

APPLICATION NOTE

CRYO POSITIONING SYSTEMS CONTROLLER – MODES OF OPERATION

1. INTRODUCTION

This document describes the different *modes of operation* when using the *Cryo Positioning Systems Controller* (CPSC). This controller is needed to operate JPE's cryo & nano actuators such as the *Cryo Linear Actuator* (CLA), *Cryo Bearing Stage* (CBS) and positioning stages that contain such actuators.

The CPSC consists of a *Base Cabinet* (CAB) with standard integrated *power supply* (PSU), *communications interface* (PCI2) and has 6 free module slots. Modules can be inserted upon customer requirements. Visit <https://www.jpe-innovations.com/cryo-nano-products/cryo-positioning-systems-controller/> for an overview of all available modules.

Although there are no strict configuration boundaries, it is common to use typical combinations of driver modules (CADM2 for example) and sensor modules (RSM or OEM2 for example), specifically for using *Servodrive* mode (see below). When requesting a quote or ordering products, JPE engineers will always define one or more suitable configuration(s).



Figure 1: example of CPSC with 3x CADM2 and 1x RSM

Communication between (Windows OS) PC¹ and CPSC is possible by using an easy-to-use *Graphical User Interface* (GUI) or a more extensive *Command Line Interface* (CLI). While the GUI can be used to get diagnostic information as well, the CLI enables easy integration with other (control) software, like for example MATLAB, LabView or Python. The latest software can be downloaded from <https://www.jpe-innovations.com/cryo-nano-products/cryo-positioning-systems-controller/>.

2. MODES OF OPERATION

There are 3 different modes of operation available²:

Basedrive	low frequent / set-and-forget positioning, requires motion programming, can be used open-loop (no position feedback) or closed-loop using an external controller (user software) and the Resistive Linear Sensor (-RLS option) or Cryo Optical Encoder (-COE option)
Servodrive	addressing multiple points in a short time, uses a CPSC internal controller, closed-loop only, requires a Resistive Linear Sensor (-RLS option) or Cryo Optical Encoder (-COE option) <i>Note that Servodrive supports up to 3 actuators in closed-loop per controller cabinet! If more axes are to be used in Servodrive mode, additional cabinets are required.</i>
Flexdrive	most dynamic operation mode, requires a customer supplied external data acquisition system as well as a Resistive Linear Sensor (-RLS option) or Cryo Optical Encoder (-COE option)

Detailed information how to use these modes of operation in software can be found in the Software User manual, which can be downloaded from <https://www.jpe-innovations.com/cryo-nano-products/cryo-positioning-systems-controller/>.

¹ Communication via USB or LAN

² This application note assumes the use of software version 7.x or newer, when using older software versions please contact JPE.

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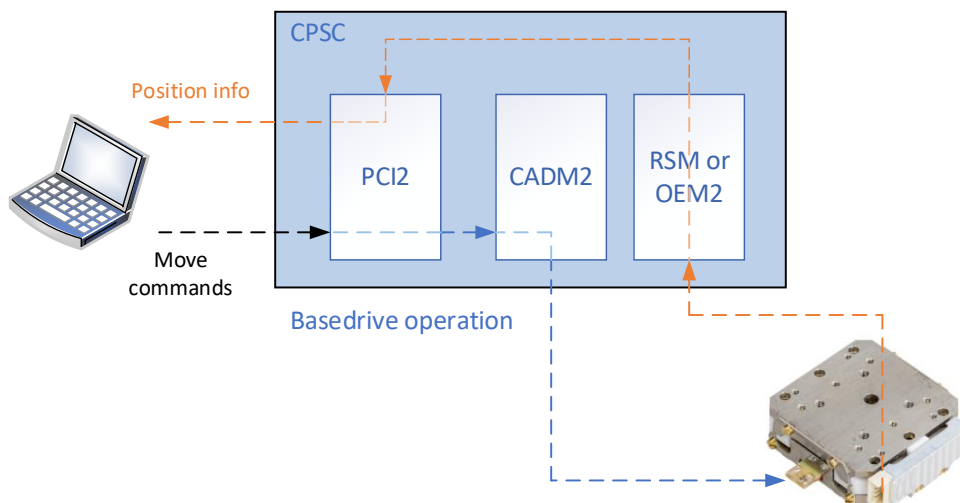
Throughout this document the following modules are used:

CADM2	Cryo Actuator Driver Module 2	outputs the drive profile for an actuator, 1 axis
RSM	Resistive Sensor Module	readout of the Resistive Linear Sensor (-RLS option), 3 axes simultaneous position output
OEM2	Optical Encoder Module 2	readout of the Cryo Optical Encoder (-COE option), 3 axes simultaneous position output

3. BASEDRIVE

Basedrive operation is available in both GUI or CLI. The user can program actuator motion control, both open-loop and closed-loop (closed loop only via the CLI, using an external controller (user software)). Closed loop operation requires the use of Resistive Linear Sensors (-RLS option) or Cryo Optical Encoders (-COE option) in combination with an RSM or OEM2 respectively.

Communication overhead sets a boundary at approx. 5 command lines per second. Basedrive is especially suitable for low frequent and set-and-forget applications. Parallel operation of actuators is not possible, only sequential. Nanometer steps can be made, but detectable resolution is limited by sensor resolution (see product brochures).



4. SERVODRIVE

Note that Servodrive supports up to 3 actuators in closed-loop per controller cabinet! If more axes are to be used in Servodrive mode, additional cabinets are required.

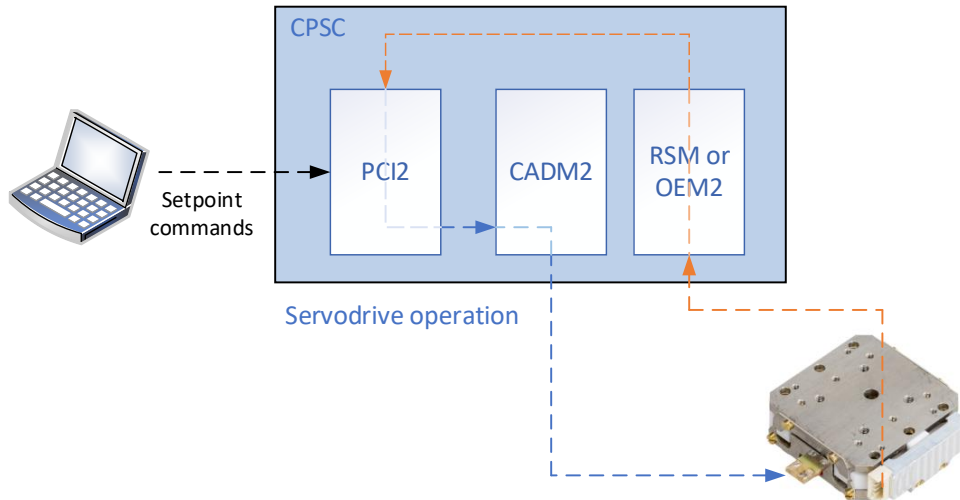
The CPSC can be set to operate in an *internal closed-loop position control* mode. The operator can simply send setpoints (set in [m] or [rad]). Servodrive mode is implemented in the PCI2 and requires the use of the *Command Line Interface* (CLI). Position feedback comes from the Resistive Linear Sensors (-RLS option) or Cryo Optical Encoders (-COE option) in combination with an RSM or OEM2 respectively.

Using Servodrive with multiple CADM2 modules makes it possible to operate multiple actuators simultaneously by sending only one combined setpoint command. The effective controller bandwidth of 40Hz and up to 2 setpoint

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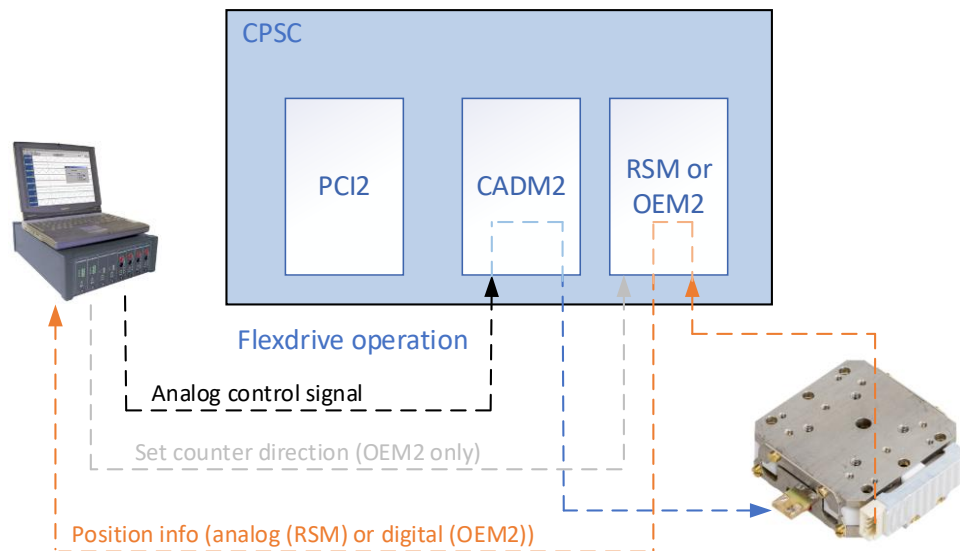
commands per second makes this mode of operation suitable for running over points in a grid with a stage. Nanometer steps can be made, but detectable resolution is limited by the used RLS or COE sensor.



5. FLEXDRIVE

If fastest position control is required, it is possible to connect the CPSC to an external data acquisition (DAQ) system.

Each CADM2 module can be controlled via a standard *analog input signal*³, the RSM has standard *analog sensor signal outputs* and the OEM2 modules are able to output a *quadrature comparable signal* which can be read by industry standard quadrature counter cards. This allows users to create their own position controller using a DAQ system and the default CPSC. For instance, integration of experiment feedback or safety signals into the controller is possible.



³ USB or LAN connection to CPSC is required to set CADM2 module in *External Input mode* (using CLI)