

APPLICATION NOTE

CRYO POSITIONING SYSTEMS CONTROLLER – MODES OF OPERATION

1. INTRODUCTION

This document describes the different *modes of operation* of using the *Cryo Positioning Systems Controller* (CPSC). This controller enables easy operation of JPE's Cryo & Nano Products such as the *Cryo Linear Actuator* (CLA), *Cryo Bearing Stage* (CBS) and positioning stages like the *Cryo Stage 02* (CS02).

The CPSC consists of a *Base Cabinet* (CAB) with standard integrated *power supply* (PSU), *communications interface* (PCI) 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 (CADM for example) and sensor modules (RSM or OEM 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).

A direct communication between host and CPSC is possible by sending simple text (ascii) commands via USB Virtual COM port, Ethernet or RS-422. This enables easy integration with other (control) software, like for example MATLAB, LabView or Python.

A Software User Manual can be downloaded from <https://www.jpe-innovations.com/cryo-nano-products/cryo-positioning-systems-controller/>. Also available are demo (GUI) scripts written in Python. These scripts can be used for simple interaction with the CPSC to control positioners, actuators or stages.



Figure 1: example of CPSC with CADM and RSM

2. MODES OF OPERATION

There are 3 different modes of operation available¹:

Basedrive	Set-and-forget type of positioning. Can be used open-loop or closed-loop (using a setpoint controller on host level) using the Optical Encoder Module (OEM2) or Resistive Sensor Module (RSM).
Servodrive	Easy to use internal position feedback control to address multiple (position) setpoints per controller (closed-loop). Servodrive requires the Optical Encoder Module (OEM2) or Resistive Sensor Module (RSM) installed. <i>Note that Servodrive supports up to 3 positioners 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, but requires a customer supplied Data Acquisition System. Requires setting the CADM2 module into <i>External Input Mode</i> prior to use, as well as a Resistive Linear Sensor (-RLS option) or Cryo Optical Encoder (-COE option).

¹ This application note assumes the use of the CPSC₁ model, when using legacy models please contact JPE.

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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/>.

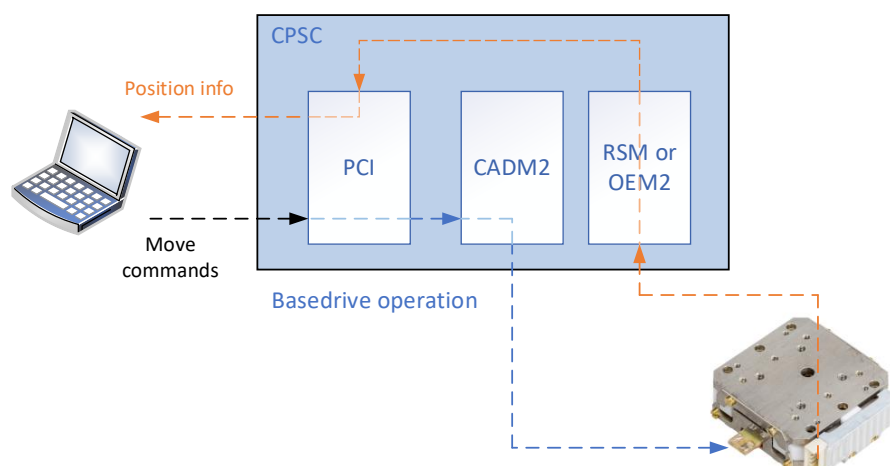
Throughout this document the following modules are used:

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

The user can program motion control, both open-loop and closed-loop (closed loop only 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 can set a boundary on the update rate. Basedrive is especially suitable for low frequent and set-and-forget applications. Parallel operation of positioners or actuators is not possible, only sequential. Nanometer steps can be made, but detectable resolution is limited by sensor resolution (see product brochures).



4. SERVODRIVE

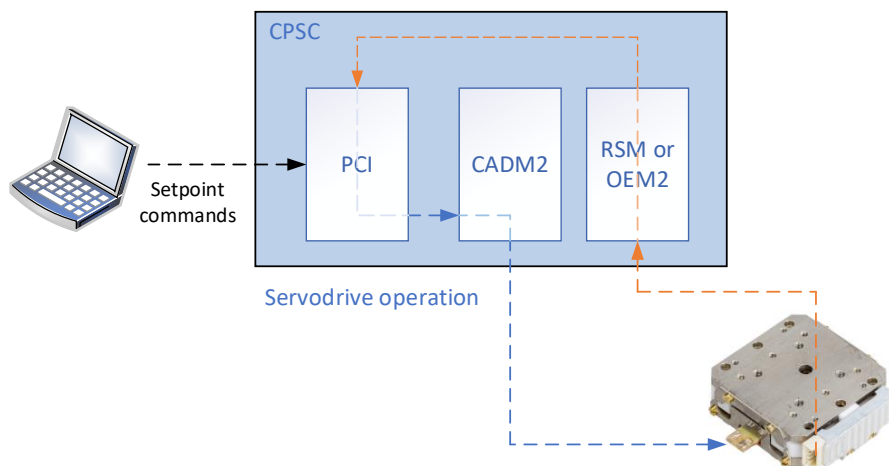
Note that Servodrive supports up to 3 positioners in closed-loop per controller cabinet! If more axes are to be used in Servodrive mode, additional cabinets are required.

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 PCI. Position feedback comes from the Resistive Linear Sensors (-RLS option) or Cryo Optical Encoders (-COE option) in combination with an RSM or OEM2 respectively.

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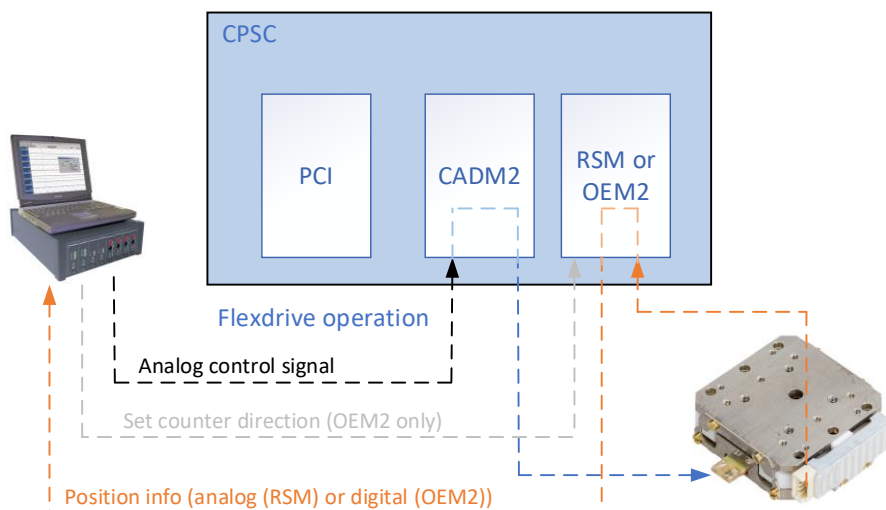
Using Servodrive with multiple CADM2 modules makes it possible to operate multiple actuators simultaneously by sending only one combined setpoint command. This makes this mode of operation suitable for running over points in a grid with a stage. Nanometer steps can be made, but detectable resolution 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*², 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.



² USB, LAN or RS-422 connection to CPSC is required to set CADM2 module in *External Input mode* prior to movement.