch the bootloader sequence.

When the bootloader sequence is finished, the following green message appears: **“Drive updated successfully”**.



**WARNING:** Bootloader sequence is an expert procedure to update the firmware. If there is a problem during the firmware update, you can permanently lose the communication with the motor.



**WARNING:** During bootloader sequence (firmware update), you must never disconnect the power cable (or power supply) or the CAN communication cable before the end of the downloading, you can permanently lose the communication with the motor and be not able to use it. If it happens, send motor to Crouzet After sales department to reset completely the motor. Your parameters could not be saved, you should reset the motor after the repair. This repair is not covered by the warranty.



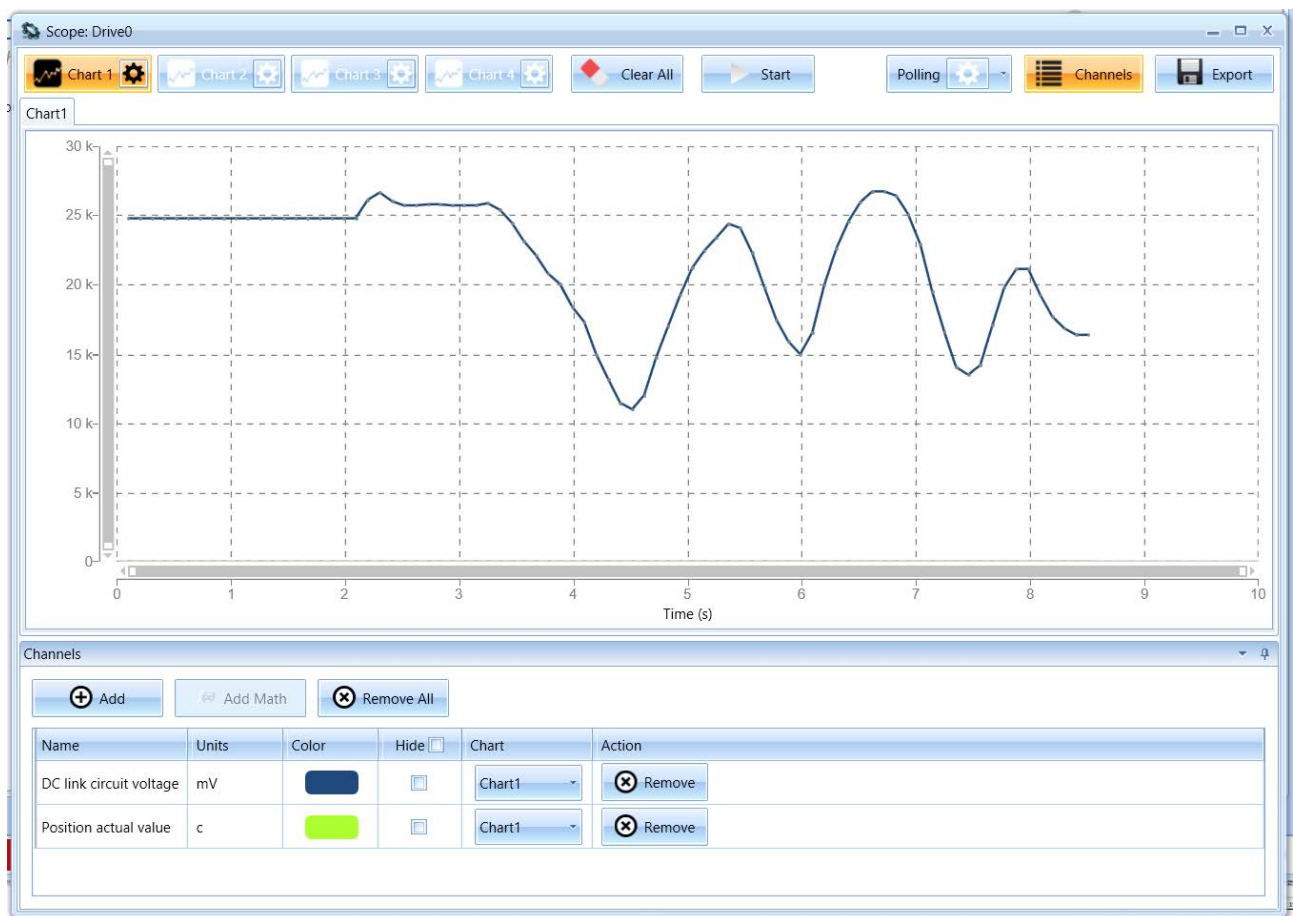
**CAUTION:** With SMI21 CANopen drive, the BOOTLOADER USB isn't available.

## 16. SCOPE

The Digital Scope allows the user to optimize system performance using data collection. It works in two different modes, collecting data continuously from the servo drive (polling) or monitoring and gathering a fixed amount of point (2500). Depending on system performance, one or another will be more appropriate and accurate to collect data.

### Some features:

- Up to 4 simultaneous charts
- Collect and plot various signals including position, velocity and position error on multiple axes
- Update rates up to 50 ms in polling mode and 2500 samples in monitoring mode
- Graphically examine collected data using cursor and zooming tools
- Add math functions between channels
- Auto-scale



Available scope modes are:

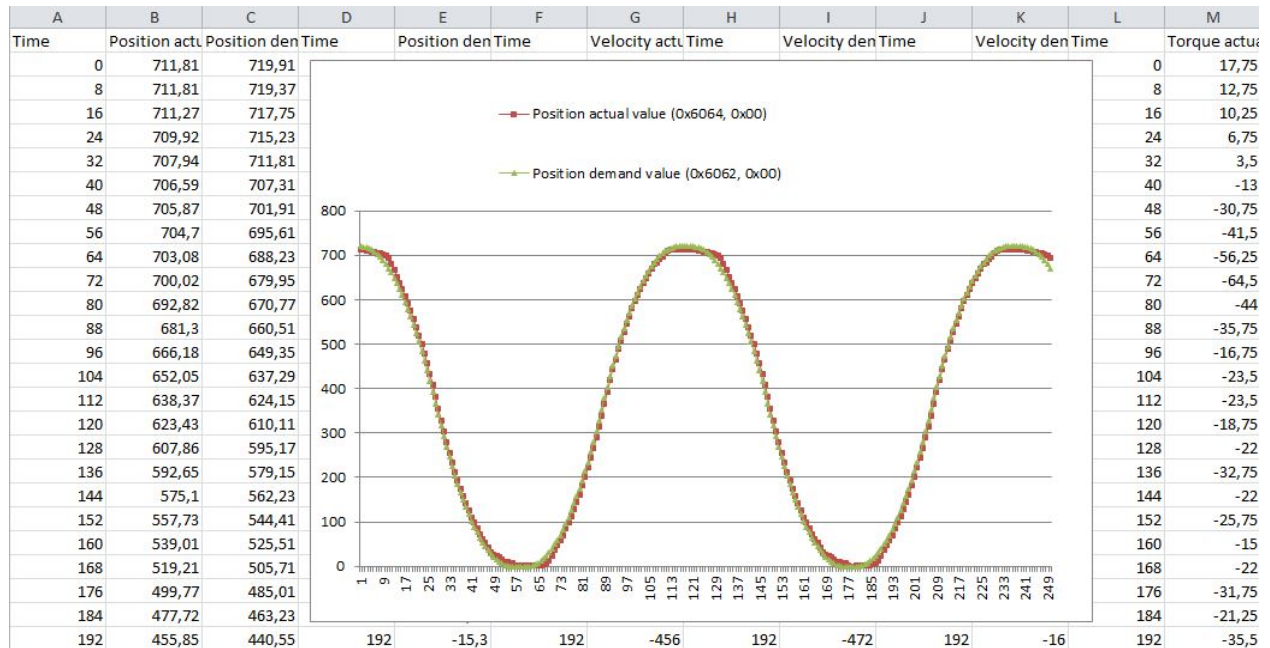
**Polling Mode:** In this mode, the scope collects continuous data from a set of signals previously selected; sample rate can be set up to 50 ms.

**Monitoring Mode:** This mode allows a more accurate data collection and analysis. After setting the recording time in ms, it will gather data using as trigger any motion start (future triggers will be available). It collects up to 2500 points and by default plots all the relevant motion signals (demanded and current values) which afterwards can be disabled for individual channel analysis.

The two modes allow to select multiple signals and assign different colors or primary/ secondary Y axis for better values visibility. Also In both modes the collected plots can be exported to a CSV file.


In polling mode only the enabled signal is exported; in monitoring mode all the signals are exported regardless of the number that are enabled:

- Position: actual value, demanded value and difference between both (following error)
- Velocity: actual value, demanded value and difference between both (following error)
- Torque: actual value, demanded value and difference between both (following error)



Notice that together with the channel description, you will find the internal register associated with this value. These registers are following the CANopen protocol structure since SMI21 and SMI22 CANopen drive is compliant with the following profiles: CiA-301, CiA-303, CiA-305, CiA-306 and CiA-402.

## ANNEXE 1 – OBJECT DICTIONARY

 CAUTION: The following dictionaries are both for SMI21 and SMI22 CANopen drives, some register are not present on the two drives.

### CiA 301 object dictionary:

| Index (hex) | Sub-index (hex) | Description                      | Data type | PDO mappable | Access | NVM | Default value |
|-------------|-----------------|----------------------------------|-----------|--------------|--------|-----|---------------|
| 1000        | 0               | Device type                      | UINT32    | N            | RO     | N   | 0x00020192    |
| 1001        | 0               | Error register                   | UINT8     | N            | RO     | N   | 0x00          |
| 1003        | -               | Pre-defined Error Field          | ARRAY     | -            | -      | -   | -             |
| 1003        | 0               | Number of entries                | UINT8     | N            | RW     | N   | 0x00          |
| 1003        | 1               | Standard error field             | UINT32    | N            | RO     | N   | 0x00000000    |
| 1003        | 2               | Standard error field             | UINT32    | N            | RO     | N   | 0x00000000    |
| 1003        | 3               | Standard error field             | UINT32    | N            | RO     | N   | 0x00000000    |
| 1003        | 4               | Standard error field             | UINT32    | N            | RO     | N   | 0x00000000    |
| 1005        | 0               | COB-ID SYNC                      | UINT32    | N            | RW     | N   | 0x80          |
| 1006        | 0               | Communication Cycle period       | UINT32    | N            | RW     | N   | 0x00000000    |
| 1007        | 0               | Sync window length               | UINT32    | N            | RW     | N   | 0x00000000    |
| 1008        | 0               | Device name                      | STR       | N            | CONST  | N   | emcl          |
| 1009        | 0               | Hardware version                 | STR       | N            | CONST  | N   | See PCB       |
| 100A        | 0               | Software version                 | STR       | N            | CONST  | N   | 1.2.1         |
| 100C        | 0               | Guard time                       | UINT16    | N            | RW     | N   | 0x0000        |
| 100D        | 0               | Life Time Factor                 | UINT8     | N            | RW     | N   | 0x00          |
| 1010        | -               | Store parameters                 | ARRAY     | -            | -      | -   | -             |
| 1010        | 0               | Number of entries                | UINT8     | N            | CONST  | N   | 3             |
| 1010        | 1               | Save all parameters              | UINT32    | N            | RW     | N   | 1             |
| 1010        | 2               | Save communication parameters    | UINT32    | N            | RW     | N   | 1             |
| 1010        | 3               | Save application parameters      | UINT32    | N            | RW     | N   | 1             |
| 1011        | -               | Restore default parameters       | ARRAY     | -            | -      | -   | -             |
| 1011        | 0               | Number of entries                | UINT8     | N            | CONST  | N   | 3             |
| 1011        | 1               | Restore all parameters           | UINT32    | N            | RW     | N   | 1             |
| 1011        | 1               | Restore communication parameters | UINT32    | N            | RW     | N   | 1             |
| 1011        | 1               | Restore application parameters   | UINT32    | N            | RW     | N   | 1             |
| 1014        | 0               | COB-ID Emergency message         | UINT32    | N            | RW     | Y   | 0x000000A0    |
| 1017        | 0               | Producer heartbeat time          | UINT16    | N            | RW     | Y   | 0x0000        |
| 1018        | -               | Identity object                  | RECORD    | -            | -      | -   | -             |
| 1018        | 0               | Number of entries                | UINT8     | N            | CONST  | N   | 4             |
| 1018        | 1               | Vendor-ID                        | UINT32    | N            | RO     | N   | 0x000003F8    |
| 1018        | 2               | Product code                     | UINT32    | N            | RO     | N   | 0x00011402    |

|      |   |                          |        |   |    |   |            |
|------|---|--------------------------|--------|---|----|---|------------|
| 1018 | 3 | Revision number          | UINT32 | N | RO | N | 0x00000111 |
| 1018 | 4 | Serial number            | UINT32 | N | RO | N | -          |
| 1200 | - | SSDO                     | -      | N | RO | N | -          |
| 1400 | - | RPDO1                    | -      | N | RW | Y | -          |
| 1401 | - | RPDO2                    | -      | N | RW | Y | -          |
| 1402 | - | RPDO3                    | -      | N | RW | Y | -          |
| 1403 | - | RPDO4                    | -      | N | RW | Y | -          |
| 1600 | - | RPDO 1 mapping parameter | -      | N | RW | Y | -          |
| 1601 | - | RPDO 2 mapping parameter | -      | N | RW | Y | -          |
| 1602 | - | RPDO 3 mapping parameter | -      | N | RW | Y | -          |
| 1603 | - | RPDO 4 mapping parameter | -      | N | RW | Y | -          |
| 1800 | - | TPDO 1                   | -      | N | RW | Y | -          |
| 1801 | - | TPDO 2                   | -      | N | RW | Y | -          |
| 1802 | - | TPDO 3                   | -      | N | RW | Y | -          |
| 1803 | - | TPDO 4                   | -      | N | RW | Y | -          |
| 1A00 | - | TPDO 1 mapping parameter | -      | N | RW | Y | -          |
| 1A01 | - | TPDO 2 mapping parameter | -      | N | RW | Y | -          |
| 1A02 | - | TPDO 3 mapping parameter | -      | N | RW | Y | -          |
| 1A03 | - | TPDO 4 mapping parameter | -      | N | RW | Y | -          |



**CiA 402 object dictionary:**

| Index (hex) | Sub-index (hex) | Description                    | Data type | PDO mappable | Access | NVM | Default value |
|-------------|-----------------|--------------------------------|-----------|--------------|--------|-----|---------------|
| 603F        | 0               | Error code                     | UINT16    | Y            | RO     | N   | 0x0000        |
| 6040        | 0               | Controlword                    | UINT16    | Y            | RW     | N   | 0x0000        |
| 6041        | 0               | Statusword                     | UINT16    | Y            | RO     | N   | -             |
| 6060        | 0               | Modes of operation             | INT8      | Y            | RW     | Y   | 1             |
| 6061        | 0               | Modes of operation display     | INT8      | Y            | RO     | N   | -             |
| 6062        | 0               | Position demand value          | INT32     | Y            | RO     | N   | -             |
| 6063        | 0               | Position actual internal value | INT32     | Y            | RO     | N   | -             |
| 6064        | 0               | Position actual value          | INT32     | Y            | RO     | N   | -             |
| 6065        | 0               | Following error window         | UINT32    | Y            | RW     | Y   | 0xFFFFFFFF    |
| 6066        | 0               | Following error timeout        | UINT16    | Y            | RW     | Y   | 100           |
| 6067        | 0               | Position window                | UINT32    | Y            | RW     | Y   | 100           |
| 6068        | 0               | Position window time           | UINT16    | Y            | RW     | Y   | 10            |
| 6069        | 0               | Velocity sensor actual value   | INT32     | Y            | RO     | N   | 0             |
| 606B        | 0               | Velocity demand value          | INT32     | Y            | RO     | N   | -             |
| 606C        | 0               | Velocity actual value          | INT32     | Y            | RO     | N   | -             |
| 606D        | 0               | Velocity window                | UINT16    | Y            | RW     | Y   | 1000          |
| 606E        | 0               | Velocity window time           | UINT16    | Y            | RW     | Y   | 10            |
| 606F        | 0               | Velocity threshold             | UINT16    | Y            | RW     | Y   | 1000          |
| 6070        | 0               | Velocity threshold time        | UINT16    | Y            | RW     | Y   | 100           |
| 6071        | 0               | Target torque                  | INT16     | Y            | RW     | N   | 0             |
| 6072        | 0               | Max torque                     | UINT16    | Y            | RW     | Y   | 1000          |
| 6073        | 0               | Max current                    | UINT16    | Y            | RW     | Y   | 1000          |
| 6074        | 0               | Torque demand                  | INT16     | Y            | RO     | N   | -             |
| 6075        | 0               | Motor rated current            | UINT32    | Y            | RW     | Y   | 3000          |
| 6076        | 0               | Motor rated torque             | UINT32    | Y            | RW     | Y   | 310           |
| 6077        | 0               | Torque actual value            | INT16     | Y            | RO     | N   | -             |
| 6078        | 0               | Current actual value           | INT16     | Y            | RO     | N   | -             |
| 6079        | 0               | DC link circuit voltage        | UINT32    | Y            | RO     | N   | 0             |
| 607A        | 0               | Target position                | INT32     | Y            | RW     | N   | 0             |
| 607C        | 0               | Home offset                    | INT32     | N            | RW     | Y   | 0             |
| 607D        | -               | Software position limit        | ARRAY     | -            | -      | -   | -             |
| 607D        | 0               | Number of entries              | UINT8     | N            | CONST  | N   | 2             |
| 607D        | 1               | Min position limit             | INT32     | Y            | RW     | Y   | 0x80000000    |
| 607D        | 2               | Max position limit             | INT32     | Y            | RW     | Y   | 0x7FFFFFFF    |
| 607E        | 0               | Polarity                       | UINT8     | Y            | RW     | Y   | 0             |
| 607F        | 0               | Max profile velocity           | UINT32    | Y            | RW     | Y   | 200000        |
| 6080        | 0               | Max motor speed                | UINT32    | Y            | RW     | Y   | 100000        |
| 6081        | 0               | Profile velocity               | UINT32    | Y            | RW     | Y   | 100000        |
| 6083        | 0               | Profile acceleration           | UINT32    | Y            | RW     | Y   | 100000        |

|      |   |   |        |   |       |   |          |
|------|---|---|--------|---|-------|---|----------|
| 6084 | 0 | Profile deceleration                    | UINT32 | Y | RW    | Y | 100000   |
| 6085 | 0 | Quick stop deceleration                 | UINT32 | Y | RW    | Y | 200000   |
| 6086 | 0 | Motion profile type                     | INT16  | Y | RW    | Y | 0        |
| 6087 | 0 | Torque slope                            | UINT32 | Y | RW    | Y | 10000    |
| 6088 | 0 | Torque profile type                     | INT16  | Y | RW    | Y | 0        |
| 608F | - | Position encoder resolution             | ARRAY  | - | -     | - | -        |
| 608F | 0 | Number of entries                       | UINT8  | N | CONST | N | 2        |
| 608F | 1 | Encoder increments                      | UINT32 | Y | RW    | Y | 2000     |
| 608F | 2 | Motor revolutions                       | UINT32 | Y | RW    | Y | 1        |
| 6090 | - | Velocity encoder resolution             | ARRAY  | - | -     | - | -        |
| 6090 | 0 | Number of entries                       | UINT8  | N | CONST | N | 2        |
| 6090 | 1 | Encoder increments                      | UINT32 | Y | RW    | Y | 2000     |
| 6090 | 2 | Motor revolutions                       | UINT32 | Y | RW    | Y | 1        |
| 6091 | - | Gear ratio                              | ARRAY  | - | -     | - | -        |
| 6091 | 0 | Number of entries                       | UINT8  | N | CONST | N | 2        |
| 6091 | 1 | Motor shaft revolutions                 | UINT32 | N | RW    | Y | 1        |
| 6091 | 2 | Driving shaft revolutions               | UINT32 | N | RW    | Y | 1        |
| 6092 | - | Feed constant                           | ARRAY  | - | -     | - | -        |
| 6092 | 0 | Number of entries                       | UINT8  | N | CONST | N | 2        |
| 6092 | 1 | Feed                                    | UINT32 | N | RW    | Y | 1        |
| 6092 | 2 | Shaft revolutions                       | UINT32 | N | RW    | Y | 1        |
| 6098 | 0 | Homing method                           | INT8   | N | RW    | Y | 35       |
| 6099 | - | Homing speeds                           | ARRAY  | - | -     | - | -        |
| 6099 | 0 | Number of entries                       | UINT8  | N | CONST | N | 2        |
| 6099 | 1 | Speed for switch search                 | UINT32 | N | RW    | Y | 50000    |
| 6099 | 2 | Speed for zero search                   | UINT32 | N | RW    | Y | 5000     |
| 609A | 0 | Homing acceleration                     | UINT32 | N | RW    | Y | 100000   |
| 60A8 | 0 | SI unit position                        | UINT32 | N | RW    | Y | 11862016 |
| 60A9 | 0 | SI unit velocity                        | UINT32 | N | RW    | Y | 11862784 |
| 60AA | 0 | SI unit acceleration                    | UINT32 | N | RW    | Y | 11884288 |
| 60B2 | 0 | Torque offset                           | INT16  | Y | RW    | Y | 0        |
| 60C1 | - | Interpolation data record               | ARRAY  | - | -     | - | -        |
| 60C1 | 0 | Highest sub-index supported             | UINT8  | N | CONST | N | 1        |
| 60C1 | 1 | Interpolation 1 <sup>st</sup> Set-point | INT32  | T | RW    | N | 0        |
| 60C2 | - | Interpolation time period               | RECORD | - | -     | - | -        |
| 60C2 | 0 | Highest sub-index supported             | UINT8  | N | CONST | N | 2        |
| 60C2 | 1 | Interpolation time period value         | UINT8  | N | RW    | N | 0        |
| 60C2 | 2 | Interpolation time index                | INT8   | N | RW    | N | -3       |
| 60C4 | - | Interpolation data configuration        | RECORD | - | -     | - | -        |
| 60C4 | 0 | Highest sub-index supported             | UINT8  | N | CONST | N | 6        |
| 60C4 | 1 | Maximum buffer size                     | UINT32 | N | RO    | N | 16       |
| 60C4 | 2 | Actual buffer size                      | UINT32 | N | RW    | N | 16       |
| 60C4 | 3 | Buffer organization                     | UINT8  | N | RW    | N | 0        |
| 60C4 | 4 | Buffer position                         | UINT16 | N | RW    | N | 0        |

|      |   |                                |        |   |       |   |            |
|------|---|--------------------------------|--------|---|-------|---|------------|
| 60C4 | 5 | Size of data record            | UINT8  | N | WO    | N | -          |
| 60C4 | 6 | Buffer clear                   | UINT8  | N | WO    | N | -          |
| 60C5 | 0 | Max acceleration               | UINT32 | Y | RW    | Y | 200000     |
| 60C6 | 0 | Max deceleration               | UINT32 | Y | RW    | Y | 200000     |
| 60E0 | 0 | Positive torque limit value    | INT16  | Y | RW    | Y | 1000       |
| 60E1 | 0 | Negative torque limit value    | INT16  | Y | RW    | Y | -1000      |
| 60F4 | 0 | Following error actual value   | INT32  | Y | RO    | N | -          |
| 60FA | 0 | Control effort                 | INT32  | Y | RO    | N | -          |
| 60FC | 0 | Position demand internal value | INT32  | Y | RO    | N | -          |
| 60FD | 0 | Digital inputs                 | UINT32 | Y | RO    | N | -          |
| 60FE | - | Digital outputs                | ARRAY  | - | -     | - | -          |
| 60FE | 0 | Number of entries              | UINT8  | N | CONST | N | 2          |
| 60FE | 1 | Physical outputs               | UINT32 | N | RW    | Y | 0x00000000 |
| 60FE | 2 | Bit mask                       | UINT32 | N | RW    | Y | 0x00000000 |
| 60FF | 0 | Target velocity                | INT32  | Y | RW    | Y | 0          |
| 6402 | 0 | Motor type                     | UINT16 | Y | RW    | Y | 10         |
| 6502 | 0 | Supported drive modes          | UINT32 | Y | CONST | N | 0x300EF    |
| 6505 | 0 | Http drive catalog address     | STRING | N | CONST | N | -          |

### Manufacturer specific object dictionary:

| Index (hex) | Sub-index (hex) | Description                 | Data type | PDO mappable | Access | NVM | Default value |
|-------------|-----------------|-----------------------------|-----------|--------------|--------|-----|---------------|
| 2000        | -               | Uart configuration          | ARRAY     | -            | -      | -   | -             |
| 2000        | 0               | Number of entries           | UINT8     | N            | CONST  | N   | 5             |
| 2000        | 1               | Node ID                     | UINT8     | N            | RW     | Y   | 32            |
| 2000        | 2               | Baudrate                    | UINT8     | N            | RW     | Y   | 0             |
| 2000        | 3               | Daisy chain mode            | UINT8     | N            | RW     | Y   | 0             |
| 2000        | 4               | Base format                 | UINT8     | N            | RW     | Y   | 0             |
| 2000        | 5               | Statusword mode             | UINT8     | N            | RW     | Y   | 1             |
| 2000        | 6               | CRC enable                  | UINT8     | N            | RW     | Y   | 0             |
| 2000        | 7               | Lifeguard message           | UINT8     | N            | RW     | Y   | 0             |
| 2001        | -               | CANopen configuration       | ARRAY     | -            | -      | -   | -             |
| 2001        | 0               | Number of entries           | UINT8     | N            | CONST  | N   | 2             |
| 2001        | 1               | Node ID                     | UINT8     | N            | RW     | N   | 32            |
| 2001        | 2               | Baudrate                    | UINT8     | N            | RW     | Y   | 0             |
| 200F        | -               | Communication password      | ARRAY     | -            | -      | -   | -             |
| 200F        | 0               | Number of entries           | UINT8     | N            | CONST  | N   | 3             |
| 200F        | 1               | All password                | UINT32    | N            | WO     | N   | 0             |
| 200F        | 2               | UART password               | UINT32    | N            | WO     | N   | 0             |
| 200F        | 3               | CANopen password            | UINT32    | N            | WO     | N   | 0             |
| 20C2        | -               | Driver temperature          | ARRAY     | -            | -      | -   | -             |
| 20C2        | 0               | Number of entries           | UINT8     | N            | CONST  | N   | 3             |
| 20C2        | 1               | Actual temperature          | INT32     | Y            | RO     | N   | -             |
| 20C2        | 2               | Max user temperature        | INT32     | N            | RW     | Y   | 72000         |
| 20C2        | 3               | Min user temperature        | INT32     | N            | RW     | Y   | -20000        |
| 20C3        | -               | Motor temperature           | ARRAY     | -            | -      | -   | -             |
| 20C3        | 0               | Number of entries           | UINT8     | N            | CONST  | N   | 3             |
| 20C3        | 1               | Max motor temperature       | INT32     | TBD          | RO     | TDB | 125000        |
| 20C3        | 2               | Current limiting enabled    | UINT8     | TBD          | RO     | TBD | -             |
| 20C3        | 3               | Toogle current limit enable | INT32     | TBD          | WO     | TBD | 0             |
| 2101        | -               | Bus voltage                 | ARRAY     | -            | -      | -   | -             |
| 2101        | 0               | Number of entries           | UINT8     | N            | CONST  | N   | 3             |
| 2101        | 1               | DC link circuit voltage     | UINT32    | Y            | RO     | N   | -             |
| 2101        | 2               | Max user voltage            | UINT32    | N            | RW     | Y   | 60000         |
| 2101        | 3               | Min user voltage            | UINT32    | N            | RW     | Y   | 12000         |
| 2102        | -               | Homing extra parameters     | RECORD    | -            | -      | -   | -             |
| 2102        | 0               | Number of entries           | UINT8     | N            | CONST  | N   | 3             |
| 2102        | 1               | Total homing timeout        | UINT16    | N            | RW     | Y   | 8000          |
| 2102        | 2               | Torque limit                | UINT16    | N            | RW     | Y   | 200           |
| 2102        | 3               | Torque limit timeout        | UINT32    | N            | RW     | Y   | 1000          |
| 2103        | -               | Shunt configuration         | ARRAY     | -            | -      | -   | -             |
| 2103        | 0               | Number of entries           | UINT8     | N            | CONST  | N   | 3             |
| 2103        | 1               | Available                   | UINT8     | N            | RW     | Y   | 0             |

|      |   |                                    |        |   |       |   |      |
|------|---|------------------------------------|--------|---|-------|---|------|
| 2103 | 2 | Duty used                          | UINT16 | N | RW    | Y | 1024 |
| 2103 | 3 | Hysteresis                         | UINT8  | N | RW    | Y | 5    |
| 2301 | 0 | Motor pair poles                   | UINT8  | N | RW    | Y | 4    |
| 2305 | - | Commutation                        | RECORD | - | -     | - | -    |
| 2305 | 0 | Number of entries                  | UINT8  | N | CONST | N | 3    |
| 2305 | 1 | Commutation sensor                 | UINT8  | N | RW    | Y | 0    |
| 2305 | 2 | Initial angle determination method | UINT8  | N | RW    | Y | 0    |
| 2305 | 3 | Actual system angle                | UINT8  | Y | RO    | N | -    |
| 2306 | - | Forced alignment method            | RECORD | - | -     | - | -    |
| 2306 | 0 | Number of entries                  | UINT8  | N | CONST | N | 3    |
| 2306 | 1 | Process time                       | UINT32 | N | RW    | Y | 1000 |
| 2306 | 2 | Process current                    | UINT32 | N | RW    | Y | 500  |
| 2306 | 3 | Process tolerance                  | UINT8  | N | RW    | Y | 5    |
| 2307 | - | Known alignment method             | RECORD | - | -     | - | -    |
| 2307 | 0 | Number of entries                  | UINT8  | N | CONST | N | 1    |
| 2307 | 1 | Initial rotor angle                | UINT16 | N | RW    | Y | 0    |
| 2308 | - | Non-incremental alignment          | RECORD | - | -     | - | -    |
| 2308 | 0 | Number of entries                  | UINT8  | N | CONST | N | 1    |
| 2308 | 1 | Offset from phase A                | UINT16 | N | RW    | Y | 0    |
| 2310 | - | Feedbacks                          | ARRAY  | - | -     | - | -    |
| 2310 | 0 | Number of entries                  | UINT8  | N | CONST | N | 3    |
| 2310 | 1 | Torque sensor                      | UINT8  | N | RW    | Y | 0    |
| 2310 | 2 | Velocity sensor                    | UINT8  | N | RW    | Y | 0    |
| 2310 | 3 | Position sensor                    | UINT8  | N | RW    | Y | 0    |
| 2311 | 0 | Position encoder swap mode         | UINT8  | N | RW    | Y | 1    |
| 2312 | 0 | Position encoder type              | UINT8  | N | RW    | Y | 2    |
| 2321 | - | Digital halls                      | RECORD | - | -     | - | -    |
| 2321 | 0 | Number of entries                  | UINT8  | N | CONST | N | 3    |
| 2321 | 1 | Polarity                           | UINT8  | N | RW    | Y | 1    |
| 2321 | 2 | Value                              | UINT8  | Y | RO    | N | -    |
| 2321 | 3 | Halls step offset                  | UINT8  | N | RW    | Y | 0    |
| 2400 | 0 | System polarity                    | UINT8  | N | RW    | Y | 0    |
| 2430 | 0 | Command reference source           | UINT8  | N | RW    | Y | 0    |
| 2431 | 0 | Local/remote control               | UINT8  | N | RW    | Y | 0    |
| 2433 | - | Step and direction command source  | ARRAY  | - | -     | - | -    |
| 2433 | 0 | Number of entries                  | UINT8  | N | CONST | N | 1    |
| 2433 | 1 | Step value                         | UINT32 | N | RW    | Y | 1    |
| 2434 | - | Analog input command source        | RECORD | - | -     | - | -    |
| 2434 | 0 | Number of entries                  | UINT8  | N | CONST | N | 3    |
| 2434 | 1 | Analog input used                  | UINT8  | N | RW    | Y | 1    |
| 2434 | 2 | Analog input motion offset         | INT32  | N | RW    | Y | 0    |
| 2434 | 3 | Analog input velocity deadband     | UINT32 | N | RW    | Y | 0    |
| 2434 | 4 | Analog input motion range          | INT32  | N | RW    | Y | 1000 |
| 2435 | - | PWM cmd source                     | RECORD | - | -     | - | -    |

|      |   |                                   |        |   |       |   |        |
|------|---|-----------------------------------|--------|---|-------|---|--------|
| 2435 | 0 | Number of entries                 | UINT8  | N | CONST | N | 1      |
| 2435 | 1 | Mode                              | UINT8  | N | RW    | Y | 0      |
| 2435 | 2 | PWM input motion offset           | INT32  | N | RW    | Y | 0      |
| 2435 | 3 | PWM input velocity deadband       | UINT32 | N | RW    | Y | 0      |
| 2435 | 4 | PWM input motion range            | INT32  | N | RW    | Y | 1000   |
| 2435 | 5 | PWM duty actual                   | UINT16 | N | RO    | N | -      |
| 2435 | 6 | PWM period actual                 | UINT16 | N | RO    | N | -      |
| 243A | 0 | Internal target value             | INT32  | N | RO    | N | -      |
| 2500 | - | Position control parameter set    | ARRAY  | - | -     | - | -      |
| 2500 | 0 | Number of entries                 | UINT8  | N | CONST | N | 7      |
| 2500 | 1 | Proportional constant             | UINT32 | N | RW    | Y | 1000   |
| 2500 | 2 | Integral constant                 | UINT32 | N | RW    | Y | 5      |
| 2500 | 3 | Derivative constant               | UINT32 | N | RW    | Y | 40000  |
| 2500 | 4 | Integral antiwindup constant      | UINT32 | N | RW    | Y | 0      |
| 2500 | 5 | Velocity feedforward constant     | UINT32 | N | RW    | Y | 0      |
| 2500 | 6 | Acceleration feedforward constant | UINT32 | N | RW    | Y | 0      |
| 2500 | 7 | Integral limit                    | UINT32 | N | RW    | Y | 1      |
| 2501 | - | Velocity control parameter set    | ARRAY  | - | -     | - | -      |
| 2501 | 0 | Number of entries                 | UINT8  | N | CONST | N | 6      |
| 2501 | 1 | Proportional constant             | UINT32 | N | RW    | Y | 4000   |
| 2501 | 2 | Integral constant                 | UINT32 | N | RW    | Y | 50     |
| 2501 | 3 | Derivative constant               | UINT32 | N | RW    | Y | 0      |
| 2501 | 4 | Integral antiwindup constant      | UINT32 | N | RW    | Y | 100000 |
| 2501 | 5 | Acceleration feedforward constant | UINT32 | N | RW    | Y | 0      |
| 2501 | 6 | Integral limit                    | UINT32 | N | RW    | Y | 1      |
| 2502 | - | Flux control parameter set        | ARRAY  | - | -     | - | -      |
| 2502 | 0 | Number of entries                 | UINT8  | N | CONST | N | 2      |
| 2502 | 1 | Proportional constant             | UINT16 | N | RW    | Y | 3000   |
| 2502 | 2 | Integral constant                 | UINT16 | N | RW    | Y | 300    |
| 2502 | 3 | Constant scaling                  | UINT8  | N | RW    | Y | 8      |
| 2503 | - | Torque control parameter set      | ARRAY  | - | -     | - | -      |
| 2503 | 0 | Number of entries                 | UINT8  | N | CONST | N | 2      |
| 2503 | 1 | Proportional constant             | UINT16 | N | RW    | Y | 3000   |
| 2503 | 2 | Integral constant                 | UINT16 | N | RW    | Y | 300    |
| 2503 | 3 | Constant scaling                  | UINT8  | N | RW    | Y | 8      |
| 2504 | - | Torque demand low pass filter     | RECORD | - | -     | - | -      |
| 2504 | 0 | Number of entries                 | UINT8  | N | CONST | N | 2      |
| 2504 | 1 | Filter enabled                    | UINT8  | N | RW    | Y | 0      |
| 2504 | 2 | Cutoff frequency                  | UINT16 | N | RW    | Y | 100    |
| 2505 | - | Torque actual low pass filter     | RECORD | - | -     | - | -      |
| 2505 | 0 | Number of entries                 | UINT8  | N | CONST | N | 2      |
| 2505 | 1 | Filter enabled                    | UINT8  | N | RW    | Y | 0      |
| 2505 | 2 | Cutoff frequency                  | UINT16 | N | RW    | Y | 100    |
| 2506 | 0 | Max torque cte speed              | UINT16 | N | RW    | Y | 1000   |

|      |   |                                 |               |   |       |   |       |
|------|---|---------------------------------|---------------|---|-------|---|-------|
| 2507 | - | Control loops configuration     | ARRAY         | - | -     | - | -     |
| 2507 | 0 | Number of entries               | UINT8         | N | CONST | N | 5     |
| 2507 | 1 | Bypass torque loop              | UINT8         | N | RW    | Y | 0     |
| 2507 | 2 | Position feedback openloop      | UINT8         | N | RW    | Y | 0     |
| 2507 | 3 | Velocity feedback openloop      | UINT8         | N | RW    | Y | 0     |
| 2507 | 4 | Torque feedback openloop        | UINT8         | N | RW    | Y | 0     |
| 2507 | 5 | Velocity mode use Position loop | UINT8         | N | RW    | Y | 0     |
| 2508 | 0 | Torque window                   | UINT16        | N | RW    | Y | 10    |
| 2509 | 0 | Torque window time              | UINT16        | N | RW    | Y | 10    |
| 250B | - | Spring torque compensation      | ARRAY         | - | -     | - | -     |
| 250B | 0 | Number of entries               | UINT8         | N | CONST | N | 3     |
| 250B | 1 | Spring available                | 0 or 1        | N | RW    | Y | 0     |
| 250B | 2 | Spring torque offset            | -1000 to 1000 | N | RW    | Y | 0     |
| 250B | 3 | Spring aperture                 | UINT32        | N | RW    | Y | 0     |
| 257F | 0 | Max controller output           | UINT16        | N | RW    | Y | 24248 |
| 2600 | - | Current readings                | ARRAY         | - | -     | - | -     |
| 2600 | 0 | Number of entries               | UINT8         | N | CONST | N | 3     |
| 2600 | 1 | Current phase A                 | INT16         | Y | RO    | N | -     |
| 2600 | 2 | Current phase B                 | INT16         | Y | RO    | N | -     |
| 2600 | 3 | Current phase C                 | INT16         | Y | RO    | N | -     |
| 2601 | - | Current d-q                     | ARRAY         | - | -     | - | -     |
| 2601 | 0 | Number of entries               | UINT8         | N | CONST | N | 2     |
| 2601 | 1 | Current direct                  | INT16         | Y | RO    | N | -     |
| 2601 | 2 | Current quadrature              | INT16         | Y | RO    | N | -     |
| 2602 | - | Voltage readings                | ARRAY         | - | -     | - | -     |
| 2602 | 0 | Number of entries               | UINT8         | N | CONST | N | 3     |
| 2602 | 1 | Voltage phase A                 | INT32         | Y | RO    | N | -     |
| 2602 | 2 | Voltage phase B                 | INT32         | Y | RO    | N | -     |
| 2602 | 3 | Voltage phase C                 | INT32         | Y | RO    | N | -     |
| 2603 | - | Voltage d-q                     | ARRAY         | - | -     | - | -     |
| 2603 | 0 | Number of entries               | UINT8         | N | CONST | N | 2     |
| 2603 | 1 | Voltage direct                  | INT16         | Y | RO    | N | -     |
| 2603 | 2 | Voltage quadrature              | INT16         | Y | RO    | N | -     |
| 2701 | - | Motor parameters                | RECORD        | - | -     | - | -     |
| 2701 | 0 | Number of entries               | UINT8         | N | CONST | N | 6     |
| 2701 | 1 | Resistance phase-to-phase       | UINT16        | N | RW    | Y | 800   |
| 2701 | 2 | Inductance phase-to-phase       | UINT16        | N | RW    | Y | 120   |
| 2701 | 3 | Magnetic pole pitch             | UINT32        | N | RW    | Y | 1     |
| 2701 | 4 | Motor backemf constant - Kv     | UINT32        | N | RW    | Y | 0     |
| 2701 | 5 | Stroke (um)                     | UINT32        | N | RW    | Y | 0     |
| 2701 | 6 | Motor torque constant - Km      | UINT32        | N | RW    | Y | 0     |
| 2702 | - | I2T parameters                  | RECORD        | - | -     | - | -     |
| 2702 | 0 | Number of entries               | UINT8         | N | CONST | N | 2     |

|      |   |                               |        |   |       |   |        |
|------|---|-------------------------------|--------|---|-------|---|--------|
| 2702 | 1 | Peak current                  | UINT16 | N | RW    | Y | 1000   |
| 2702 | 2 | Peak time                     | UINT16 | N | RW    | Y | 1000   |
| 2702 | 3 | Continuous current            | UINT16 | N | RW    | Y | 500    |
| 2A02 | - | Digital inputs/outputs        | RECORD | - | -     | - | -      |
| 2A02 | 0 | Number of entries             | UINT8  | N | CONST | N | 1      |
| 2A02 | 1 | Input Polarity                | UINT16 | N | RW    | Y | 0xFFFF |
| 2A02 | 2 | Output Polarity               | UINT16 | N | RW    | Y | 0xFFFF |
| 2A03 | - | Analog inputs                 | ARRAY  | - | -     | - | -      |
| 2A03 | 0 | Number of entries             | UINT8  | N | CONST | N | 8      |
| 2A03 | 1 | Analog input 1 value          | UINT32 | N | RO    | N | -      |
| 2A03 | 2 | Analog input 2 value          | UINT32 | N | RO    | N | -      |
| 2A03 | 3 | Analog input 3 value          | UINT32 | N | RO    | N | -      |
| 2A03 | 4 | Analog input 4 value          | UINT32 | N | RO    | N | -      |
| 2A03 | 5 | Analog input 5 value          | UINT32 | N | RO    | N | -      |
| 2A03 | 6 | Analog input 6 value          | UINT32 | N | RO    | N | -      |
| 2A03 | 7 | Analog input 7 value          | UINT32 | N | RO    | N | -      |
| 2A03 | 8 | Analog input 8 value          | UINT32 | N | RO    | N | -      |
| 2A05 | - | Brake option                  | ARRAY  | - | -     | - | -      |
| 2A05 | 0 | Number of entries             | UINT8  | N | CONST | N | 6      |
| 2A05 | 1 | Available                     | UINT8  | N | RW    | Y | 0      |
| 2A05 | 2 | Delay before release brake    | UINT16 | N | RW    | Y | 0      |
| 2A05 | 3 | Delay after enable brake      | UINT16 | N | RW    | Y | 0      |
| 2A05 | 4 | Duty cycle                    | UINT16 | N | RW    | Y | 2047   |
| 2A05 | 5 | Full release brake pulse time | UINT16 | N | RW    | Y | 0      |
| 2A0A | - | PWM inputs                    | RECORD | - | -     | - | -      |
| 2A0A | 0 | Number of entries             | UINT8  | N | CONST | N | 5      |
| 2A0A | 1 | Max PWM frequency             | UINT32 | N | CONST | N | 937500 |
| 2A0A | 2 | PWM period 1                  | UINT16 | Y | RO    | N | 20000  |
| 2A0A | 3 | PWM duty 1                    | UINT16 | Y | RO    | N | 10000  |
| 2A0A | 4 | PWM period 2                  | UINT16 | Y | RO    | N | 20000  |
| 2A0A | 5 | PWM duty 2                    | UINT16 | Y | RO    | N | 10000  |
| 2A0B | - | PWM outputs                   | RECORD | - | -     | - | -      |
| 2A0B | 0 | Number of entries             | UINT8  | N | CONST | N | 5      |
| 2A0B | 1 | Max PWM frequency             | UINT32 | N | CONST | N | 937500 |
| 2A0B | 2 | PWM period 1                  | UINT16 | Y | RW    | N | 20000  |
| 2A0B | 3 | PWM duty 1                    | UINT16 | Y | RW    | N | 10000  |
| 2A0B | 4 | PWM period 2                  | UINT16 | Y | RW    | N | 20000  |
| 2A0B | 5 | PWM duty 2                    | UINT16 | Y | RW    | N | 10000  |
| 2A10 | - | GPI mapping parameter         | ARRAY  | - | -     | - | -      |
| 2A10 | 0 | Number of entries             | UINT8  | N | CONST | N | 10     |
| 2A10 | 1 | GPI 1 function                | UINT16 | N | RW    | Y | 0      |
| 2A10 | 2 | GPI 2 function                | UINT16 | N | RW    | Y | 0      |
| 2A10 | 3 | GPI 3 function                | UINT16 | N | RW    | Y | 0      |
| 2A10 | 4 | GPI 4 function                | UINT16 | N | RW    | Y | 0      |



|      |     |                           |        |   |       |   |        |
|------|-----|---------------------------|--------|---|-------|---|--------|
| 2A10 | 5   | GPI 5 function            | UINT16 | N | RW    | Y | 0      |
| 2A10 | 6   | GPI 6 function            | UINT16 | N | RW    | Y | 0      |
| 2A10 | 7   | GPI 7 function            | UINT16 | N | RW    | Y | 0      |
| 2A10 | 8   | GPI 8 function            | UINT16 | N | RW    | Y | 0      |
| 2A10 | 9   | HS GPI 1 function         | UINT16 | N | RW    | Y | 0      |
| 2A10 | A   | HS GPI 2 function         | UINT16 | N | RW    | Y | 0      |
| 2A10 | -   | GPI mapping parameter     | ARRAY  | - | -     | - | -      |
| 2A11 | 0   | Number of entries         | UINT8  | N | CONST | N | 10     |
| 2A11 | 1   | GPO 1 function            | UINT16 | N | RW    | Y | 0      |
| 2A11 | 2   | GPO 2 function            | UINT16 | N | RW    | Y | 0      |
| 2A11 | 3   | GPO 3 function            | UINT16 | N | RW    | Y | 0      |
| 2A11 | 4   | GPO 4 function            | UINT16 | N | RW    | Y | 0      |
| 2A11 | 5   | GPO 5 function            | UINT16 | N | RW    | Y | 0      |
| 2A11 | 6   | GPO 6 function            | UINT16 | N | RW    | Y | 0      |
| 2A11 | 7   | GPO 7 function            | UINT16 | N | RW    | Y | 0      |
| 2A11 | 8   | GPO 8 function            | UINT16 | N | RW    | Y | 0      |
| 2A1F | -   | Halls pulse parameters    | RECORD | - | -     | - | -      |
| 2A1F | 0   | Number of entries         | UINT8  | N | CONST | N | 2      |
| 2A1F | 1   | Max pulse frequency       | UINT32 | N | CONST | N | 937500 |
| 2A1F | 2   | Pulse width               | UINT16 | N | RW    | N | 500    |
| 2C00 | -   | General purpose registers | ARRAY  | - | -     | - | 0      |
| 2C00 | 0   | Number of entries         | UINT8  | N | CONST | N | 150    |
| 2C00 | 1   | Accumulator               | INT32  | N | RW    | Y | 0      |
| 2C00 | 2   | W2                        | INT32  | N | RW    | Y | 0      |
|      | ... | ...                       | INT32  | N | RW    | Y | 0      |
| 2C00 | 96  | W150                      | INT32  | N | RW    | Y | 0      |
| 2C10 | -   | Application access        | RECORD | - | -     | - | -      |
| 2C10 | 0   | Number of entries         | UINT8  | N | CONST | N | 2      |
| 2C10 | 1   | Application call          | UINT8  | N | RW    | Y | 0      |
| 2C10 | 2   | Run after power on        | UINT8  | N | RW    | Y | 1      |
| 2C11 | 0   | Application status        | UINT16 | N | RO    | N | 0      |
| 2C50 | -   | Monitor config            | RECORD | - | -     | - | -      |
| 2C50 | 0   | Number of entries         | UINT8  | N | CONST | N | 2      |
| 2C50 | 1   | Sampling rate             | UINT16 | N | RW    | N | 0      |
| 2C50 | 2   | Enable mode               | UINT8  | N | RW    | N | 0      |
| 2C50 | 3   | Trigger Delay in samples  | UINT32 | N | RW    | Y | 0      |
| 2C51 | -   | Monitor result            | RECORD | - | -     | - | -      |
| 2C51 | 0   | Number of entries         | UINT8  | N | RO    | N | 7      |
| 2C51 | 1   | Max entry number          | UINT16 | N | RO    | N | 250    |
| 2C51 | 2   | Filled entry value        | UINT8  | N | RO    | N | 0      |
| 2C51 | 3   | Entry number              | UINT16 | N | RW    | N | 0      |
| 2C51 | 4   | Actual entry table 1      | INT32  | N | RO    | N | 0      |
| 2C51 | 5   | Actual entry table 2      | INT32  | N | RO    | N | 0      |
| 2C51 | 6   | Actual entry table 3      | INT32  | N | RO    | N | 0      |

|      |    |                                   |        |     |       |     |            |
|------|----|-----------------------------------|--------|-----|-------|-----|------------|
| 2C51 | 7  | Actual entry table 4              | INT32  | N   | RO    | N   | 0          |
| 2C52 | -  | Monitor mapping                   | RECORD | -   | -     | -   | -          |
| 2C52 | 0  | Number of entries                 | UINT8  | N   | CONST | N   | 4          |
| 2C52 | 1  | Channel 1                         | INT32  | N   | RW    | Y   | 0x60640020 |
| 2C52 | 2  | Channel 2                         | INT32  | N   | RW    | Y   | 0x60620020 |
| 2C52 | 3  | Channel 3                         | INT32  | N   | RW    | Y   | 0x606C0020 |
| 2C52 | 4  | Channel 4                         | INT32  | N   | RW    | Y   | 0x606B0020 |
| 2D00 | -  | Open loop parameters              | RECORD | -   | -     | -   | -          |
| 2D00 | 0  | Number of entries                 | UINT8  | N   | RO    | N   | 2          |
| 2D00 | 1  | Target voltage                    | INT16  | Y   | RW    | N   | 0          |
| 2D00 | 2  | Target frequency                  | UINT16 | Y   | RW    | N   | 0          |
| 2E00 | 0  | Motor brake enabled               | UINT8  | N   | RW    | N   | 0          |
| 2FF0 | -  | Hardware configuration            | -      | -   | -     | -   | -          |
| 2FF0 | 0  | Number of entries                 | UINT8  | N   | CONST | N   | 52         |
| 2FF0 | 1  | Current sensing resistor value    | UINT16 | TBD | RO    | TBD | 100        |
| 2FF0 | 2  | Preamplifier gain                 | UINT16 | TBD | RO    | TBD | 1370       |
| 2FF0 | 3  | VGA available                     | UINT8  | TBD | RO    | TBD | 0          |
| 2FF0 | 4  | Temperature sensor available      | UINT8  | TBD | RO    | TBD | 0          |
| 2FF0 | 5  | Max absolute temperature (m°C)    | INT32  | TBD | RO    | TBD | -          |
| 2FF0 | 6  | Min absolute temperature (m°C)    | INT32  | TBD | RO    | TBD | -          |
| 2FF0 | 7  | Vbus sensor available             | UINT8  | TBD | RO    | TBD | 1          |
| 2FF0 | 8  | Max absolute voltage (mV)         | UINT32 | TBD | RO    | TBD | -          |
| 2FF0 | 9  | Min absolute voltage (mV)         | UINT32 | TBD | RO    | TBD | -          |
| 2FF0 | A  | Nominal current (mA – RMS value)  | UINT32 | TBD | RO    | TBD | -          |
| 2FF0 | B  | Peak current (mA – RMS value)     | UINT32 | TBD | RO    | TBD | -          |
| 2FF0 | C  | Maximum peak time (100µs)         | UINT32 | TBD | RO    | TBD | -          |
| 2FF0 | D  | Maximum current (mA - peak value) | UINT32 | TBD | RO    | TBD | -          |
| 2FF0 | E  | Stepper in 3phases available      | UINT8  | TBD | RO    | TBD | 1          |
| 2FF0 | F  | NVM available                     | UINT8  | TBD | RO    | TBD | 0          |
| 2FF0 | 10 | HW error available                | UINT8  | TBD | RO    | TBD | 1          |
| 2FF0 | 11 | Temperature sensor offset (mV)    | UINT32 | TBD | RO    | TBD | 0          |
| 2FF0 | 12 | Temperature sensor gain (mV/C)    | UINT16 | TBD | RO    | TBD | 0          |
| 2FF0 | 13 | Vbus sensor gain                  | UINT16 | TBD | RO    | TBD | -          |
| 2FF0 | 14 | Deadtime (ns)                     | UINT16 | TBD | RO    | TBD | -          |
| 2FF0 | 15 | PWM frequency scale (legacy)      | UINT8  | TBD | RO    | TBD | 0          |
| 2FF0 | 16 | Bootstrap charge time (ms)        | UINT16 | TBD | RO    | TBD | 0          |
| 2FF0 | 17 | NTC sensor available              | UINT8  | TBD | RO    | TBD | 1          |
| 2FF0 | 18 | NTC Rext (Ohm)                    | UINT16 | TBD | RO    | TBD | -          |
| 2FF0 | 19 | NTC R25 (Ohm)                     | UINT32 | TBD | RO    | TBD | -          |
| 2FF0 | 1A | NTC B25 (K)                       | UINT16 | TBD | RO    | TBD | -          |
| 2FF0 | 1B | Resolver available                | UINT8  | TBD | RO    | TBD | 0          |
| 2FF0 | 1C | Node ID by HW                     | UINT8  | TBD | RO    | TBD | 0          |
| 2FF0 | 1D | PWM frequency (Hz)                | UINT32 | TBD | RO    | TBD | -          |
| 2FF0 | 1E | Available digital inputs          | UINT32 | TBD | RO    | TBD | 63         |

|      |    |                                   |        |     |       |     |      |
|------|----|-----------------------------------|--------|-----|-------|-----|------|
| 2FF0 | 1F | Available digital outputs         | UINT32 | TBD | RO    | TBD | 15   |
| 2FF0 | 20 | Available analog inputs           | UINT32 | TBD | RO    | TBD | 3    |
| 2FF0 | 21 | Available analog outputs          | UINT32 | TBD | RO    | TBD | 0    |
| 2FF0 | 22 | Commercial product ID             | UINT32 | TBD | RO    | TBD | -    |
| 2FF0 | 23 | Commercial Serial Number          | UINT32 | TBD | RO    | TBD | -    |
| 2FF0 | 24 | 2 Phases Switching Scheme         | UINT8  | TBD | RO    | TBD | 1    |
| 2FF0 | 25 | Driver enable in UART com.        | UINT8  | TBD | RO    | TBD | 0    |
| 2FF0 | 26 | Available current sensors         | UINT8  | TBD | RO    | TBD | -    |
| 2FF0 | 27 | Digitak inputs polarity mask      | UINT32 | TBD | RO    | TBD | 15   |
| 2FF0 | 28 | Digital output polarity mask      | UINT32 | TBD | RO    | TBD | 0    |
| 2FF0 | 29 | Analog reference voltage          | UINT8  | TBD | RO    | TBD | 1    |
| 2FF0 | 2A | Analog input 1-2 parameters       | UINT16 | TBD | RO    | TBD | -    |
| 2FF0 | 2B | Analog input 3-4 parameters       | UINT16 | TBD | RO    | TBD | -    |
| 2FF0 | 2C | Analog output 1-2 parameters      | UINT16 | TBD | RO    | TBD | -    |
| 2FF0 | 2D | Macro parameters                  | UINT16 | TBD | RO    | TBD | -    |
| 2FF0 | 2E | Supported motor types             | UINT16 | TBD | RO    | TBD | -    |
| 2FF0 | 2F | Supported communication interface | UINT16 | TBD | RO    | TBD | -    |
| 2FF0 | 30 | Supported feedback                | UINT16 | TBD | RO    | TBD | -    |
| 2FF0 | 31 | PWM maximum duty cycle            | UINT16 | TBD | RO    | TBD | -    |
| 2FF0 | 32 | Current loop frequency            | UINT16 | TBD | RO    | TBD | -    |
| 2FF0 | 33 | Velocity/Position loop frequency  | UINT16 | TBD | RO    | TBD | -    |
| 2FF0 | 34 | Supported command source          | UINT16 | TBD | RO    | TBD | -    |
| 2FF1 | 0  | Ardware configuration pass        | UINT16 | TBD | RW    | TBD | -    |
| 2FF2 | 0  | EDS version                       | UINT16 | N   | CONST | N   | -    |
| 2FF3 | 0  | HW available registers            | UINT16 | -   | RW    | -   | 0x35 |
| 2FFC | -  | Motor informations                | -      | -   | -     | -   | -    |
| 2FFC | 0  | Number of entry                   | UINT8  | N   | CONST | N   | 11   |
| 2FFC | 1  | Motor reference                   | UINT32 | TBD | RW    | TBD | -    |
| 2FFC | 2  | Coil reference                    | UINT32 | TBD | RW    | TBD | -    |
| 2FFC | 3  | Manufacturing date                | UINT8  | TBD | RW    | TBD | -    |
| 2FFC | 4  | Firmware                          | UINT32 | TBD | RW    | TBD | -    |
| 2FFC | 5  | Firmware index ref                | UINT8  | TBD | RW    | TBD | -    |
| 2FFC | 6  | Bootloader                        | UINT32 | TBD | RW    | TBD | -    |
| 2FFC | 7  | Bootloader index ref              | UINT8  | TBD | RW    | TBD | -    |
| 2FFC | 8  | Hardware                          | UINT32 | TBD | RW    | TBD | -    |
| 2FFC | 9  | Hardware index ref                | UINT8  | TBD | RW    | TBD | -    |
| 2FFC | A  | Project name                      | INT32  | TBD | RW    | TBD | -    |
| 2FFC | B  | Motor inforation key              | INT32  | TBD | WO    | TBD | -    |
| 2FFD | 0  | Maximum current range             | UINT8  | N   | RW    | Y   | 0    |
| 2FFF | 0  | Reset device                      | UINT32 | N   | RW    | N   | -    |

## ANNEXE 2 – LIST OF ERROR CODES

| Error code | Description   |
|------------|---|
| 0x0000     | <b>No error</b>   |
| 0x2280     | <b>Over-current peak has been detected in phase or DC-Bus line (HW system protection).</b><br>It could indicate a short circuit between phase and ground.<br>This is a generic error without information of the phases involved in the error.   |
| 0x2290     | <b>Over-current peak has been detected in phase (FW system protection).</b><br>It could indicate a short circuit between two phases or between a phase and DC-Bus input. This is a generic error without information of the phases involved in the error.   |
| 0x2291     | <b>Over-current peak has been detected in phase A (FW system protection).</b><br>It could indicate a short circuit between phase A and another phase or DC-Bus input.   |
| 0x2292     | <b>Over-current peak has been detected in phase B (FW system protection).</b><br>It could indicate a short circuit between phase B and another phase or DC-Bus input.   |
| 0x2293     | <b>Over-current peak has been detected in phase C (FW system protection).</b><br>It could indicate a short circuit between phase C and another phase or DC-Bus input.   |
| 0x22A0     | <b>Initial current reading out of range (FW system protection).</b><br>This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.  |
| 0x22A1     | <b>Initial current reading of Phase A out of range (FW system protection).</b><br>This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.   |
| 0x22A2     | <b>Initial current reading of Phase B out of range (FW system protection).</b><br>This error indicates a Hardware malfunction, please contact Couzet or your local vendor.  |
| 0x22A3     | <b>Initial current reading of Phase C out of range (FW system protection).</b><br>This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.   |
| 0x2350     | <b>An I<sup>2</sup>T over-current has been detected (FW system protection).</b><br>The maximum phase peak current (Overload capacity) allowed by the controller has been reached.   |
| 0x2380     | <b>Saturation of current measurement system has been detected.</b><br>In system with VGA it could indicate a selected measurement range too narrow.   |
| 0x2381     | <b>Saturation of current measurement system has been detected in phase A.</b><br>In system with VGA it could indicate a selected measurement range too narrow.  |
| 0x2382     | <b>Saturation of current measurement system has been detected in phase B.</b><br>In system with VGA it could indicate a selected measurement range too narrow.  |
| 0x2383     | <b>Saturation of current measurement system has been detected in phase C.</b><br>In system with VGA it could indicate a selected measurement range too narrow.  |
| 0x3210     | <b>System over voltage detected.</b><br>Indicates that maximum absolute voltage of the controller has been exceeded. This error could be the consequence of a regenerative movement when working on power supplies with low capacitance or negative current protection. In such case use an external shunt to dissipate the excess of energy generated by the load. |
| 0x3211     | <b>User over voltage detected.</b><br>Indicates that the maximum voltage indicated by the user has been over passed. This error is only generated in systems without shunt resistor.  |

| Error code    | Description  |
|---------------|--|
| <b>0x3220</b> | <b>System under voltage detected.</b><br>Indicates that minimum absolute voltage of the controller is not reached.   |
| <b>0x3221</b> | <b>User under voltage detected.</b><br>Indicates that the minimum voltage indicated by the user has not been reached.  |
| <b>0x4300</b> | <b>User temperature out of range detected.</b><br>Indicates that the temperature of the controller is out of the range specified by the user.  |
| <b>0x4310</b> | <b>System over temperature detected (FW system protection).</b><br>Indicates that the maximum allowed temperature of the controller has been exceeded.                                     |
| <b>0x4320</b> | <b>System under temperature detected (FW system protection).</b><br>Indicates that the minimum allowed temperature of the controller is not reached.                                       |
| <b>0x4400</b> | <b>Motor temperature out of range detected.</b><br>Indicates that the temperature of the motor is out of the range specified by the user.  |
| <b>0x5210</b> | <b>Internal VGA communication problem detected.</b><br>This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.   |
| <b>0x5400</b> | <b>Output power section problem detected (system protection).</b><br>This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.                             |
| <b>0x5430</b> | <b>Input stage problem detected. Voltage not stable or not available (system protection).</b><br>This error indicates a Hardware malfunction, please contact Crouzet or your local vendor. |
| <b>0x5530</b> | <b>Internal NVM communication problem detected.</b><br>This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.   |
| <b>0x6185</b> | <b>Internal EEPROM full error.</b><br>This error indicates that size of object dictionary data is higher than the space available in EEPROM. NA  |
| <b>0x6186</b> | <b>Internal EEPROM full error (Communication Dictionary).</b><br>This error indicates that size of Communication object dictionary is higher than assigned space in EEPROM. NA             |
| <b>0x6187</b> | <b>Internal EEPROM full error (Manufacturer Dictionary).</b><br>This error indicates that size of Manufacturer object dictionary is higher than assigned space in EEPROM. NA               |
| <b>0x6188</b> | <b>Internal EEPROM full error (Device Dictionary).</b><br>This error indicates that size of Device object dictionary is higher than assigned space in EEPROM. NA                           |
| <b>0x7121</b> | <b>Motor blocked.</b><br>This error indicates that the motor has been blocked. Only applies to stepper with encoder position feedback. NA  |
| <b>0x7124</b> | <b>Motor not detected.</b><br>This error indicates that the motor has not been detected. Only applies to stepper motors when entering in Operation Enable state. NA                        |
| <b>0x7303</b> | <b>Error in resolver signals detected.</b><br>This error indicates a loss or degradation of resolver signals. NA   |

| Error code    | Description  |
|---------------|--|
| <b>0x7306</b> | <b>Differential encoder broken wire detected.</b><br>Indicates that one of the differential signals of the quadrature incremental encoder, probably due to the breakage of the line. NA  |
| <b>0x7380</b> | <b>SSI encoder error.</b><br>Indicates that an error occurs during the decodification of a SSI frame. Usually it means that an error flag in the SSI frame is enabled. NA  |
| <b>0x7390</b> | <b>Magnetic sensor error.</b><br>Indicates that an error occurs during the decodification of the magnetic interface SPI frame. Usually it means that an error flag in the frame header is enabled, or that the read back value after a write is different than the intended value. |
| <b>0x8110</b> | <b>CAN bus over-run.</b><br>Indicates that one or more CAN message has been lost.  |
| <b>0x8120</b> | <b>CAN in error passive mode.</b><br>Indicates that have been detected more than 127 reception errors, or more than 127 but less than 255 transmission errors.   |
| <b>0x8130</b> | <b>Lifeguard error.</b><br>It indicates that the node has not received a Node Guard message within its Lifetime.   |
| <b>0x8140</b> | <b>Recovered from CAN bus off.</b><br>Indicates that the controller has been recovered from a previous CAN bus off situation.  |
| <b>0x8141</b> | <b>CAN Bus off occurred.</b><br>Indicates that has been detected more than 255 errors during transmission of messages.   |
| <b>0x8210</b> | <b>PDO not processed due to length error.</b><br>This error indicates that a CAN RPDO has not been processed because the received data length does not match the expected one.   |
| <b>0x8280</b> | <b>Error decoding serial message.</b><br>This error indicates that the serial message sent to the driver is incorrect.   |
| <b>0x8613</b> | <b>Homing timeout detected.</b><br>Indicates that the homing has not been able to finish the process within the maximum allowed time.  |
| <b>0xFF02</b> | <b>Not allowed digital hall combination detected.</b><br>Indicates that a not allowed combination of digital halls feedback has been detected (i.e all zero or all ones).  |
| <b>0xFF03</b> | <b>Not allowed sequence of digital halls has been detected.</b><br>Indicates that a not allowed sequence of digital halls combination has been detected.   |
| <b>0xFF04</b> | <b>Angular error in forced alignment method is out of tolerance.</b><br>Indicates that the result of forced alignment method during initial angle determination process for brushless motor has been out of specified tolerance during all retries.                                |
| <b>0xFF05</b> | <b>Interpolated position mode buffer full.</b><br>Indicates that the interpolation data input buffer has reached its limit.  |
| <b>0xFF06</b> | <b>Error in Analog hall signals detected.</b><br>Indicates that one of the analog signals has been disconnected or it is out of allowed range. NA  |

| Error code    | Description  |
|---------------|--|
| <b>0xFF10</b> | <b>A stand-alone divide by zero instruction detected.</b><br>Indicates that a division instruction has been executed with a zero divisor.  |
| <b>0xFF20</b> | <b>RS232 reception overflow.</b><br>Indicates that some of the RS232 characters have been lost. NA   |
| <b>0xFF30</b> | <b>Executing a non-existing macro or instruction address.</b><br>Indicates that a macro or instruction higher than the allowed 64 has been executed. NA  |
| <b>0xFF31</b> | <b>Macro stack full.</b><br>Indicates that the macro calling stack is full due to an excess of nested execution. NA  |
| <b>0xFF33</b> | <b>Detected interrupt without associated macro function.</b><br>Indicates that an interrupt has been activated and generated but it does not have an associated macro function. NA   |
| <b>0xFF34</b> | <b>Saving or restoring out of learned position space.</b><br>Indicates that an access to a not existing learned position table has been done.  |
| <b>0xFF40</b> | <b>EtherCAT synchronization error.</b><br>Indicates that a synchronization error has occurred using EtherCAT in DC mode. NA  |
| <b>0xFF41</b> | <b>EtherCAT plugin board disconnected.</b><br>Indicates that the Crouzet drive with the EtherCAT firmware has been powered up without the EtherCAT plugin board. NA  |
| <b>0xFF50</b> | <b>Incorrect object access.</b><br>This error appears if the application tries to access to a nonexistent object, write in a read-only object or read a write-only object. Other incorrect access situations are signaled with this error. |
| <b>0xFF60</b> | <b>Safe torque off activated.</b><br>Indicates that the power stage has been deactivated due to the STO mechanism  |