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CONTENTS

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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]	CNP_APN02_Rxx_CPSC1-Modes-of-Operation.pdf (JPE)
[5]	

DOCUMENT HISTORY

JPE	2022-03-18	R01. Creation.

DEFINITIONS

ABBREVIATIONS

1. INTRODUCTION

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

This *User Manual* describes the handling and use of the Cryo Positioning Systems Controller 1 (CPSC1), from here on described as *controller*). This controller consists of a Base Cabinet (CAB1) with one or more function specific *plug-in modules* installed (from here on described as *modules*).

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*).

1.1 Document version

This *User Manual* assumes using the latest products and controller software: **v8.x.yyyymmdd.**

Please note that all content in this document is superseded by any new versions of this document.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.

1.2 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) as well as the Software User Manual (MAN02).

2. BASE CABINET 1 (CAB1)

This is a 19" desktop cabinet including a power supply unit, a control module at the back with a USB Virtual COM, Ethernet (LAN) and RS-422 interface and six slots for up to six[1] plug-in modules (slot #1 = most left as seen from the front). The picture below shows an example of a typical configuration with 5x Cryo Actuator Driver Module 2 (CADM2) and 1x Resistive Sensor Module (RSM) in slot #4.

Figure 1: Controller - front side

Figure 2: Controller - back side

At the back there are the following connectors:

- Mains Power IEC inlet with ON/OFF switch
- USB connector for the Virtual COM port interface
- Ethernet RJ-45 connector for connection to a Local Area Network (LAN)
- 9p female D-sub for the RS-422 interface

Consult the *Cryo & Nano Positioning products Software User Manual (MAN02)* on how to send commands to the control module via the available interfaces.

By default the system is powered by 230VAC (European) [2], but alternatively there is also an 115VAC (US)[3] version available[4].

At the back (either above the IEC inlet or above the USB port) there is also a label with a unique 5-digit ID of the controller (in the format: **yyxzz**).

2.1 USB Virtual COM

Connect the supplied USB A to B cable to this connector and to a free USB port on the host system. The USB Virtual COM port is based on a USB2.0 Full Speed interface by FDTI. Consult the *Cryo & Nano Positioning products Software User Manual (MAN02)* for information about the default communication settings.

2.2 Ethernet LAN

Connect a standard CAT5e/CAT6 (or comparable) cable to the LAN port on the back of the controller and to a free network connection point on a Local Area Network (LAN). Consult the *Cryo & Nano Positioning products Software User Manual (MAN02)* for information about the default communication settings.

[1] The practical number of plug-in modules depends on the selected modules. Please consult JPE when ordering a controller.

[2] Acceptable input range 220VAC to 240VAC

[3] Acceptable input range 110VAC to 120VAC

[4] Needs to be specified before ordering!

2.3 RS-422

Connect a suitable D-Sub cable to the standard 9p female D-Sub connector on the cabinet. See the table below for the pinning.

Pin	Signal[5]	
1	TXD-	Transmitted Data -
2	TXD+	Transmitted Data +
5	GND	Ground
6	RXD-	Received Data -
7	RXD+	Received Data +
3-4 + 8-9	n/c	

USB to RS-422 converters can also be used, for example a Brainboxes US-320 can be connected directly to the RS-422 interface. Then this setup work similar as when connected to the USB Virtual COM port interface.

Consult the *Cryo & Nano Positioning products Software User Manual (MAN02)* for information about the default communication settings.

2.4 Troubleshooting

2.4.1 Cabinet does not power on

Unplug the power supply cable and check that the input fuse is still undamaged. If the fuse is still okay, make sure that the power supply cable is fully inserted into the IEC inlet. Check in the input voltage level: the CAB1-230 will not work on 115VAC mains power. When connecting a CAB1-115 to 230VAC mains power, the input fuse will blow.

[5] Typical default pinning that can connect directly to most RS-422 host devices.

3. CRYO ACTUATOR DRIVER MODULE 2 (CADM2)

The Cryo Actuator Driver Module 2 (CADM2) can be used to drive piezo based positioners and actuators like the Cryo Linear Actuator (CLA), Cryo Linear Drive (CLD) or Cryo Bearing Stage (CBS). Each CADM2 module has one drive output and one analog control input. In total there can be up to six CADM2 modules in one base cabinet (CAB1), which enables driving up to 6 positioners or actuators in parallel.

The module generates a set point profile with a maximum step size of 150[V_{pp}] and a maximum step frequency of 600[Hz]. This set point profile can be adjusted in *direction*, *step size* and *frequency* as well as be compensated for the *operating temperature of the actuators*.

Please note that this module generates an (floating) output signal with a maximum of 150 [Vpp] and high peak currents up to 10[A] for a short period of time (up to 30 [µsec])!

Figure 3: CADM2

3.1 Output

The output of the CADM2 is a 3 pin LEMO 1b.303 connector with the following pin configuration:

LEMO output pin configuration		
Pin 1	*Do not connect*	
Pin 2	REF	Reference
Pin 3	SIG	Signal
Shield	PE	

The default Ambient Cables (ACL) can be connected directly to the LEMO output connector of this module. If any custom cabling is required, please consult the Getting Started Guide (MAN00).

Because of the high output voltages and peak currents, do not touch the pins of the output connectors! Please note that REF is not the same as GND (0V), so do not connect this pin to any ground reference.

3.2 External (analog) input

The module has an additional differential analog input which enables the use of an external DAQ system (*Flexdrive* mode). For more information about this feature, consult the Application Note *CPSC1 Modes of Operation (CNP APN02)*. To be able to use this external input, it is required to execute a software command to put the module in this mode (the analog input is inactive by default after power on).

The differential input signal can be applied via a standard BNC connector.

Analog input (BNC)		
Input signal	Center pin	-10[V_{DC}] to +10[V_{DC}]
Reference	Outer	0[V_{DC}] (GND)

By varying the input signal, the output *frequency* and *direction* of movement can be set.

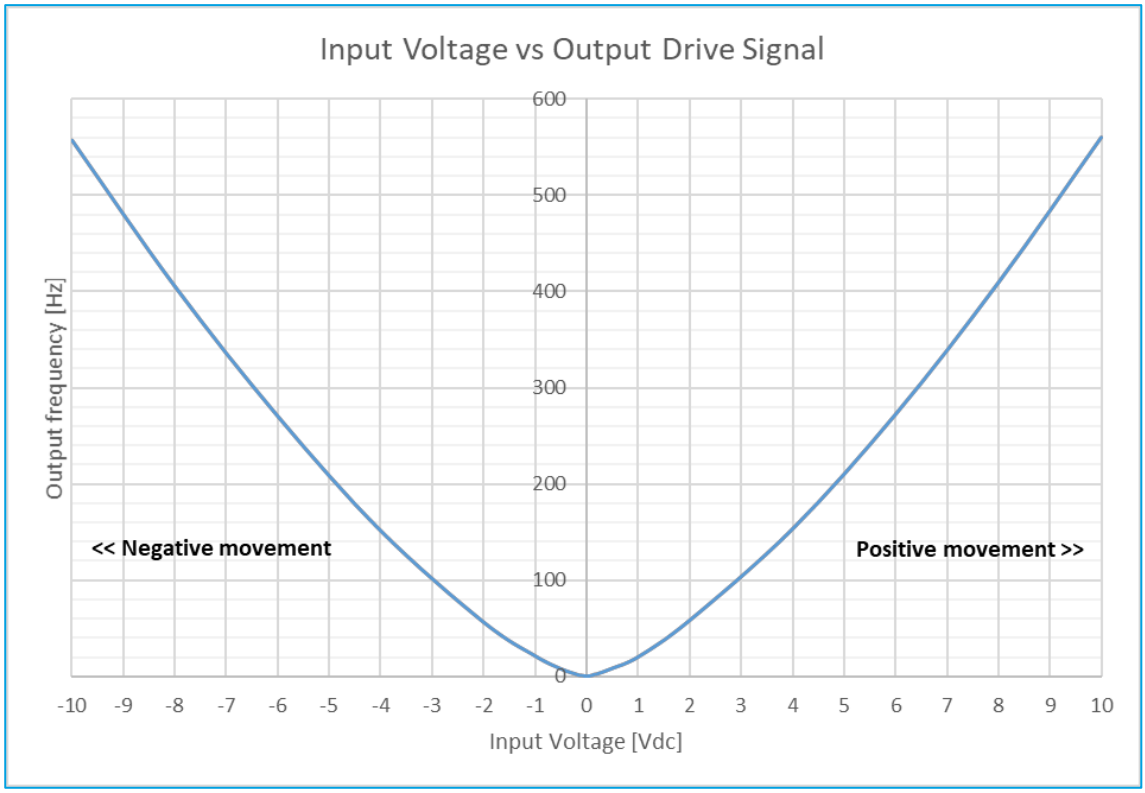


Figure 4: Input signal vs output frequency

Note that the curve is not completely linear; this to make sure that around 0 ± 0.05[V] input, the actuator will not be moving (dead point) and that it is possible to easily set a 1-2Hz step frequency (comparable with *single stepping*). Use the graph as general guide only; the exact values may vary slightly depending on component tolerances in the modules.

Please note that the *step size* parameter cannot be adjusted with the analog input control. This value needs to be set before selecting the analog input (see the *Software User Manual* for more information).

The 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] (see above). However, this means that it is required to hold the input at 0 (zero) [V] during power on of the module (therefore, do not let the input float).

3.3 Scanner mode

The module can be operated in a (basic) piezo *scanner* mode by using a specific software command. In this mode a DC voltage can be set to the output instead of the default drive signal. This output voltage can vary between -30[V] and +120[V] (in respect to REF) in 10bit resolution. Consult the software user manual for more detailed information on this option and how to use it.

Note that when active, the Output Active status LED on the CADM2 module will blink.

3.4 Status LEDs

The module has 3 status LEDs on the front panel:

Function	LED Color	Note
Power	Green	Turns on when module is powered on and power supplies are OK
Output Active	Blue	Turns on when (one of the) output(s) is (are) activated. This also applies when the module is in *External (analog) Input mode* (see paragraph 3.2). Will start to blink when the module is in *Scanner mode* (see paragraph 3.3)
Error	Red	Turns on when: ▪ An overcurrent has occurred. Possibly caused by a (cabling) fault or short circuit. ▪ Temperature overload of the module occurred (amplifier in module gets too hot). ▪ (Cabinet) power supplies are not present. If this led turns on, the output will be cut off from the amplifier inside the module to prevent damage to the electronics and for safety of the operator(s). In either case, power down the controller immediately and disconnect all actuators and systems. Investigate all wiring and cabling and check for faults or short circuits. Wait for at least 15 minutes for the module to cool down.

3.5 Troubleshooting

3.5.1 Heat dissipation

When the module is powered on (but in idle), the plug-in unit's front panel might feel warm to the touch after a while. This is normal behavior.

If the module is continuously (> 15 minutes) driving an actuator at full step size and at the highest frequency in ambient conditions, the module will warm up considerably. The module has a built-in temperature overload safety, which will turn off the outputs as soon as it will reach a certain temperature (red error led will light up). If that is the case, the operator must wait until the module is cooled down significantly. It is recommended to turn off the controller and to wait for at least 15 to 20 minutes before turning it back on again (if the module is still too hot, the red error led will turn on again after power on).

4. PIEZO SCANNING MODULE (PSM)

The Piezo Scanning Module (PSM) can be used to drive (single) *Scanner* piezo's (used in for example the CLS, CPSHR-S and CS02). Each module can operate up to 3 scanner piezo's (in parallel mode). In total there can be up to 6 PSMs in one base cabinet (CAB1) which enables driving up to 18 scanner piezo's in parallel mode.

Figure 5: PSM

4.1 Outputs

The outputs of the PSM are 3 pin LEMO 1b.303 connectors. The default Ambient Cables (ACL) can be connected directly to these outputs. If any custom cabling is required, please consult the Getting Started Guide (MAN00).

This module can generate an (high voltage) output signal of -150[V_{DC}] to +150[V_{DC}] up to 100[mA]! Please be aware that the default scanner piezo's in for example CLS, CPSHR-S or CS02 cannot withstand these voltages in ambient conditions. Therefore make sure to limit the output voltage to -20VDC to +130VDC (see also product brochures) by limiting the applied input voltage to the PSM![6]

Because of the high output voltages and peak currents, do not touch the pins of the output connectors!

Each output is fused with a 100[mA] fast acting 5x20[mm] glass fuse to protect the amplifier for short circuits. These fuses can be replaced by the operator by unscrewing the bayonet fuse holder by hand.

Always power down the controller first before replacing any fuses! Make sure to replace the blown fuse with the same type and value.

4.2 Analog inputs

The PSM generates a [15x] amplified output signal (in relation to an analog input signal). For each output, the analog input signal can be applied via a BNC connector.

Analog input (BNC)		
Input signal	Center pin	-10[V_{DC}] to +10[V_{DC}]
Reference	Outer	0[V_{DC}] (GND)

Please note that Ground (GND) must NOT be connected to Protective Earth (PE). Keep this in mind if you would like to monitor the input signal on an oscilloscope (often the GND lug of a probe connection is connected to PE).

Make sure not to exceed the maximum input voltage range!

[6] The PSM Input Limiter (PSMIL) add-on module is available that limits the input signals automatically.

4.3 Status LEDs

The module has 4 status LEDs on the front panel:

Function	LED Color	Note
Power	Green	Turns on when module is powered on and power supplies are OK
A/B/C Thermal Overload	Red	Turns on when (one or more) amplifiers inside the module get too hot. *This might occur if (multiple) outputs drive (multiple) load(s) at a high voltage and high frequency.* If the LED turns on, the internal power supply to the amplifiers will be cut off and the output will go to 0[V]. Once the amplifiers have been cooled down significantly, the outputs will be reactivated and return to respond to the input signals.

4.4 Troubleshooting

4.4.1 Heat dissipation

When the module is powered on (even in idle), the plug-in unit's front panel might feel warm to the touch after a while. Also, the top cover of the cabinet will feel quite warm at the spot where the module is placed. This is normal behavior.

If the module is continuously (> 5 minutes) driving loads at a high voltage and high frequency in ambient conditions, the module will warm up considerably and might go into thermal overload protection.

5. RESISTIVE SENSOR MODULE (RSM)

The Resistive Sensor Module (RSM) can be used with positioners, actuators and stages equipped with *Resistive Linear Sensors* (product type option -RLS). Each module can read up to 3 sensors (simultaneous readout).

An RSM can be used as a stand-alone module inside the controller cabinet, however typical configurations are:

Typical CADM2 / RSM Configurations
1x CADM2 + 1x RSM
3x CADM2 + 1x RSM

Figure 6: RSM

5.1 Sensor inputs

Sensor inputs are *industry standard HDMI-type connectors* (3x).

For a quick and easy connection setup, it is recommended to use the Ambient Connector Kit for RSM (I1-RSM) (available separately, see chapter 8.3).

The I1-RSM consists of 3x HDMI-type cables and a D-Sub Interface PCB that converts 3x HDMI-type connectors to a 1x 15p female D-Sub that can be connected directly to industry standard (vacuum) D-Sub (male) feedthroughs.

The kit also includes an Interface PCB that converts 3x HDMI-type connectors to 3x 4p ZIF connectors for direct connection to Resistive Linear Sensors (RLS).

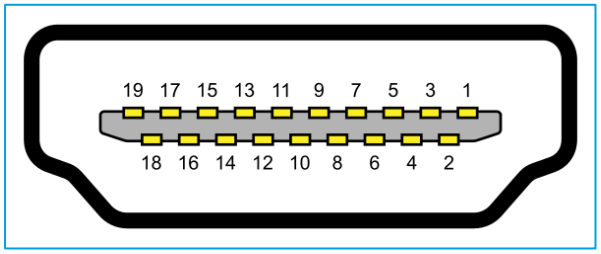


Figure 7: HDMI-type connector (front view)

Pin #	Description	Note
1	Excitation Positive	[A]
2	Shield	[B]
3	Sense Positive	[A]
4	Wiper Positive	
5	Shield	[B]
6	Wiper Negative	
7	Sense Negative	[A]
8	Shield	[B]
9	Excitation Negative	[A]
10-19	n/c	

The following signals should be wired as twisted pairs surrounded by a Shield [B][7]

1 Excitation Positive + Sense Positive (with shield pin 2)
2 Excitation Negative + Sense Negative (with shield pin 8)
3 Wiper Positive + Wiper Negative (with shield pin 5)

[A]: The Excitation and Sense signals must be merged as close as possible to the RLS. To clarify: after merge, (Excitation Positive + Sense Positive) continue as "Excitation Positive" and (Excitation Negative + Sense Negative) continue as "Excitation Negative", while Wiper Positive and Wiper Negative must continue separately.

[B]: The shield should continue around a twisted pair for as long as possible.

*When using the **I1-RSM** (see chapter 8.3) this means the merge [A] will be done at the Interface PCBs. Shields [B] will be merged to each other as well on the Interface PCBs and end there.*

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

5.2 Analog output

The analog output enables the option to use an external DAQ system to read out the sensor signals in order to setup an (external) control loop in combination with the analog input function of the CADM2 modules ("Flexdrive" mode of operation – see paragraph 3.2).

The analog output varies between +5[V_{DC}] and -5[V_{DC}] depending on the position of the (wiper of the) RLS connected to the actuator or stage.

It is important to understand that (zero) o[V_{DC}] is the center position of the RLS and not by definition the center of the positioner, actuator or stage!

Additionally in some situations the physical stroke of the positioner or actuator can be less than the stroke of the RLS, so the full range of -5[V_{DC}] to +5[V_{DC}] will not be reached (like this is the case with the CBSx-RLS).

That means that for the external control loop to work, the operator must define a signal offset in relation to the center of the connected actuator or stage first.

For each sensor there is a standard BNC-type connector available.

Analog output (BNC)		
Output signal	Center pin	-5[V_{DC}] to +5[V_{DC}]
Reference	Outer	0[V_{DC}] (GND)

[7] According to standard HDMI specification

5.3 Status LEDs

The module has 3 status LEDs on the front panel:

Function	LED Color	Note
Power	Green	Turns on when module is powered on and power supplies are OK.
Status1, Status2	Blue	Visual indication for the duty-cycle of the sensor excitation signal: Status1 = on, Status2 = on : Excitation Duty-cycle = 100% Status1 = off, Status2 = on : Excitation Duty-cycle = 10% - 99% Status1 = off, Status2 = off : Excitation Duty-cycle = 0%

5.4 Troubleshooting

5.4.1 RSM doesn't read RLS values

Check all wiring and that the HDMI connectors are fully inserted into the inputs. In case of any custom wiring, carefully read section 5.1 for important information.

6. OPTICAL ENCODER MODULE 2 (OEM2)

The (laser operated) Optical Encoder Module 2 (OEM2) can be used with positioners, actuators and stages equipped with Cryo Optical Encoders (product type option –COE). Each module can read up to 3 encoders (simultaneous readout).

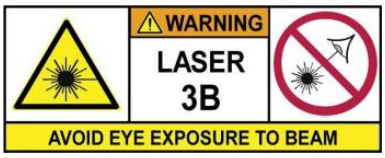
An OEM2 can be used as a stand-alone module inside the controller cabinet, however typical configurations are:

Typical CADM2 / OEM2 Configurations
1x CADM2 + 1x OEM2
3x CADM2 + 1x OEM2

Figure 8: OEM2

6.1 Optical outputs

The laser used inside the OEM2 is a Class 3B emitting invisible (infrared) light. According to the CE Directive 2006/25/EC is it required to take the following safety measures:



1. *Prevent direct eye exposure. Always cover unconnected outputs with the supplied metal (screw-on) caps and never look at the open beam at the encoder itself.*
2. *Always use a fully connected setup: all cabling must be present and connected from COE to OEM2 before turning on the controller.*
3. *Do not place a cabinet containing an OEM2 module at eye level.*
4. *Wear safety glasses suitable for protection against Laser Class 3B infrared light.*

One 5[mW] laser module inside the OEM2 is split into 3 individual outputs. For safety reasons and to minimize power dissipation in the Cryo Optical Encoder (COE), the duty cycle of the laser light has been reduced to 0.2[%]. In practice this means that, although a 5[mW] laser is used, the effective (average) power per output is only ca. 3.33[µW] ***(this however does not mean the safety precautions as described above should be neglected)****.*

The default Ambient Fiber (AF5) cable can be connected directly to the outputs of this module (*FC/APC narrow key female connectors*). If any custom cabling is required, please consult the Getting Started Guide (MAN00).

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6.2 Electrical in-/ outputs

To connect the OEM2 to an external DAQ system (*Flexdrive* mode), a standard 25-pin D-Sub male connector is available for optical isolated user in-/outputs *(required cabling is not supplied)*. For more information about this feature, consult the Application Note *CPSC1 Modes of Operation (CNP APN02)*.

Pin #	Signal name	Note	
1	[A] Quadrature (comparable) A		*5V TTL compatible.*
2	[A] Quadrature (comparable) B		
3	[A] Quadrature Direction	*Required user input!*	
4	[A] Raw Analog detector signal	*For debug purposes, no direction*	*o to 5V$_{max}$*
5	[B] Quadrature (comparable) A		*5V TTL compatible.*
6	[B] Quadrature (comparable) B		
7	[B] Quadrature Direction	*Required user input!*	
8	[B] Raw Analog detector signal	*For debug purposes, no direction*	*o to 5V$_{max}$*
9	[C] Quadrature (comparable) A		*5V TTL compatible.*
10	[C] Quadrature (comparable) B		
11	[C] Quadrature Direction	*Required user input!*	
12	[C] Raw Analog detector signal	*For debug purposes, no direction*	*o to 5V$_{max}$*
13	5V$_{opt(out)}$		
14-25	GND$_{opt}$		

The OEM2 quadrature-comparable output requires a user supplied Direction input. This means that the user has to instruct the OEM2 the direction of movement before actual movement of the actuators. This to ensure CW/CCW movement information in the output signal. Please note that this is only required when using an external DAQ system.

6.3 Status LEDs

The module has 3 status LEDs on the front panel:

Function	LED Color	Note
Power	Green	Turns on when module is powered on and power supplies are OK.
Status1, Status2	Blue	*Reserved for future functionality.*

7. ENDSWITCH DETECTOR MODULE (EDM)

The Endswitch Detector Module (EDM) can be used with positioners, actuators and stages equipped with optical switches (photo interrupters) that are used for end-switch detection. Each module can read up to 6 photo interrupters simultaneously.

Furthermore, the EDM has 3 general purpose analog inputs and 8 general purpose digital inputs which makes the module also useful for self-built customer setups.

An EDM can be used as a stand-alone module inside the controller cabinet, however typical configurations are:

Typical CADM2 / RSM Configurations
1x CADM2 + 1x EDM
3x CADM2 + 1x EDM

Figure 9: EDM

7.1 Photo Interrupters

The EDM can control and read general purpose photo interrupters that have a typical forward current (I_f) of 10[mA]-20[mA], for example the *Sharp GP1S094HCZ0F*. The EDM has built-in optical power reduction by means of changing the duty cycle of the drive signal.

A typical connection scheme suitable for the EDM is seen in the figure on the right, where:

- common: a low impedance 12[V] signal
- k: LED cathode
- e: Photo-transistor emitter or photo-diode cathode

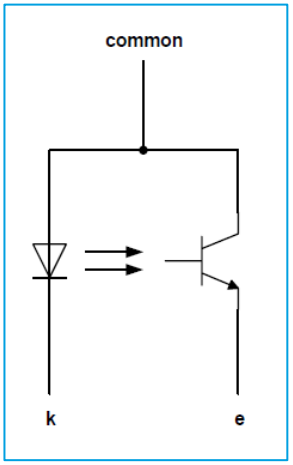

Figure 10: photo interrupter typical connection scheme

Signals are supplied on a standard 15p female high-density D-SUB (DE type) connector with the following pinout:

Photo Interrupter (15p female HD D-SUB)		
Pin #	Interrupter #	Signal
1	3	emitter (Detector)
2	3	cathode (LED)
3	Common	12V
4	4	emitter (Detector)
5	4	cathode (LED)
6	2	emitter (Detector)
7	2	cathode (LED)
8	Common	12V
9	5	emitter (Detector)
10	5	cathode (LED)
11	1	emitter (Detector)
12	1	cathode (LED)

13	Common	12V
14	6	emitter (Detector)
15	6	cathode (LED)

7.2 Auxiliary Inputs

The EDM has 8 general purpose digital inputs (Dix) that accept 0[V] - 5[V] signals (TTL compatible). The EDM has 3 general analog inputs (Aix) that accept 0[V] to 5[V] signals (16bit resolution). Input sample frequency is (at least) 100[Hz]. Input impedance for all inputs is 100[kΩ]. Digital and analog inputs can be connected to a standard 15p female D-SUB (DA type) connector with the following pinout:

Auxiliary input (15p female HD D-SUB)			
Pin #	Input	Pin #	Input
1	Ai0	9	GND
2	Ai1	10	GND
3	Ai2	11	GND
4	GND	12	Di7
5	Di6	13	Di5
6	Di4	14	Di3
7	Di2	15	Di1
8	Di0		

7.3 Status LEDs

The module has various status LEDs on the front panel:

Function	**LED Color**	**Note**
Power	Green	Turns on when module is powered on and power supplies are OK.
Status	Red	*Reserved for future functionality. Normally off.*
Sw P & Sw Q	Blue	Turns on when photo interrupter is active. The following cross reference applies: Software Channel [CHx] / SW PQ LED 1 / P1 2 / Q1 3 / P2 4 / Q2 5 / P3 6 / Q3 *Note that the LED state will depend on active high or active low setting. When set to active high (via user software), the LED will turn on when an obstacle is detected.*

8. CABLING AND CONNECTOR INTERFACE KITS

Various cables and interface kits are available to quickly connect positioner(s), actuator(s), scanner piezo(s) and/or sensor(s) to the available modules.

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

Because each customer setup is different and there are many options depending on the cryostat or vacuum chamber that is being used, JPE does not supply feedthroughs or additional specific connectors by default.

However, a solution based on industry standard 15p male-male D-Sub type feedthroughs can be offered with connector kits like the I1-ACL, I1-RSM and CCL and/or CCR cabling. In this situation the customer only has to arrange and install one or more D-Sub male-male feedthroughs.

Please refer to the Connection Overview application note (CNP APN01) for more information about this subject.

8.1 Ambient Cable (ACL)

The Ambient Cable (ACL) is the default way to connect positioner(s), actuator(s) and scanner piezo's (product type option –S) and to plug-in modules.

The default length is 3.0[m][8] and has a *LEMO 1b.303* connector on one side (connects to CADM2 and PSM for example) and a white colored 2-pin (crimp) socket connector (*Molex KK 22-01-2025* housing with *Molex KK 08-50-0032* crimp pins) on the other end to quickly interface to positioner(s) and actuator(s).

Figure 11: Ambient Cable (ACL)

Pin configuration on the (Molex) 2-pin (crimp) socket side		
Pin 1	Piezo SIG	Signal, White wire
Pin 2	Piezo REF	Reference, Black wire

Although not recommended, it is allowed to de-solder the Molex socket connector for final integration in the Customer's setup – however, any soldering must be carried out by qualified personnel only and double-check correct pin wiring afterwards! JPE does not assume liability for damages to property or personal injury!

It is vital to make sure that Signal (SIG) and Reference (REF) wires are not mixed up when adding additional cabling. Incorrect wiring will result in a risk of mortal electric shock and/or damage to the controller (s), actuator(s) and/or system(s).

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! Beware of any open voltage contacts!

[8] Shorter or longer cables (up to 6.0[m]) available on request.

JPE recommends the use of the Ambient Connector Kit for ACL (I1-ACL) to easily connect up to 6x ACL to a 15p D-Sub interface (see section 8.4)

8.2 Cryostat Cable for RLS (CCR)

The Cryostat Cable for RLS (CCR) kit is a cable set to connect up to 3x Resistive Linear Sensors (RLS) on the vacuum-cryo side and consists of a Kapton flex-PCB and a small FPC to D-Sub Interface.

This cable set works best in combination with the Ambient Connector Kit for the RSM (I1-RSM). With this a complete (electrical) connection from RLS to RSM can be constructed without the need for any additional wiring.

The total length of the CCR is approximately 0.5[m] and has [3x] 4p FPC ZIF connectors *(Würth WR-FPC 1.00mm, PPS)* on one end and a 15p female UHV PPS D-Sub with screw locks *(Vacom PLUG-SUBD-15-P with EK-SUBD-F contacts)* on the other side. This D-Sub can be connected directly to industry standard 15p (vacuum) D-Sub (male) feedthroughs.

The D-Sub Interface can be disconnected from the Kapton flex-PCB for easy installation in the customer setup. Mounting holes in the flex-PCB are available for fixing / routing the CCR inside the vacuum-cryo chamber.

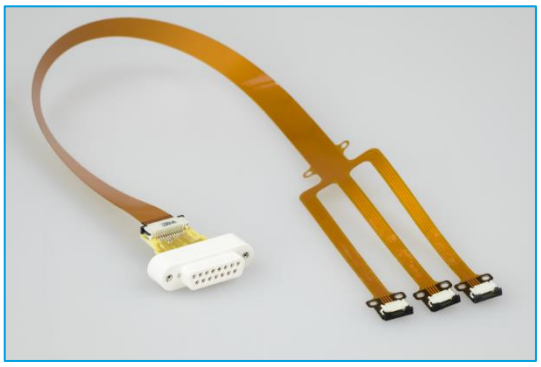

Figure 12: CCR

Actuators and systems that have the -RLS option can be connected directly to the 4p FPC ZIF connectors.

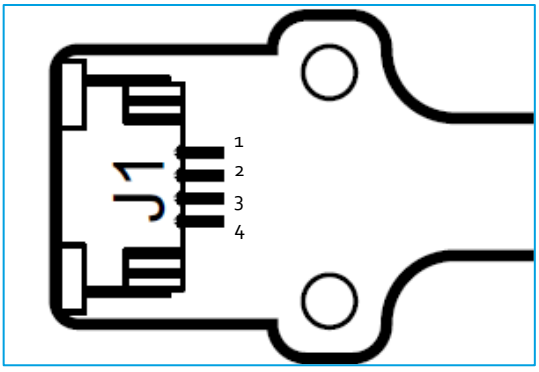

Figure 13: 4p WR-FPC 1.00mm FPC ZIF (top view)

4p WR-FPC ZIF (3x)		
Pin #	Description	RLS PCB Ref.
1	Excitation Negative	D
2	Wiper Positive	C
3	Excitation Positive	B
4	Wiper Negative	A

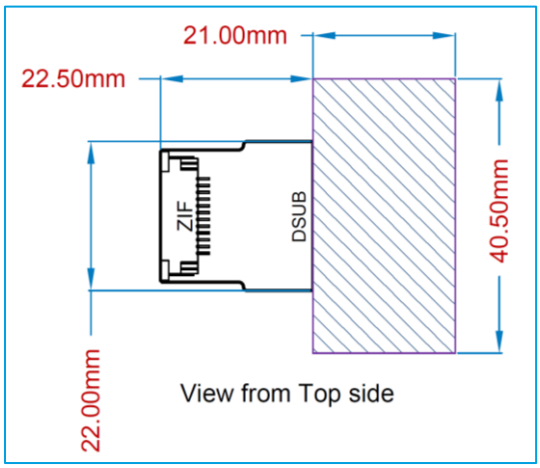

Figure 14: (approx.) Dimensions FPC to D-Sub Interface

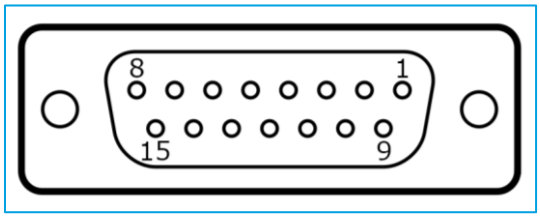

Figure 15: CCR 15p female D-Sub (front view)

CCR 15p female PPS UHV D-Sub			
Pin #	RLS #	XYZ Conf.	Signal
8	1	X	Excitation Negative
7	1	X	Wiper Positive
6	n/c		
5	2	Y	Wiper Negative
4	2	Y	Excitation Positive
3	n/c		
2	3	Z	Wiper Negative
1	3	Z	Excitation Positive
15	1	X	Wiper Negative
14	1	X	Excitation Positive
13	2	Y	Excitation Negative
12	2	Y	Wiper Positive
11	n/c		
10	3	Z	Excitation Negative
9	3	Z	Wiper Positive

Note that most (D-Sub) vacuum feedthroughs are "male-male" type. This means that the pinning will be mirrored from one side to the other. The pinning of the CCR 15p female D-Sub is defined such that it works correctly by default with the I1-RSM and a male-male feedthrough (!).

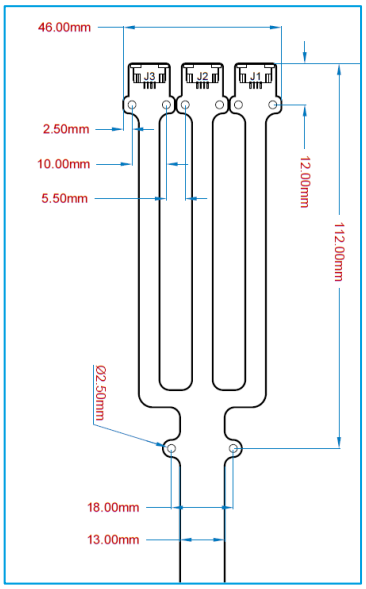

Figure 16: Dimensions of CCR

8.3 Cryostat Cable (CCL)

The Cryostat Cable (CCL) is a cable to connect positioners, actuators and scanner piezo's (product type option –S) on the vacuum-cryo side. There are 3 variants available:

- CCL6: consists of [3x] 2-pin crimp socket connector (*Molex KK 22-01-2025* housing with *Molex KK 08-50-0032* crimp pins) at one end. Pinning is the same as the ACL.
- CCL12: consists of [6x] 2-pin crimp socket connector (*Molex KK 22-01-2025* housing with *Molex KK 08-50-0032* crimp pins) at one end. Pinning is the same as the ACL.
- CCL15-OE: consists of 15 Kapton wires with open-ends. Pinning up to customer.

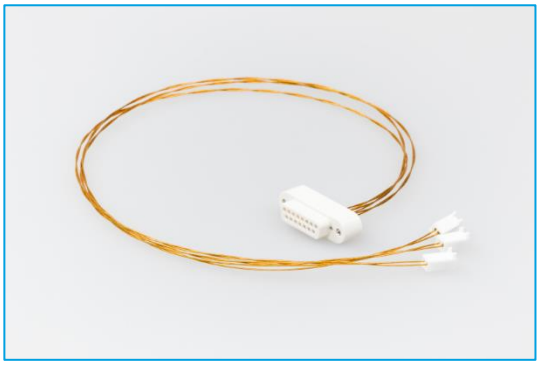

Figure 17: CCL6

Each cable variant is approximately 0.5[m] in length and has a 15p female UHV PPS D-Sub with screw locks *(Vacom PLUG-SUBD-15-P with EK-SUBD-F contacts)* on one end. This D-Sub can be connected directly to industry standard 15p (vacuum) D-Sub (male) feedthroughs.

This cable works best in combination with the Ambient Connector Kit for the ACL (I1-ACL). With this a complete (electrical) connection from CADM2 or PSM to each positioner, actuator or scanner piezo can be constructed without the need for any additional wiring.

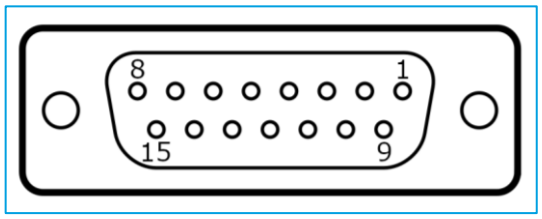

Figure 18: CCL female D-Sub (front view)

CCL 15p female PPS UHV D-Sub			
Pin #	Description	CCL12 #	CCL6 #
8	n/c		
7	Sig	6	n/c
6	Sig	5	
5	Sig	4	
4	n/c		
3	Sig	3	3
2	Sig	2	2
1	Sig	1	1
15	Ref	6	n/c
14	Ref	5	
13	Ref	4	
12	n/c		
11	Ref	3	3
10	Ref	2	2
9	Ref	1	1

Note that most (D-Sub) vacuum feedthroughs are "male-male" type. This means that the pinning will be mirrored from one side to the other. The pinning of the CCL 15p female D-Sub is defined such that it works correctly by default with the I1-ACL and a male-male feedthrough (!).

8.4 Ambient Connector Kit for ACL (I1-ACL)

The Ambient Connector Kit for ACL (I1-ACL) consist of a D-SUB Interface PCB that converts 6x ACL connectors *(Molex KK 22-05-7028 2-pin 2.54mm pitch headers)* to a 1x 15p female D-Sub that can be connected directly to industry standard 15p (vacuum) D-Sub (male) feedthroughs.

This cable works best in combination with the Cryostat Cable (CCL). With this a complete (electrical) connection from CADM2 or PSM to each positioner, actuator or scanner piezo can be constructed without the need for any additional wiring.

Included in the kit is a dummy feedthrough adapter (15p male-male D-Sub) for ambient testing, so it is not required to use an actual vacuum / cryostat feedthrough for initial setup or testing.

I1-ACL 15p female D-Sub		
Pin #	Description	ACL #
1	n/c	
2	Sig	6
3	Sig	5
4	Sig	4
5	n/c	
6	Sig	3
7	Sig	2
8	Sig	1
9	Ref	6
10	Ref	5
11	Ref	4
12	n/c	
13	Ref	3
14	Ref	2
15	Ref	1

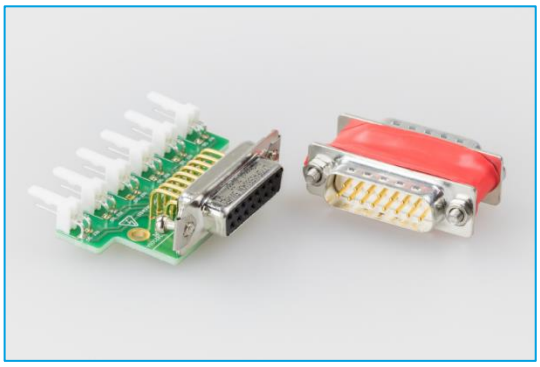

Figure 19: I1-ACL with dummy feedthrough adapter

ACL connector (6x)	
Pin #	Description
1	Sig
2	Ref

Note that most (D-Sub) vacuum feedthroughs are "male-male" type. This means that the pinning will be mirrored from one side to the other. The pinning of the I1-ACL is defined such that it works correctly by default with the CCL 15p female D-Sub and a male-male feedthrough (!).

8.5 Ambient Connector Kit for RSM (I1-RSM)

The Ambient Connector Kit for the RSM (I1-RSM) consist of 3x HDMI-type cables, a D-SUB Interface PCB that converts 3x HDMI-type connectors to a 1x 15p female D-Sub that can be connected directly to industry standard 15p (vacuum) D-Sub (male) feedthroughs and a FPC Interface PCB that enables a direct connection of 3 RLS sensors to an RSM.

This cable kit works best in combination with the Cryostat Cable for RLS (CCR) kit. With this a complete (electrical) connection from RSM to RLS can be constructed without the need for any additional wiring.

Included in the kit is a dummy feedthrough adapter (15p male-male D-Sub) for ambient testing, so it is not required to use an actual vacuum / cryostat feedthrough for initial setup or testing

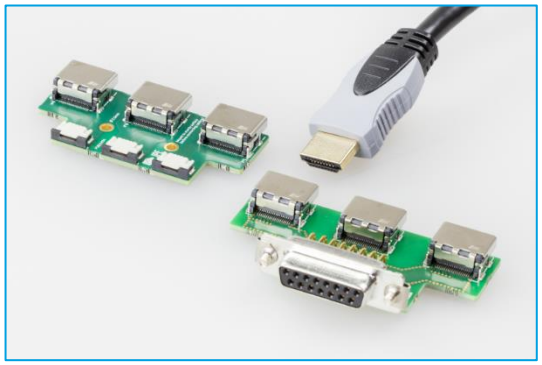

Figure 20: I1-RSM kit with D-SUB Interface PCB (right) and FPC Interface PCB (left)

The default HDMI cable length is 3.0[m].

The *D-SUB Interface PCB* has 3x HDMI-type connectors and 1x standard 15p female D-Sub with screw locks to fix to standard D-Sub vacuum feedthroughs.

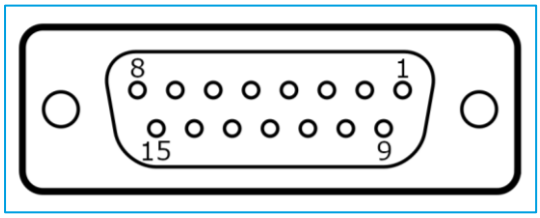

Figure 21: I1-RSM 15p female D-Sub (front view)

I1-RSM 15p female D-Sub			
Pin #	RLS #	XYZ conf.	Signal
1	1	X	Excitation Negative
2	1	X	Wiper Positive
3			n/c
4	2	Y	Wiper Negative
5	2	Y	Excitation Positive
6			n/c
7	3	Z	Wiper Negative
8	3	Z	Excitation Positive
9	1	X	Wiper Negative
10	1	X	Excitation Positive
11	2	Y	Excitation Negative
12	2	Y	Wiper Positive
13			n/c
14	3	Z	Excitation Negative
15	3	Z	Wiper Positive

The *FPC Interface PCB* has 3x HDMI-type connectors and 3x 4p FPC ZIF (*Würth WR-FPC 1.00mm)* connectors that accept default RLS flex PCB cables. The pinning is the same as for the CCR, see section 8.2 for further information.

8.6 Ambient Connector Kit for EDM (I1-EDM)

The Ambient Connector Kit for the EDM (I1-EDM) consists of the following items:

- An easy-to-use *screw terminal board* can connect directly to the Photo Interrupter input of the EDM (15p female high-density D-SUB (DE type) connector), see section 7.1.

  There are 4x M3 mounting holes available (at a pitch of 26mm on the short side and 58mm on the long side).

Figure 22: I1-EDM kit

- A *15p high-density male D-SUB (DE type) to 15p normal female D-SUB adapter* can be used to connect the Photo Interrupter input of the EDM to an industry standard 15p (vacuum) D-Sub (male) feedthrough.

  Pin 1 on one connector connects to pin 1 on the other (and so on). On cryo-vacuum side, the CCL15-OE can be used to continue with the wiring.

- A *1-to-1 15p high-density male-female D-SUB cable* and one *1-to-1 15p (normal) male-female D-SUB cable* to make interfacing more convenient.

Note that there are no feet or spacers underneath the PCB, so make sure not to lay or mount the PCB on an electrically conducting surface (will result in a short-circuit). Use spacers or (rubber) feet to supply sufficient stand-off space.

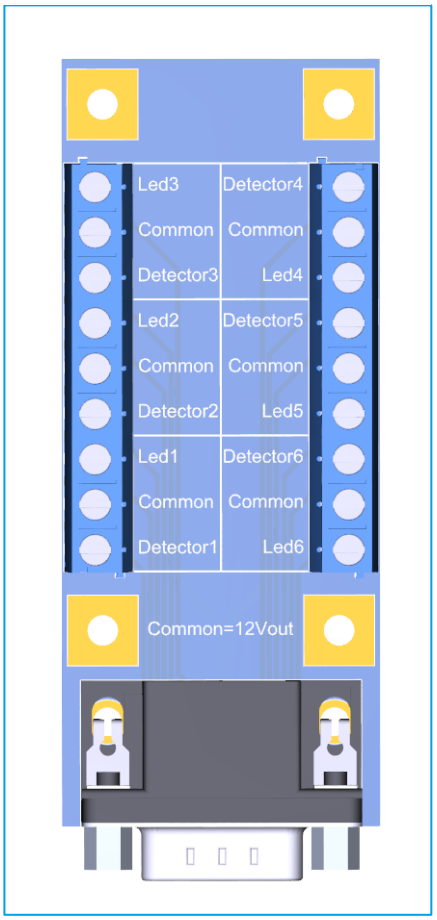

Figure 23: I1-EDM terminal board

8.7 Ambient Fiber (AF5)

The Ambient Fiber (AF5) is a hybrid patch cable and is the default way to connect Cryo Optical Encoder(s) (product type option -COE) to Optical Encoder Module(s) (OEM2).

The default length is 3.0[m][9] and has a *FC/APC (male)* connector both sides. To connect this side directly to (stand-alone) Cryo (Linear) Actuators (CLA) it is required to use the supplied FC/APC female/female adapter.

Figure 25: FC/APC female/female adapter

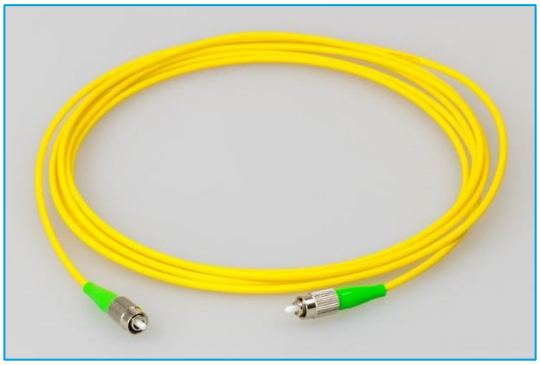

Figure 24: Ambient Fiber (AF5)

Some systems already have this adapter mounted, so these do not require to use an additional adapter.

Always cover ends of unused cables and adapters with the supplied (screw-on) caps.

[9] Shorter or longer cables available on request.

9. DECLARATION OF CONFORMITY

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

The manufacturer hereby declares that the product:

Product Name	:	**Cryo Positioning Systems Controller 1 (CPSC1)**
Product Description	:	**Modular electronics system consisting of a 19" cabinet including function specific modules and add-on components.**
Product Number	:	**C181055**

Complies with the following European directives:

2014/35/EU	**Low Voltage Directive**
2014/30/EU	**EMC Directive**
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, 18 March 2022

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