

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This user manual has been superseded by a newer version.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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SUPERSEDED! FOR INFORMATION ONLY



RELEVANT DOCUMENTATION

Ref	Title (Author)	File name
[1]	Cryo & Nano Positioning products Hardware User Manual (JPE)	1036_MAN03_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
[3]		
[4]		
[5]		

DOCUMENT HISTORY

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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, (single) 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*² 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*².

Please note that all content in this manual is superseded by any new versions of this manual (see file name).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) to obtain the most recent version³. 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.

¹ See reference [1]

² See reference [2]

³ 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 mortal electric shock! Therefore follow all instructions carefully!

2.2 General Safety Rules

- 1 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).
- 2 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.
- 3 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.
- 4 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).
- 5 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.
- 6 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).
- 7 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.
- 8 Never open the controller cabinet (this will result in loss of warranty) or remove any modules while the controller is turned ON! Any other servicing, adjustment or repair works must only be carried out by JPE.

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:

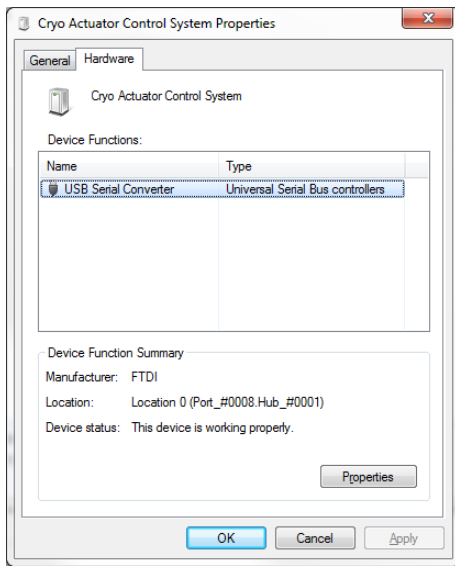


Figure 2: Driver properties

(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 Manual⁴.

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. If no MCM is present the controller is in the correct mode automatically, however please wait at least another 5-10 seconds after all modules are powered on to give the controller time to boot (there is no visual indication). When the controller is in the correct mode the LCD will display the text "EXTERNAL CONTROL INPUT SELECTED".

Start the GUI by double-clicking the file **CAControlSystem.exe**. The program will automatically recognize the installed modules⁵ and load the internally stored parameter settings for each output channel (if present!).

The screenshot below shows an example configuration with 2x CADM and 2x OEM2 for driving Cryo Linear Actuators (products **CLA##xx**) with Cryo Optical Encoders (product type option **-COE**):

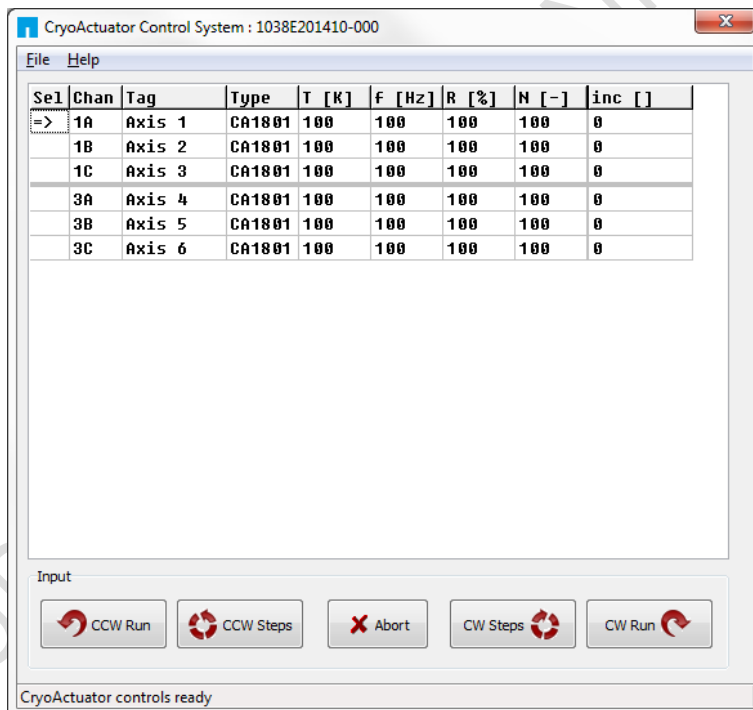


Figure 3: GUI with example configuration

⁴ See reference [1]

⁵ 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 cabinet⁶.

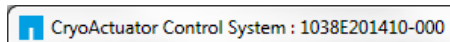


Figure 4: Controller ID display


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 slots 2 and 4 are used for the OEM2 modules, therefore Channels 2A...2C and 4A...4C do not exist as actuator outputs*).

Se1	Chan	Tag	Type	T [K]	F [Hz]	R [%]	N [-]	inc []
=>	1A	Axis 1	CA1801	100	100	100	100	0
	1B	Axis 2	CA1801	100	100	100	100	0
	1C	Axis 3	CA1801	100	100	100	100	0
	3A	Axis 4	CA1801	100	100	100	100	0
	3B	Axis 5	CA1801	100	100	100	100	0
	3C	Axis 6	CA1801	100	100	100	100	0

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	Channel number. In case of a CADM2 module only 1A (or 2A or 3A) is shown. <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.
Type	NONE CA1801 CA3001	Sets specific internal system parameters for the type of Cryo Linear Actuator attached to that particular channel output. <i>Right-click on the parameter to set / change the type. Select CA1801 by default, unless specified otherwise by JPE!</i>
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).

⁶ See reference [1]

Parameter	Value	Notes
F [Hz]	0 to 600	Frequency of operation input. Value is in Hertz [Hz] (numerical values only).
R [%]	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>
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)	Displays the current encoder counter value [Encoder Ticks ⁷] if an actuator is equipped with a Cryo Optical Encoder (product type option -COE) and an OEM2 module is installed. Right-click any value will give the option to [Reset] the counter value or to get the current value [Get Position]. <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> <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>

4.3 Input box

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

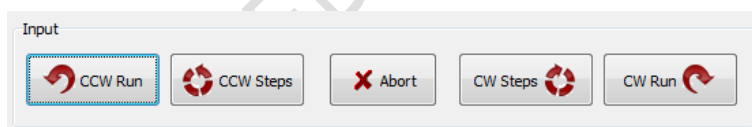


Figure 6: Input box

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).

⁷ 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).

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).

4.4 File Menu

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

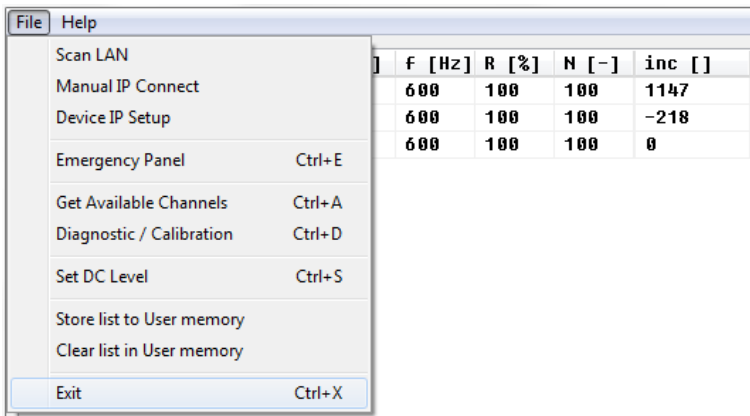


Figure 7: File menu

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 4.5).</i>

Function	Description
Set DC Level ⁸	<p>CADM/CADM₂ Scanner function (mode).</p> <p>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).</p> <p><i>Note that when active, the Output Active status LED on the CADM / CADM₂ module will blink.</i></p>
Store list and Clear list in User Memory	<p>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.</p>

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).

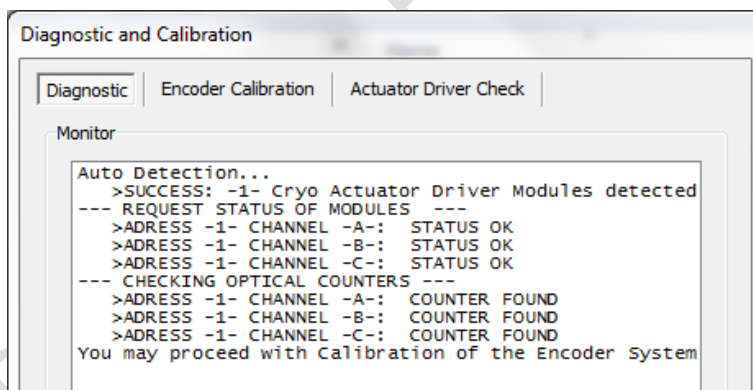


Figure 8: Diagnostic Auto Detection (example screenshot)

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

4.5.1 Encoder Calibration

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

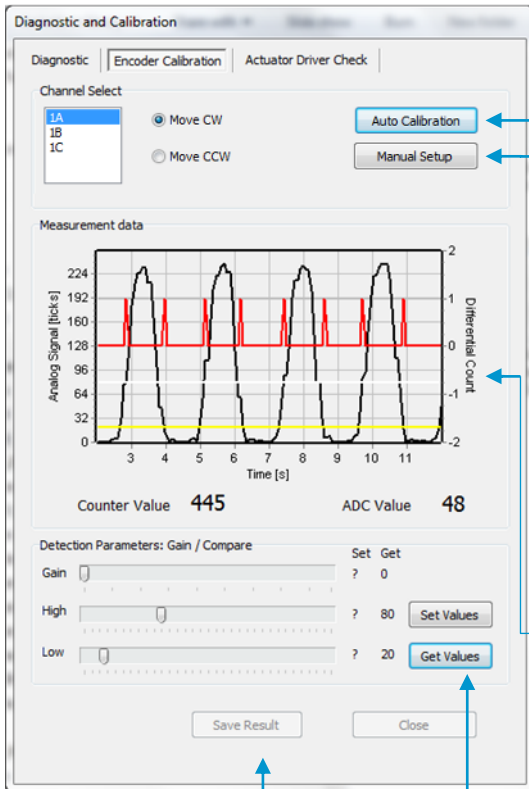


Figure 9: Encoder calibration window (example)

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

Make sure the actuator can run freely and is not near an end-stop¹⁰.

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.

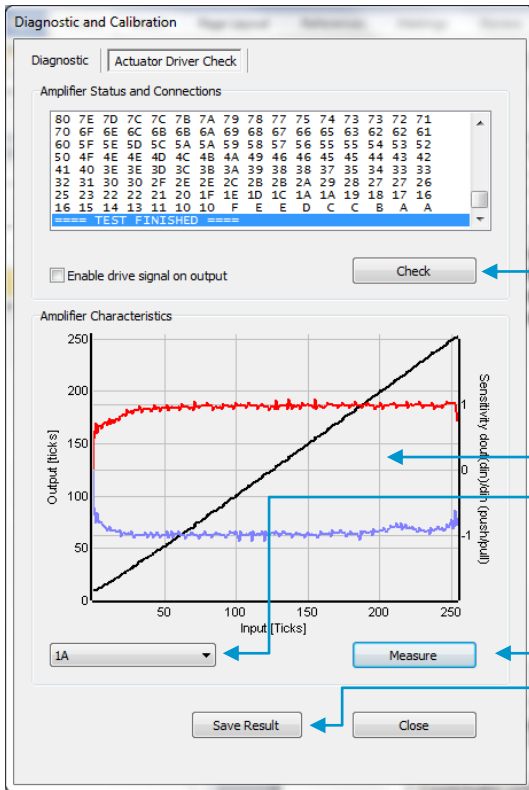
Gain, *Low* and *High Threshold* values can be set with the sliders. Current values can be looked up with the **Get Values** button. To set new (changed) values click the **Set Values** button.

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

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

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

4.5.2 Actuator Driver Check



Click the **Check** button to (re-) check the CADM/CADM2 status and connections (the option "Enable drive signal on output" can be left off by default).

To verify that the *amplifier characteristics* are still within normal operating range, select an output from the **dropdown menu** and click the **Measure** button to start the check. The result (graph) should be (very) similar to this screenshot.

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

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 Manual¹¹.

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.

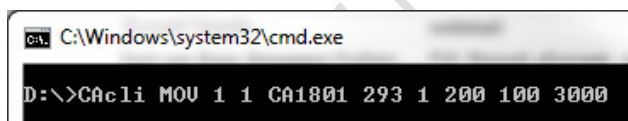
Specific commands / parameters combinations for the command line interface will define the mode of operation the controller is in. For a clear understanding of the different modes, please read the Application Note "CPSC Modes Of Operation"¹² before continuing!

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. If no MCM is present the controller is in the correct mode automatically, however please wait at least another 5-10 seconds after all modules are powered on to give the controller time to boot (there is no visual indication). When the controller is in the correct mode the LCD will display the text "EXTERNAL CONTROL INPUT SELECTED".

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:



```

C:\Windows\system32\cmd.exe
D:\>CAcli MOU 1 1 CA1801 293 1 200 100 3000
  
```

Figure 11: CLI example with various arguments

¹¹ See reference [1]

¹² 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) ¹³ , 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 => slot 1 => 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 CA1801 CA3001	Sets specific internal system parameters for the type of Cryo Linear Actuator attached to that particular channel output. Use command /type to get list of the available options. <i>Use CA1801 by default, unless specified otherwise by JPE!</i>
[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>
[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).

¹³ CADM2 only

5.2 General CLI commands

5.2.1 Get CLI version information

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

5.2.2 List supported cryo linear actuator (CLA) types

Command [followed by enter]	(Example) Response
cacli /type	List of Cryo Actuator types: CA3101 CA1801 CA3001 CASOFT

5.2.3 Get information about installed modules

Command to list the automatically detected modules in the controller.

Command [followed by enter]	(Example) Response
cacli 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:

```
cacli @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
cacli DESC [ADDR] example: cacli 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]¹⁴. 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.

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 Ticks¹⁵]. Note: command specific for Basedrive mode of operation.

¹⁴ See reference [1]

¹⁵ 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).



Command [followed by enter]	(Example) Response
<pre>cacli POS [ADDR] [CH] example: 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] example: 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 module¹⁶. 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] example: 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>

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.

¹⁶ 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).

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>cacli FBEN [PGAIN] [TYPE] [TEMP] [TRQFR]</pre> <p>example: cacli FBEN 300 CA1801 293</p>	STATUS : POSITION CONTROL ENABLED

5.5.2 Disable Servodrive

Disable the internal position feedback control.

Command [followed by enter]	(Example) Response
<pre>cacli FBXT</pre> <p>example: cacli FBXT</p>	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 FB_{CS} command has been send, the controller will react immediately by moving the actuators towards the set points [SP1], [SP2] and [SP3] [in Encoder Ticks¹⁷].

Command [followed by enter]	(Example) Response
<pre>cacli FB_{CS} [SP1] [SP2] [SP3]</pre> <p>example: cacli -100 -100 -100</p>	STATUS : POSITION CONTROL SET

Note that if an actuator is not connected to one of the outputs, enter o (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 case only use [SP1] and leave the others at zero (o).
- Encoder values will be reset after a power cycle (COE is a relative incremental encoder, current positions will not be stored).

¹⁷ 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).



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]	STATUS : POSITION CONTROL FIND ENDSTOP
example: cacli FBFE 1 20 1	

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

Return	Description
[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 ¹⁸].
[ERRx]	Current position error information [Encoder Ticks ¹⁸].

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".

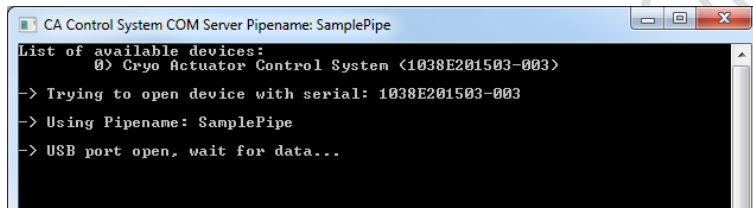


Figure 12: automatic opening of pipe server (with name "SamplePipe")

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

```
cacli SERV
```

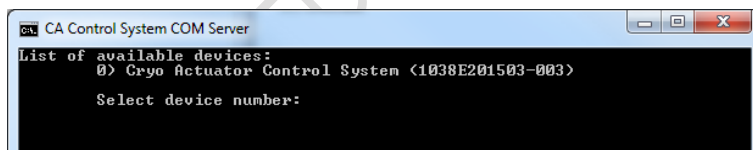


Figure 13: select the controller by number

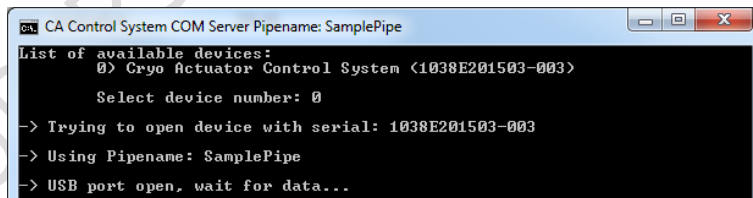


Figure 14: manual selected controller number. Pipe name: "SamplePipe".

Or by directly entering the controller ID#:

¹⁸ 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).

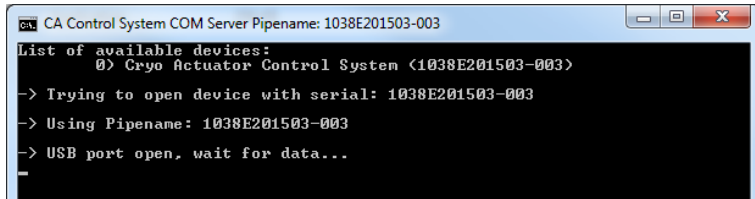

```
cacli SERV:[SERIALNUMBER]
```

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



```
C:\Windows\system32\cmd.exe
D:\>cacli SERV:1038E201503-003
```

Figure 15: select by controller ID#



```
CA Control System COM Server Pipename: 1038E201503-003
List of available devices:
 0) Cryo Actuator Control System (1038E201503-003)
-> Trying to open device with serial: 1038E201503-003
-> Using Pipename: 1038E201503-003
-> USB port open, wait for data...
```

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

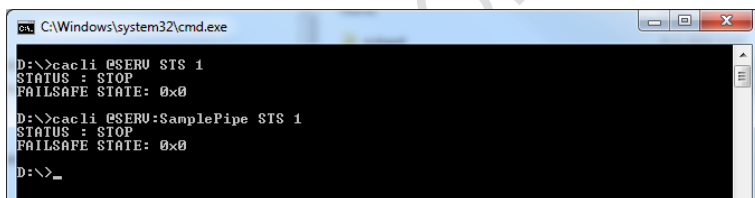
In the two latter cases the user has to open a new terminal window to be able send commands via the pipe to the controller.

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)
```



```
C:\Windows\system32\cmd.exe
D:\>cacli @SERV STS 1
STATUS : STOP
FAILSAFE STATE: 0x0
D:\>cacli @SERV:SamplePipe STS 1
STATUS : STOP
FAILSAFE STATE: 0x0
D:\>_
```

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/CADM ₂ 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 OEM ₂ 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 OEM ₂ 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
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



Failsafe State code	Description
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

SUPERSEDED! FOR INFORMATION ONLY

6. TROUBLESHOOTING

6.1 Unable to detect available channels

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

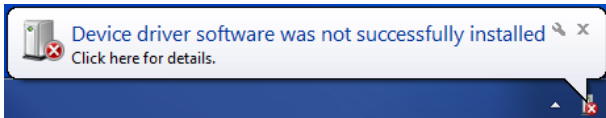
- 1 Close the GUI or CLI application
- 2 Disconnect the USB cable
- 3 Power cycle the controller cabinet
- 4 (If applicable) Make sure the *Channel* knob on the MCM is set to "EXT"
- 5 Reconnect the USB cable
- 6 Start the GUI application or CLI again

6.2 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\`.

6.3 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_v5.2b

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.

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