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

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

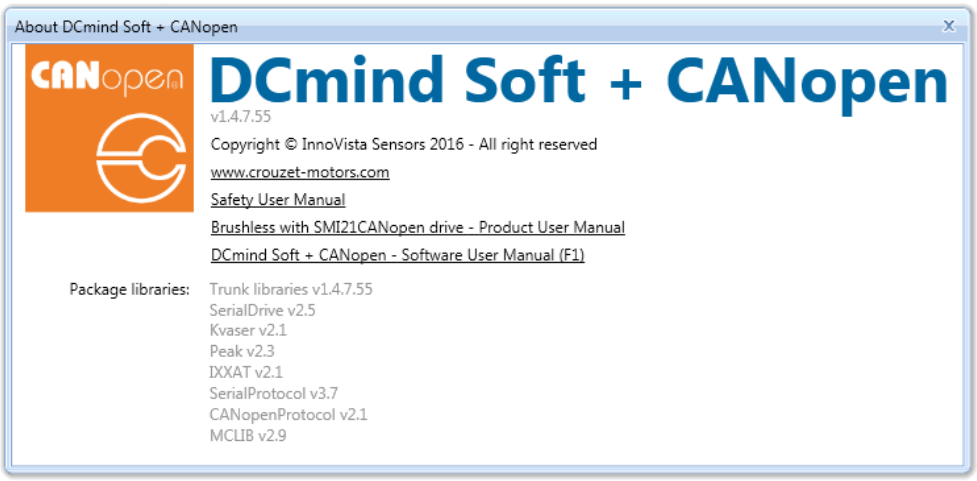
In order to install and run the DCmind Soft + CANopen software, you must have Administrator privileges (for installation).

1.2. Communication Interfaces

DCmind Soft + CANopen supports the following communication interfaces:

- CAN Peak.
- CAN IXXAT (Not compatible with windows 10)
- 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.

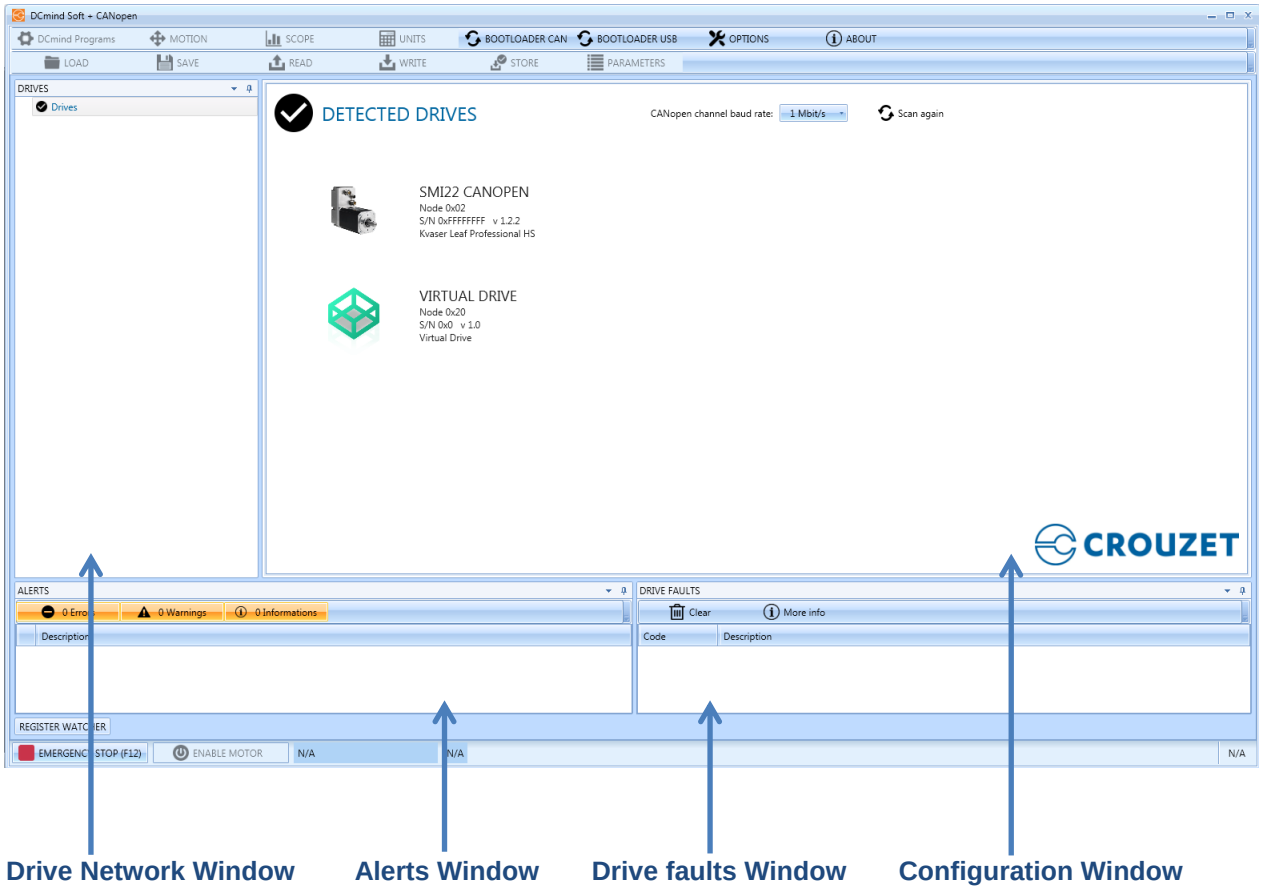
1.3. Before you begin

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).

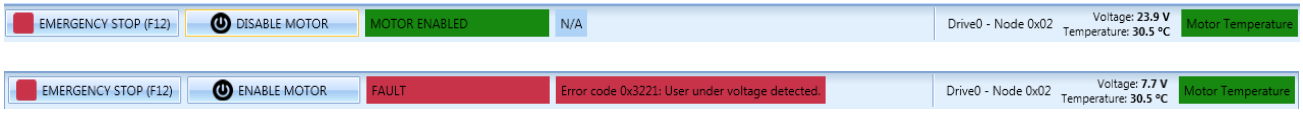
Title	Description
DCmind Programs	Open DCmind soft Programs (V101, P101, P200, C101, conveyor belt, valves…)
MOTION	Open motion test (velocity, position and torque profile, homing…)
SCOPE	Open digital scope
UNITS	Convert values between different units WARNING: Do not dynamically change units during SMI21 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 WARNING: 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. To save a configuration, click the **SAVE** 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. CAUTION: 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.

WARNING: The .hex file path must not contain blank space. If an .hex file is load with a blank space in the path and the connexion is lost : physicaly disconnect and reconnect the USB and try again without blank space in the path.

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

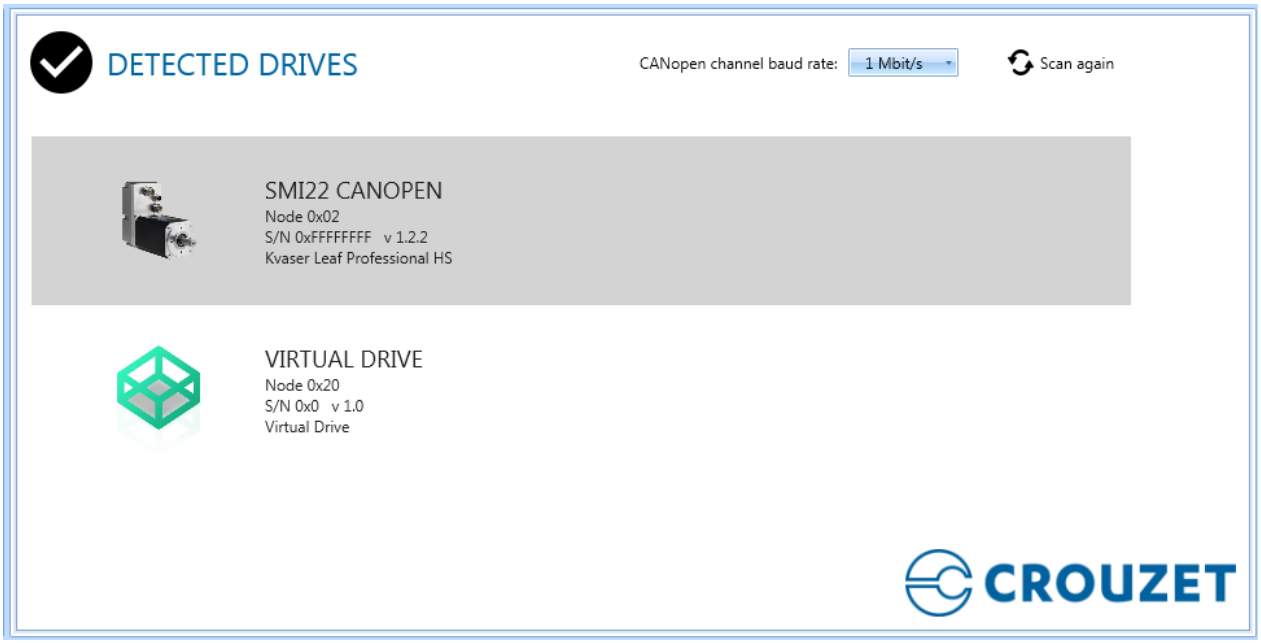
2.4. Parameters file

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).

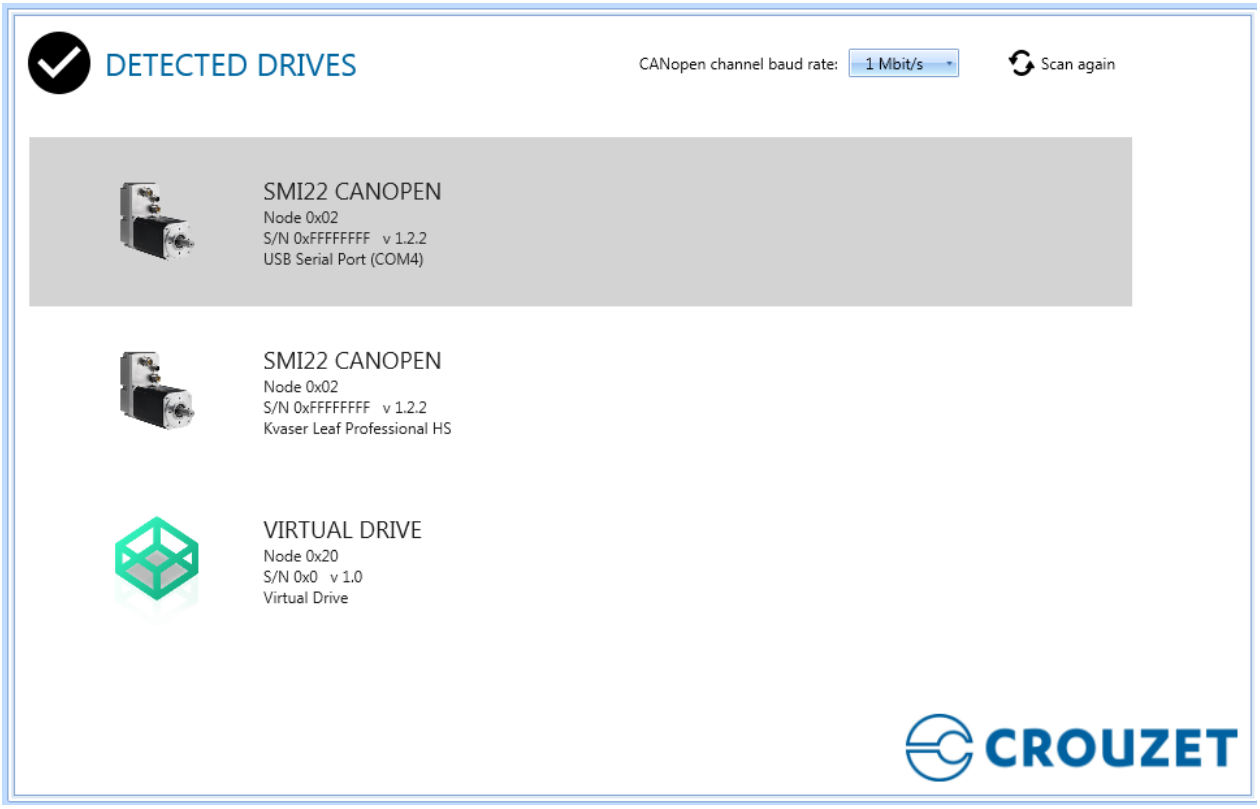
CAUTION: XDC files are the recommended format for saving SMI21 or SMI22 CANopen drive configurations.

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:

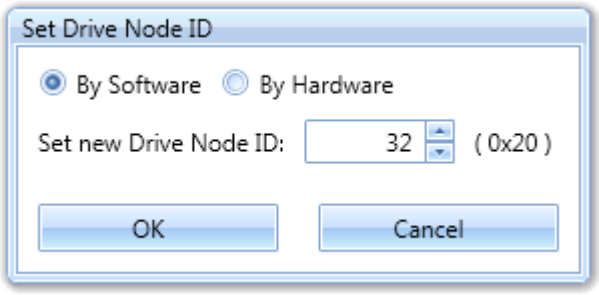
Field	Description
Motor type	Brushless AC (sinusoidal) or Brushless DC (trapezoidal)
Commutation sensor	Digital encoder or digital halls
Motion mode	Velocity, Position or Torque profile, homing…
Velocity feedback	How is estimated the actual velocity
Position feedback	Digital encoder or digital halls
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:

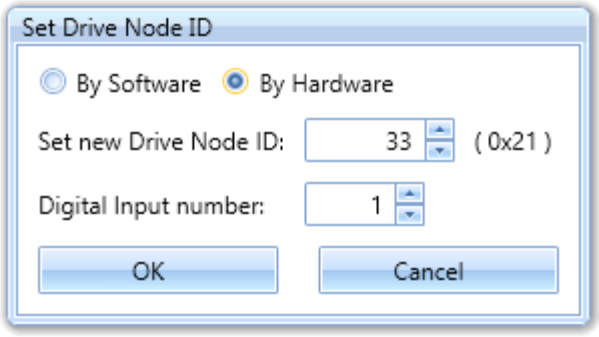
Field	Description	Editable field
Drive Name	Name assigned to the SMI21 or SMI22 CANopen drive being used	No
Node ID	CAN Node ID used for the SMI21 or SMI22 CANopen drive	Yes
CANopen baud rate	Baud rate used in CANopen communications	Yes

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 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*

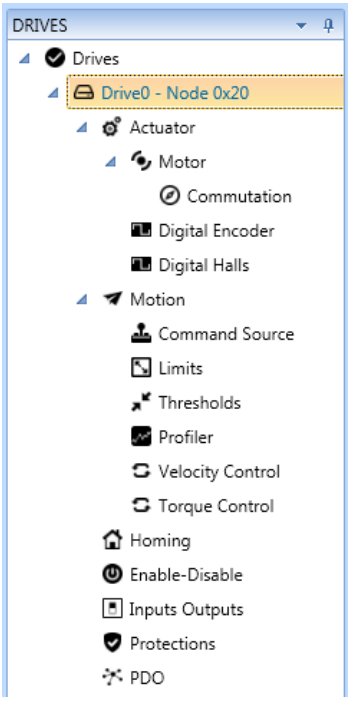
If you click on the button “Additional drive information”, the following information is available:

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

4. MOTION SETTINGS

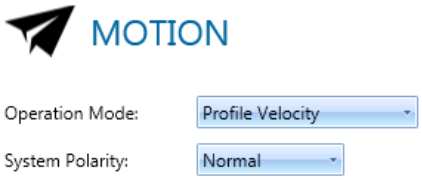
The Settings menu on the left allows you to configure properly several parameters for your SMI21 or SMI22 CANopen drive based on the requirements of your application. The DCmind Soft + CANopen software provides among others windows for:

- 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.

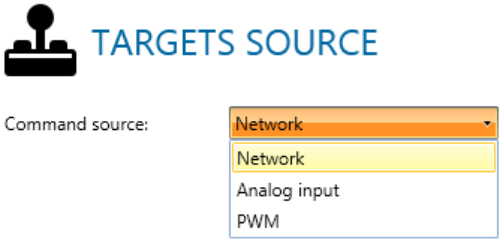


- **Operation mode**: There are up to eight operation modes available in SMI21 or SMI22 CANopen drive (position, velocity, homing, etc.).
- **System polarity** indicates the direction for positive movements and for negative movements. The system polarity is used in all modes. As the direction of torque, 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.

There 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.

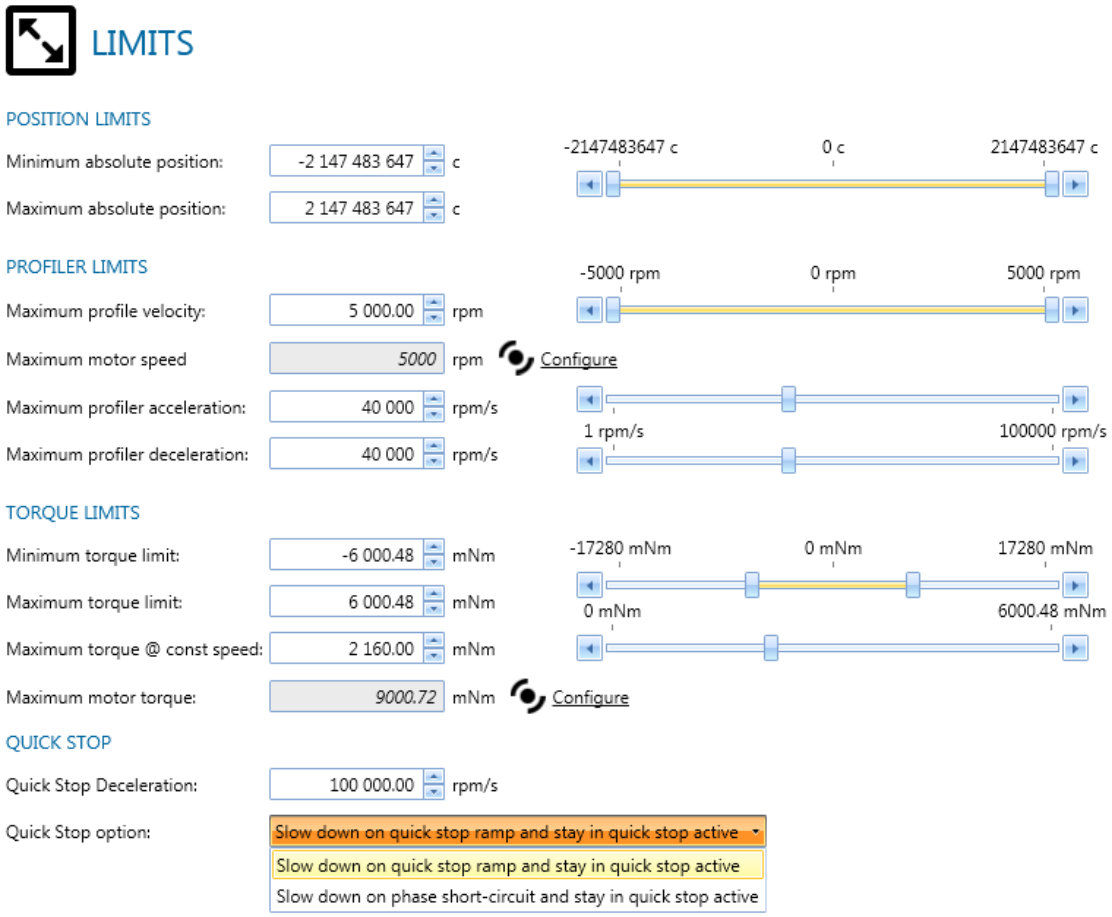
The chart on the right represents the final motion movement depending on the PWM duty. This allows an easy way to modify the parameters by seeing the effect on the final motion movement.

 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.



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.

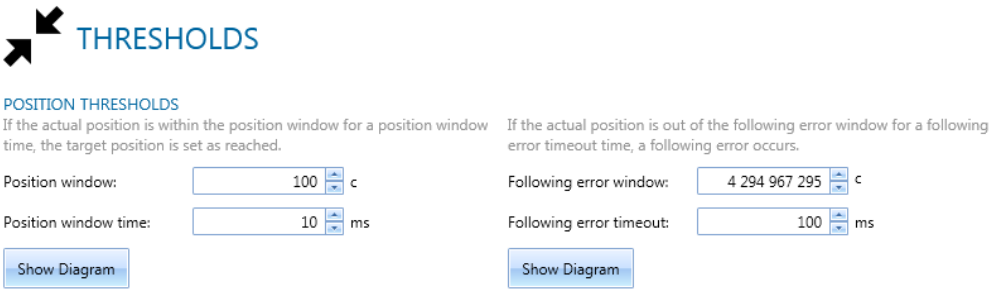
 CAUTION: Please, note that in V100 expert programs the Quick stop is always "Slow down on short circuit and stay in quick stop active".

4.3. **Thresholds**

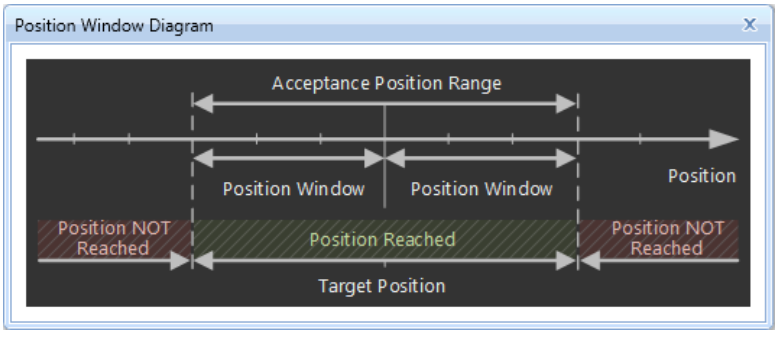
The position, velocity and torque control functions parameters work in conjunction with position, velocity and torque loops. The position and velocity loops are powered from the output of the profiler and from the position/velocity detector or feedback output.

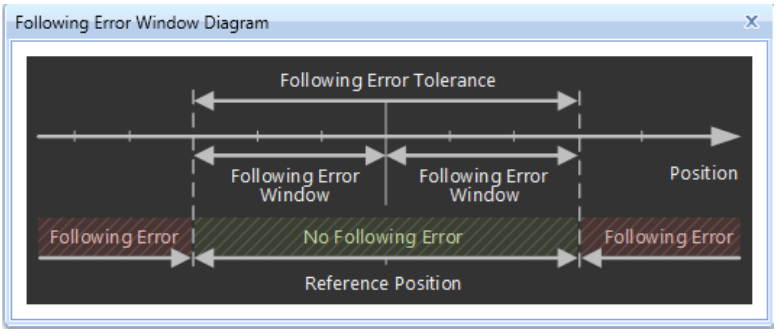
The output of the position/velocity loops will be input to the flux-torque or current loop.

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

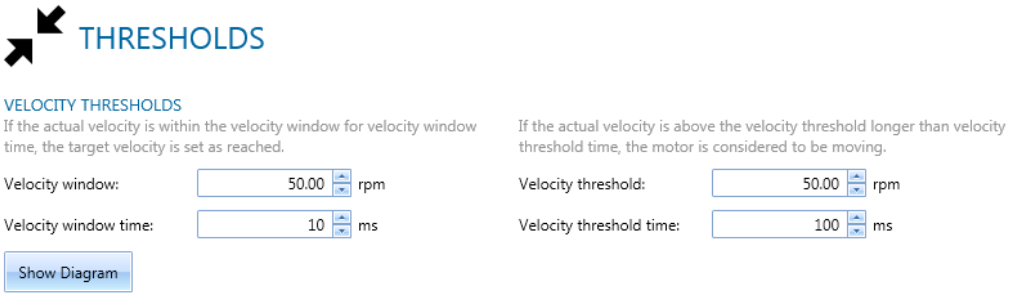


- **Position window**: this parameter indicates the configured symmetrical range of accepted position relative to the target position. If the actual value of the position encoder is within the position window, this target position shall be regarded as having been reached. As the user mostly prefers to 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.

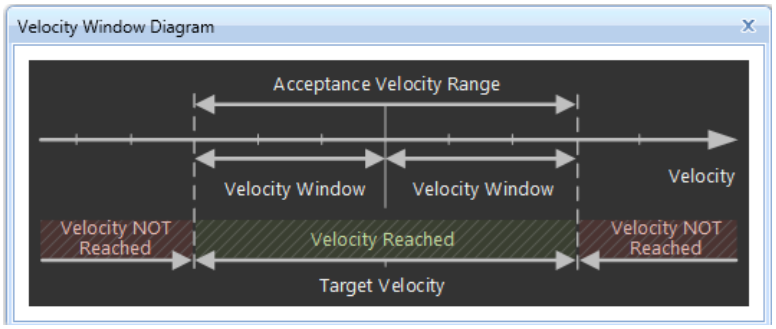




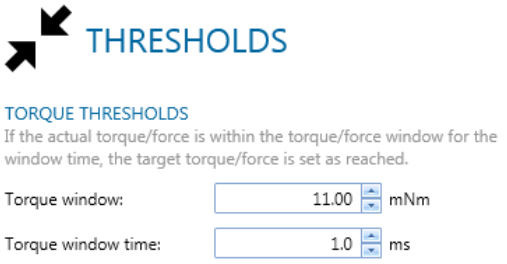
Parameters for *Velocity control functions* sub-group are:



- **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 T*orque control functions* sub-group are:

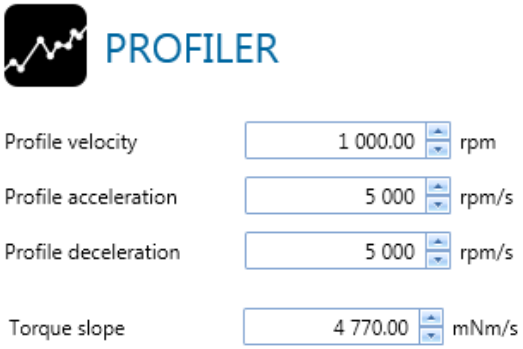


- **Torque window**: this parameter indicates the configured symmetrical range of accepted torque/force relative to the target torque/force. If the actual value of the torque/force is within the torque window, this target torque/force shall be regarded as having been reached.
- **Torque window time**: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



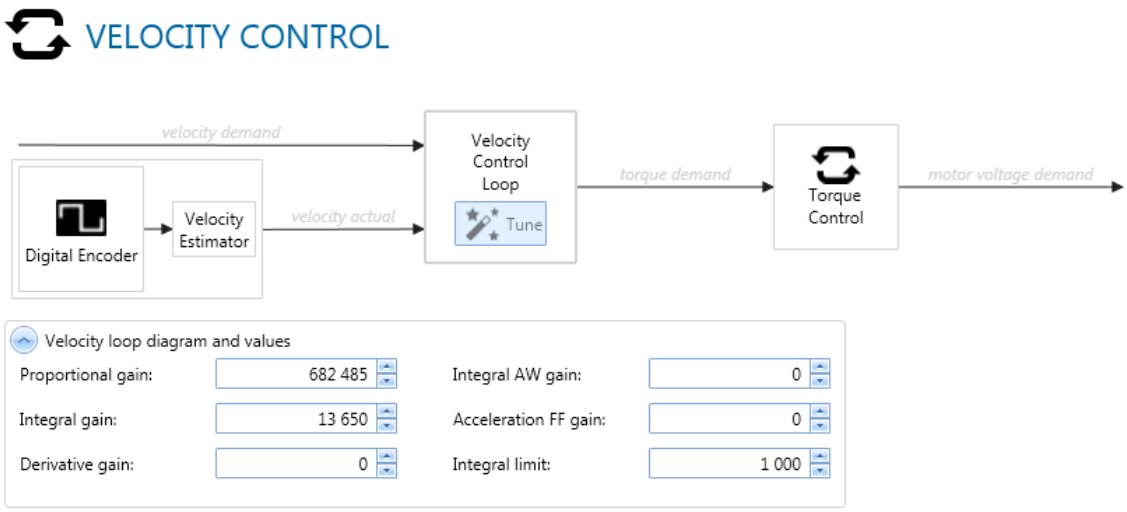
The available parameters are:

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

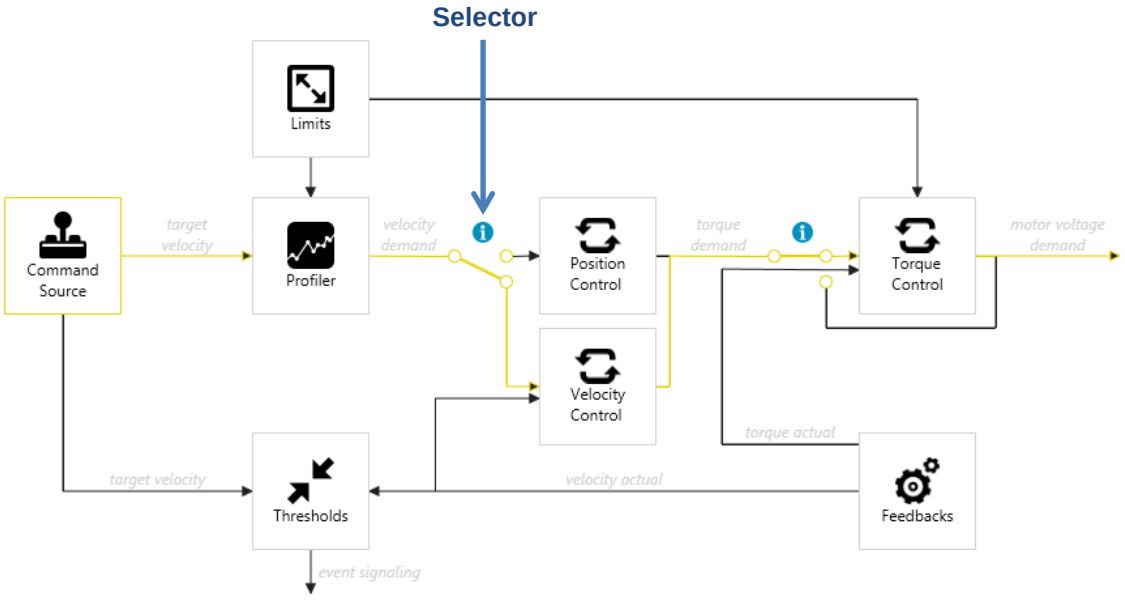
4.5. Loop control

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:



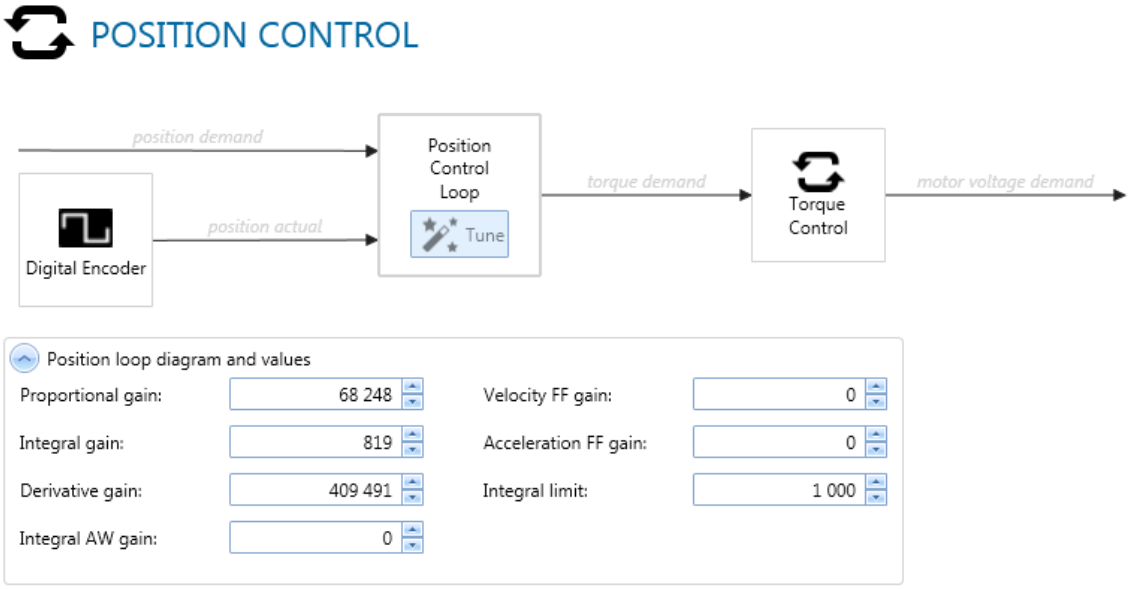
Note that you can set the position loop (or alternatively the velocity loop) for velocity modes such as homing or profile velocity with a selector:



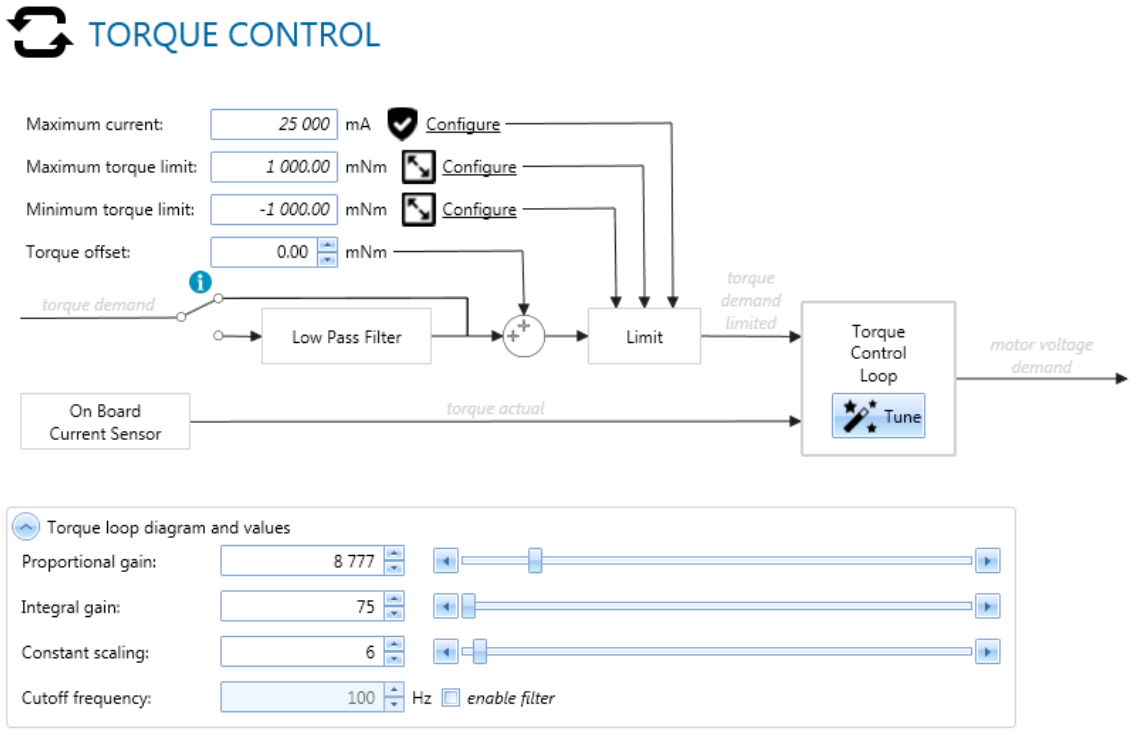
CAUTION: If your system is using a position sensor as a feedback (ex: encoder) it is highly recommended to use position loop for velocity modes.

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:



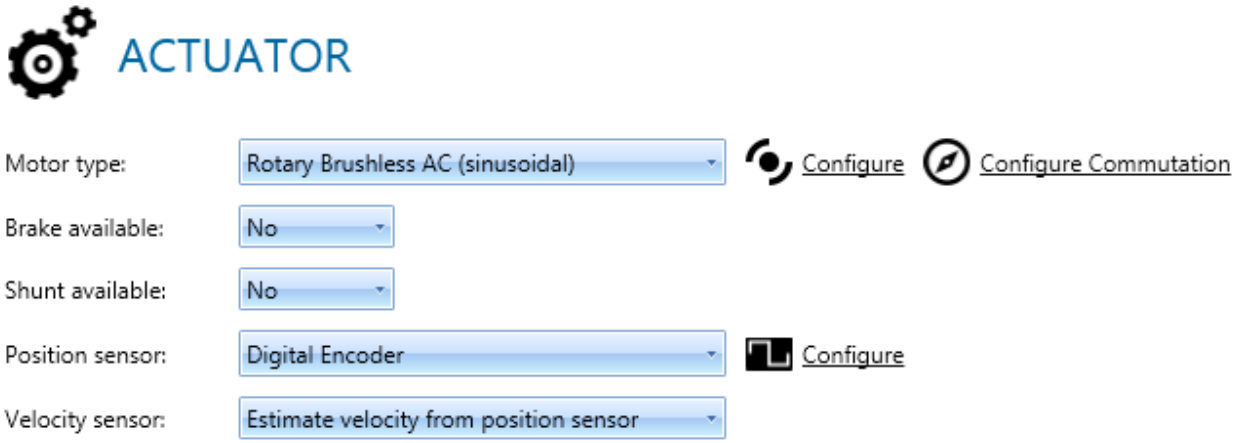
Parameters for *Torque control loop* sub-group are:



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.



The drive supports the following motors:

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

The drive supports the following feedbacks:

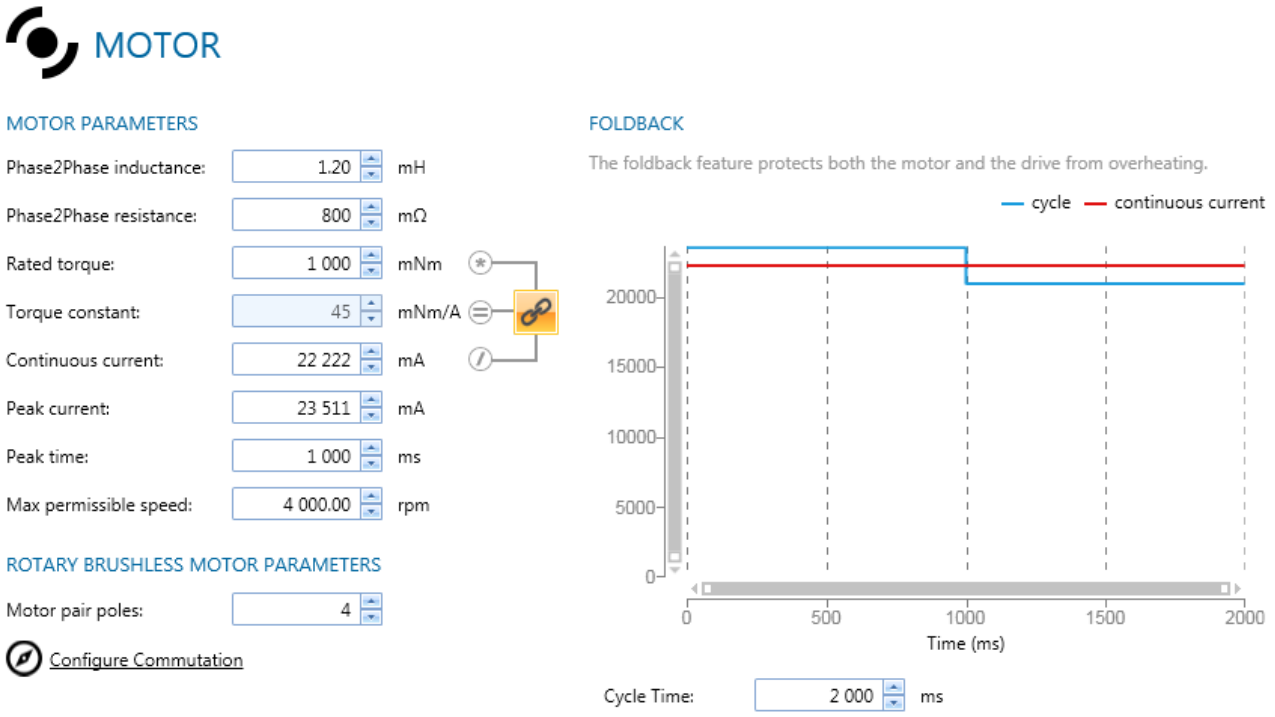
- Digital encoder
- Digital halls

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.



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.

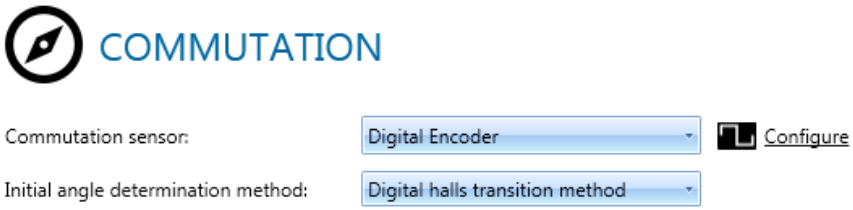
CAUTION: Foldback is not the same as current limits. Instantaneous current limits for the drive are set by the Max system current in the system Limits view in DCmind Soft CANopen. The foldback algorithms may reduce the current output to the motor in spite of the current limit settings.

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 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

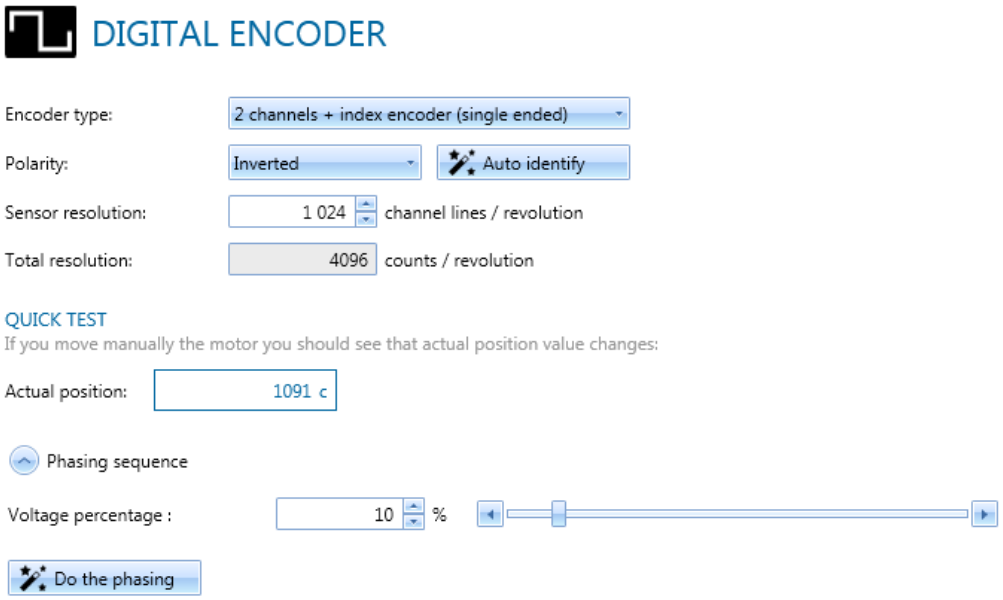
This view allows configuration of feedback sensors used for position and velocity modes. Once the sensor is selected in the Actuator menu, the sensor item will be displayed in the settings navigation tree and from them can be properly configured.

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

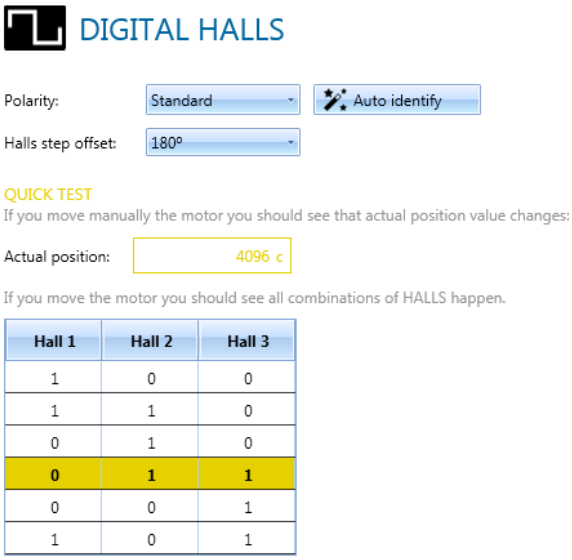
(Cycles Per Revolution) encoder is used, the encoder resolution will be 4096 increments per mechanical revolution.

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)



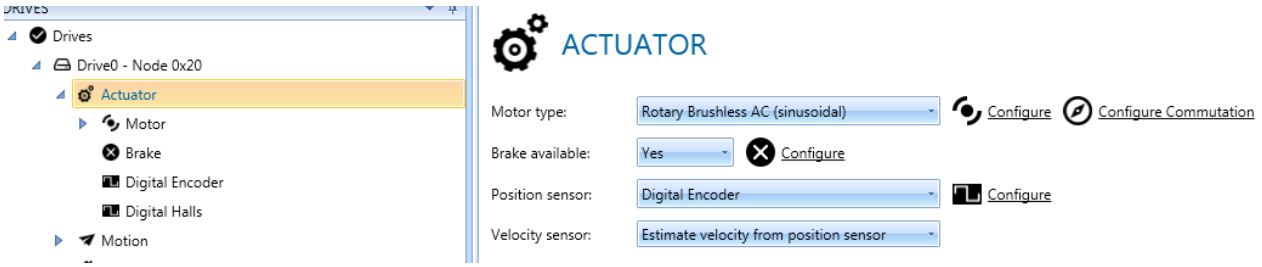
- **Polarity**: Define whether halls are active at high or low logical level.
- **Hall step offset**: Define the angular displacement (expressed in multiples of 60º) between the sequence of values generated by the Hall sensors and its corresponding excitation. This offset only applies when the system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

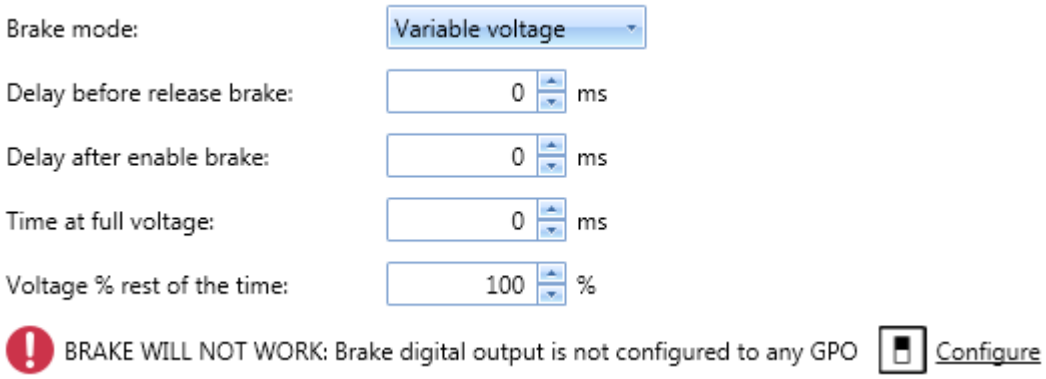
5.3. Brake

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.

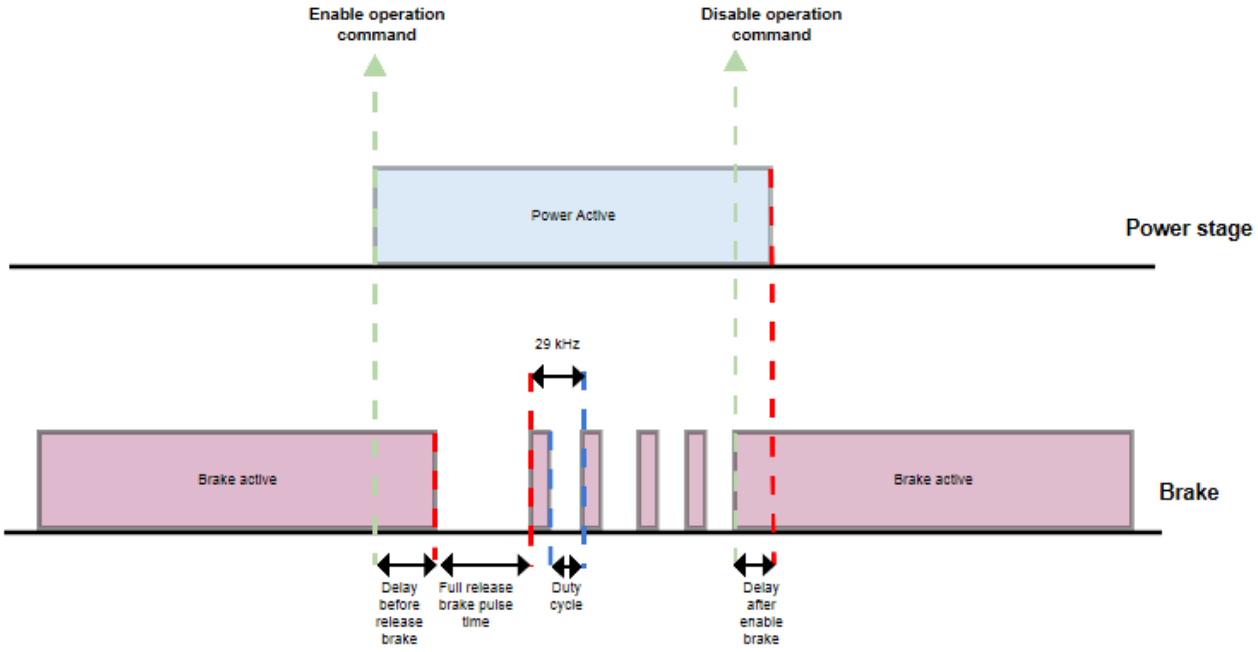
Delay before release brake is the delay between release the brake and activation of the power stage (in ms). This delay is designed to prevent loads from falling or coasting when the effects of gravity or other external forces are seen in the system.

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:

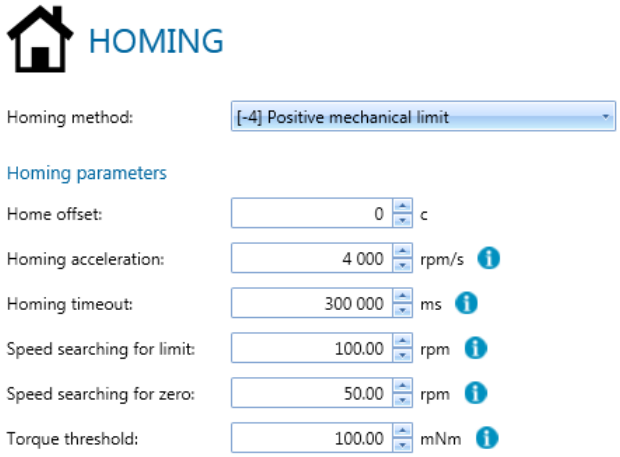


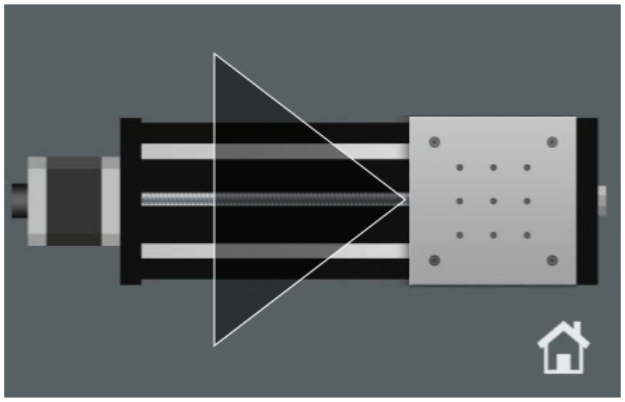
CAUTION: Brake must be configured to the correct GPO, otherwise it would be like if there were no brake.

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.





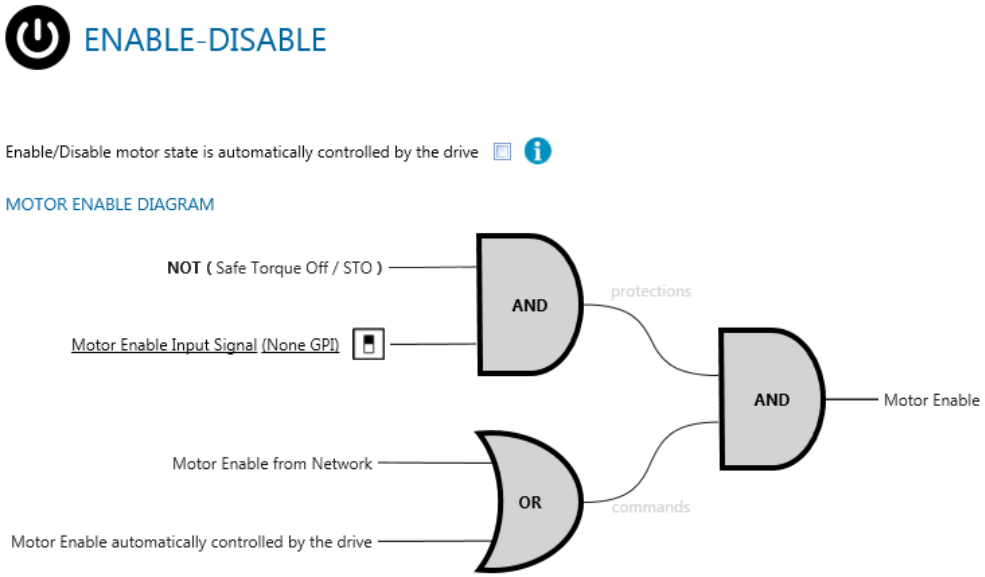
Parameters for *homing* are:

- **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 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

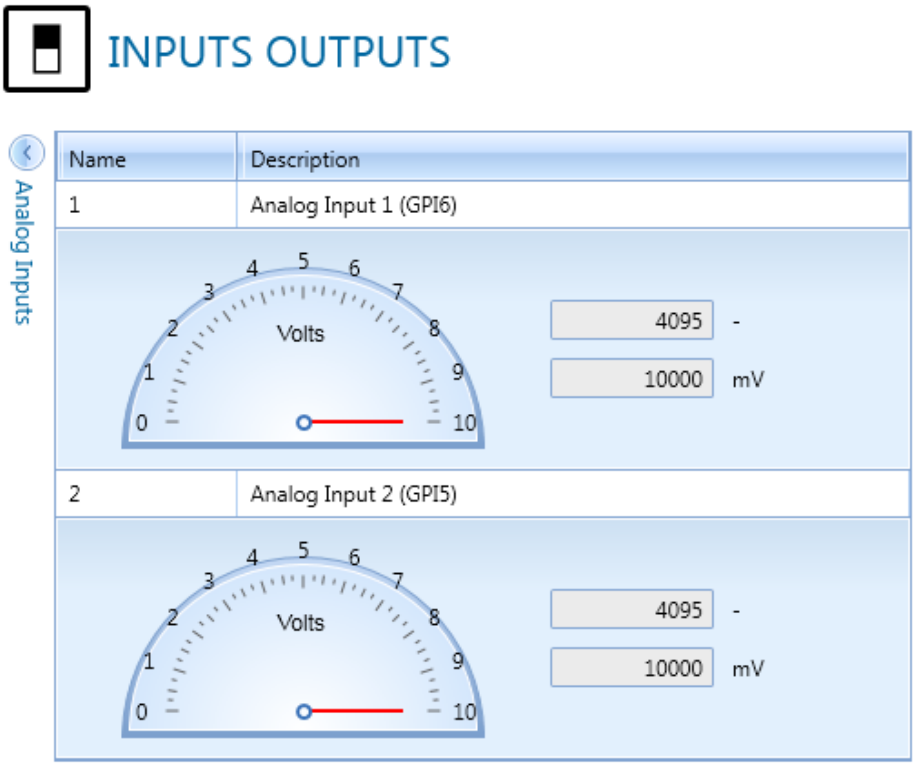
The SMI21 or SMI22 CANopen drive has programmable digital/analog inputs and outputs that you can use to initiate motion, control auxiliary devices, or trigger other actions. The inputs and outputs should be wired according to the instructions in the motor datasheet.

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

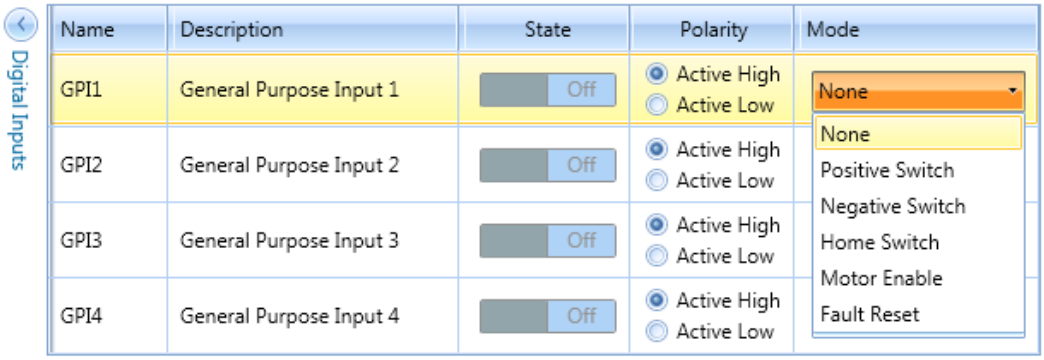
All the analog input values are shown graphically and numerically (in ADC counts and mV).



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".



Two parameters can be configured:

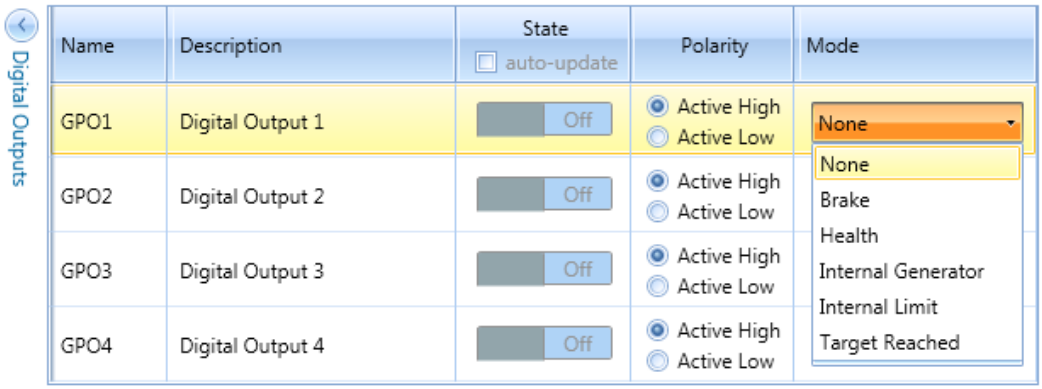
- **Polarity**: Indicates which signal level turns the state to "On".
  - "Active High": High value turns the state to "On".
  - "Active Low": Low value turns the state to "On".

- **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.



Two parameters can be configured:

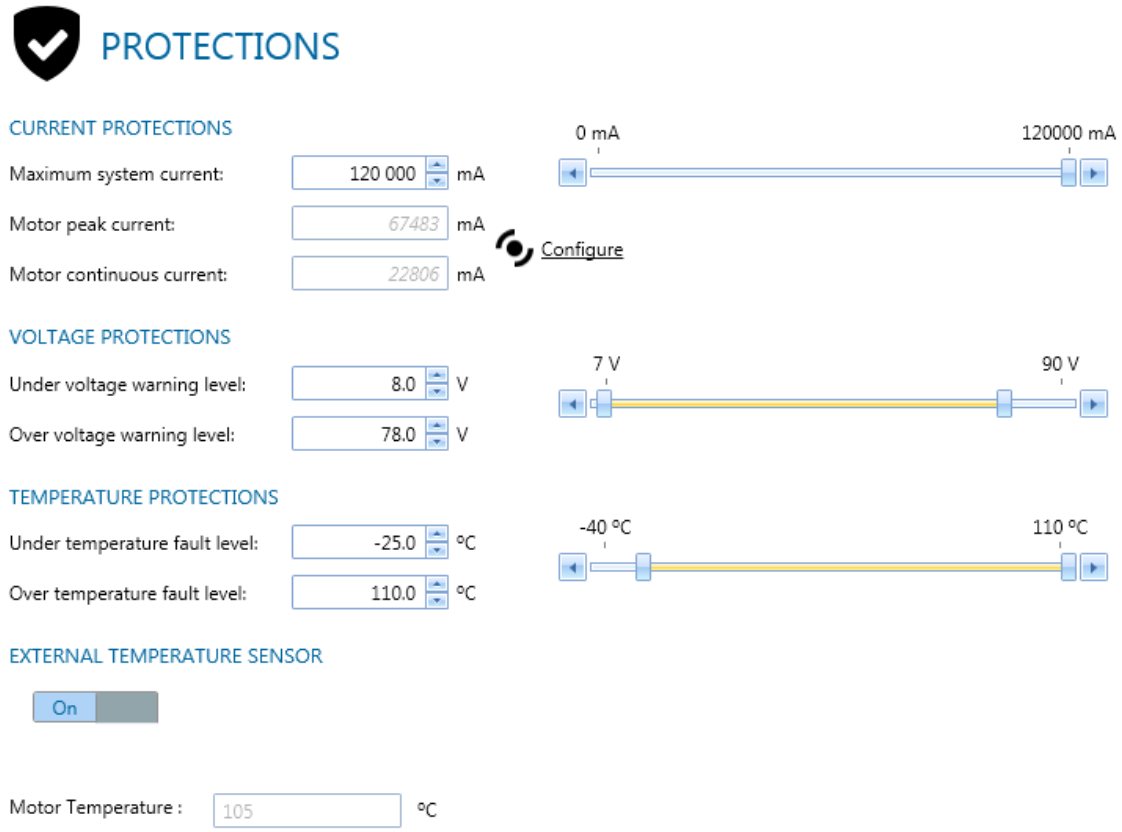
- **Polarity**: Indicates which signal level comes from the state "On".
  - "Active High": "On" state creates a high level signal.
  - "Active Low": "On" state creates a low level signal.

- **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



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 overheat.

9.2.2. *Shunt*

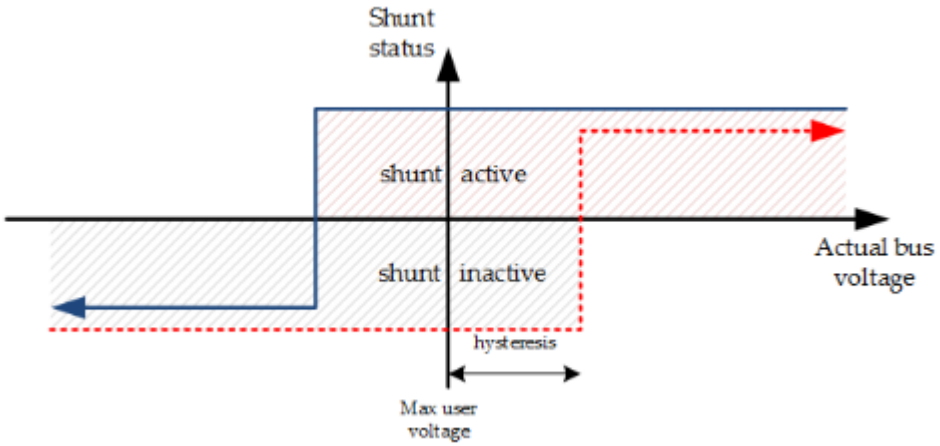
While decelerating a mechanical load (abrupt motion brakes or reversals), the mechanical energy is converted into electrical energy by the motor. This energy is injected into the power supply and could lead to an increase of the supply voltage (depending on the power supply characteristics, especially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

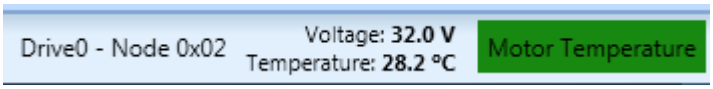
WARNING: In case of incorrect setting of ballast activation threshold, or in case of incorrect sizing of the ballast resistor (value and power), the ballast resistor can be damaged, can burn or explode.
The activation voltage threshold must be higher than the power voltage, and value/power of resistor must be in accordance with the amount of energy that the motor has to brake.

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.

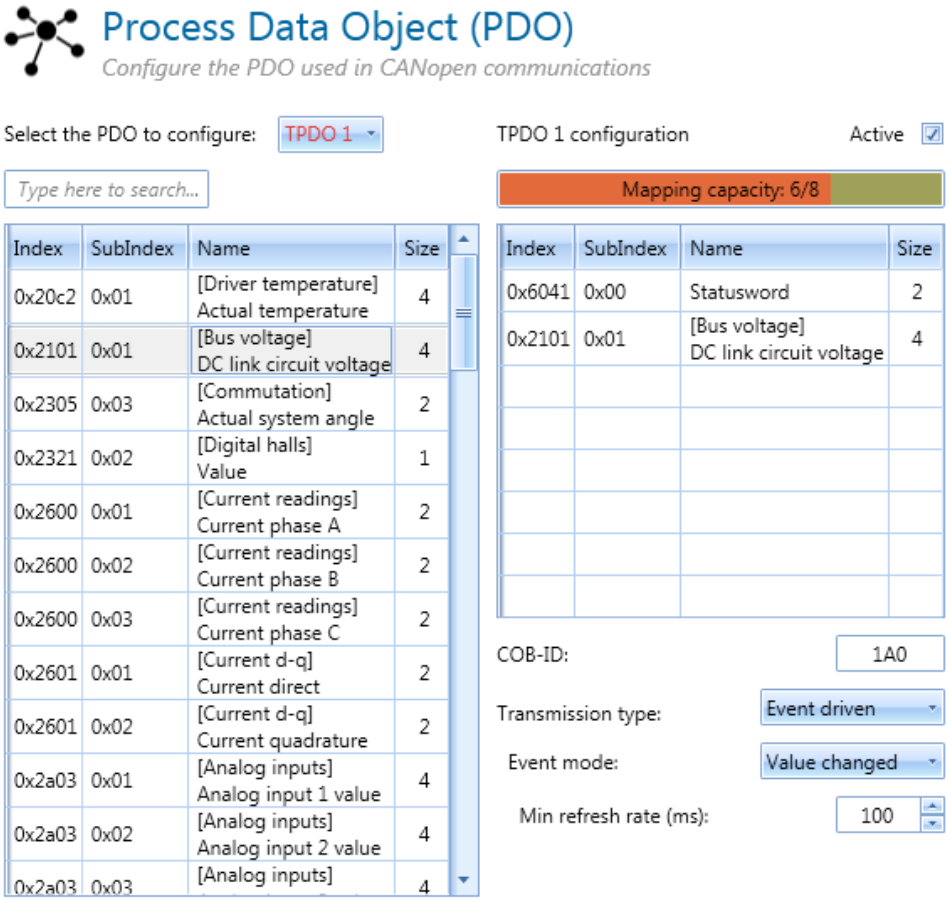
It's possible to activate an **external temperature sensor** which gives the **actual motor temperature**. When this temperature is over the warning level of 105°C the **motor temperature information** switch from green to red:



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.



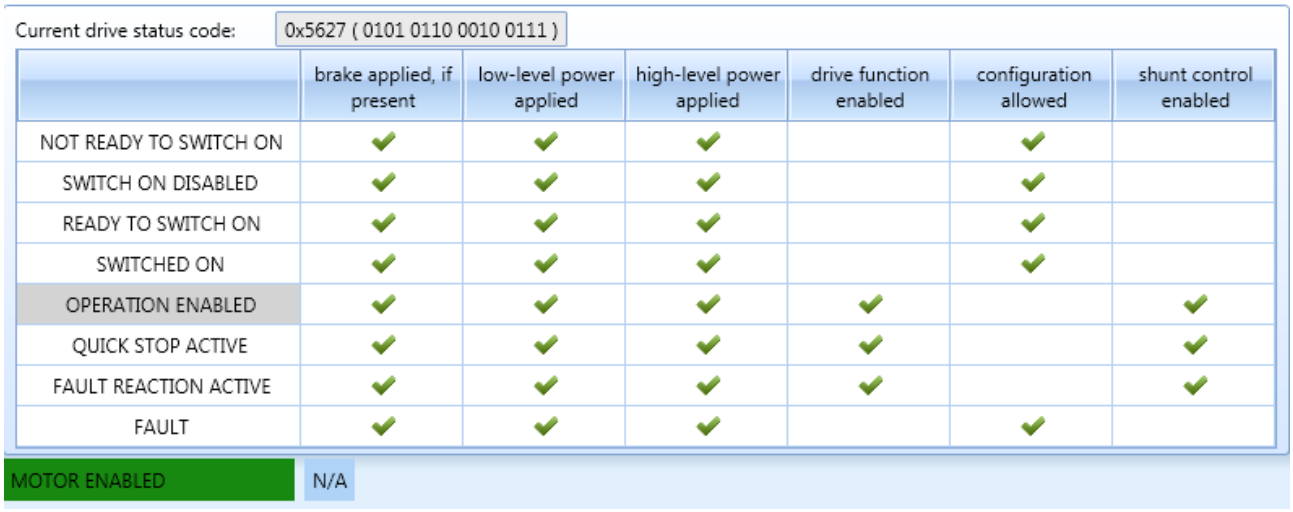
In the left part of the screen appear the **mappable objects**, and they can be dragged to the right part of the screen to map them to the current PDO.

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.



	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	✔	✔	✔		✔	
OPERATION ENABLED	✔	✔	✔	✔		✔
QUICK STOP ACTIVE	✔	✔	✔	✔		✔
FAULT REACTION ACTIVE	✔	✔	✔	✔		✔
FAULT	✔	✔	✔		✔	

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

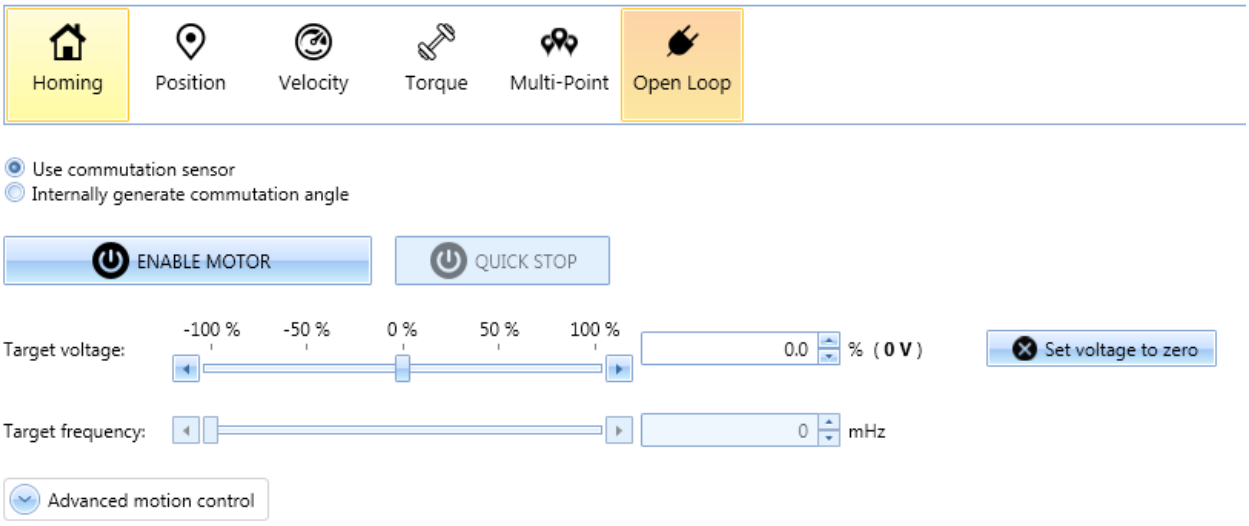
See HOMING part of this document (section 6)

To do it just click on the ENABLE/DISBLE 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

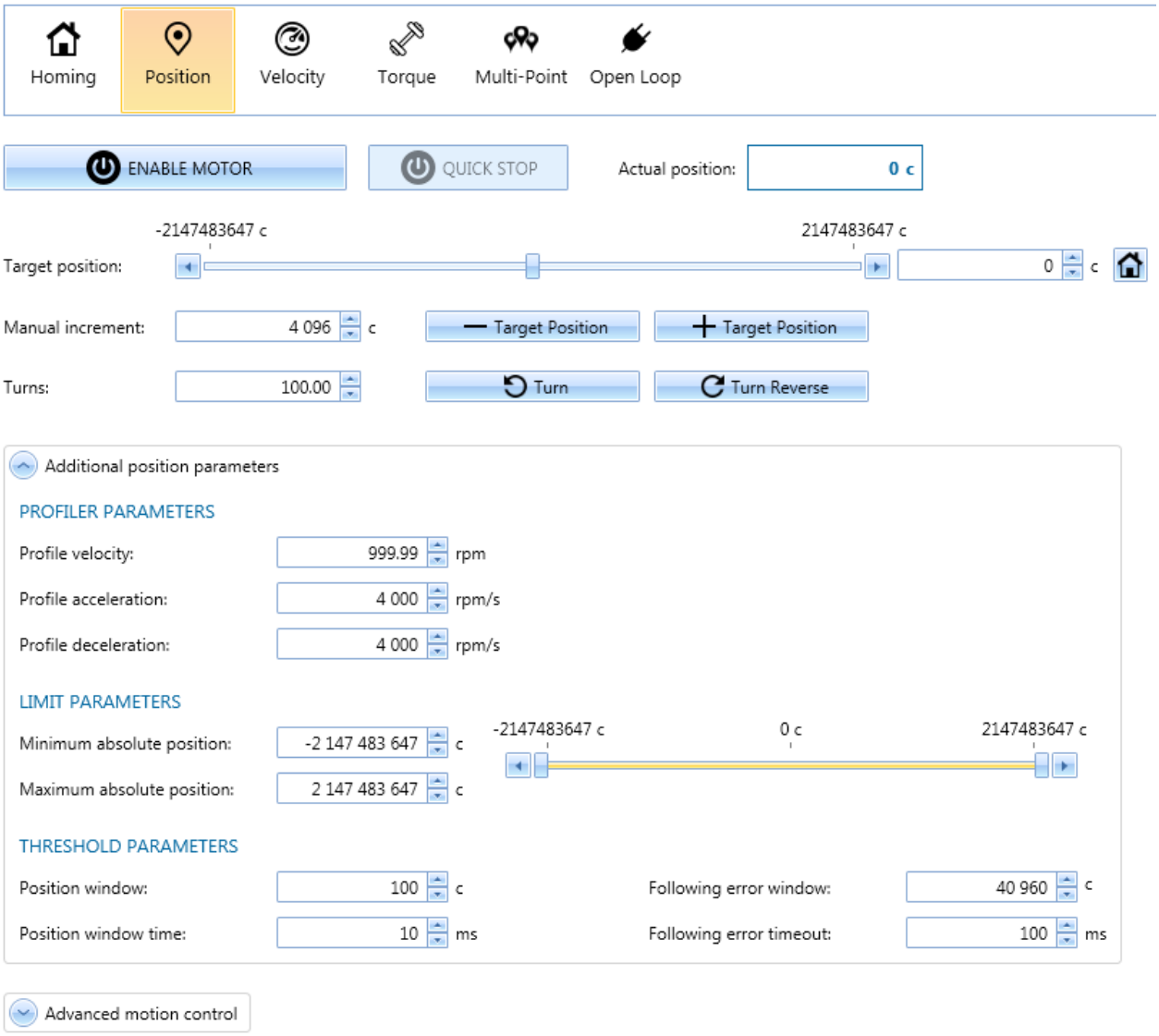
Specify target voltage (in %) to reach a target velocity without feedback.



CAUTION: Open loop is available only in administrator mode

13.2. **Profile Position**

Specify velocity and acceleration to reach a given position.



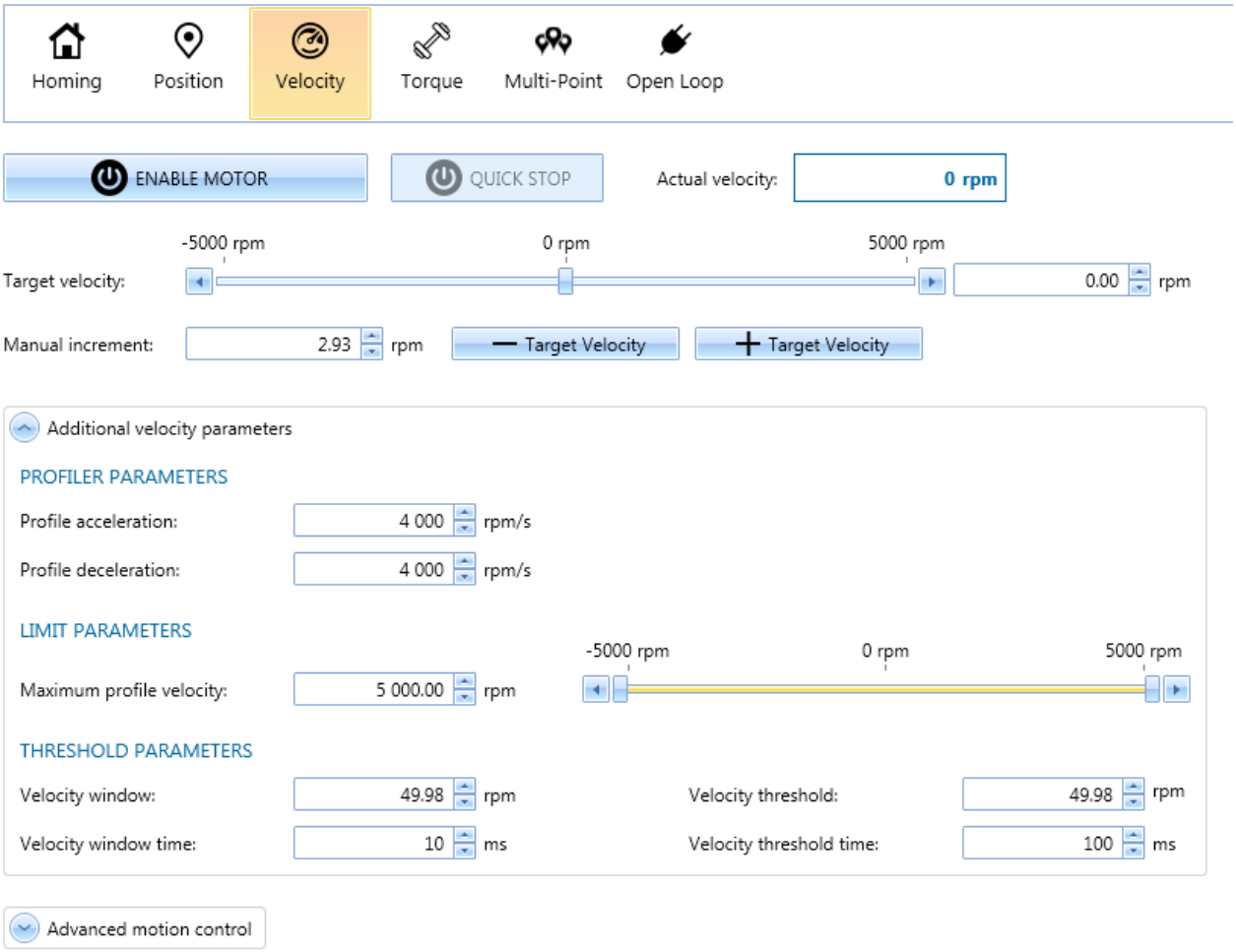
Parameters for *Profile position* are:

- **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.

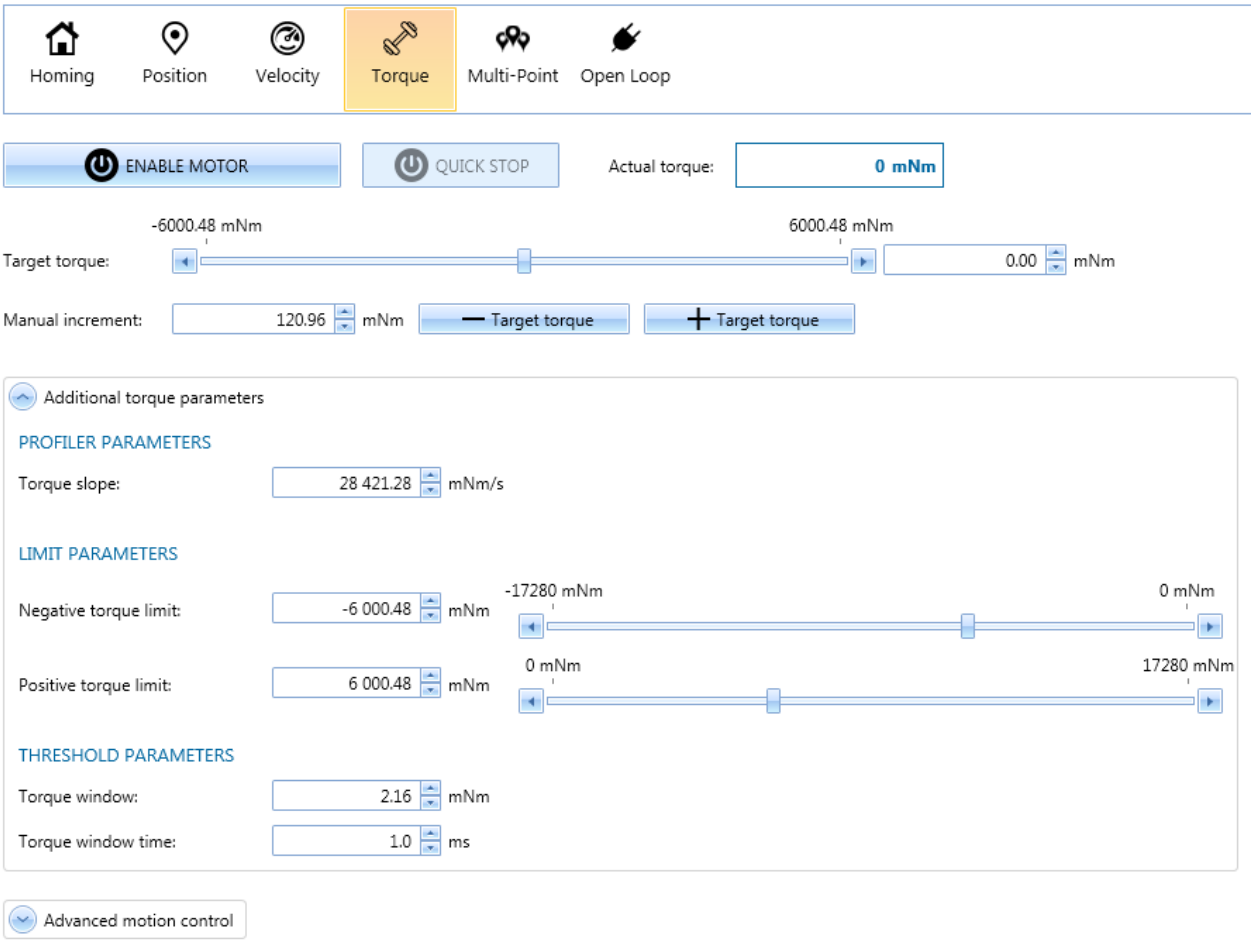


Parameters for *Profile Velocity* are:

- **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.



Parameters for *Profile force* are:

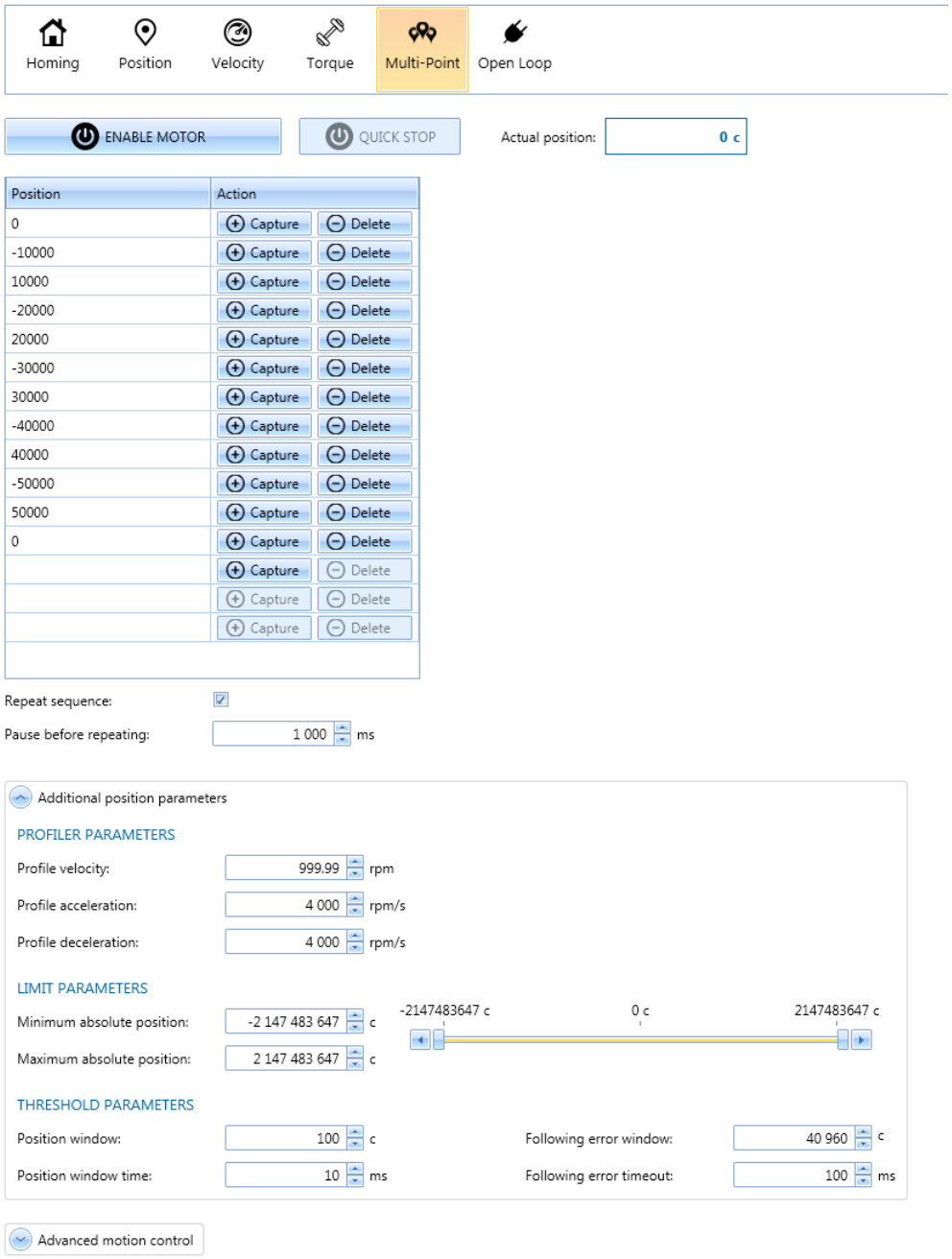
- **Torque slope:** It sets how torque will increase.
- **Target torque:** Setpoint in mNm.

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).



Parameters for *Profile position* are:

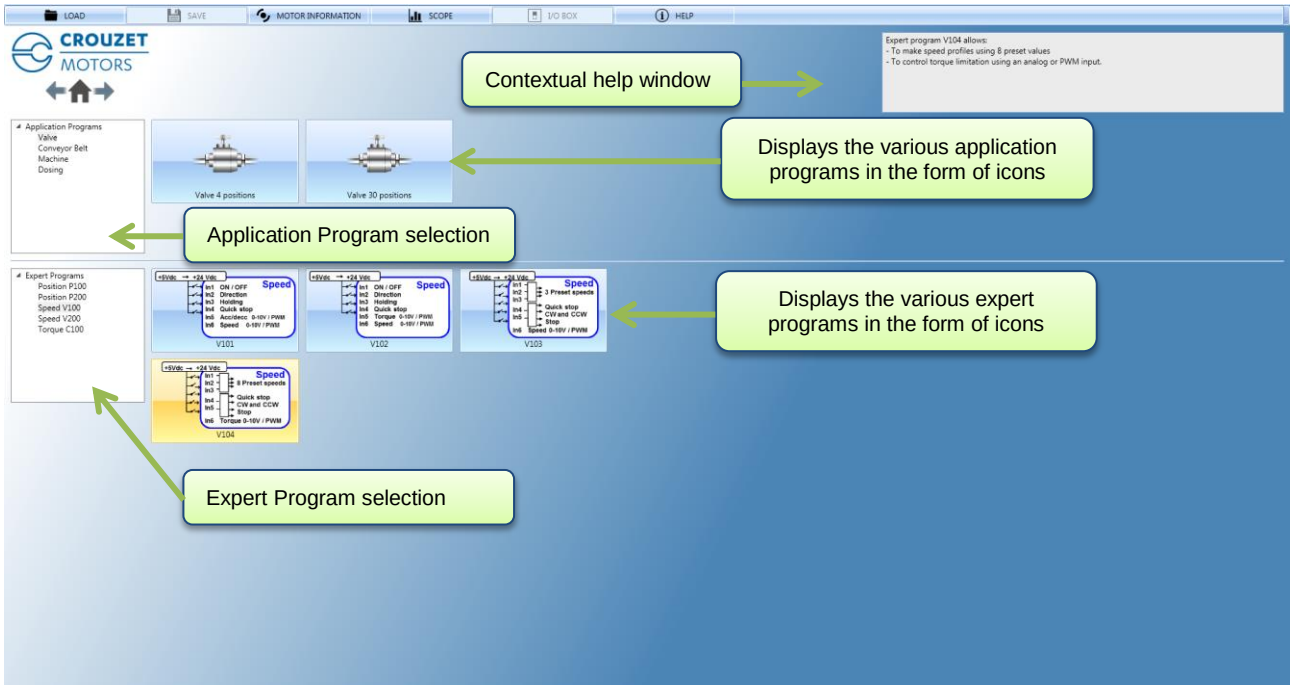
- **Velocity:** It indicates the velocity applied to the profile.
- **Acceleration / Deceleration:** Acc/ decel applied to the displacement.
- **Target positions:** Displacement in counts or user units.

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. To save a configuration, click the **SAVE** 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:

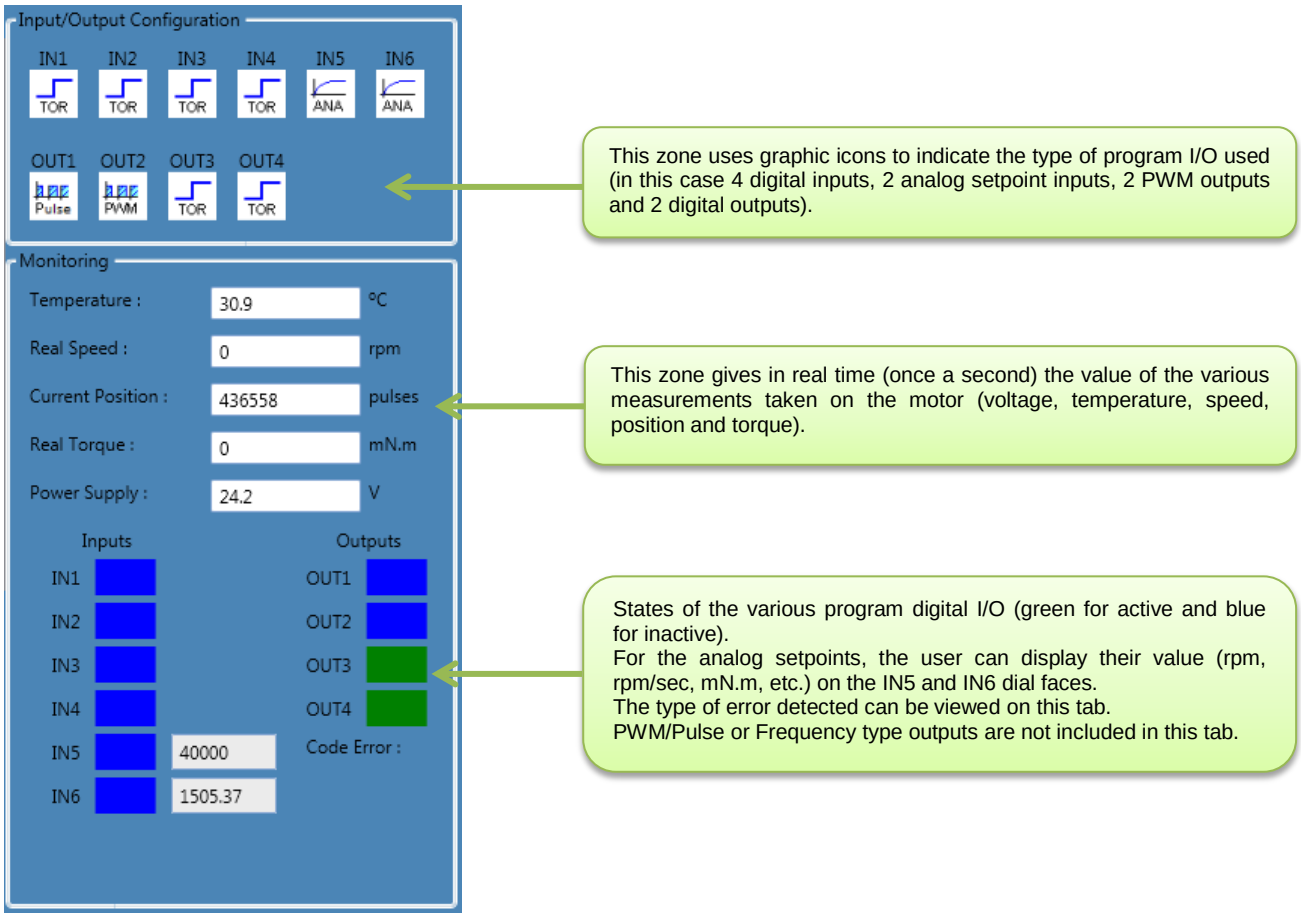
- The application programs are grouped together with similar applications (valve, conveyor belt, machine, etc.).
- They enable quick start-up with completion of just a few key application values.
- Each application program is based on a preconfigured expert program. After testing the motor a few times 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.

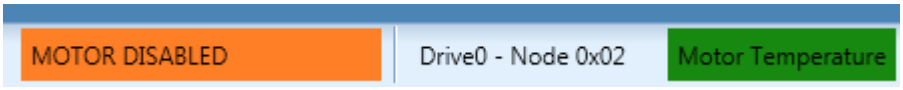
14.1.3. *Monitoring window*

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



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).

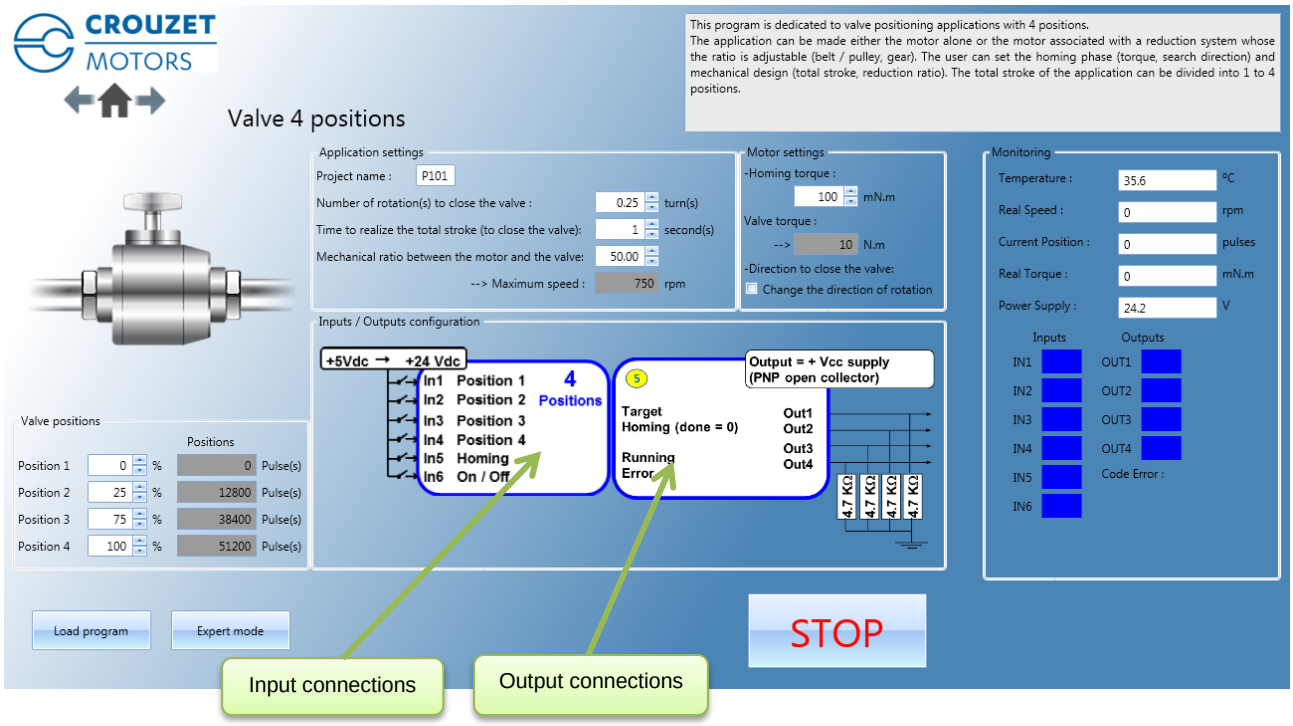
WARNING: To go from DCmind programs to Motion standard profile, it's mandatory to click on the stop button (not only on the red cross), otherwise the drive can have an undesirable behavior.

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:

$$Total\ course\ [Rotation\ motor] = Nb\ of\ rotation r_{Closing\ \ valve} \times \eta_{\ Vaves\ vs\ Motor}$$

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

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

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:

$$Nominal\ torque = Homing\ torque$$

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

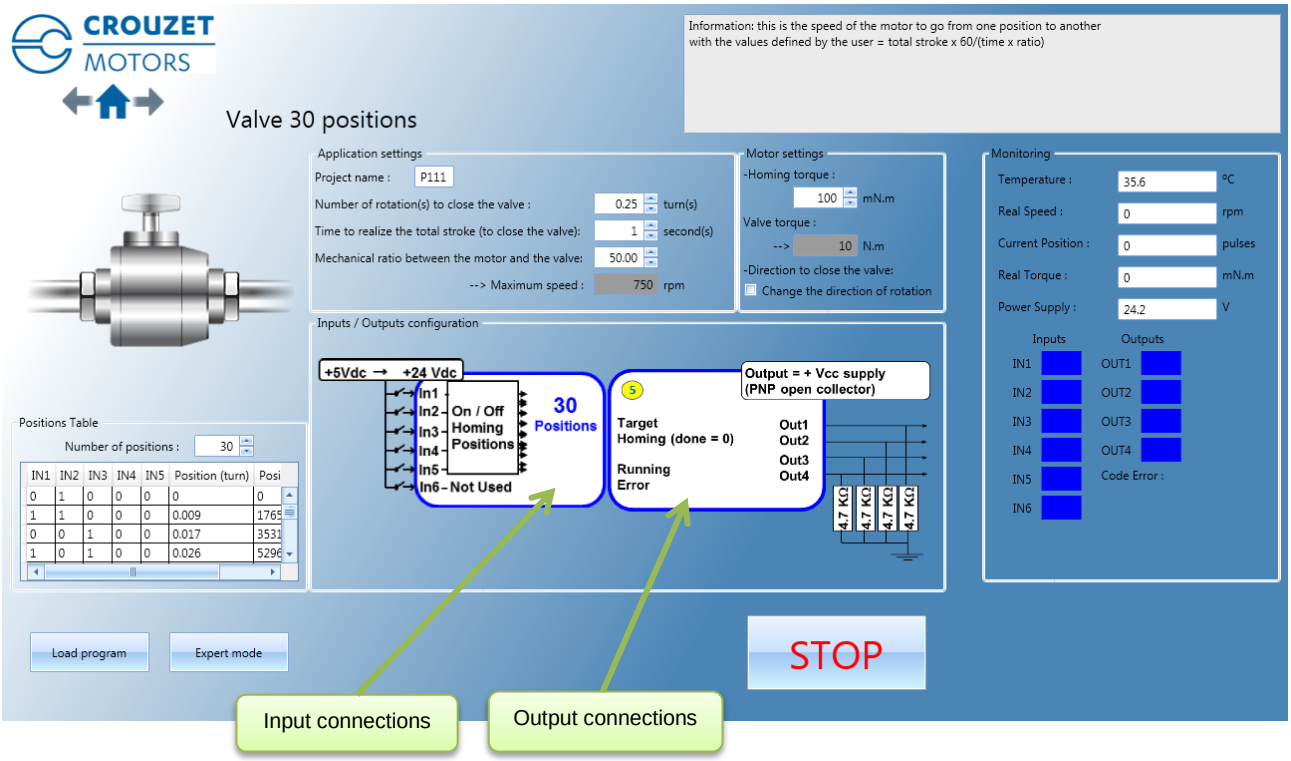
- For information, the maximum torque value **seen by the valve** during operation is given in the grayed-out box.

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



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:

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

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:

$$Nominal\ torque = Homing\ torque$$

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

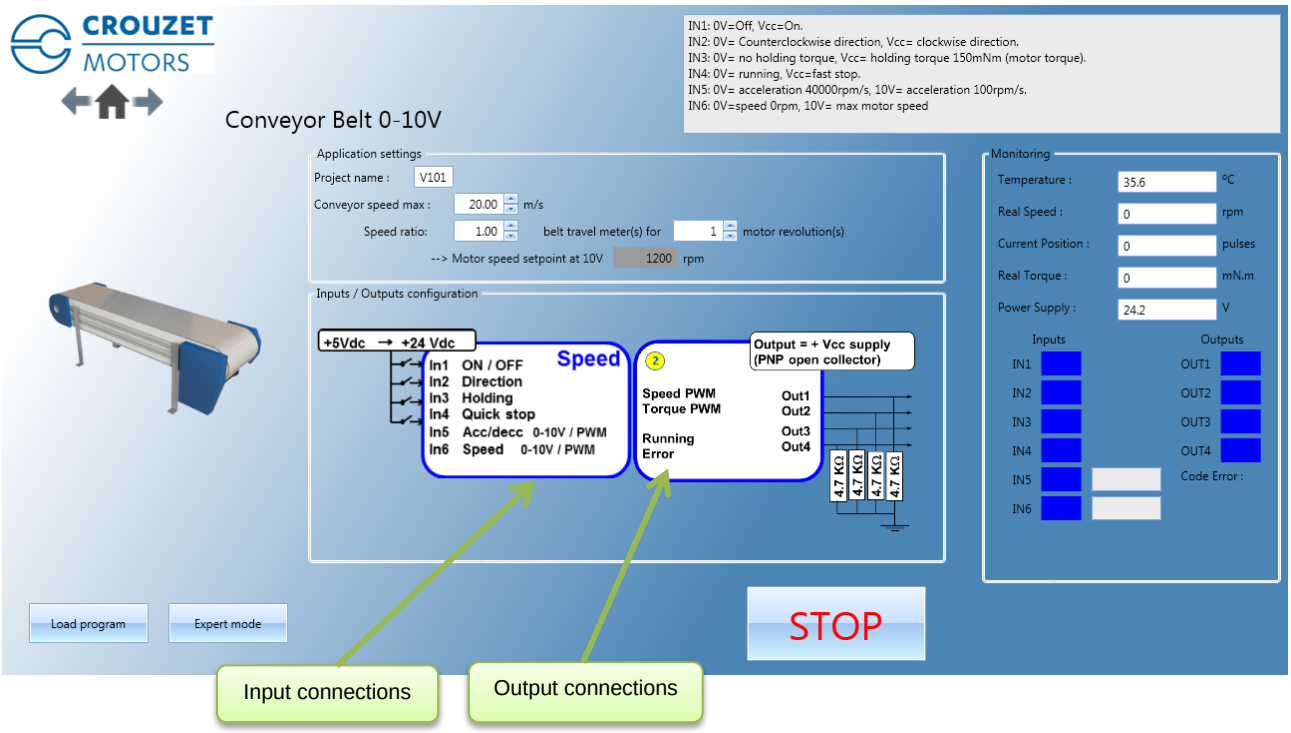
- For information, the maximum torque value **seen by the valve** during operation is given in the grayed-out box.

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.

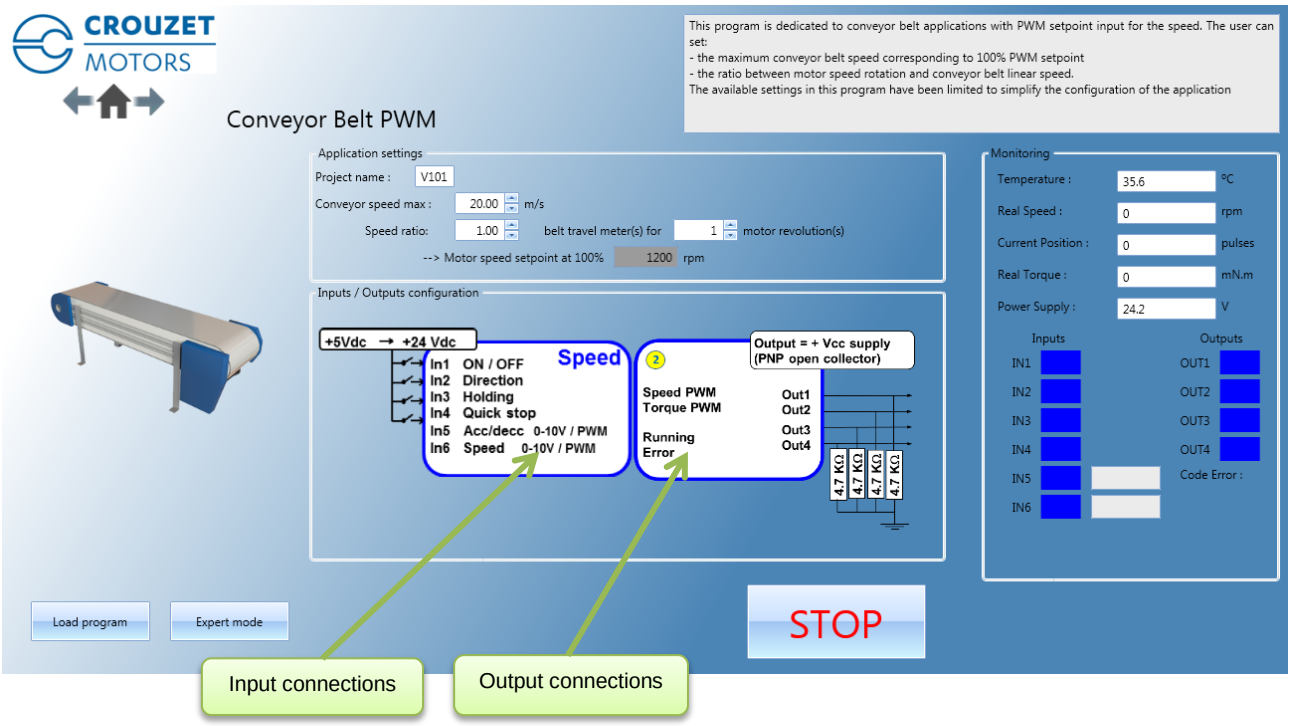
14.2.2.1.2. Application Settings

- 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:

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

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

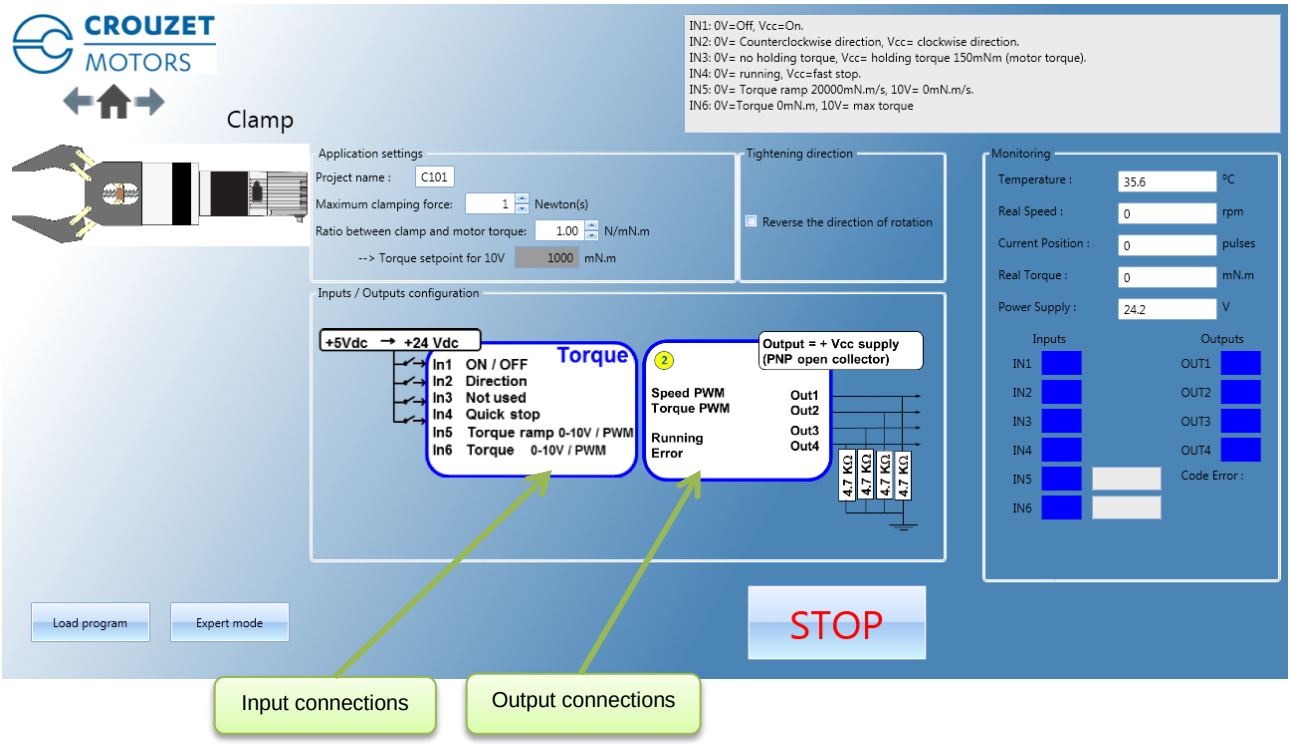
- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default.
- The maximum motor speed corresponding to a PWM signal with 100% cyclical ratio is calculated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

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

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

14.2.3. *“Machine” Group*

14.2.3.1. "Clamp"



The "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 grayed-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.

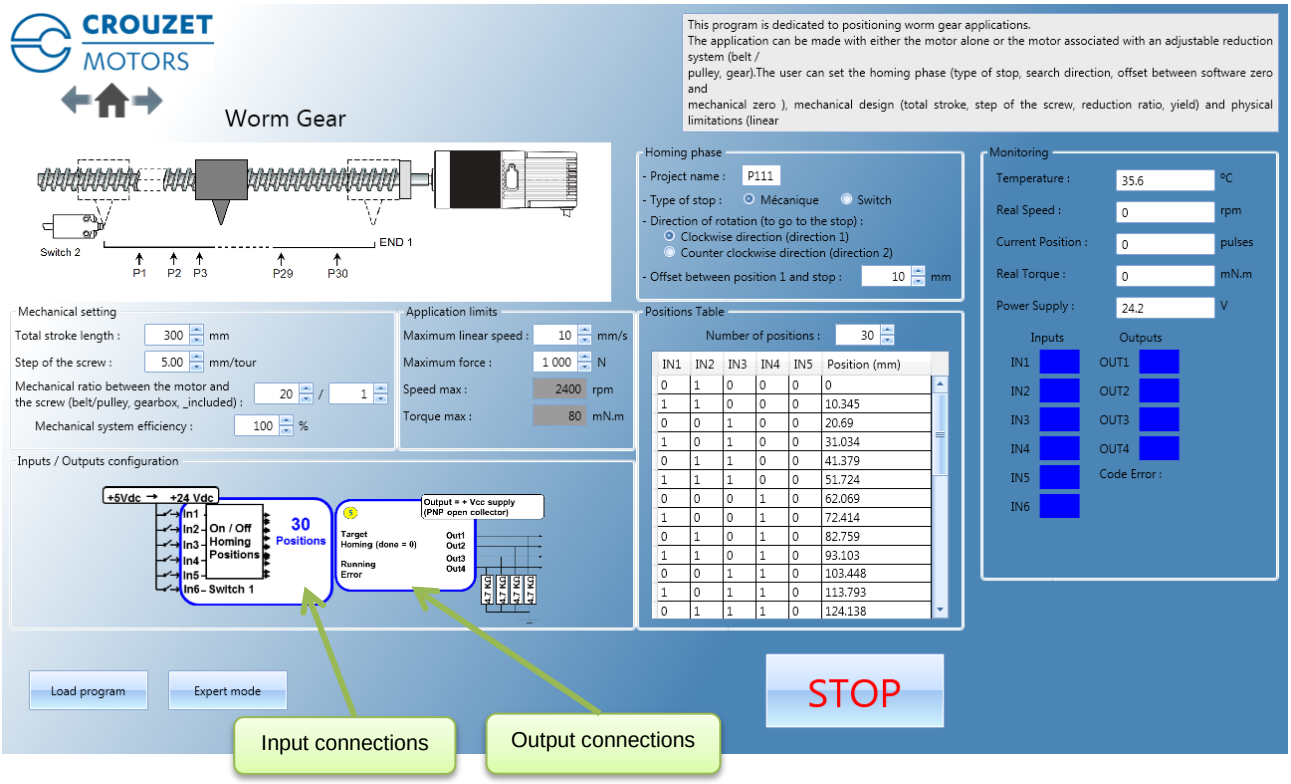
14.2.3.1.2. Application Settings

- 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:

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

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

14.2.3.2. "Worm Gear"



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:

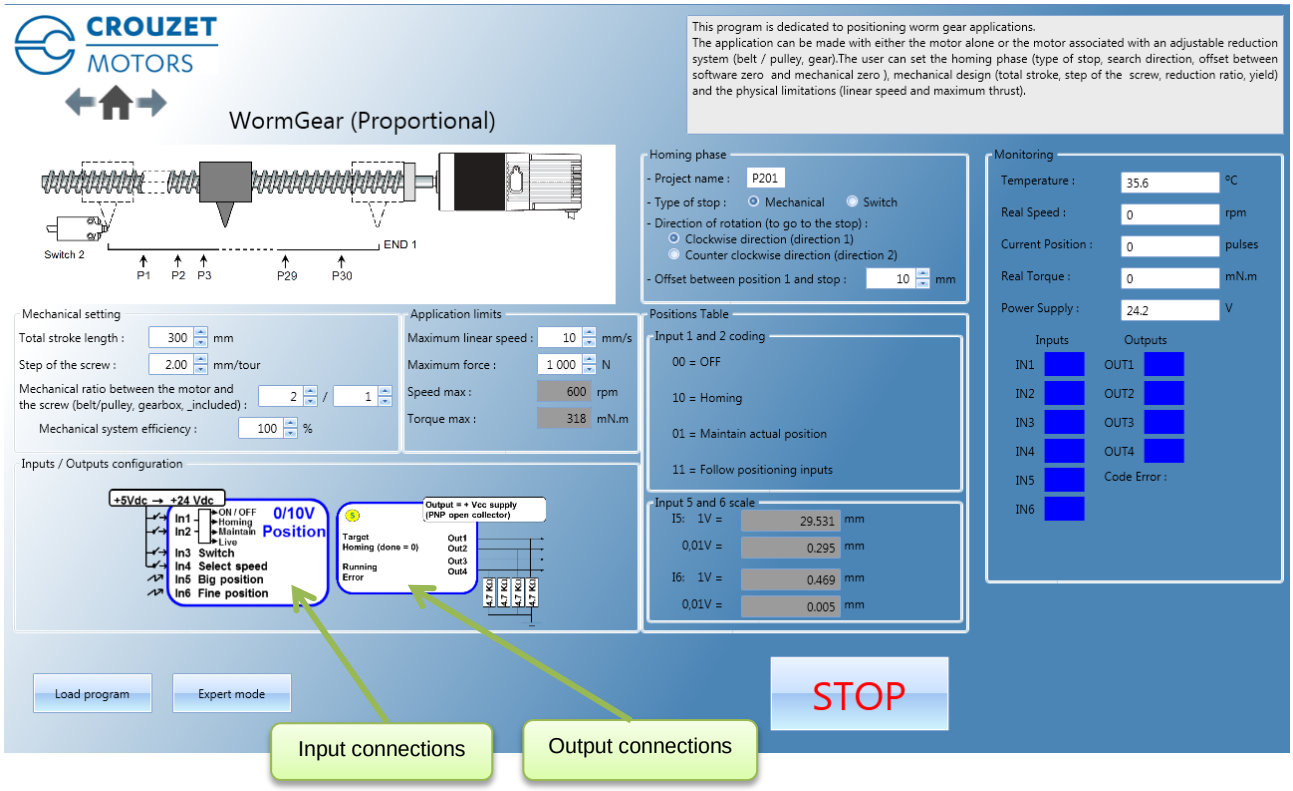
$$Homing\ torque = Motor\ torque$$

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

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:

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

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

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

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

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

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:

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

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

- 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: $Stroke_{E5} = \frac{63}{64} \times 300mm = 295{,}3125mm$ (for 10V applied)

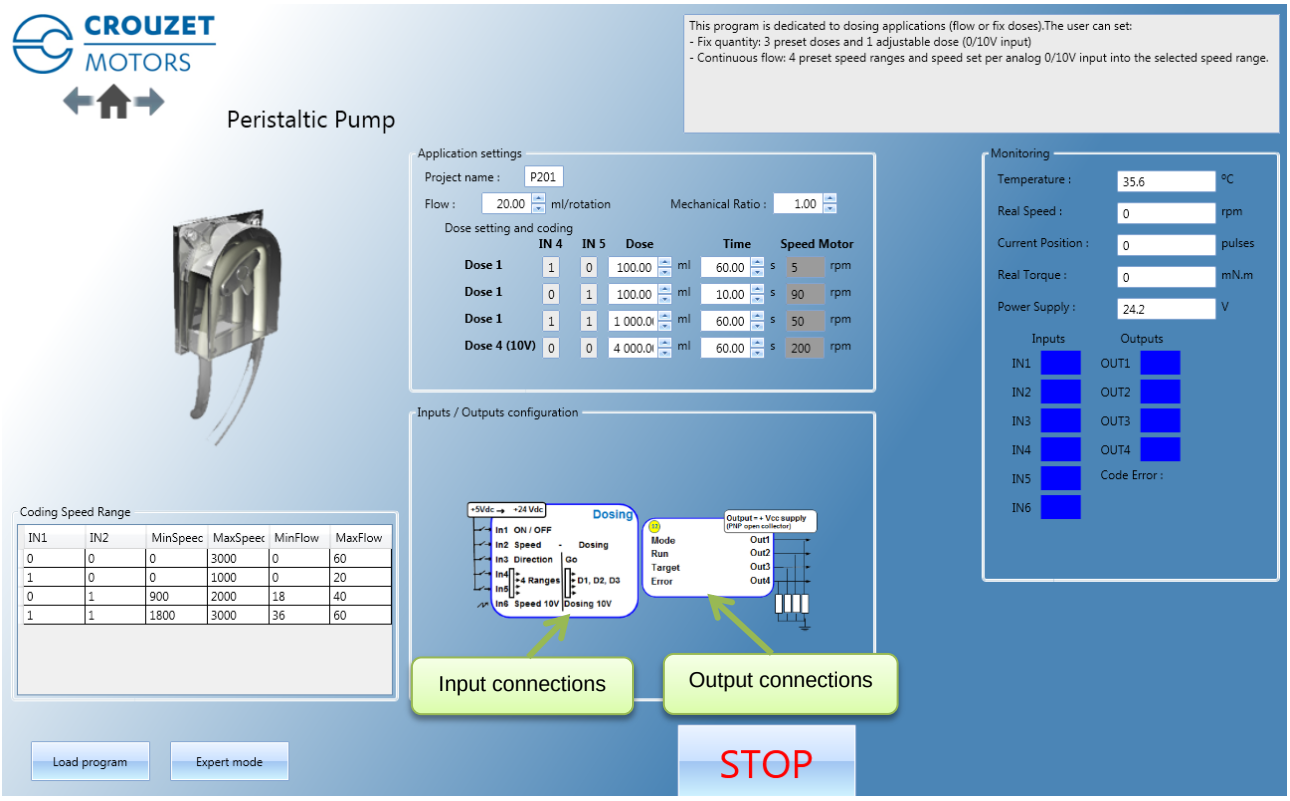
Meaning 29,53125 mm for 1V
Meaning 0,2953125 mm for 0,01V

→ Input IN6 allows to travel: $Stroke_{E6} = \frac{1}{64} \times 300mm = 4{,}6875mm$ (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"



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.

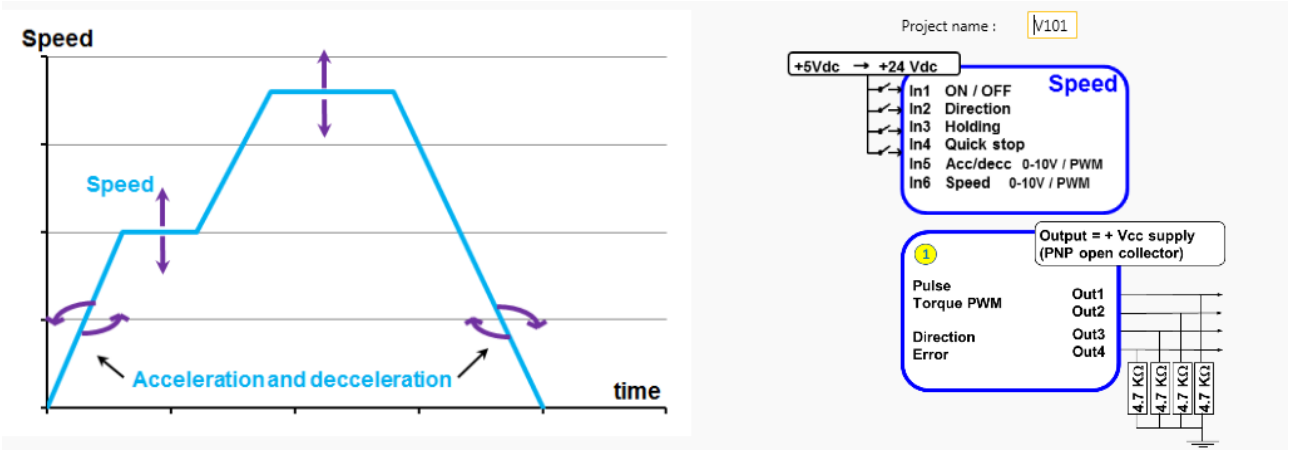
- For this program, speed ranges are fixed. You could modify them in going in "Expert mode".

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*

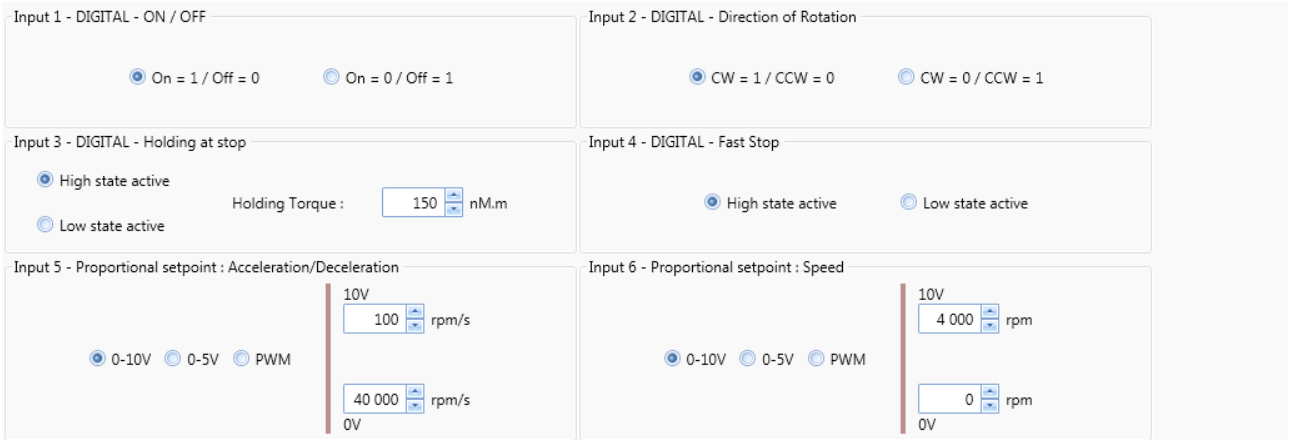
14.3.1.1. "V101"



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



- 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.

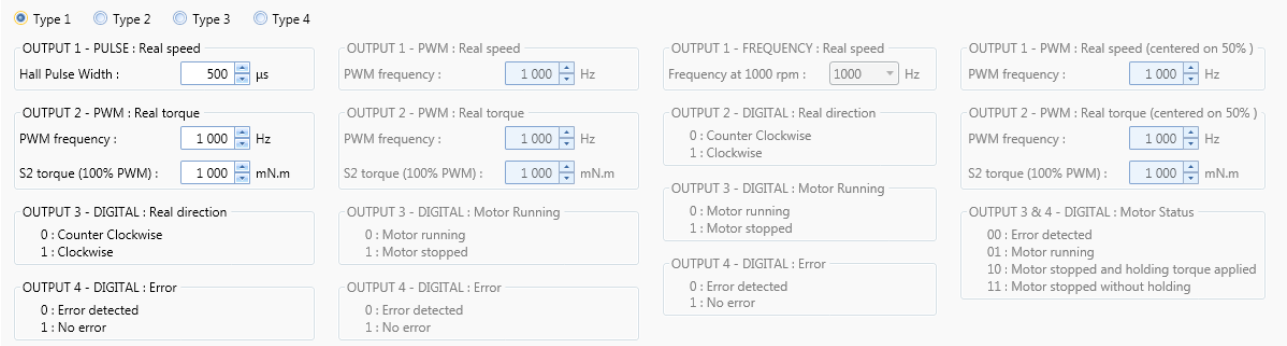
- Digital input 4: Used to set the "Fast stop" input polarity.

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).

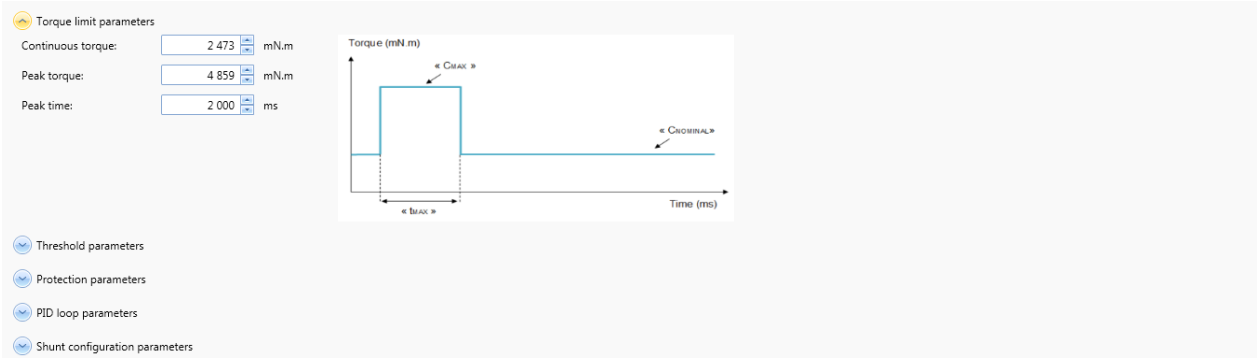
If cyclical ratio = 0% → Braking torque supplied = "S2 torque".
If cyclical ratio = 50% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

CAUTION: In holding torque this output will be between 0 and 50% if the motor runs in CCW, and between 50 and 100% if the motor runs in CW.

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

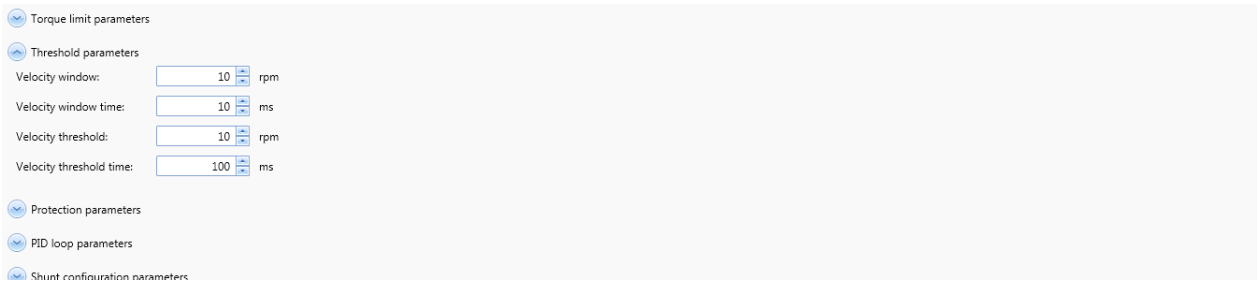
14.3.1.1.3. "Settings" tab parameters

a) Torque limit parameters



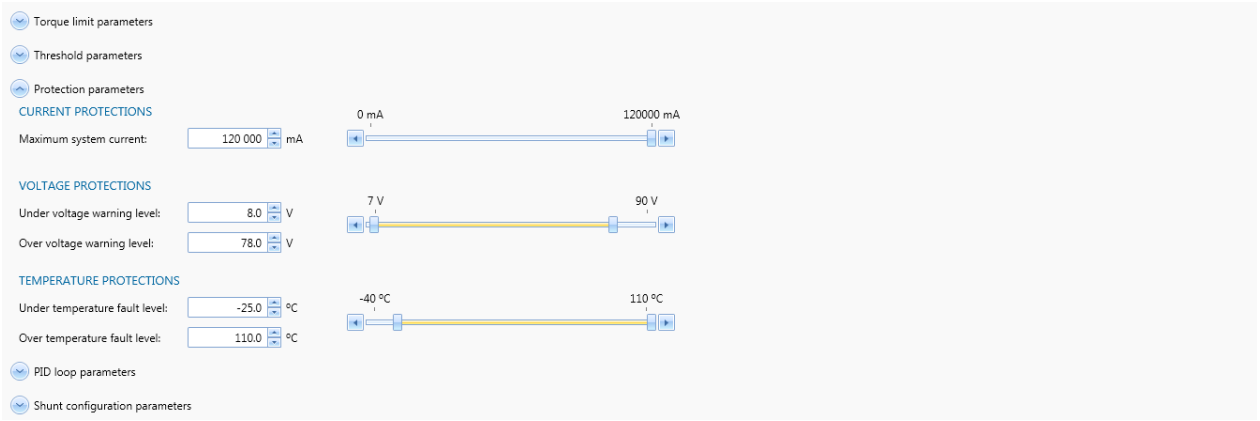
- Setting the various torque parameters: When the application torque exceeds the torque "$C_{NOMINAL}$" (Continuous torque), the motor can provide torque up to the value "C_{MAX}" (Peak torque) for the maximum duration " t_{MAX}" (Peak time). Thereafter, if the application torque is still higher than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

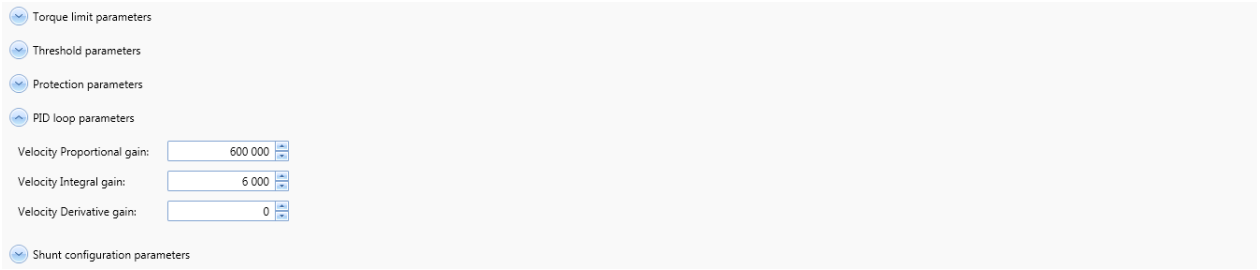
c) Protection parameters



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

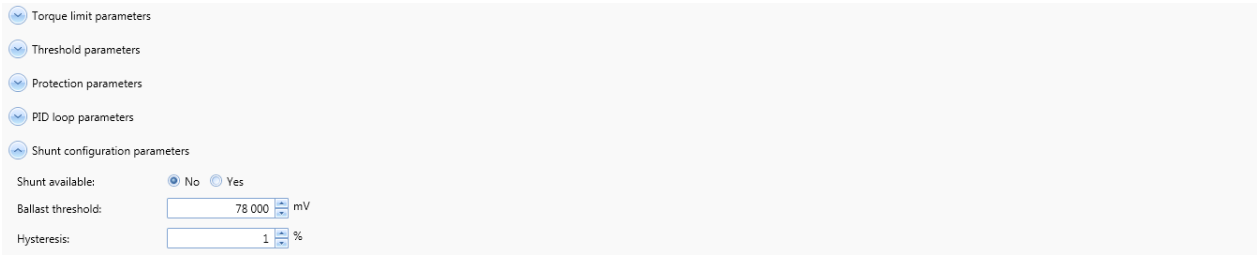
If one of these protection parameters is exceeded, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).

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.

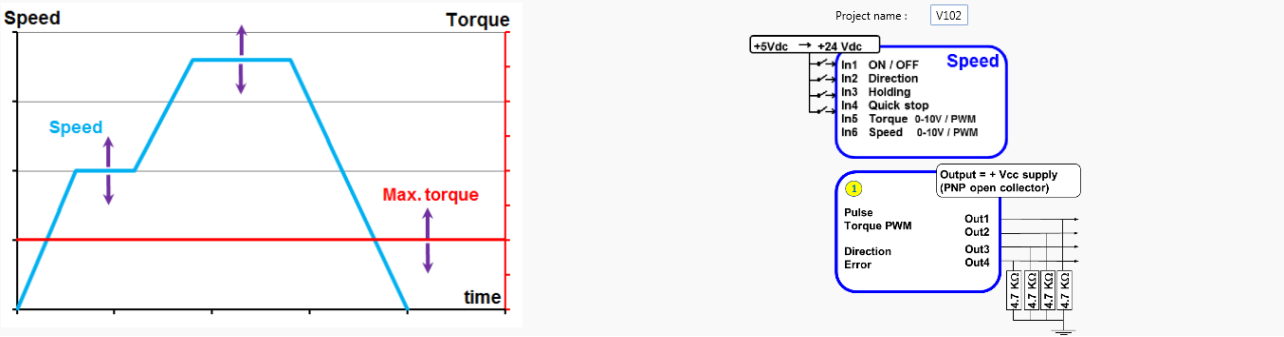
e) Shunt configuration parameters



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"

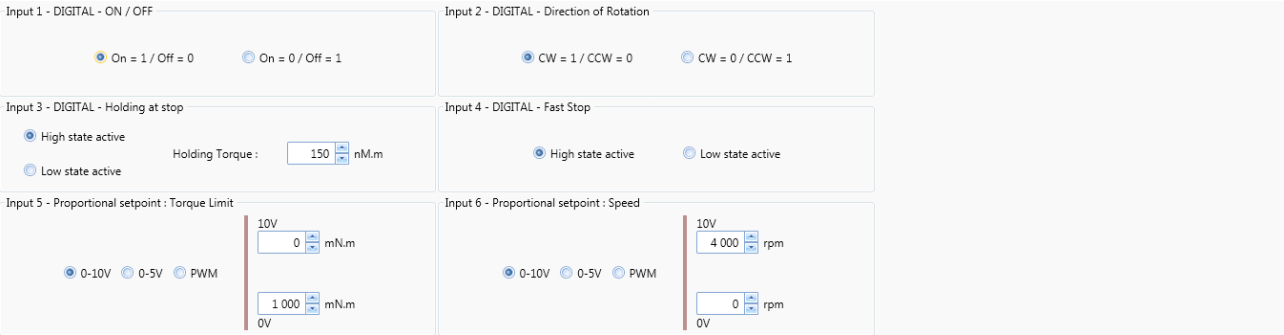


Expert program V102 is used to:

- 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.

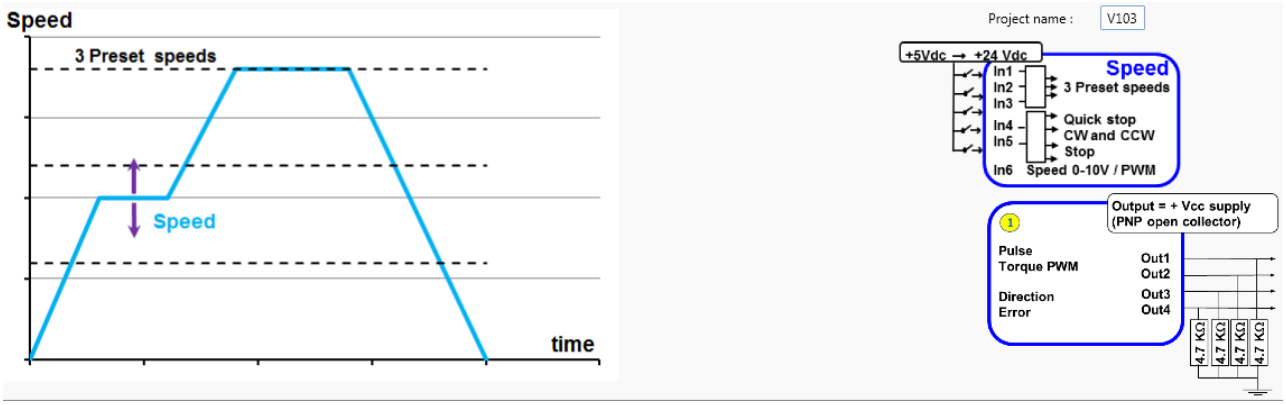
14.3.1.2.2. "Outputs" tab parameters

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).

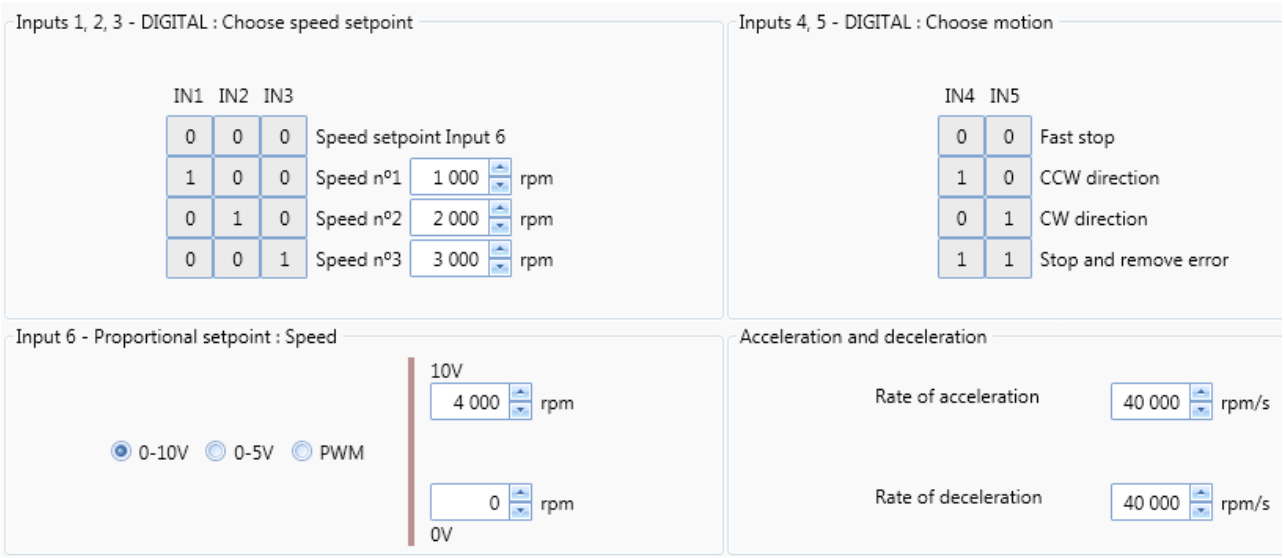
14.3.1.3. “V103”



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



<u>- Combinations of digital inputs 1 to 3</u>: 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.

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

<u>- Setpoint input 6</u>: 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.

<u>- Setting the acceleration and braking ramps</u>: 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.

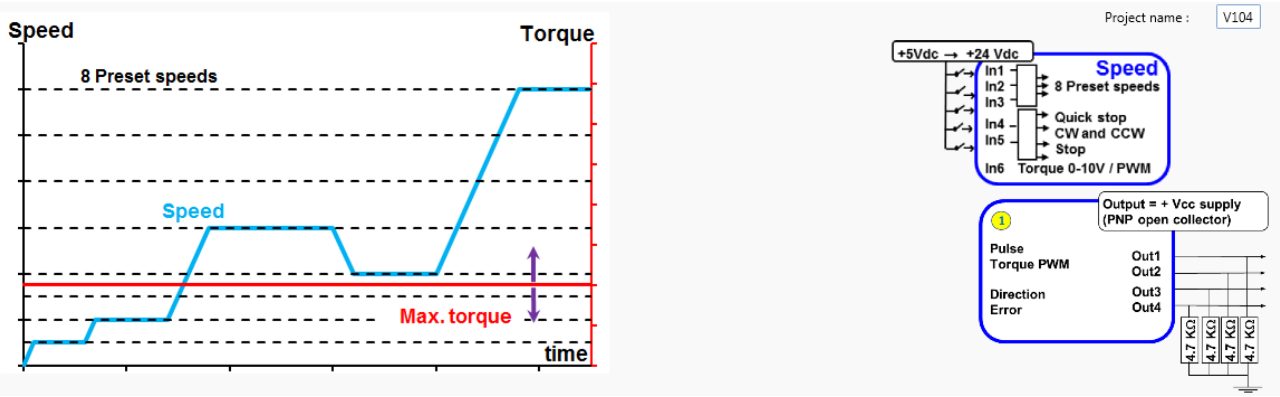
14.3.1.3.2. “Outputs” tab parameters

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.

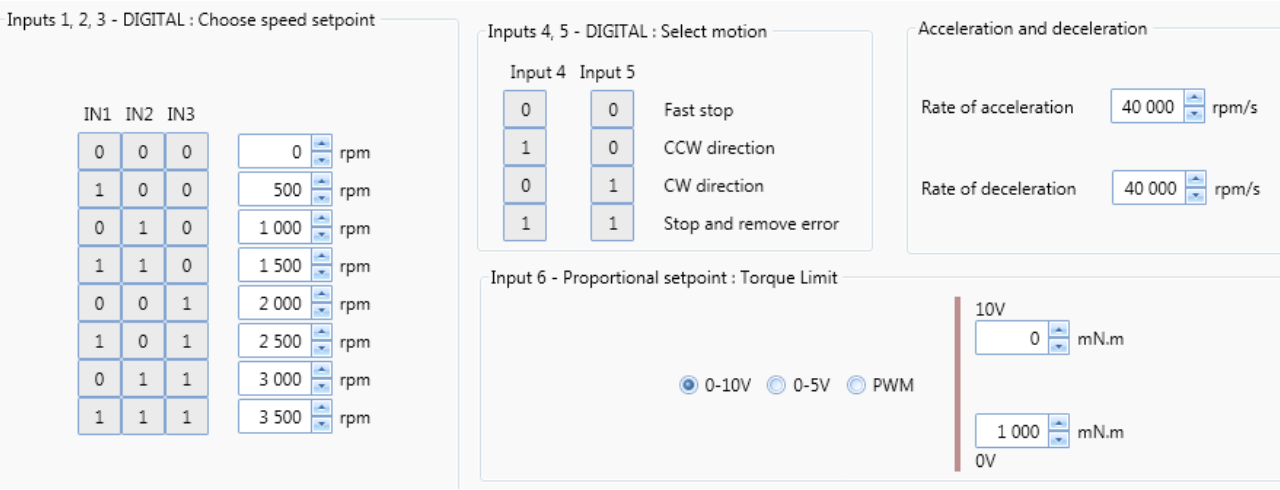
14.3.1.4. “V104”



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



- 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.

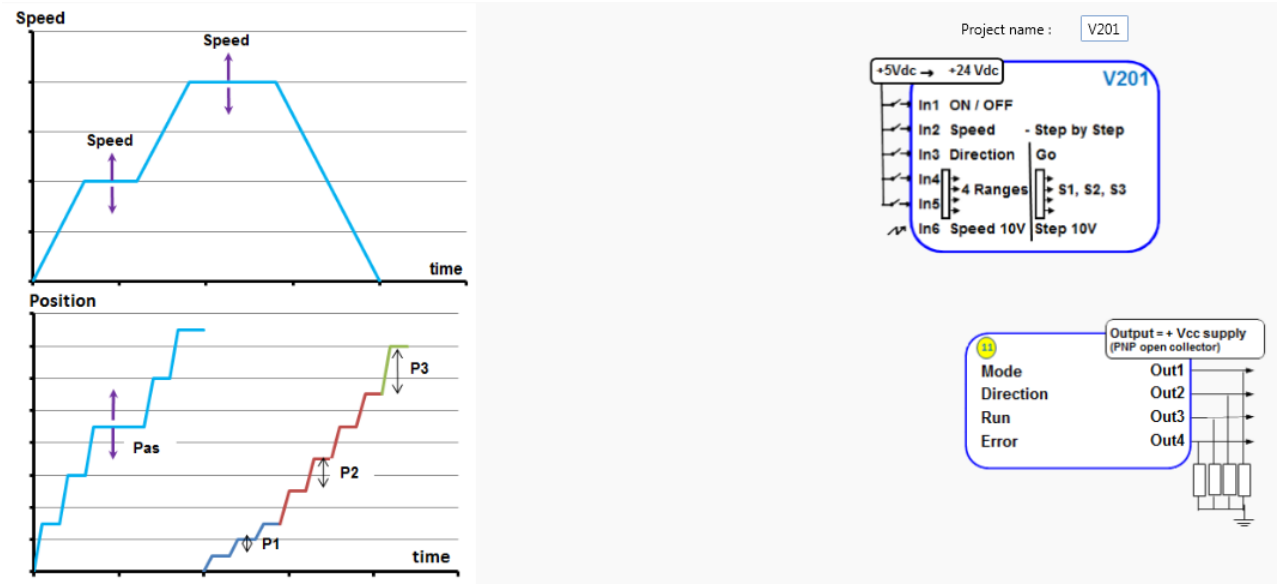
14.3.1.4.2. “Outputs” tab parameters

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



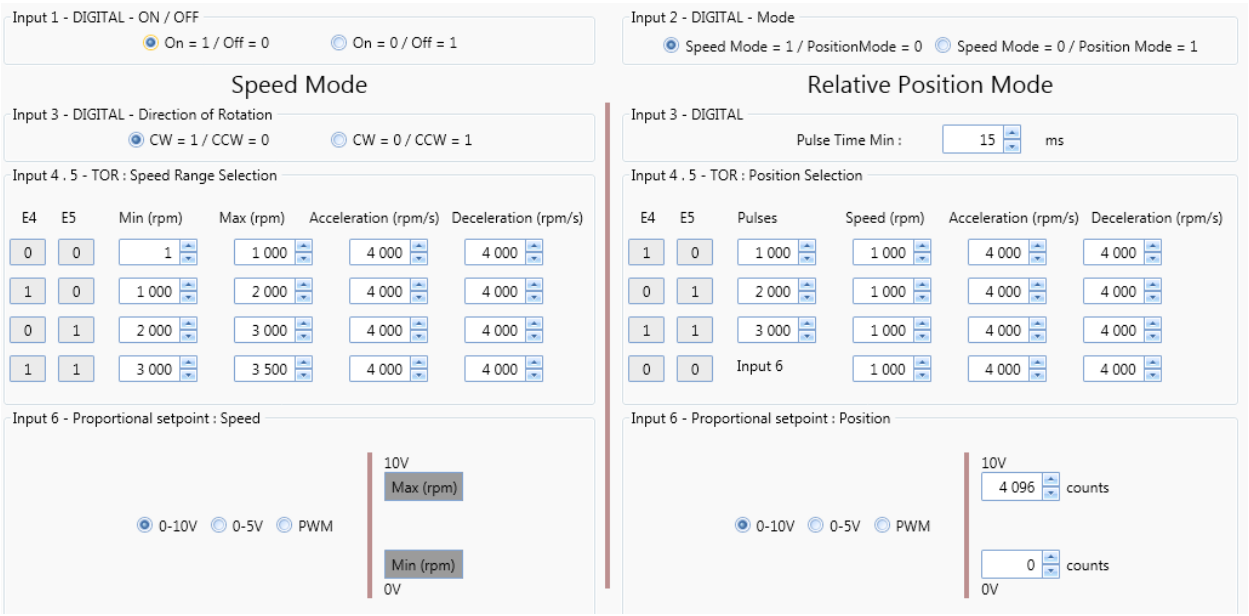
V201 expert program allows to:

- 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



- 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.

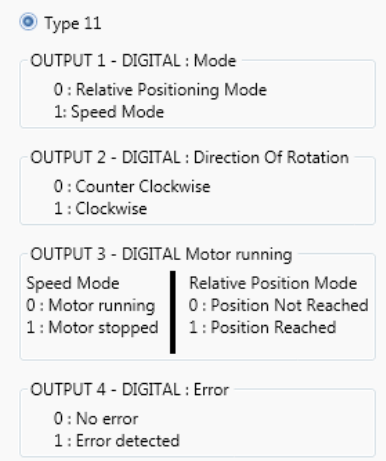
The setting parameter is analog or PWM signal type.

- 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

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

14.3.1.5.2. "Outputs" tab parameters



- 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.

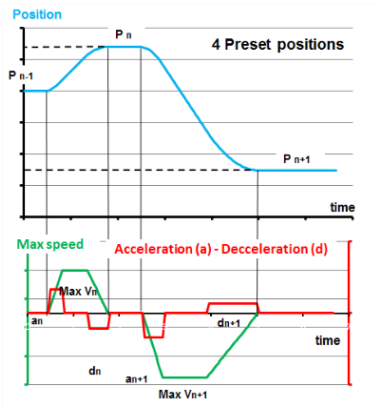
14.3.1.5.3. “Settings” tab parameters

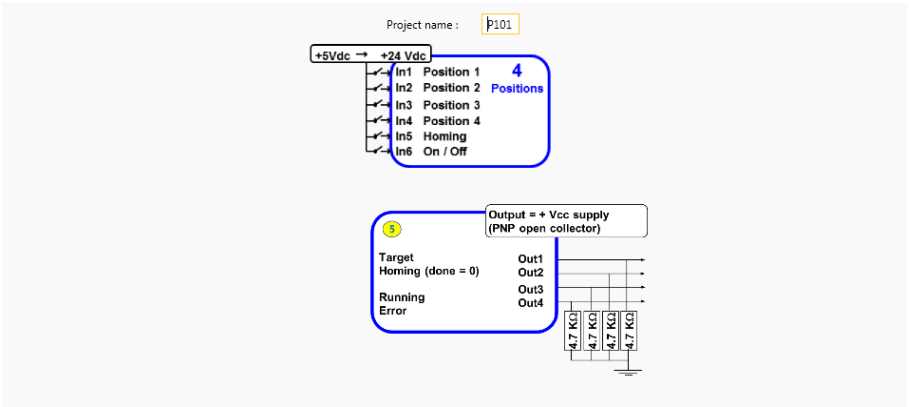
See part “*14.3.1.1. “V101” / 14.3.1.1.3 “Settings” tab parameters*” of this user manual.

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".

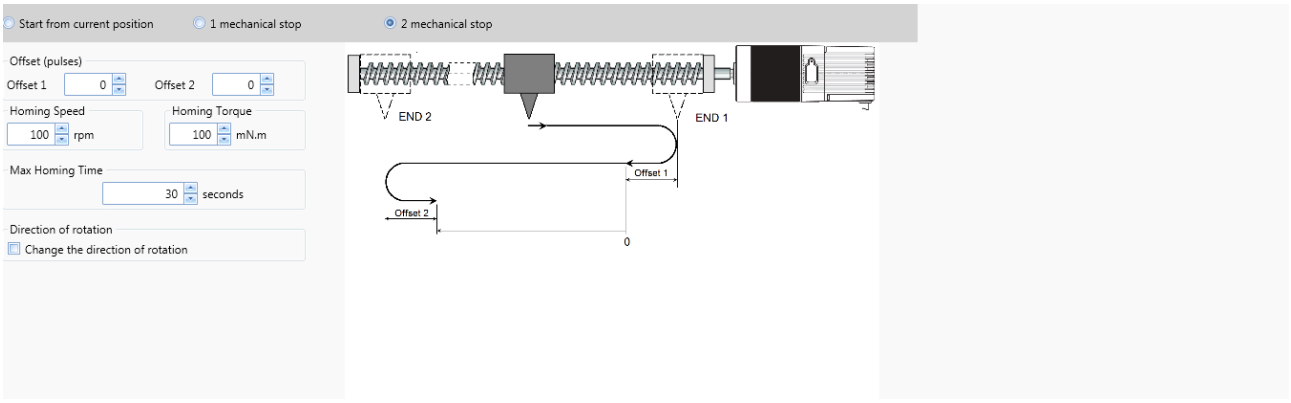
- Set the acceleration/deceleration phases and the maximum speed that must not be exceeded between each point via the HMI.

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.

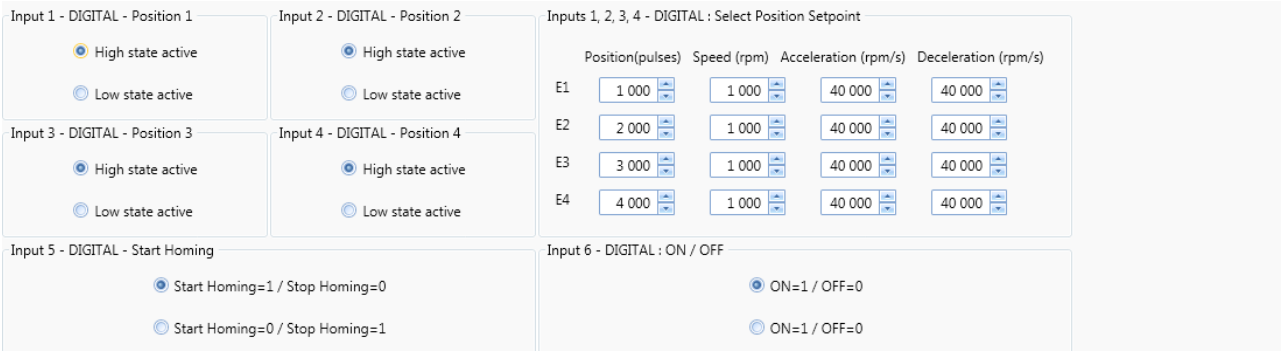
- Homing torque: Set the homing torque that allows the mechanical stop to be found by detection of overtorque.

- 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



- 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.

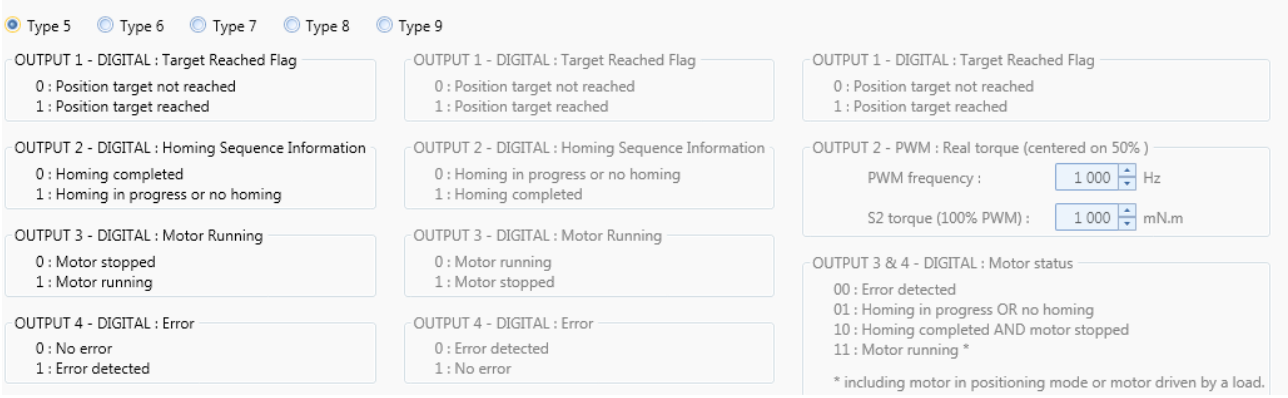
- Digital input 4: Used to set the "Position 4" input polarity.

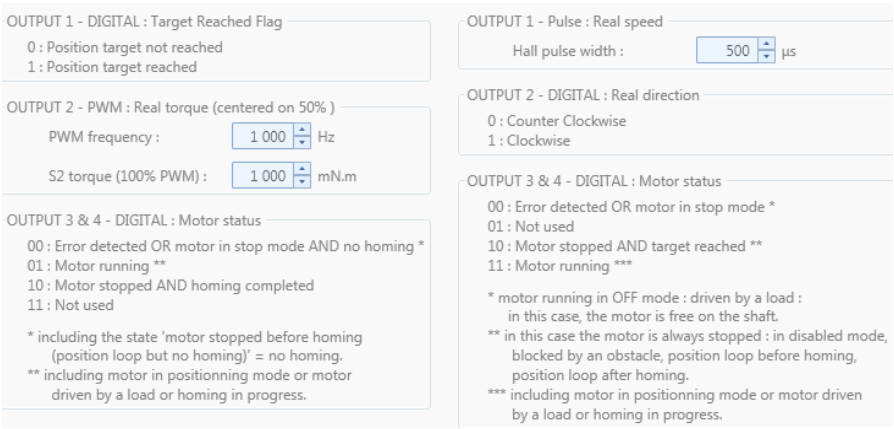
- Digital Inputs 1, 2, 3, 4: Set the 4 position setpoints and the speed profiles to be followed (acceleration ramp, speed step and deceleration ramp: trapezoidal profile).

- 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





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 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).

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

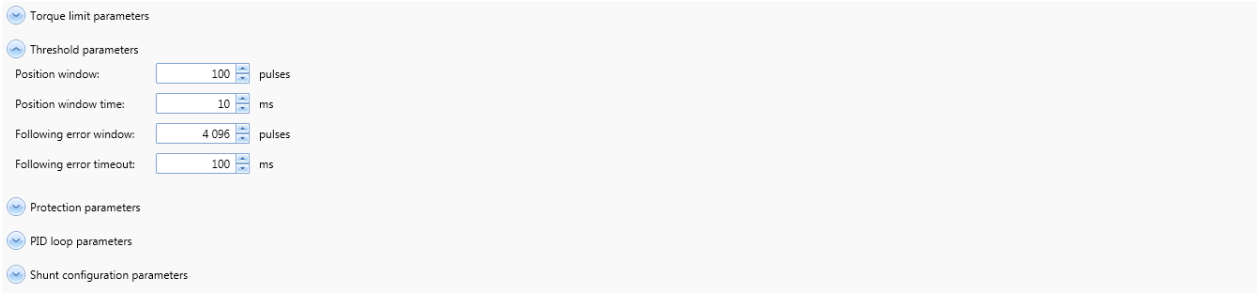
- Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

14.3.2.1.4. “Settings” tab parameters

a) Torque limit parameters

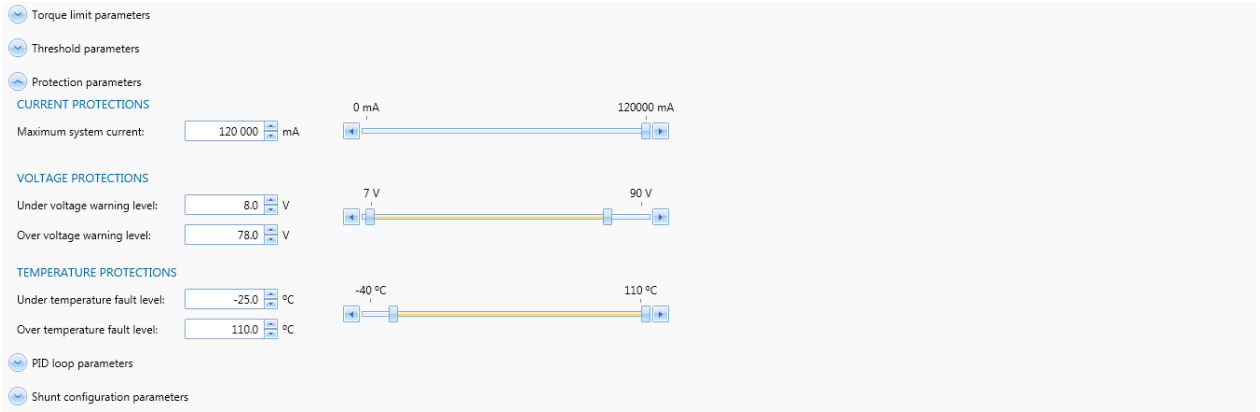
- Setting the various torque parameters: When the application torque exceeds the torque "$C_{NOMINAL}$" (Continuous torque), the motor can provide torque up to the value "C_{MAX}" (Peak torque) for the maximum duration " t_{MAX}" (Peak time). Thereafter, if the application torque is still higher than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

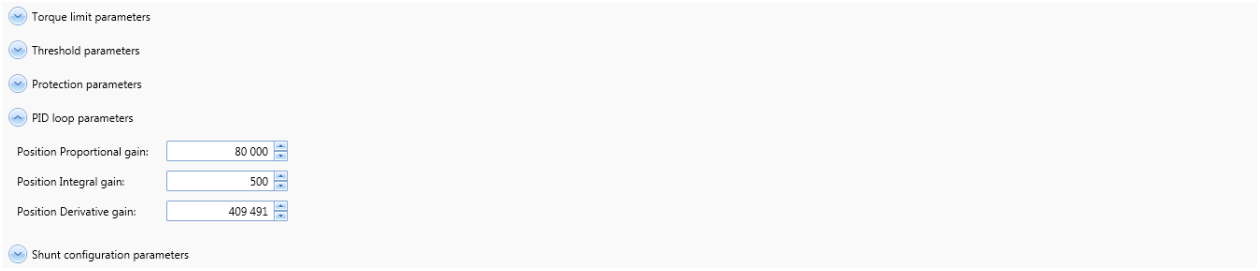
c) Protection parameters



See part “*9. PROTECTIONS*” of this user manual.

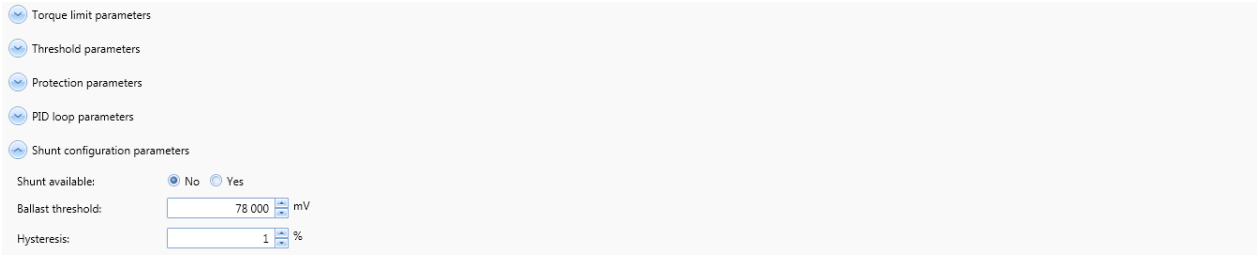
If one of these protection parameters is exceeded, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).

d) PID loop parameters



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.

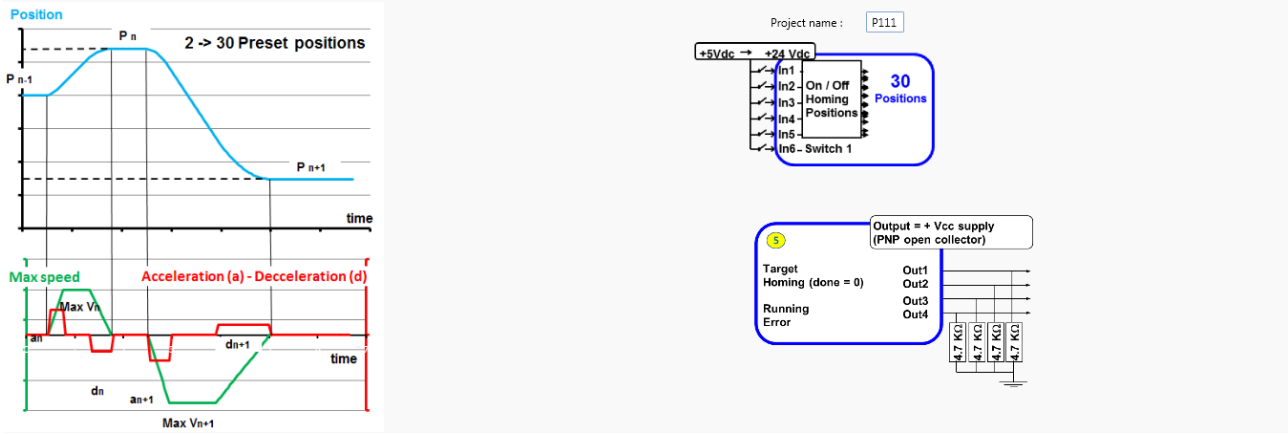
e) Shunt configuration parameters



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”



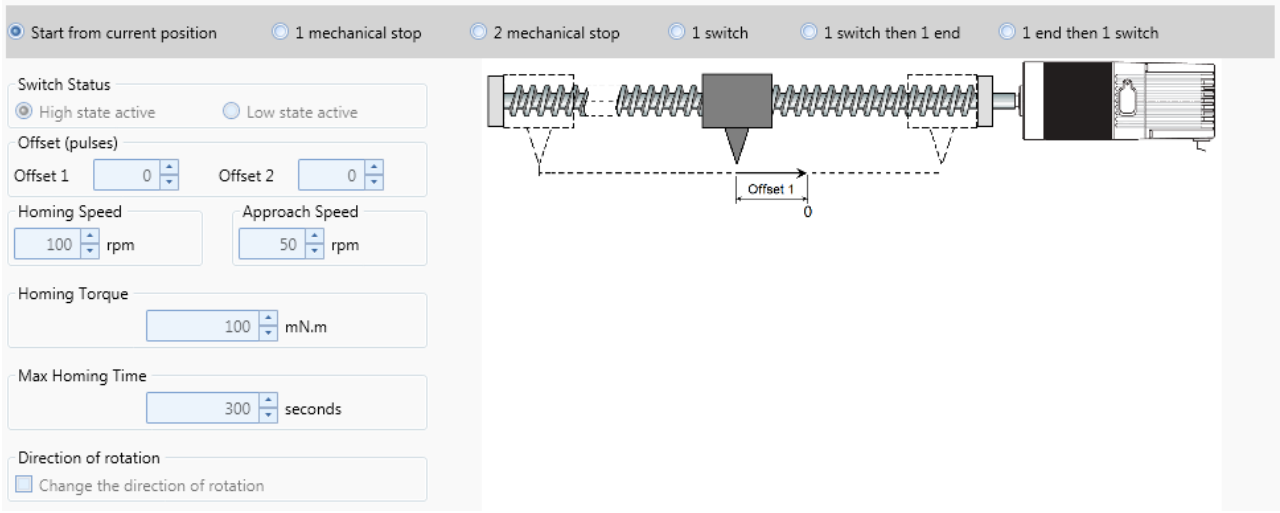
Expert program P111 is used to:

- 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



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

<u>Switch status</u>: Set the polarity of the switch wired on digital input "In6":

- <u>Offset</u>: 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.

- <u>Homing speed</u>: 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).

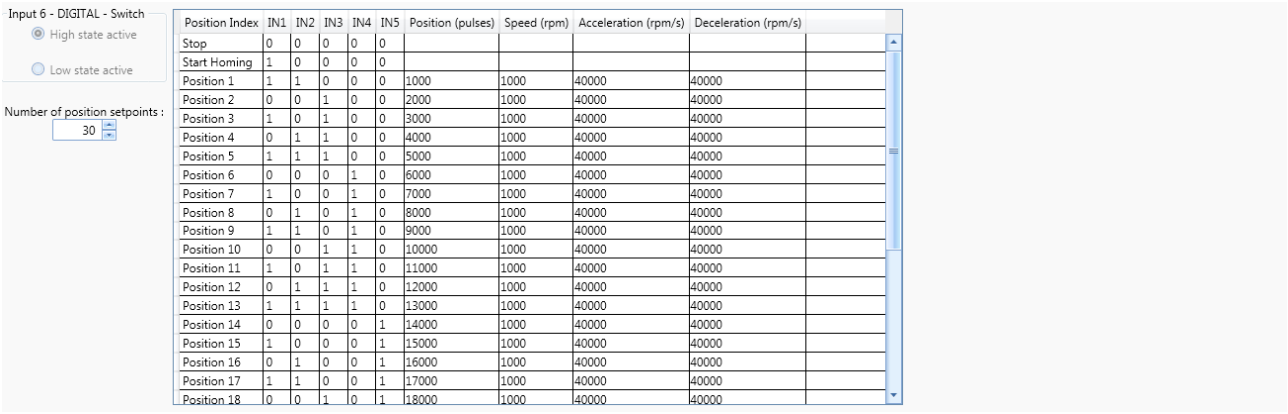
- Homing torque: Set the homing torque that allows the mechanical stop to be found by detection of overtorque.

- 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



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).

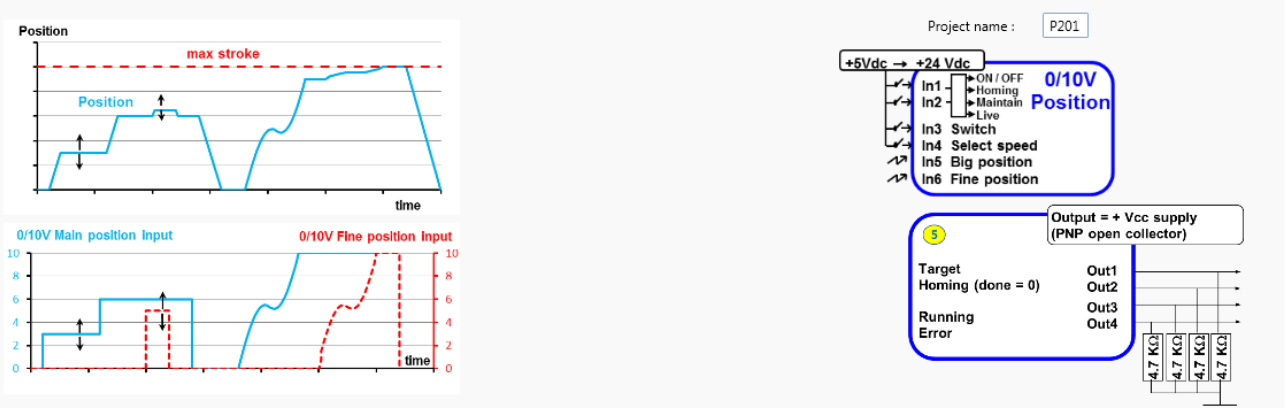
14.3.2.2.3. “Outputs” tab parameters

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 swtich is the input 3)

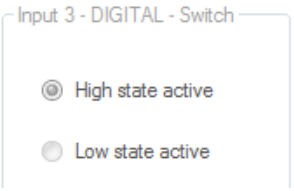
14.3.2.3.2. “Inputs” tab parameters

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

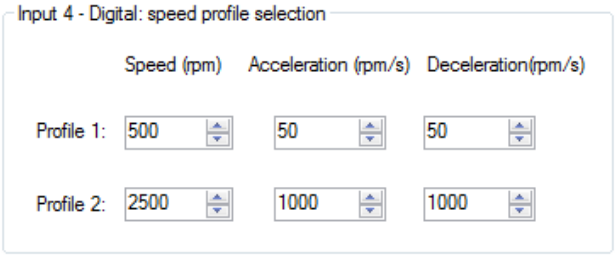
Input 1 and 2 - Digital: move selection

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).



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.



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 ovoid overruns targets.

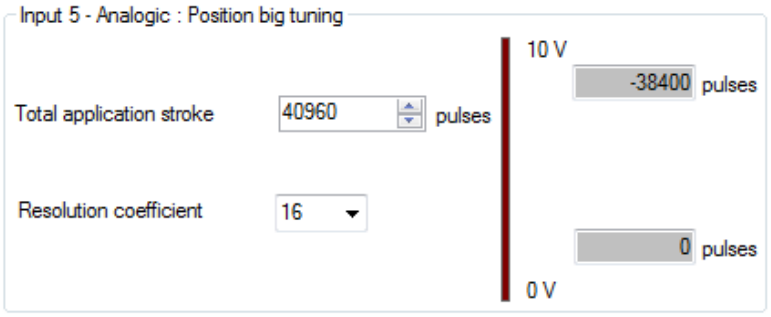
Input IN5 and IN6 setpoints: To do the position setting using the two 0-10V analog inputs.

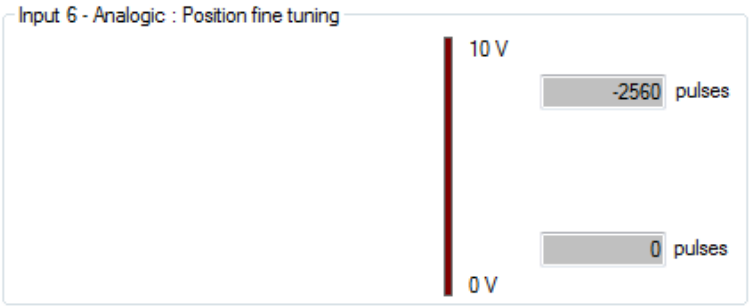
Parameter « total stroke lenght » is the number of encoder pulses corresponding to the stroke when IN5 and IN6 are at 10V.

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)





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

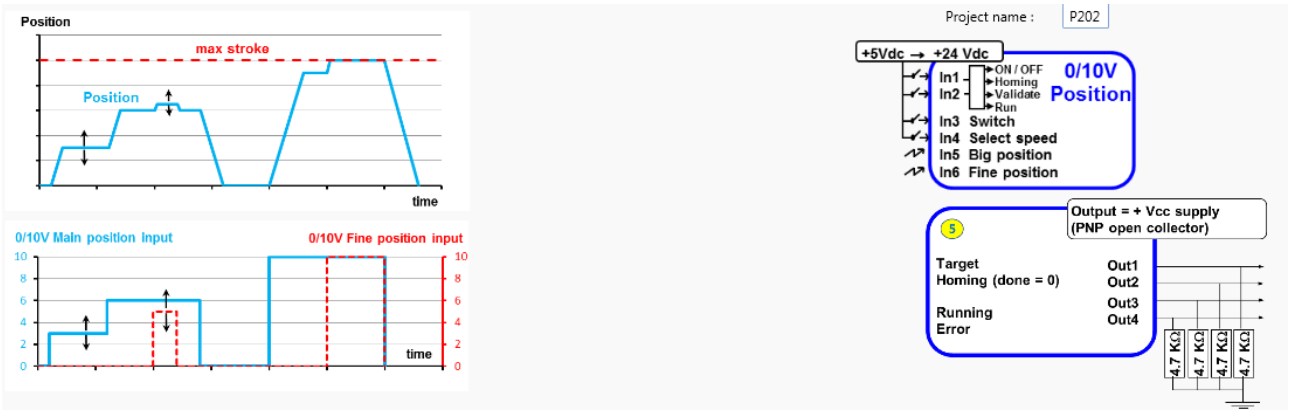
See part “*14.3.2.1. “P101” / 14.3.2.1.3 “Outputs” tab parameters*” of this user manual.

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.

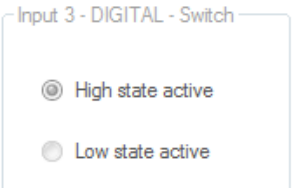
14.3.2.4.2. “Inputs” tab parameters

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

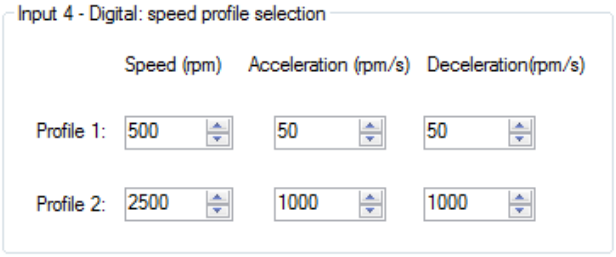
Input 1 and 2 - Digital: move selection

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).



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.



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 ovoid overruns targets.

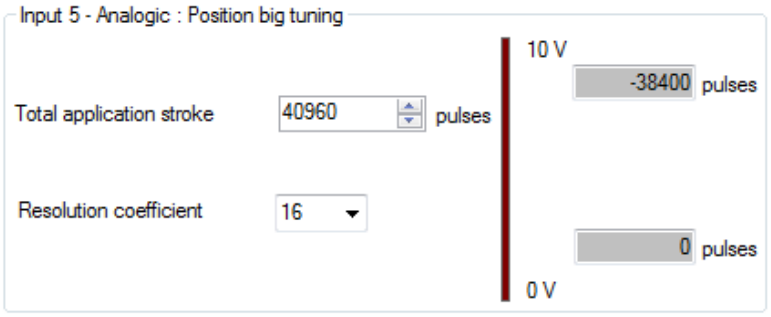
Input IN5 and IN6 setpoints: To do the position setting using the two 0-10V analog inputs.

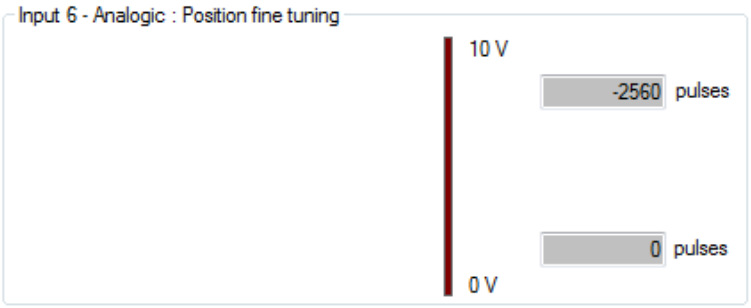
Parameter « total stroke lenght » is the number of encoder pulses corresponding to the stroke when IN5 and IN6 are at 10V.

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)





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.

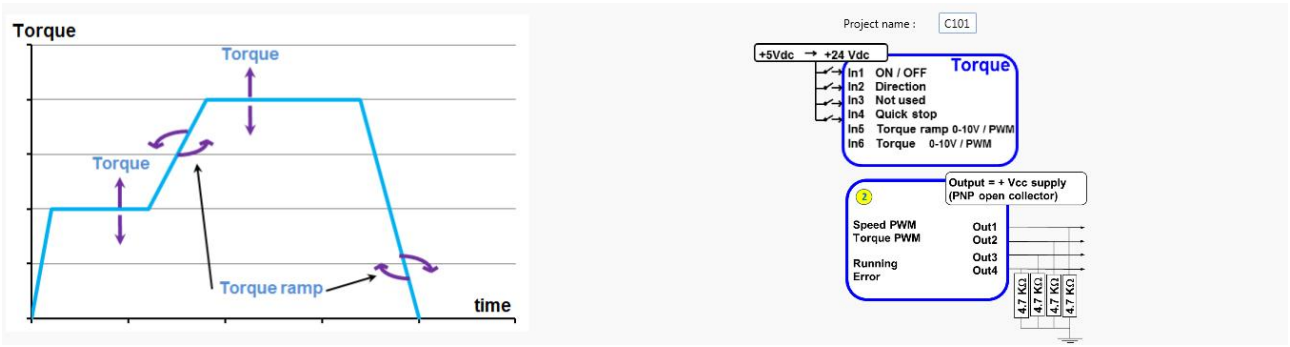
14.3.2.4.4. “Settings” tab parameters

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”

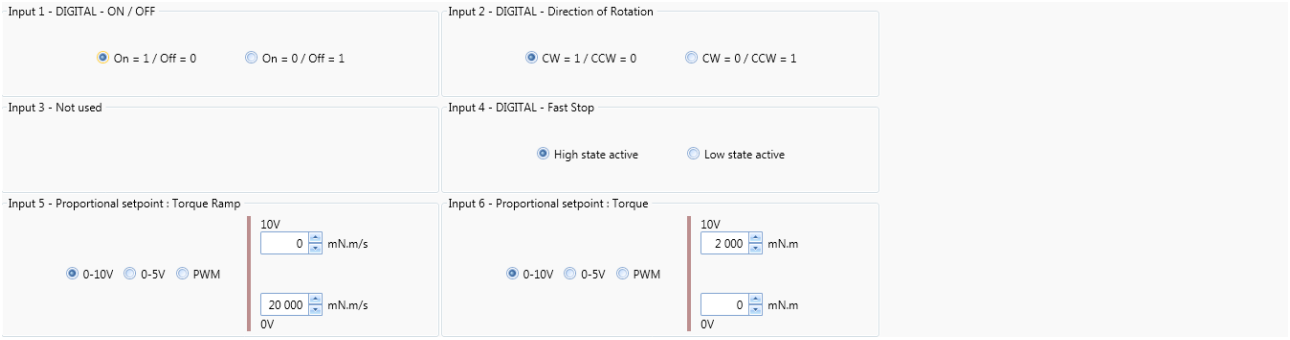


Expert program C101 is used to:

- 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

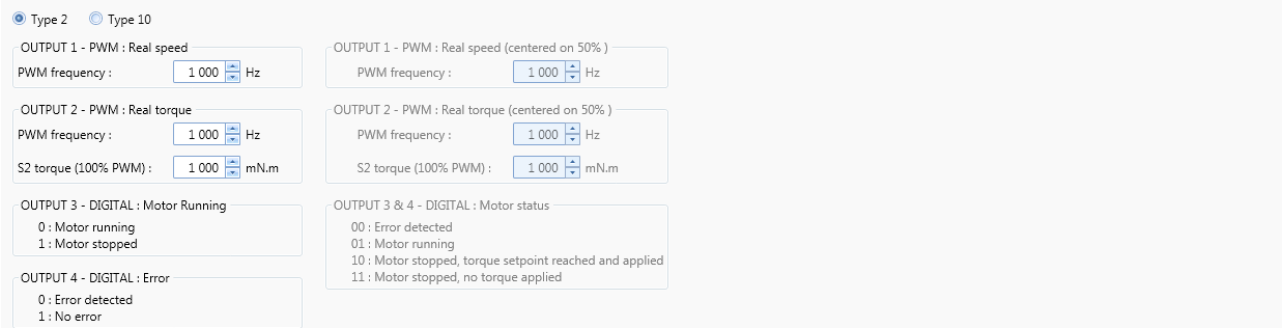
- Digital input 4: Used to set the "Fast stop" input polarity.

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.

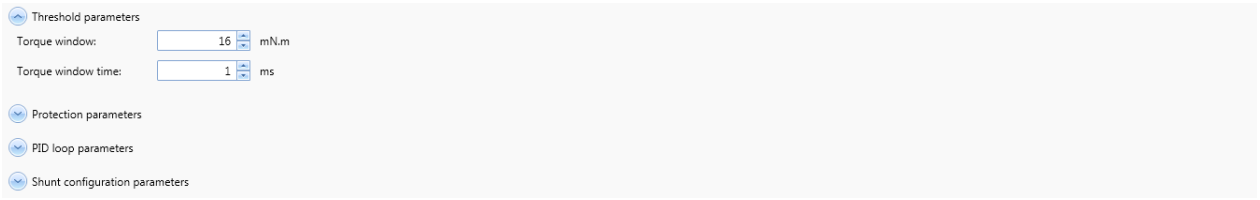
- Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

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.

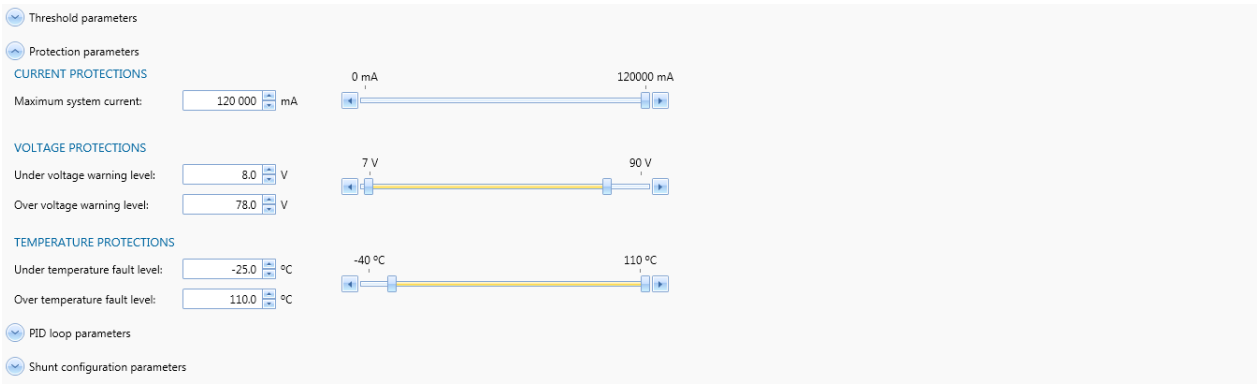
14.3.3.1.3. “Settings” tab parameters

a) Threshold parameters



See part “*4. MOTION SETTINGS / 4.3. Thresholds*” of this user manual.

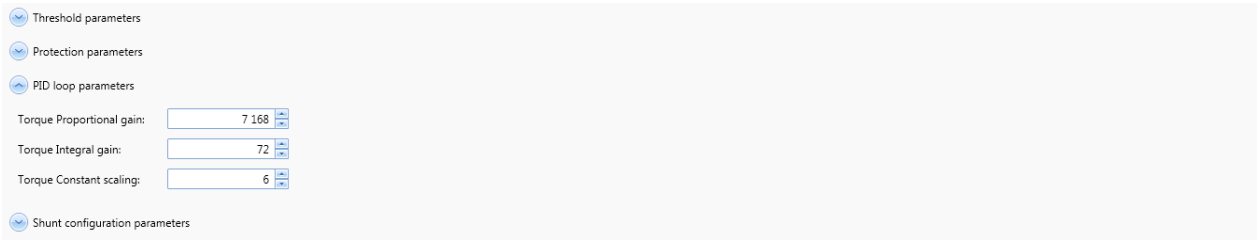
b) Protection parameters



See part “*9. PROTECTIONS*” of this user manual.

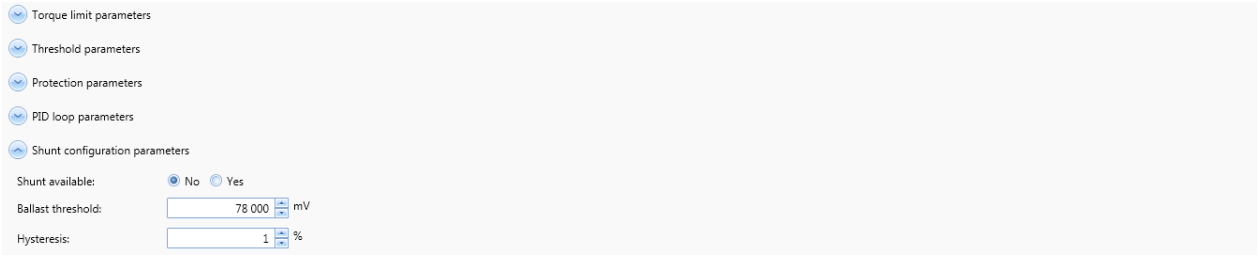
If one of these protection parameters is exceeded, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).

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



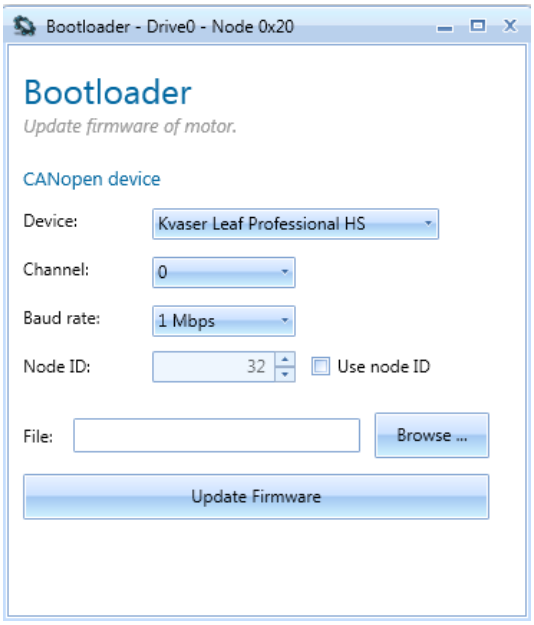
See part "*9. PROTECTIONS/ 9.2. Voltage protections/ 9.2.2. Shunt*" of this user manual.

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.

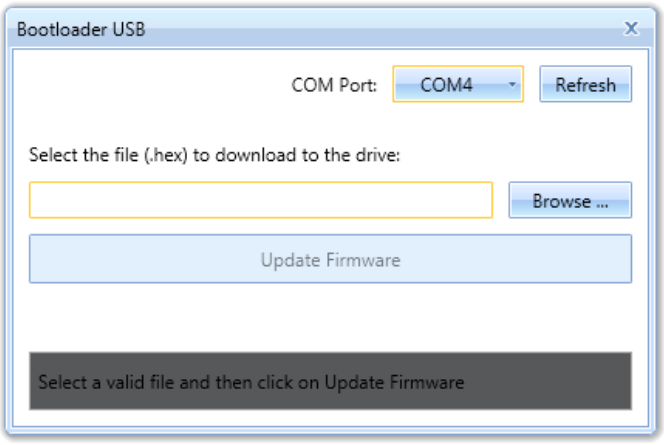
WARNING: During bootloader sequence (firmware update), you must never disconnect the power cable (or power supply) or the CAN communication cable before the end of the downloading, you can permanently lose the communication with the motor and be not able to use it.
If it happens, send motor to Crouzet 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.

WARNING: The .hex file path must not contain blank space. If an .hex file is load with a blank space in the path and the connexion is lost : physicaly disconnect and reconnect the USB and try again without blank space in the path.

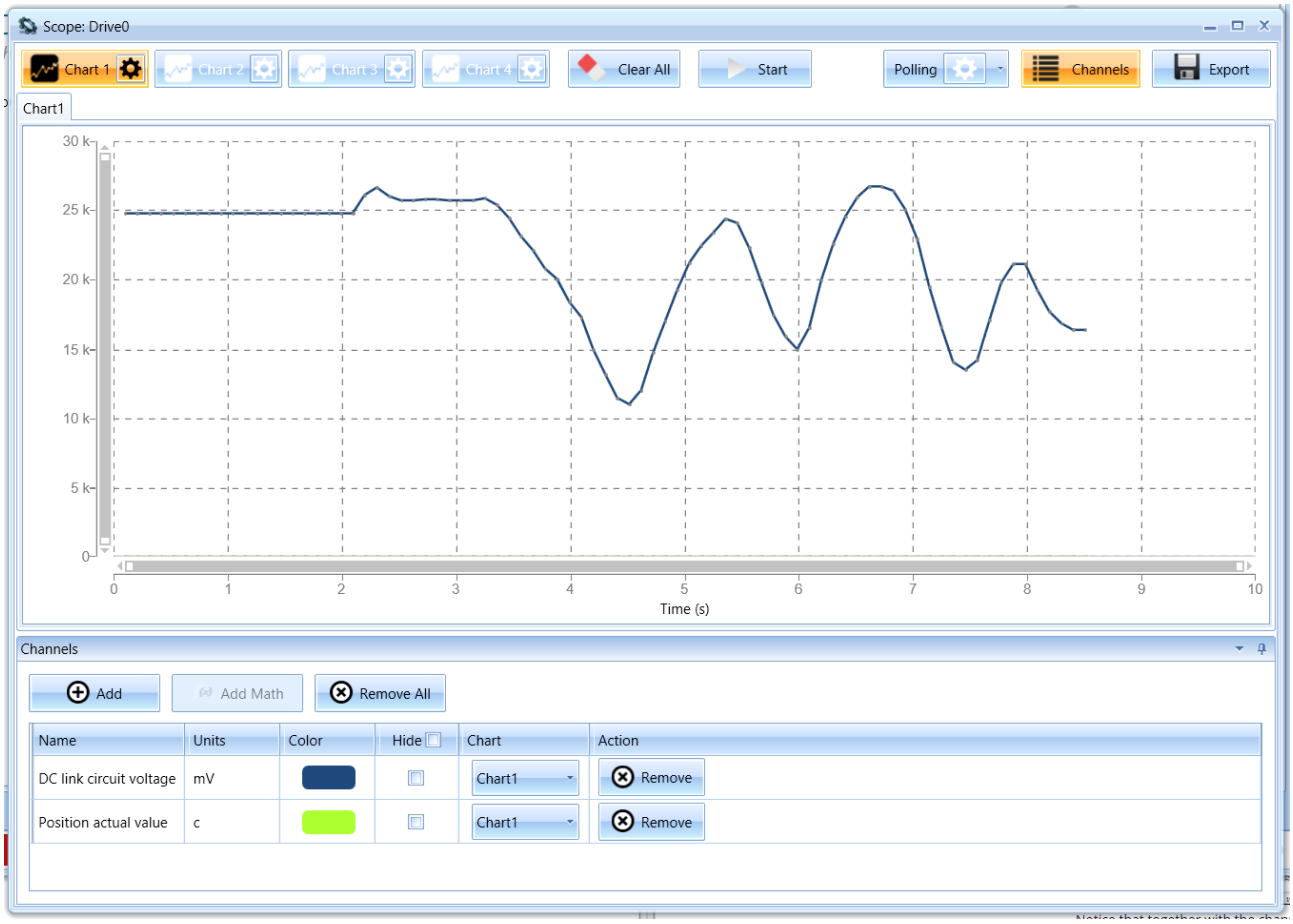
CAUTION: With SMI21 CANopen drive, the BOOTLOADER USB isn’t available.

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.

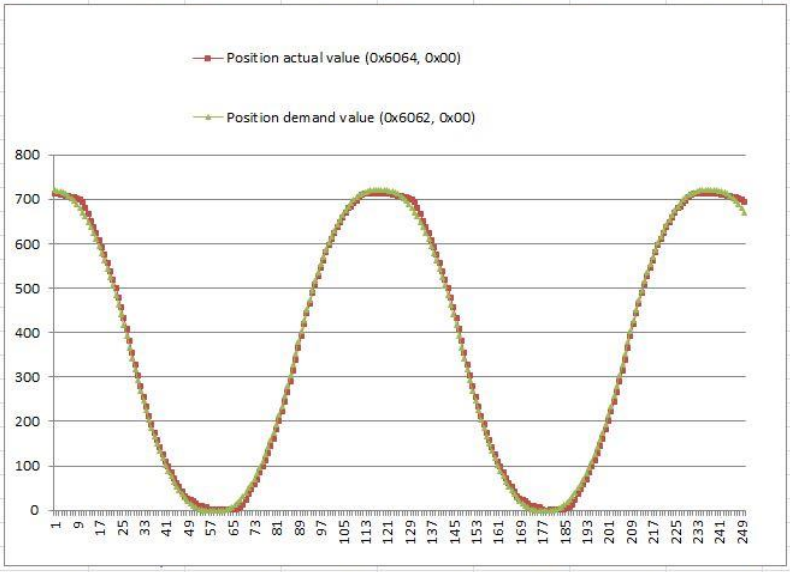
Monitoring Mode: This mode allows a more accurate data collection and analysis. After setting the recording time in ms, it will gather data using as trigger any motion start (future triggers will be available). It collects up to 2500 points and by default plots all the relevant motion signals (demanded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

A	B	C	D	E	F	G	H	I	J	K	L	M
Time	Position actu	Position den	Time	Position den	Time	Velocity actu	Time	Velocity den	Time	Velocity den	Time	Torque actua
0	711,81	719,91									0	17,75
8	711,81	719,37									8	12,75
16	711,27	717,75									16	10,25
24	709,92	715,23									24	6,75
32	707,94	711,81									32	3,5
40	706,59	707,31									40	-13
48	705,87	701,91									48	-30,75
56	704,7	695,61									56	-41,5
64	703,08	688,23									64	-56,25
72	700,02	679,95									72	-64,5
80	692,82	670,77									80	-44
88	681,3	660,51									88	-35,75
96	666,18	649,35									96	-16,75
104	652,05	637,29									104	-23,5
112	638,37	624,15									112	-23,5
120	623,43	610,11									120	-18,75
128	607,86	595,17									128	-22
136	592,65	579,15									136	-32,75
144	575,1	562,23									144	-22
152	557,73	544,41									152	-25,75
160	539,01	525,51									160	-15
168	519,21	505,71									168	-22
176	499,77	485,01									176	-31,75
184	477,72	463,23									184	-21,25
192	455,85	440,55	192	-15,3	192	-456	192	-472	192	-16	192	-35,5



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 1st 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	0x0000000
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 witdh	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 resisror 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	Temperaure 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 avalable	UINT8	TBD	RO	TBD	0
2FF0	10	HW error avilable	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	Boostrap 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 avilable	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	**No error**
0x2280	**Over-current peak has been detected in phase or DC-Bus line (HW system protection).** It could indicate a short circuit between phase and ground. This is a generic error without information of the phases involved in the error.
0x2290	**Over-current peak has been detected in phase (FW system protection).** 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	**Over-current peak has been detected in phase A (FW system protection).** It could indicate a short circuit between phase A and another phase or DC-Bus input.
0x2292	**Over-current peak has been detected in phase B (FW system protection).** It could indicate a short circuit between phase B and another phase or DC-Bus input.
0x2293	**Over-current peak has been detected in phase C (FW system protection).** It could indicate a short circuit between phase C and another phase or DC-Bus input.
0x22A0	**Initial current reading out of range (FW system protection).** This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.
0x22A1	**Initial current reading of Phase A out of range (FW system protection).** This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.
0x22A2	**Initial current reading of Phase B out of range (FW system protection).** This error indicates a Hardware malfunction, please contact Couzet or your local vendor.
0x22A3	**Initial current reading of Phase C out of range (FW system protection).** This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.
0x2350	**An I^2T over-current has been detected (FW system protection).** The maximum phase peak current (Overload capacity) allowed by the controller has been reached.
0x2380	**Saturation of current measurement system has been detected.** In system with VGA it could indicate a selected measurement range too narrow.
0x2381	**Saturation of current measurement system has been detected in phase A.** In system with VGA it could indicate a selected measurement range too narrow.
0x2382	**Saturation of current measurement system has been detected in phase B.** In system with VGA it could indicate a selected measurement range too narrow.
0x2383	**Saturation of current measurement system has been detected in phase C.** In system with VGA it could indicate a selected measurement range too narrow.
0x3210	**System over voltage detected.** 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	**User over voltage detected.** 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
0x3220	**System under voltage detected.** Indicates that minimum absolute voltage of the controller is not reached.
0x3221	**User under voltage detected.** Indicates that the minimum voltage indicated by the user has not been reached.
0x4300	**User temperature out of range detected.** Indicates that the temperature of the controller is out of the range specified by the user.
0x4310	**System over temperature detected (FW system protection).** Indicates that the maximum allowed temperature of the controller has been exceeded.
0x4320	**System under temperature detected (FW system protection).** Indicates that the minimum allowed temperature of the controller is not reached.
0x4400	**Motor temperature out of range detected.** Indicates that the temperature of the motor is out of the range specified by the user.
0x5210	**Internal VGA communication problem detected.** This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.
0x5400	**Output power section problem detected (system protection).** This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.
0x5430	**Input stage problem detected. Voltage not stable or not available (system protection).** This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.
0x5530	**Internal NVM communication problem detected.** This error indicates a Hardware malfunction, please contact Crouzet or your local vendor.
0x6185	**Internal EEPROM full error.** This error indicates that size of object dictionary data is higher than the space available in EEPROM. NA
0x6186	**Internal EEPROM full error (Communication Dictionary).** This error indicates that size of Communication object dictionary is higher than assigned space in EEPROM. NA
0x6187	**Internal EEPROM full error (Manufacturer Dictionary).** This error indicates that size of Manufacturer object dictionary is higher than assigned space in EEPROM. NA
0x6188	**Internal EEPROM full error (Device Dictionary).** This error indicates that size of Device object dictionary is higher than assigned space in EEPROM. NA
0x7121	**Motor blocked.** This error indicates that the motor has been blocked. Only applies to stepper with encoder position feedback. NA
0x7124	**Motor not detected.** This error indicates that the motor has not been detected. Only applies to stepper motors when entering in Operation Enable state. NA
0x7303	**Error in resolver signals detected.** This error indicates a loss or degradation of resolver signals. NA

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

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