

Software User Manual

## CRYO & NANO POSITIONING PRODUCTS (PIEZOKNOB TECHNOLOGY)

*This user manual has been superseded by a newer version. Use for information only. Most information in this document will still be valid, however follow only the General Safety Rules listed in the most recent user manual!*

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**RELEVANT DOCUMENTATION**

Ref	Title (Author)	File name
[1]	Cryo & Nano Positioning products Hardware User Manual (JPE)	1036_MANo3_Rxx_yyyy-mm-dd_CNP_UM_HW.pdf
[2]	CPSC Modes of Operation (JPE)	1038_APNo1_Rxx_yyyy-mm-dd_CPSC_Modes_Of_Operation.pdf

**DOCUMENT HISTORY**

Author	Date	Comment
JPE	2016-06-01	Ro1. Creation.
JPE	2016-06-01	Ro2. Software v5.2 information added.
JPE	2017-03-27	Ro3. Updated / added information on commands.
JPE	2017-12-05	Ro4. Software v5.3 information added (Type parameter change).
JPE	2018-01-31	Ro5. Troubleshooting section updated.
JPE	2018-06-04	Ro6. Type parameter selection information updated.
JPE	2018-06-26	Ro6. Safety information added.

**DEFINITIONS**

Definition	Description

**ABBREVIATIONS**

Abbreviation	Description

## 1. ABOUT THIS MANUAL

This manual describes the control and operation via software of *Cryo & Nano Positioning Systems* (from here on described as systems) using JPE's *PiezoKnob Technology* cryogenic compatible actuators (from here on described as actuator). These actuators can be operated by using a (modular) Controller System (from here on described as controller).



Please read this User Manual carefully prior to installation and (initial) operation of the controller, (stand-alone) actuators and systems. Failure to observe the safety regulations results in a risk of mortal electric shock and/or damage to the controller(s), actuator(s) and/or system(s)!

JPE shall not be liable for damage or injury resulting from misuse of the controller system(s), actuator(s) and/or device(s) or unauthorized alterations to either of those.

**All products mentioned in this manual are intended for use in a laboratory and/or scientific research environment only** and may only be installed, maintained and used by higher educated, technical skilled personnel (from here on described as operators).

Consult the *Cryo & Nano Positioning products Hardware User Manual*<sup>1</sup> on how to install and setup systems and actuators using the controller and its function specific modules. For a quick reference on the various (software) control methods read the Application Note *CPSC Modes of Operation*<sup>2</sup>.

Please note that all content in this manual is superseded by any new versions of this manual (see file name). Visit the JPE website ([www.jpe.nl](http://www.jpe.nl)) to obtain the most recent version<sup>3</sup>. All images in this User Manual are for illustrative purposes only.

**For a quick-start at least read and follow the instructions in Chapters 2, 3 and 4.**

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<sup>1</sup> See reference [1]

<sup>2</sup> See reference [2]

<sup>3</sup> This manual is intended for products ordered and delivered from *June 2016 onwards*. For products ordered and delivered prior to this date, please refer to the previous User Manual(s), see also paragraph 7.

## 2. IMPORTANT SAFETY INFORMATION

### 2.1 User Manual Instructions

In this manual important (mostly safety related) information is shown inside a (red colored) bordered box, like this:

*Important notes are shown inside a bordered box.*

**Please note that it is obligatory to follow the instructions mentioned in these (red colored) bordered boxes! Failing to observe instructions may result in a risk of electric shock! Therefore follow all instructions carefully!**

### 2.2 General Safety Rules

- 1 *Assembly and mounting of actuators and systems may only be carried out when not (electrically or optically) connected to the controller.*
- 2 *Always check all cabling, wiring and connectors (electrical as well as optical) on defects prior to connecting to actuators, systems or controllers.*
- 3 *Actuators and systems must only be connected to the controller when all actuators and systems have been placed in a safe environment towards the operator(s), i.e. out of reach by the operator(s) when driving them electrically (by using the controller).*
- 4 *Touching actuators and systems including all cabling and connectors while driving electrically, is not allowed and may result in a dangerous electrical shock! Avoid physically touching unconnected in- or outputs when the controller is powered ON (open voltage contacts present!).*
- 5 *Always place the controller(s), actuator(s) and system(s) on a sturdy surface or mount, the controller at level (and preferably) on a bench top, desk or 19" rack, and away from any wet or damp locations. Do not cover the top of the controller cabinet! In case of installing in a 19" rack, keep at least 2U height free above the cabinet.*
- 6 *It is allowed to place actuator(s) and system(s) inside a vacuum chamber and/or cryogenic environment (cryostat). Actuator(s) and system(s) must only be operated when the environment is in a defined state (for instance: do not operate when cooling down procedure or vacuum pumping procedure is still in progress to reduce the risks of Paschen's Law).*
- 7 *Do not use the controller in any other way than to operate actuators and systems supplied by JPE and do not operate actuators and systems in any other way than by using the controller supplied by JPE.*
- 8 *The controller is designed to be powered by commonly used 230V AC / 50Hz (European version) or 115V / 60Hz (US version) via a socket with protective earth. Note that it is not possible to switch in between both (i.e. the ordered controller is either the 230V version or the 115V version). Always ensure proper grounding via the protective earth connection of the power inlet.*



- 9 *Do not turn ON the controller immediately after it has been brought from a cool into a warmer environment (risk of condensing water) or vice versa. After unpacking, wait at least 4 hours before using the controller.*
- 10 *Always keep metal screw on caps on the ends of unconnected (optical) cabling.*

SUPERSEDED! FOR INFORMATION ONLY

### 3. CONTROLLER DRIVER SETUP

#### 3.1 System requirements

To be able to control actuators and systems via software, use a PC system with (at least) Windows 7 (SP1) (32bit or 64bit) installed and make sure to have a free USB1.1/2.0 port available (for optimal performance it is best not use a hub device).

*Currently the software is not available for other operating systems, however integration in third-party (control) software (like Matlab® or LabView®) is supported by the Command Line Interface (see chapter 5).*

#### 3.2 Driver installation

- 1 Log on to Windows with an account with (full) *Administrator* privileges.
- 2 Download a copy of the latest *Controller Software* at <http://www.jpe.nl/page/cryo-positioning-systems-controller/> (click on the drop down item "*Controller Software & User Manuals*") and unpack the .zip file in a folder of your choice.
- 3 Place the controller on an appropriate surface (for example a sturdy workbench) and make sure that no actuators or systems are connected to the controller!
- 4 Make sure that the *Mains Power Switch* on the back of the controller is in the "o" (OFF) position.
- 5 Connect the supplied USB cable to the back of the cabinet (USB connector labelled "EXT") and on the other end in to a free USB port.
- 6 Because the USB interface is bus powered, Windows will automatically detect new hardware (it is not required to power on the controller). Because the controller uses a standard FTDI interface, a suitable driver should be found. Most likely this will result in (one or more of) the following message(s):



Figure 1: Installing software messages

*(Please note that the screenshots above may vary depending on the version of operating system that is being used)*

- 7 After successful installation, the *Device Properties* should look (similar) to this:



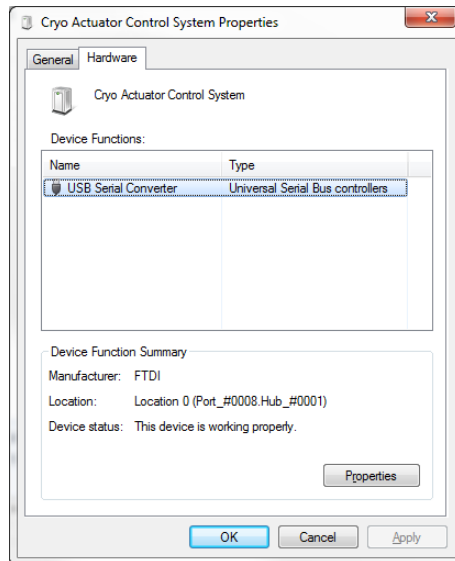


Figure 2: Driver properties

(Go to Start > Devices and Printers > (right-click) on (Unspecified) Cryo Actuator Control System > select Properties > tab Hardware)

- 8 Driver installation finished.

## 4. GRAPHICAL USER INTERFACE (GUI)

Before continuing, make sure to follow the proper setup and installation as described in the *Cryo & Nano Positioning products Hardware User Manual*<sup>4</sup>.

The stand-alone Graphical User Interface (GUI) can be used for basic movement control, parameter setting changes and diagnostics. The program is portable which means that it does not require installation and that it can run directly from within the folder containing the executable.

Please note that the GUI is a basic movement and control tool only and not a comprehensive motion control environment!

Note that the controller needs to be in External Control Mode. If a Manual Control Module (MCM) is installed, set the Channel knob to **EXT** before starting the GUI. When the controller is in the correct mode the LCD will display the text "EXTERNAL CONTROL INPUT SELECTED".

If no MCM is present the controller is in the correct mode automatically, however please wait at least 10 seconds after all modules are powered on to give the controller time to boot (there is no visual indication).

Start the GUI by double-clicking the file **CAControlSystem.exe**. The program will automatically recognize the installed modules<sup>5</sup> and load the internally stored parameter settings for each output channel (if present).

The screenshot below shows an example configuration with 4x CADM2 for driving *Cryo Linear Actuators* (products **CLA##xx**):

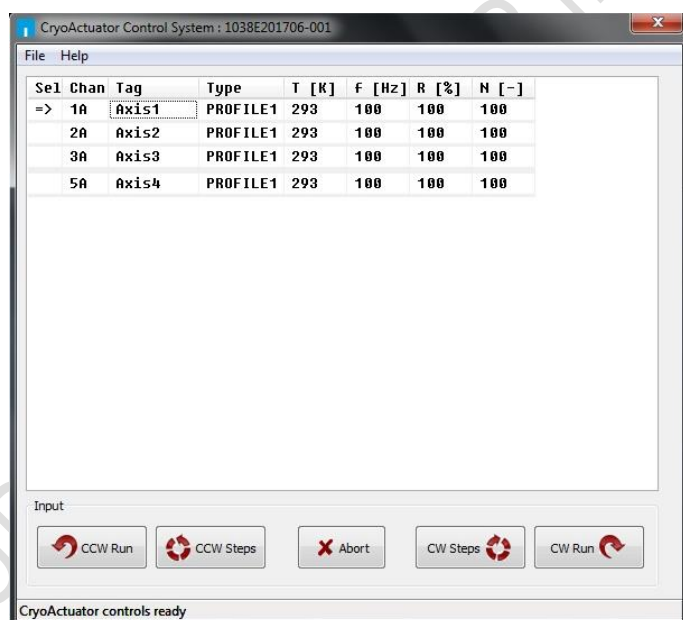


Figure 3: GUI with example configuration. Physical Slot 4 is left empty, hence there is no Channel 4A.

<sup>4</sup> See reference [1]

<sup>5</sup> CADM, CADM2 and OEM2 modules are supported by the GUI.

If the program cannot find the controller, a popup error message will be displayed. If necessary, go to: *File > Get Available Channels* to retrieve the available channels and settings again.

#### 4.1 Controller ID

In the top bar of the program window the ID of the connected controller is displayed. This ID must match the ID at the back of the controller cabinet<sup>6</sup>.

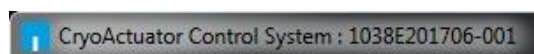


Figure 4: Controller ID display


This ID is useful for when multiple controllers have been connected to the same PC to be able to select (and distinguish) between controllers.

#### 4.2 Channel List Box

The main part of the program is the channel list box displaying the (current) parameter settings for each available output channel. This box lists module slots 1 to 6 from top to bottom (*note that in this case Slot 4 is left empty, therefore Channel 4A does not exist as actuator output*).

Sel	Chan	Tag	Type	T [K]	f [Hz]	R [%]	N [-]
=>	1A	Axis1	PROFILE1	293	100	100	100
	2A	Axis2	PROFILE1	293	100	100	100
	3A	Axis3	PROFILE1	293	100	100	100
	5A	Axis4	PROFILE1	293	100	100	100

Figure 5: Channel List Box

Select an output by clicking on the corresponding line in the channel list box. The selected channel is displayed in the "Sel" column with a -mark. The following parameters and options are available:

Parameter	Value	Notes
Chan	1A (, 1B, 1C) 2A (, 2B, 2C) 3A (, 3B, 3C) 4A (, 4B, 4C) 5A (, 5B, 5C) 6A (, 6B, 6C)	Channel number. In case of a CADM2 module only 1A (or 2A, 3A, 4A, 5A or 6A) is shown. In case of a CADM module the xB and xC channels are also listed.  <i>Display only - cannot be changed by the user.</i>
Tag	Max. 8 alphanumerical characters (space character is not allowed)	Identification parameter that can be chosen freely by the user and is displayed on the MCM (if installed) in between [ ]-brackets when in manual control mode.

<sup>6</sup> See reference [1]

Parameter	Value	Notes
Type	NONE PROFILE1 <b>PROFILE2</b> PROFILE3	<p>Sets specific internal system parameters for the type of Cryo Linear Actuator attached to that particular channel output.</p> <p>PROFILE1 is used for all CA22xx(-COE) actuators with IDs up to #173xx-yyy as well as all CA26xx(-COE) actuators with IDs up to #172xx-yyy. Use this profile also for CLD and CRM and all stages that have the actuators with ID's listed above.</p> <p>PROFILE2 is used for CA22xx(-COE) actuators with IDs #174xx-yyy and upwards as well as CA26xx(-COE) actuators with IDs #18xxx-yyy and upwards.</p> <p>PROFILE3 is used for backwards compatibility with actuators delivered prior to 03/2013 (PKxxxx actuators).</p> <p><i>Right-click on the parameter to set / change the type.</i></p>
T [K]	0 to 300	Set this parameter to the temperature of the environment in which the actuator is used. Input is in Kelvin [K] (numerical values only).
F [Hz]	0 to 600	Frequency of operation input. Value is in Hertz [Hz] (numerical values only).
R [%]	0 to 100	<p>(Relative) Piezo step size parameter input. Value is a percentage [%] (numerical values only).</p> <p><i>See product datasheets for typical step size values for each actuator or system. Typical leave this at 100[%] unless small(er) steps are required.</i></p>

Parameter	Value	Notes
N [-]	1 to 50000	Number of actuation steps. This value is used when using the CW/CCW steps buttons (numerical values only).
inc []	(numerical value)	<p>Displays the current encoder counter value [Encoder Ticks<sup>7</sup>] if an actuator is equipped with a Cryo Optical Encoder (product type option -COE) and an OEM2 module is installed.</p> <p>Right-click any value will give the option to [Reset] the counter value or to get the current value [Get Position].</p> <p><i>Please note that the inc[] column will be visible only when one (or more) OEM2 modules have been installed. In case there is an (additional) CADM/CADM2 module installed without an accompanying OEM module, the rows for this module will display "ERROR".</i></p> <p><i>Please note that the encoder value will be reset after a power cycle (COE is a relative incremental encoder, current positions will not be stored).</i></p>

### 4.3 Input box

In the Input box, buttons can be used to drive the actuator(s) in 2 different ways.

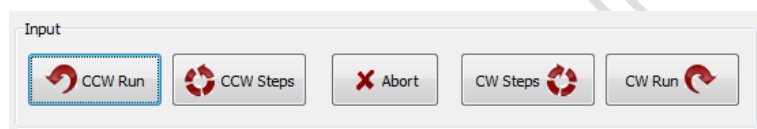


Figure 6: Input box

Use the CW (Clockwise) and CCW (Counter clockwise) buttons to drive the actuator connected to the output of the channel selected in the Channel List box:

- The **CCW Run** and **CW Run** buttons are to continuously move the actuator until the **Abort** button is pressed.
- The **CCW Steps** and **CW Steps** buttons are to move the actuator for a number of actuation steps ("N [-]" parameter, see previous paragraph).

Please note the following:

- Avoid physically touching unconnected outputs when the controller is turned ON.
- Channel or Parameter settings cannot be changed during movement.
- Do not select and actuate unconnected outputs.
- Power down the controller before disconnecting any actuator(s) or system(s).
- Encoder values will be reset after a power cycle (COE is a relative incremental encoder, positions will not be stored).

<sup>7</sup> The OEM2 encoder position readout is displayed in Encoder Ticks (pulses). Position resolution depends on type of encoder grid (PPR, Pulses Per Revolution - see brochures of each individual product).

## 4.4 File Menu

In the *File* menu (top of program window) some additional functions can be found.

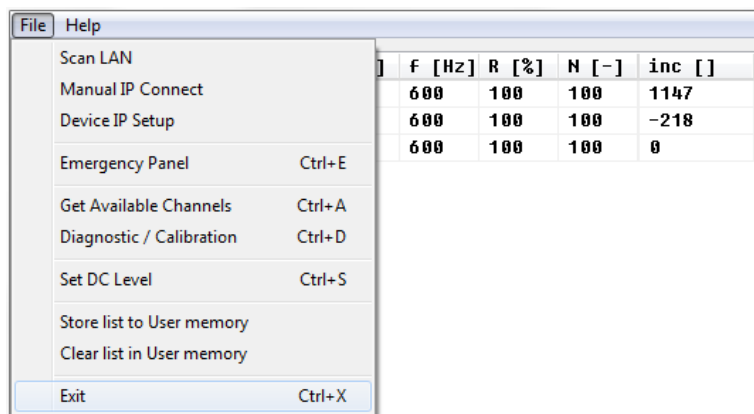


Figure 7: File menu

Function	Description
Scan LAN / Manual IP Connect / Device IP Setup	<i>Reserved for future functionality.</i>
Emergency Panel	Opens a pop-up window with a button to start moving the actuator on the <u>current selected channel</u> (!) in CCW direction with the maximum amount of torque possible. This can be useful in the case an actuator is stuck (locked) and doesn't seem to move using the regular commands and parameters.
Get Available Channels	Rescan all available channels and parameter settings stored.
Diagnostic / Calibration	Opens a pop-up windows with diagnostic and (COE) calibration functions.  <i>Only to be used when there are issues with actuators, systems or the controller (see paragraph o).</i>
Set DC Level <sup>8</sup>	CADM/CADM2 Scanner function (mode).  Can be used to set a DC voltage level to the output (to be used with a scanner piezo for example) instead of the default drive signal. Can be set to a numerical value in between 0 and 1024, where zero represents ~ -25V output (in respect to REF) and the maximum value represents ~ +120V (in respect to REF).  <i>Note that when active, the Output Active status LED on the CADM / CADM2 module will blink.</i>

<sup>8</sup> Beta version. Functional, but not yet fully developed. See also reference [1].

Function	Description
Store list and Clear list in User Memory	If changes have been made to the parameter settings, use the Store List function to save these to the (internal) memory of the controller. This is also useful when using the MCM after disconnecting the controller from the PC. The <i>command line interface</i> (CLI) does not use any of the stored parameters. However, stored <i>Tag</i> and <i>Type</i> parameters can be requested from within the command line interface for information.

## 4.5 Diagnostic & Calibration

Typically only to be used when there are issues with actuators, systems or the controller. Please consult JPE when using this function!

When opening the Diagnostic & Calibration window the GUI will auto-detect the connected controller and installed modules. After auto-detection is completed one or more additional tabs will appear (depending on the controller module configuration).

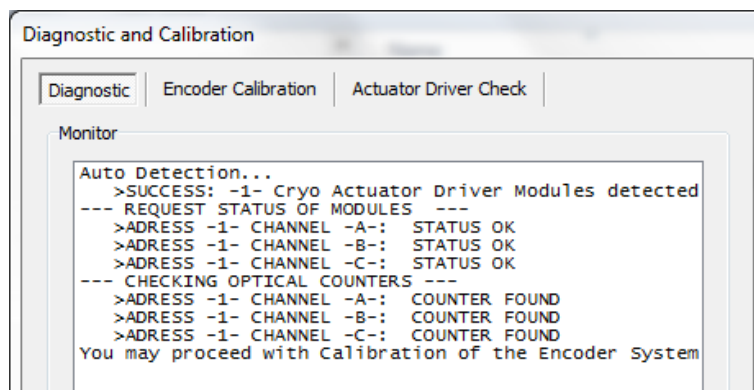


Figure 8: Diagnostic Auto Detection (example screenshot)



#### 4.5.1 Encoder Calibration

Note that this tab will only appear if the controller is equipped with one (or more) OEM2 modules.

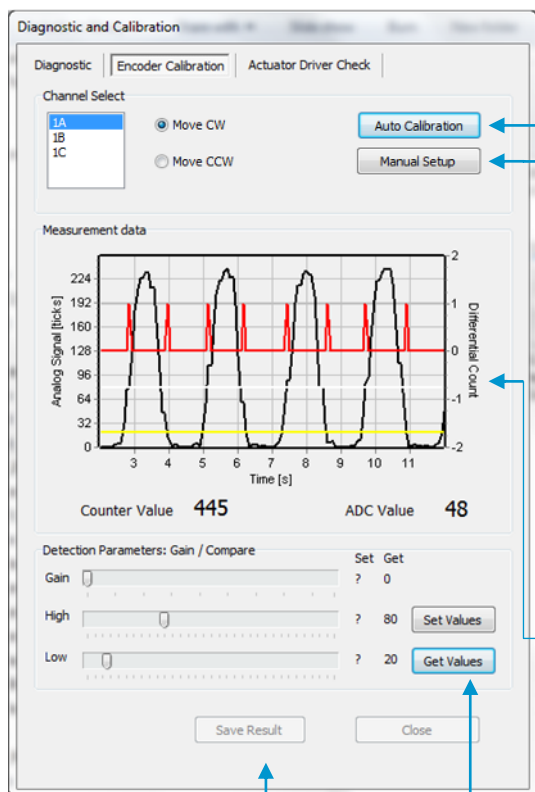


Figure 9: Encoder calibration window (example)

Select the appropriate output channel (*Channel Select*) and click the **Auto Calibration**<sup>9</sup> button to (re-) calibrate the connected Cryo Optical Encoder (-COE option).

**Make sure the actuator can run freely and is not near an end-stop**<sup>10</sup>.

A (black) command line box will pop-up; follow the on-screen instructions carefully!

Select **Manual Setup** to do a manual calibration. Move CW can be selected by default. As soon as the actuator starts to move a similar graph as shown here should appear.

The **black** line shows the **raw encoder signal**, while the **yellow** and **white** lines depict the set **Low** and **High Threshold** respectively. The **red** line are the actual measured encoder 'pulses' (= **counter value**). The raw analog encoder signal value (black line) should be as high as possible without clipping.

*Gain*, *Low* and *High Threshold* values can be set with the sliders. Current values can be looked up with the **Get Values** button. To set new (changed) values click the **Set Values** button.

To save measurement data (for example to send to JPE engineers), click the **Save Result** button (data can be saved as plain text file).

<sup>9</sup> The Auto Calibration requires the command line interface (cacli.exe) to be located in the same folder as the GUI executable.

<sup>10</sup> Auto Calibration may not work properly with the *Cryo Linear Drive* (CLD). Please use Manual Setup instead.

#### 4.5.2 Actuator Driver Check

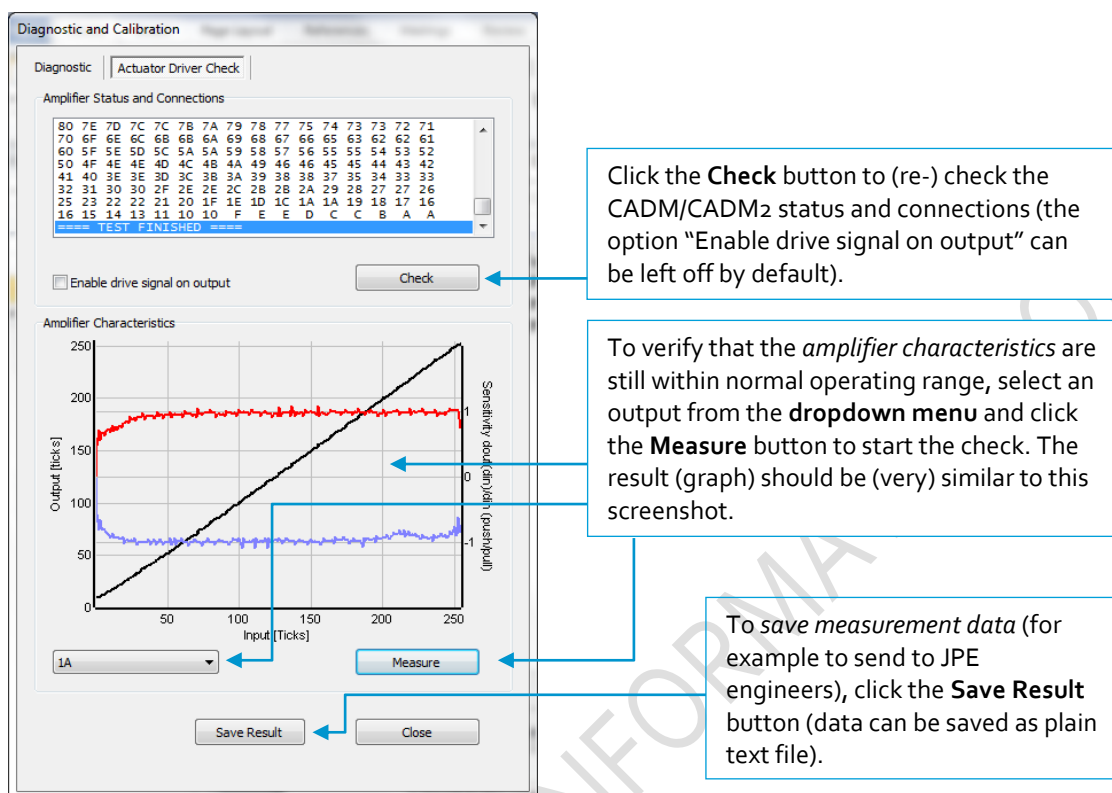


Figure 10: Amplifier Drive Check window (example)

## 5. COMMAND LINE INTERFACE (CLI)

Before continuing, make sure to follow the proper setup and installation as described in the Cryo & Nano Positioning products Hardware User Manual<sup>11</sup>.

Please note that the controller can be used in different Modes of Operation: Mdrive, Basedrive, Servodrive or Flexdrive. With the Command Line Interface (CLI) it is possible to set the controller in Servodrive or Flexdrive operation enabling the most dynamic operation modes available.

Specific commands / parameters combinations for the command line interface will define the mode of operation the controller is in. For a clear understanding of the different modes, please read the Application Note "CPSC Modes Of Operation"<sup>12</sup> before continuing!

The command line interface (CLI) enables easy integration with other control software (for example LabView® or MATLAB®) to be able to program movement sequences, to enable Servodrive or to set the CADM2 module in *analog input mode* (Flexdrive).

*Note that the CLI cannot run at the same time as the GUI (or vice versa); only one can have control over the controller. Also it is not possible to move an actuator manually by using the Manual Control Module (MCM) when in External Control Mode.*

If a Manual Control Module (MCM) is installed, set the Channel knob to **EXT** before starting the CLI. When the controller is in the correct mode the LCD will display the text "EXTERNAL CONTROL INPUT SELECTED".

If no MCM is present the controller is in the correct mode automatically, however please wait at least 5-10 seconds after all modules are powered on to give the controller time to boot (there is no visual indication).

The command line interface is a single file (**CAcli.exe**) that is called from the (Windows) command prompt and needs various arguments to work. The picture below shows an example:

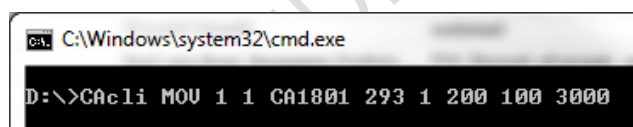


Figure 11: CLI example with various arguments

<sup>11</sup> See reference [1]

<sup>12</sup> See reference [2]

## 5.1 Common argument parameters

The command line interface accepts parameters in a particular order. Depending on the first command argument one of multiple other arguments are required. See the following paragraphs for examples of all available user commands for the available modules.

Argument	Value	Description
[COMMAND]	MOV EXT STP STS INFO POS RST OEMC	First argument for the command line interface.  <i>CADM/CADM2:</i> MOV (Move), EXT (External mode input) <sup>13</sup> , STP (Stop movement), STS (Status) or INFO (Information).  <i>OEM2 specific:</i> POS (get Encoder position), RST (Reset encoder position) or OEMC (Encoder Auto calibration).
[ADDR]	1 to 6	Address of CADM or CADM2 corresponding to controller slot. <i>Address 1 =&gt; slot 1 =&gt; the module on the leftmost position as seen from front of the cabinet.</i>
[CH]	1 to 3	Module channel. Only applicable for the CADM module (which has 3 outputs), in case of a CADM2 module, this parameter should be set to 1.
[TYPE]	NONE PROFILE1 <b>PROFILE2</b> PROFILE3	Sets specific internal system parameters for the type of Cryo Linear Actuator attached to that particular channel output.  <i>PROFILE1</i> is used for all CA22xx(-COE) actuators with IDs up to #173xx-yyy as well as all CA26xx(-COE) actuators with IDs up to #172xx-yyy. Use this profile also for CLD and CRM and all stages that have the actuators with ID's listed above.  <i>PROFILE2</i> is used for CA22xx(-COE) actuators with IDs #174xx-yyy and upwards as well as CA26xx(-COE) actuators with IDs #18xxx-yyy and upwards.  <i>PROFILE3</i> is used for backwards compatibility with actuators delivered prior to 03/2013 (PKxxxx actuators).  Use command <code>/type</code> to get list of the available options.
[TEMP]	0 to 300	Set this parameter to the temperature of the environment in which the actuator is used. Input is in Kelvin [K] (numerical values only).
[DIR]	0 to 1	Direction of movement: set to 1 for clockwise (CW) movement and 0 (zero) for counter-clockwise (CCW).
[FREQ]	0 to 600	Frequency of operation input. Value is in Hertz [Hz] (numerical values only).
[REL]	0 to 100	(Relative) Piezo step size parameter input. Value is a percentage [%] (numerical values only).  <i>See product datasheets for typical step size values for each actuator or system. Typical leave this at 100[%] unless small(er) steps are required.</i>

<sup>13</sup> CADM2 only

Argument	Value	Description
[STEPS]	0 to 50000	Number of actuation steps. Range 0 to 50000, where 0 is used for infinite move (use STP command to stop actuator movement).
[TRQFR]	1 to 30	Optional torque factor to apply (numerical values only).

## 5.2 General CLI commands

### 5.2.1 Get CLI version information

Command [followed by enter]	(Example) Response
caccli /ver	CAControlSystem_5.1-20151026

### 5.2.2 List supported cryo linear actuator (CLA) types

Command [followed by enter]	(Example) Response
caccli /type	List of Cryo Actuator types: PROFILE1 PROFILE2 PROFILE3a

### 5.2.3 Get information about installed modules

Command to list the automatically detected modules in the controller.

Command [followed by enter]	(Example) Response
caccli modlist	STATUS : INQUIRY OF INSTALLED MODULES Configuration:3 SLOT 1 : Cryo Actuator Driver Module (CADM)      ADR:1 SLOT 2 : Cryo Actuator Driver Module (CADM)      ADR:2 SLOT 3 : Cryo Actuator Driver Module (CADM)      ADR:3 SLOT 4 : Optical Encoder Module      (OEM )      ADR:3 SLOT 5 : SLOT 6 :

### 5.2.4 Addressing a specific controller

If more than one controller is connected to the same PC, the user has to define the target device for communication. Targets are defined by the controller ID# (see paragraph 4.1). The first argument preceded with @, will define the target device. This argument needs to precede any other command arguments. For example:

```
caccli @1038E201503-003 {followed by other command arguments}
```

Note that if only one controller is connected, there is no need to define the target device (as it is selected by default).

## 5.3 CADM / CADM2 specific commands

### 5.3.1 Get information on installed modules

Requests the module description and available output channels.

Command [followed by enter]	(Example) Response
caccli DESC [ADDR]  example: caccli DESC 1	Version : CADM2 Available Channels: 1

### 5.3.2 Get information on actuator types set

Request information about a user defined *Tags* (name) or set actuator *Types*.

Command [followed by enter]	(Example) Response
<pre>cacli INFO [ADDR] [CH]  example: cacli INFO 1 1</pre>	<pre>TYPE : CA1801 TAG  : NONE</pre>

### 5.3.3 Move

The move command starts moving an actuator with specified parameters. If an OEM2 is installed, the CLA-COE position will be tracked automatically. *Note: command specific for Basedrive mode of operation.*

Command [followed by enter]	(Example) Response
<pre>cacli MOV [ADDR] [CH] [TYPE] [TEMP] [DIR] [FREQ] [REL] [STEPS] [TRQFR]*  (* optional)  example: cacli MOV 1 1 CA1801 293 1 600 100 100</pre>	<pre>STATUS : MOVE</pre>

Please note the following:

- Avoid physically touching unconnected outputs when the controller is turned ON.
- Do not select and actuate unconnected outputs.
- Power down the controller before disconnecting any actuator(s) or system(s).
- Encoder values will be reset after a power cycle (COE is a relative incremental encoder, current positions will not be stored).

### 5.3.4 Stop

Stops movement of an actuator. *Note: command specific for Basedrive mode of operation.*

Command [followed by enter]	(Example) Response
<pre>cacli STP [ADDR]  example: cacli STP 1</pre>	<pre>STATUS : STOP</pre>

### 5.3.5 Status

Requests the amplifier status: Moving or Stop. In addition the amplifier Failsafe State (see paragraph 5.7) is being shown. If any error of the amplifier occurred (red status LED on front panel), the cause of the error may be requested via this command. *Note: command specific for Basedrive mode of operation.*

Command [followed by enter]	(Example) Response
<pre>cacli STS [ADDR]  example: cacli STS 1</pre>	<pre>STATUS : STOP FAILSAFE STATE: 0x0</pre>

### 5.3.6 Select Analog Input (CADM2 only)

*Note: command specific for CADM2 and Flexdrive mode of operation only.*

To use the CADM2 in Flexdrive mode, it is required to set the module in analog input mode prior to using Flexdrive. The `EXT` command basically works similar to the `MOV` command, however there are a few differences:

- The `[FREQ]` parameter now defines the step frequency at maximum (absolute) input signal. By default set this to 600 [Hz].
- With the `[DIR]` parameter it is possible to reverse the input <> direction of movement relation. By default this parameter is set to 1 so that a positive input voltage results in a CW movement.

Command [followed by enter]	(Example) Response
<pre> cacli EXT [ADDR] [CH] [TYPE] [TEMP] [DIR] [FREQ] [REL] [TRQFR]* (* optional)  example: cacli EXT 1 1 CA1801 293 1 600 100 </pre>	<pre> STATUS : USING EXTERNAL INPUT </pre>

Please note that the relative step size needs to be set within the `EXT` command! If a different step size is required in Flexdrive mode, this command needs to be executed again with a different `[REL]` value! The analog input only directs Frequency and Direction (CW/CCW) of movement.

Note that the CADM2 module will perform an 'automatic zero calibration' upon power on to make sure the connected actuator will not move at an input voltage of 0 (zero) [V]<sup>14</sup>. However, this means that it is required to hold the input at 0 (zero) [V] during power on of the module (do not let the input float).

Also be aware of:

- Avoid physically touching unconnected outputs when the controller is turned ON.
- Do not select and actuate unconnected outputs.
- Power down the controller before disconnecting any actuator(s) or system(s).
- The (blue) Output Active LED will turn to indicate the module output is active.

<sup>14</sup> See reference [1]

## 5.4 OEM2 specific commands

### 5.4.1 Get Position

Request the position of an encoder channel. Please note that the [ADDR] and [CH] parameters relate to the accompanying CADM or CADM2 module! Position value is in [Encoder Ticks<sup>15</sup>]. *Note: command specific for Basedrive mode of operation.*

Command [followed by enter]	(Example) Response
<pre>cacli POS [ADDR] [CH]</pre> <p>example:</p> <pre>cacli POS 1 1</pre>	<pre>POS: 2 RVL: 0</pre>

Encoder values will be reset after a power cycle (COE is a relative incremental encoder, current positions will not be stored).

### 5.4.2 Reset Position to Zero

To reset the position to zero for a specific encoder channel. Please note that the [ADDR] and [CH] parameters relate to the accompanying CADM or CADM2 module! *Note: command specific for Basedrive mode of operation.*

Command [followed by enter]	(Example) Response
<pre>cacli RST [ADDR] [CH]</pre> <p>example:</p> <pre>cacli RST 1 1</pre>	<pre>Counter for CH1 has been reset to zero</pre>

### 5.4.3 Start Auto Calibration Procedure

Only to be used when there are issues with the Cryo Optical Encoder (-COE option) or OEM2 module<sup>16</sup>. Please consult JPE first before using this function!

To start a calibration procedure for a specific channel. Please note that the [ADDR] and [CH] parameters relate to the accompanying CADM or CADM2 module!

Command [followed by enter]	(Example) Response
<pre>cacli OEMC [ADDR] [CH] [TYPE] [TEMP] [DIR] [FREQ]</pre> <p>example:</p> <pre>cacli OEMC 1 1 CA1801 293 0 600</pre>	<pre>=== OEM Calibration Procedure === Progress Count: 400\400 Using 800 pulses for process CALIBRATION QUALITY: 4/4 Summary of determined values: SWG: 25 TH: 67 TL: 27 Do you want to use the determined values for module:1 channel:1 (y/n)?</pre>

<sup>15</sup> The OEM2 encoder position readout is displayed in Encoder Ticks (pulses). Position resolution depends on type of encoder grid (PPR, Pulses Per Revolution - see brochures of each individual product).

<sup>16</sup> Auto Calibration may not work properly with the Cryo Linear Drive (CLD). Please use Manual Setup instead using the GUI (see paragraph 4.5.1).



The result of the calibration procedure are new detector settings: *gain* (SWG) and two-level *threshold* values (TH and TL). The user will be asked to store or cancel the calibration once new values have been determined.

## 5.5 Servodrive specific commands

Once in Servodrive mode do not mix with other (non-servodrive) CADM/CADM2 commands (for example do not use the MOV command while in Servodrive mode). Only OEM2 specific commands are allowed.

### 5.5.1 Enable Servodrive

Enable the internal position feedback control and start operating in servo mode. [PGAIN] is the Controller Proportional gain in (Frequency/error) [Hz/Tick] (by default set to 300).

Command [followed by enter]	(Example) Response
<pre>caccli FBEN [PGAIN] [TYPE] [TEMP] [TRQFR]</pre> <p>example:</p> <pre>caccli FBEN 300 CA1801 293</pre>	STATUS : POSITION CONTROL ENABLED

### 5.5.2 Disable Servodrive

Disable the internal position feedback control.

Command [followed by enter]	(Example) Response
<pre>caccli FBXT</pre> <p>example:</p> <pre>caccli FBXT</pre>	STATUS : POSITION CONTROL DISABLED

### 5.5.3 Go to Set Point

When Servodrive has been enabled use this command to move actuators to the set point position. After the FBSC command has been send, the controller will react immediately by moving the actuators towards the set points [SP1], [SP2] and [SP3] [in Encoder Ticks<sup>17</sup>].

Command [followed by enter]	(Example) Response
<pre>caccli FBSC [SP1] [SP2] [SP3]</pre> <p>example:</p> <pre>caccli -100 -100 -100</pre>	STATUS : POSITION CONTROL SET

Note that if an actuator is not connected to one of the outputs, enter 0 (zero) as position set point.

Please note the following:

- Avoid physically touching unconnected outputs when the controller is turned ON.
- Do not select and actuate unconnected outputs.
- Power down the controller before disconnecting any actuator(s) or system(s).
- Servodrive with a CADM module only works with output A of that CADM module! In that

<sup>17</sup> The OEM2 encoder position readout is displayed in Encoder Ticks (pulses). Position resolution depends on type of encoder grid (PPR, Pulses Per Revolution - see brochures of each individual product).

case only use [SP1] and leave the others at zero (0).

- Encoder values will be reset after a power cycle (COE is a relative incremental encoder, current positions will not be stored).

#### 5.5.4 Emergency stop

When Servodrive has been enabled and actuators are moving use this command for an immediate stop (of all actuators).

Command [followed by enter]	(Example) Response
cacli FBES	STATUS : POSITION CONTROL STOPPED

#### 5.5.5 Find end stops

When Servodrive has been enabled use this command to move actuators to a (hard) end stop.

Please note that this function is defined to be used with systems like the **CPSHR**. Consult the interface drawings to get detailed information about the availability of (hard) end stops in systems!

Encoder values will be reset after a power cycle (COE is a relative incremental encoder, current positions will not be stored).

Command [followed by enter]	(Example) Response
cacli FBFE [DIR] [FILTER] [ZERO]  example: cacli FBFE 1 20 1	STATUS : POSITION CONTROL FIND ENDSTOP

Command	Description
[DIR]	Direction to hit end stop: 1 = CW, 0=CCW
[FILTER]	Velocity polling delay (relative) in range 1 to 20.
[ZERO]	Reset position after completion (1=yes, 0=no)

#### 5.5.6 Get status position control

Get status position and position error information of the controller.

Command [followed by enter]	(Example) Response
cacli FBST	STATUS : POSITION CONTROL INQUIRY ENABLED:1 BUSY:0 POS1:-100 POS2:-100 POS3:-100 ERR1:0 ERR2:0 ERR3:0

Return	Description
[ENABLED]	0 when position control is disabled 1 when position control is enabled 2 when the find end stop procedure is activated
[BUSY]	If 1 the controller is busy minimizing the error between the set point end the current position. When this flag is 0 (zero), the position error is 0 (zero).
[POSx]	Current position information [Encoder Ticks <sup>18</sup> ].
[ERRx]	Current position error information [Encoder Ticks <sup>18</sup> ].

## 5.6 Pipe server (optional)

Every time a new command is entered into the CLI the USB port is opened, the command is processed and transferred, then the USB port is closed again. This procedure for communicating with the controller is time consuming. In order to leave the USB communication port open, the CLI can be opened as a *pipe server* and *-client* to relay command messages from application specific interfaces (MATLAB® e.g.).

### 5.6.1 Opening and closing the pipe server

The pipe server can be opened **automatically** (in a new terminal window) with the first USB connection available by using:

```
cacli @SERV
```

The pipe will be named "SamplePipe".

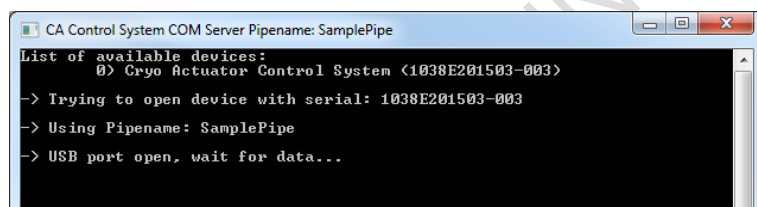


Figure 12: automatic opening of pipe server (with name "SamplePipe")

If another controller or USB connection is desired, then the user can open the pipe server **manually**:

```
cacli SERV
```

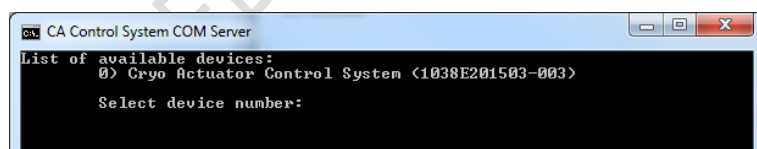


Figure 13: select the controller by number

<sup>18</sup> The OEM2 encoder position readout is displayed in Encoder Ticks. Position resolution depends on type of encoder grid (PPR, Pulses Per Revolution - see brochures of each individual product).

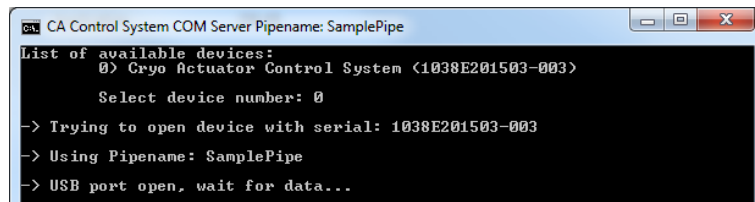


Figure 14: manual selected controller number. Pipe name: "SamplePipe".

Or by directly entering the controller ID#:

```
cacli SERV:[SERIALNUMBER]
```

Where [SERIALNUMBER] is the controller ID# (see paragraph 4.1). Note that in this case the pipe will be named after the controller ID#.



Figure 15: select by controller ID#

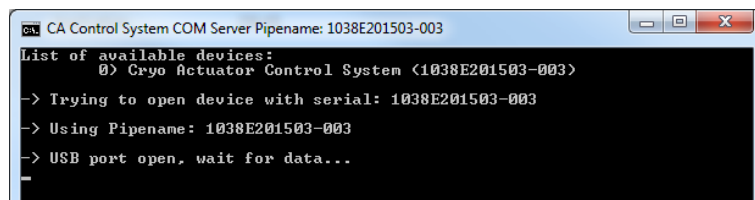


Figure 16: selected by controller id#. Pipe name: "1038E201503-003".

In the two latter cases the user has to open a new terminal window to be able send commands via the pipe to the controller.

Close the Pipe Server by simply closing the terminal window that is running the pipe or to enter **CTRL+C** in this terminal window.

### 5.6.2 Using the pipe client

If the Pipe Server is opened **automatically** (and has the name *SamplePipe*) the user can address the pipe by using the argument:

```
cacli @SERV {followed by other command arguments}
cacli @SERV:SamplePipe {followed by other command arguments} (optional)
```

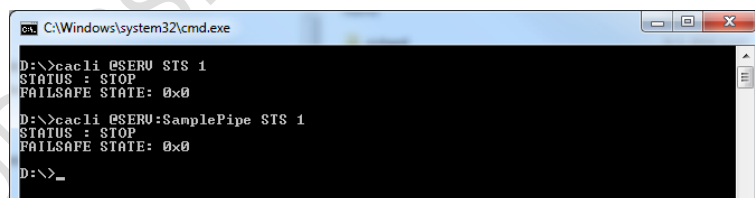
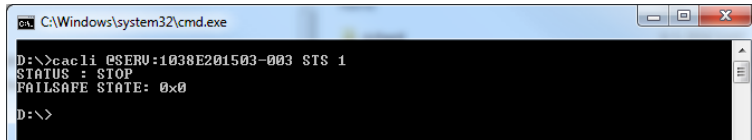


Figure 17: pipe client (automatic)

If the Pipe Server is opened **manually** (or might have a different name) the user can address it like this:

```
cacli @SERV:[pipename] {followed by other command arguments}
```



```

C:\Windows\system32\cmd.exe
D:\>cacli @SERV:1038E201503-003 STS 1
STATUS : STOP
FAILSAFE STATE: 0x0
D:\>

```

Figure 18: pipe client (manual)

## 5.7 Error codes

### 5.7.1 Command error codes

In case the controller receives an invalid command, an error response [err] will be sent back displaying the expected command arguments.

Error code	Description
err 1.x	Invalid parameter used.
err 3.x	Indicates that the CADM/CADM2 parameter argument string is not complete; so for example if the following command is send: MOV 1 1 CA1801, the controller system will respond with this error number (because the MOV parameter requires values for DIR, FREQ, REL and STEPS as well).
err 4.x	Like err 3 but for OEM2 specific parameter argument strings.
err 5.x	Like err 3 but for ServoDrive specific parameter argument strings.
ERROR: time out	Communication error between PC and controller.
ERROR: DEVICE NOT FOUND	The controller is not connected to the PC.
ERROR: COUNTER NOT FOUND	There is no Cryo Optical Encoder connected to an OEM2 channel.

### 5.7.2 Failsafe State

When using the Status command (STS) in the command line interface (See paragraph 5.3.5), the controller will display a Failsafe State value. In normal operation this value should be 0x0, however if there is an issue (amplifier status LED on front panel will light up red), the cause of the error may be requested via this command.

Failsafe State code	Description
0x01	FAILURE: *UPPER* VOLTAGE RAIL IS MISSING INSPECTION OF UNIT IS REQUIRED
0x02	FAILURE: *LOWER* VOLTAGE RAIL IS MISSING INSPECTION OF UNIT IS REQUIRED
0x04	THERMAL OVERLOAD OF AMPLIFIER STAGE CAPACITIVE LOAD IS TOO LARGE, LET UNIT COOL DOWN
0x40	FAILURE: OVERCURRENT DETECTED on UPPER RAIL: I>10A t>100us: POSSIBLE CAUSES: 1) SHORT CIRCUIT TO PROTECTED EARTH OR REFERENCE 2) CAPACITIVE LOAD OR DRIVE PARAMETERS NOT CORRECT RESET REQUIRED

Failsafe State code	Description
0x20	FAILURE: OVERCURRENT DETECTED on UPPER RAIL: $I > 0.15A$ $t > 1ms$ : POSSIBLE CAUSES: 1) SHORT CIRCUIT TO PROTECTED EARTH OR REFERENCE 2) CAPACITIVE LOAD OR DRIVE PARAMETERS NOT CORRECT RESET REQUIRED
0x10	FAILURE: OVERCURRENT DETECTED on LOWER RAIL: $I > 10A$ $t > 100\mu s$ : POSSIBLE CAUSES: 1) SHORT CIRCUIT TO PROTECTIVE EARTH 2) CAPACITIVE LOAD OR DRIVE PARAMETERS NOT CORRECT RESET REQUIRED
0x08	FAILURE: OVERCURRENT DETECTED on LOWER RAIL: $I > 0.15A$ $t > 1ms$ : POSSIBLE CAUSES: 1) SHORT CIRCUIT TO PROTECTIVE EARTH 2) CAPACITIVE LOAD OR DRIVE PARAMETERS NOT CORRECT RESET REQUIRED


## 6. TROUBLESHOOTING & KNOWN ISSUES

### 6.1 (GUI) Encoder Counter value display not updated when using specific CPSC configuration

When using a CAB-xxx with a CADM(2) module in both Slot 1 & 2 and an OEM2 module in Slot 3, the Graphical User Interface (GUI) won't update the current encoder counter value [Encoder Ticks] in the *inc[]* column when moving an actuator that has a Cryo Optical Encoder (product type option -COE) attached.

This is a known issue and will be addressed in a future update of the GUI. In the Command Line Interface (cacli.exe) this is not an issue. Also, CPSC configurations with 1x CADM(2) + 1x OEM2 or 3x CADM(2) + 1x OEM2 don't have this issue.

### 6.2 (GUI) Floating Point Error when moving actuator

Make sure the row is selected for the particular actuator. The row is correctly selected when the -mark is visible. If that is not the case, this error may pop up.

### 6.3 Unable to detect available channels

If the GUI or CLI is unable to find the available (CADM/CADM2/OEM2) channels, try the following:

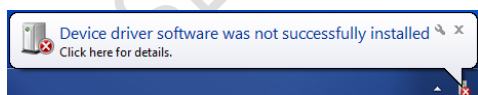
- 1 Close the GUI or CLI application
- 2 Disconnect the USB cable
- 3 Power cycle the controller cabinet
- 4 (If applicable) Make sure the *Channel* knob on the MCM is set to "EXT"
- 5 Reconnect the USB cable
- 6 Start the GUI application or CLI again

### 6.4 Windows cannot find driver

If Windows is not able to find a suitable FDTI driver itself, select a driver from the downloaded software zip file. You can find the drivers in the (sub-) folder \USBdriver\.

### 6.5 Unable to install driver in Windows 7

In a rare case it may happen that the Controller Software driver cannot be installed in Windows 7 (64bit version) because of a driver sign issue. In this case, because the software driver is not signed by Microsoft, Windows refuses to install the driver.



A workaround is to do the following:

- 1 Launch a Command Prompt under Administrative privileges by clicking the *Start > Search for "cmd"* (without quotes).
- 2 Right-click on the search results and choose *Run as administrator*. Click through the UAC prompt.
- 3 In the command prompt window execute the following two commands:

```
bcdedit.exe -set loadoptions DDISABLE_INTEGRITY_CHECKS [enter]
bcdedit.exe -set TESTSIGNING ON [enter]
```

- 4 Now restart the computer to disable digital driver signing in Windows 7.

## 7. USER MANUAL VERSION

This User Manual assumes using the latest products and controller software:

CPS\_v5.3

If you are using older products you might require consulting a different User Manual. Please visit the JPE website: <http://www.janssenprecisionengineering.com/page/cryo-positioning-systems-controller/> and click on the drop down item "Controller Software & User Manuals".

Fill in the Contact form on <http://www.janssenprecisionengineering.com/contact/> to request older User Manuals or software versions.