MAN01-01 – CRYO LINEAR ACTUATOR (CLAXXXX) USER MANUAL

CRYO & NANO PRODUCTS

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RELEVANT DOCUMENTATION

Ref	Title, Author
[1]	CNP_MAN00_Rxx_Getting-Started.pdf (JPE)
[2]	CNP_MAN02_Rxx_Software-User-Manual.pdf (JPE)
[3]	CNP_APN01_Rxx_Connection_Overview.pdf (JPE)
[4]	CLA_Interface-drawings.pdf (JPE)
[5]	CLA_Brochure.pdf (JPE)
[5]	COE_Brochure.pdf (JPE)

DOCUMENT HISTORY

JPE	2019-06-20	R01. Creation.
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DEFINITIONS

ABBREVIATIONS

1. INTRODUCTION

Thank you for using JPE's Cryo & Nano Products!

This *User Manual* describes the handling and use of Cryo Linear Actuators (CLA), from here on described as *positioner*).

Please read this document carefully prior to installation and (initial) operation of the controller, (stand-alone) positioners, actuators and stages. Failure to observe the safety regulations results in a risk of electric shock and/or damage to the controller(s), positioner(s), actuator(s) and/or stage(s)!

JPE shall not be liable for damage or injury resulting from misuse of the controller(s), positioner(s), actuator(s) and/or stage(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*).

Please note that all content in this document is superseded by any new versions of this document. Visit the JPE website (**www.jpe-innovations.com**) to obtain the most recent version. All images in this document are for illustrative purposes only.

1.1 Prerequisites

Before continuing with this user manual, please make sure to read and understand the contents of the (latest version of the) Cryo & Nano Positioning Products Getting Started Guide (MAN00).

1.2 Principle of operation

The CLA is developed for accurate positioning in vacuum environments from ambient down to cryogenic temperatures around a few Kelvin.

It is a spindle and nut drive concept for which the nut is attached to the frame and the spindle will be rotated by this piezo based positioner. The electrical wiring is attached to the rotating part, but decoupled for rotation by means of sliding contacts. With the use of the controller, it is possible to realize torque pulses in both directions on the spindle which enables the spindle to rotate with very small steps resulting in nanometer adjustability in a cryogenic environment.

Since the working principle is based on inertia drives, the spindle always needs to be preloaded with a certain force (of about 3 [N]).

For example, this can be achieved by using simple off-the-shelf extension springs connected in between the fixed world and the part that is to be moved by the positioner (basically in parallel to the positioner).

Extension springs can be purchased from numerous suppliers[1]. In order to prevent the preload force to vary much over the stroke, it is recommended to select soft springs with a low stiffness [N/mm] value.

It is important to understand that the heat dissipation in the positioner as well as in the controller is proportional to the stepping frequency and proportional to the square of the applied voltage (step size). For full step size an estimate for the dissipated energy in the positioner is about 0.59 [mJ/step] at ambient temperature but only about 0.055 [mJ/step] at 4 [K]. Note that for the CLA2603 specifically, these values are 1.48[mJ/step] and 0.14[mJ/step].

Please note that the positioners are driven with a set point profile with a maximum step size of 150 [Vpp] and high peak currents up to 10[A] for a short period of time (up to 30 [µsec])!

Because of design constraints, open voltage contacts are present!

[1] For example, https://www.tevema.com/en/webshop . Note that non-magnetic variants most likely will be custom springs.

2. INSIDE THE BOX

2.1 Positioners without -COE

Positioners will be delivered in a white-colored (membrane) polypropylene box. The inner part of the box can be taken out and bend in such way that the positioners can be easily unpacked. Carefully remove the positioner from the **transport tool PCB** using appropriate tooling.

Note the **rotation lock forks,** these needs to installed in the customer setup as well (or there must be a similar feature in the customer setup that has the same function).

Do not cut the membrane plastic. Keep the box in case products need to be returned.

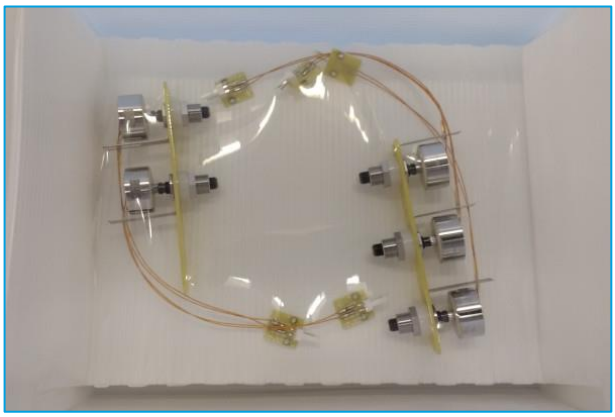


Figure 1: Example packaging with 5x CLA mounted on 2 transport tool PCBs

2.2 Positioners with -COE

Positioners equipped with a Cryo Optical Encoder (product type option –COE) are mounted on a specific **transport tool PCB** to guard the encoder grid and optical fiber. This transport tool (TTPCB) will be fixed onto the inner part of the polypropylene box using fasteners instead of being locked underneath the membrane plastic.

Unpacking these positioners require a bit more attention as it can be easy to damage the optical fiber and/or encoder grid.

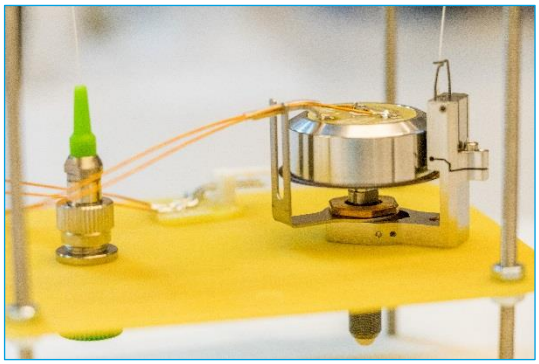
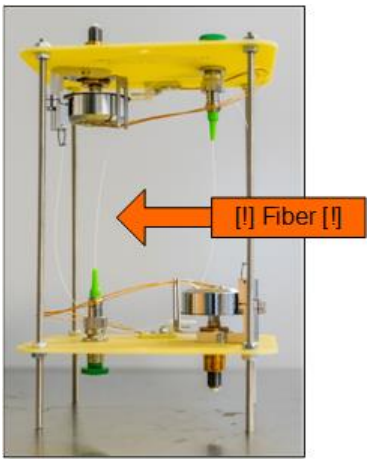
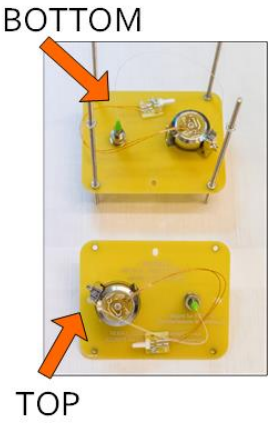


Figure 2: Transport tool PCB for CLA with COE

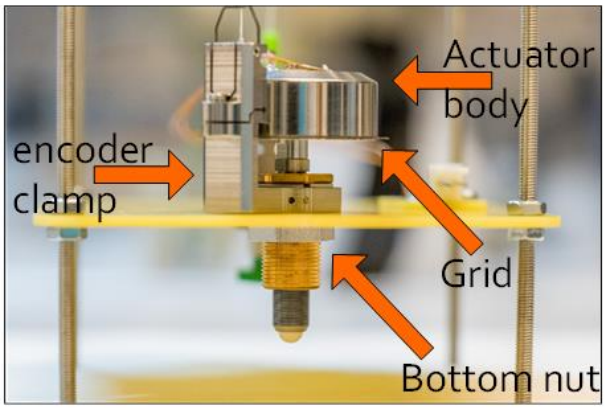
1 Open the box and take out the TTPCB **with CLAxxyy-COE** and place the tool on its studs. Notice that the images below show a tool with 2x CLAxxyy-COE; if only one CLA is shipped, one of the PCBs is left empty.

2 Remove the top TTPCB.





3 Slightly (!) loose the **bottom nut** that tightens the spindle nut. Remove the **encoder clamp** (encoder bracket) from the spindle nut. Keep hold of the **actuator body,** because it will drop slightly. Take great care not to damage the encoder grid or optical fiber!



4 Place the **encoder clamp** (bracket) next to the **actuator body** and disconnect the **fiber connector** from the **feedthrough**. Use caps to cover fiber outputs and feedthrough.

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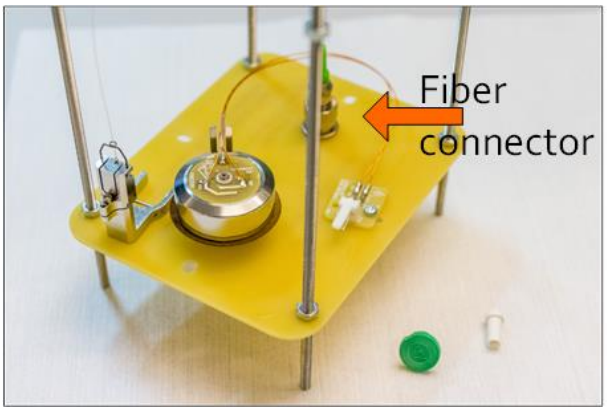
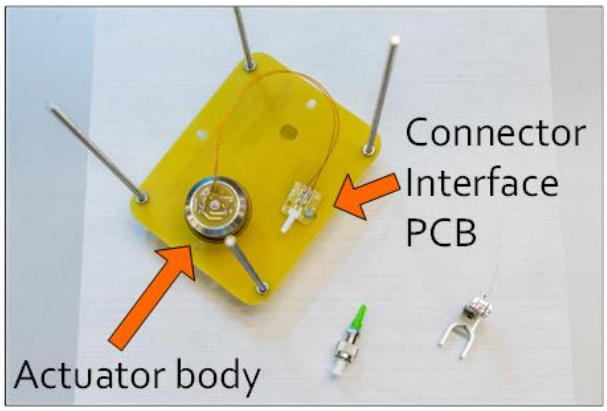


5 Unscrew the bolt that fixes the **Connector Interface PCB** and remove the actuator body from the TTPCB altogether. Finally remove the **optical feedthrough** as well. Again, take care not to damage the encoder grid or optical fiber in the process.



6 Note the **rotation lock fork,** this needs to installed in the customer setup as well (or there must be a similar feature in the customer setup that has the same function).

7 Repeat for any other positioner and keep the TTPCB for storage.

3. MOUNTING INSTRUCTIONS

Consult the Interface Drawing for detailed dimensions and mounting interfaces.

By default, the positioner is delivered with a spindle and spindle-nut that can be screwed in a setup (thread on spindle-nut). A separate locking nut is also supplied in case the spindle-nut cannot be screwed into a setup. Additionally, a rotation lock fork is supplied that needs to be mounted with the spindle-nut as well to lock the rotation of the (top) PCB on the positioner (or there must be a similar feature in the customer setup that has the same function).

If the positioner is equipped with a Cryo Optical Encoder (product type option -COE) make sure that the encoder bracket is mounted and aligned correctly in respect to the encoder grid. Fixate the FC/APC (male) connector. Take great care not to damage the encoder grid! Follow the unpacking Instructions (see 2.2) as a guide / reference.

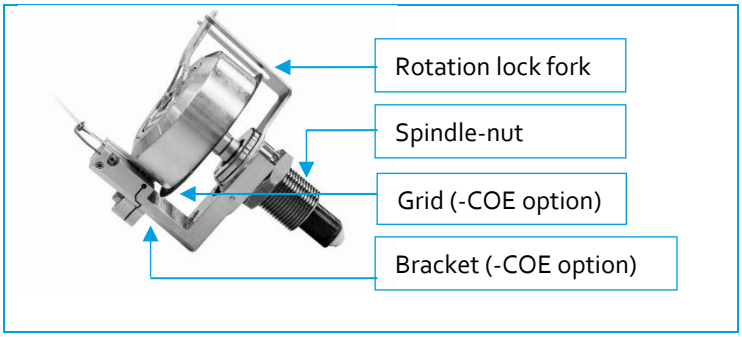


Figure 3: Example of a CLA rotation lock fork, COE encoder bracket and grid

Make sure the wiring does not get damaged or stuck in the setup when mounting the positioner. All connectors must be mounted properly prior to connecting the positioner to the electronics!

Test to see that the positioner can be rotated by hand prior to connecting to the electronics *(carefully, and only if applicable and practical).*

Don't forget that the positioner requires a certain amount of preload to work properly (see section 1.2)

4. CONNECTING TO THE CONTROLLER

Consult the Connection Overview application note for a simple and clear overview on how to connect positioners to the controller.

4.1 Drive signal

All positioners are assembled with ~150[mm] Kapton coated wire and a Connector Interface PCB at the end with a 2-pin 2.54mm pitch header mounted (*Molex KK 22-05-7028*). There are two mounting holes available for M2 bolts.

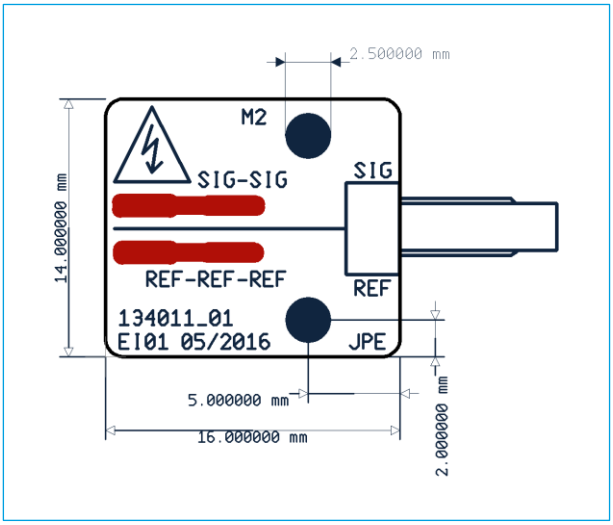


Figure 4: Connector Interface PCB (top view)

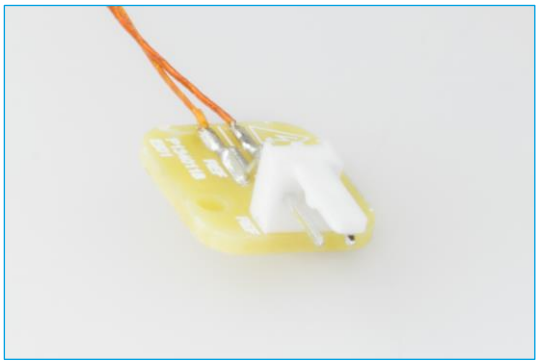


Figure 5: Connector Interface PCB

The Ambient Cable (ACL) or Cryostat Cable (CCL) can be connected directly to the Connector Interface PCB. If any custom cabling is required, please consult the Getting Started Guide (MAN00).

Pin configuration		
Pin	Name	Note
1	(Piezo) Signal	Routes to the pad labeled "S" or "SIG" on the positioner
2	(Piezo) REF	Routes to the pad labeled "R" or "REF" on the positioner

Make sure that there is no force applied to the Kapton coated wires connected to the positioner!

Please note that (Piezo) REF is NOT the same as (system) GND or PE, so do not connect these to each other and do not use standard oscilloscope probes!

Because of design constraints, open voltage contacts are present!

4.2 Encoder signal

If the positioner is equipped with a Cryo Optical Encoder (product type option –COE) an optical fiber with a length of ~200[mm] is fixed to the encoder bracket. On the end of the fiber is an *FC/APC narrow key (male)* connector.

The fiber cable and COE are delicate components that need to be handled very carefully. Take great care not to damage the encoder grid. Make sure that no force is applied to the fiber and fixate the FC/APC connector. Please read the unpacking instructions (see 2.2) as a guide / reference.

The Ambient Fiber (AF5) cable can be connected to the FC/APC narrow key (male) connector by using the supplied *FC/APC female/female adapter (Molex 106152-3000)*. If not in use, always keep (metal) screw-on cap on connector and/or adapter.

If any custom cabling is required, please consult the Getting Started Guide (MAN00).

Figure 6: FC/APC female/female adapter

4.3 Connecting to Controller

Controller with Plug-in Modules [2]		
	Module	Slot #
CLAxxyy(-COE)	CADM2 Output	1
CLAxxyy-COE	OEM2 Input A	2

[2] For available Modules see CNP MAN01-09 (CPSC).

5. SENSOR CALIBRATION

If the positioner is equipped with a Cryo Optical Encoder (product type option –COE), the device will be delivered pre-calibrated. This calibration is done to determine the correct optical signal levels for the encoder.

Calibration is done in cooperation with the Optical Encoder Module (OEM2). This means that the calibration settings for a specific COE will be stored for a specific input channel of the OEM2.

For that reason, or for a re-calibration, it is also possible to do a (manual) calibration. For this the positioner must be able to move freely. Re-calibration can be done with the user software, please read the Software User Manual (MAN02) on how to do this.

6. DECLARATION OF CONFORMITY CLA

Manufacturer	:	JPE B.V.
Address	:	Aziëlaan 12 6199 AG Maastricht-Airport The Netherlands

The manufacturer hereby declares that the product:

Product Name	:	**Cryo Linear Actuator (CLA)**
Product Description	:	**Linear motor for cryogenic applications, including non-magnetic version.**
Product Number	:	**C181047**

Complies with the following European directives:

2014/35/EU	**Low Voltage Directive**
2014/30/EU	**EMC Directive**
2011/65/EU	**RoHS**

A copy of the Technical file for this equipment is available at JPE.

Maastricht-Airport, 29 June 2018

Ir. H. Janssen
Founder & CEO
JPE B.V.
The Netherlands

7. DECLARATION OF CONFORMITY COE

Manufacturer	:	JPE B.V.
Address	:	Aziëlaan 12 6199 AG Maastricht-Airport The Netherlands

The manufacturer hereby declares that the product:

Product Name	:	**Cryo Optical Encoder (COE)**
Product Description	:	**Cryogenic Optical Encoder for the CLA.**
Product Number	:	**C181045**

Complies with the following European directives:

2006/25/EC	**Artificial Optical Radiation**
2011/65/EU	**RoHS**

A copy of the Technical file for this equipment is available at JPE.

Maastricht-Airport, 29 June 2018

Ir. H. Janssen
Founder & CEO
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