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THORLABS

MOTORIZED WORM DRIVE ROTATION STAGE

▶ **High-Torque DC-Servo Motor**
▶ **Continuous 360° Rotation**
▶ **25 lb Max Vertical Load**

Application Idea

CR1A

CR1-Z7
Motorized Continous
Rotation Platform

CR1-Z7
Shown with PM3 Clamping Arm
and Prism PS610

[Hide Motorized Continuous Rotation Stage](#)

Motorized Continuous Rotation Stage

[Hide Overview](#)

OVERVIEW

Rotation Stage Features

- 360° Continuous Motion Provided by Fine Pitch Worm Gear
- High-Torque DC-Servo Motor with Gear Head and Optical Encoder
- High-Count Optical Encoder (12,288 pulses/rev)
- Vernier Scale Provides 5 arcmin Resolution
- Designed for Mounting MS1 and T12X Series Translation Stages (Using the CR1A Adapter Plate)
- Application Tested for Vertical Loads up to 25 lbs.

The CR1-Z7 motorized rotation stage with round strain relief cables offers high-precision continuous motion in a sturdy, compact package. The reduced-backlash worm gear design, coupled with a high-resolution incremental optical encoder provides the rotational precision required in optical laboratories. The high torque 12 VDC servo motor supplies ample power for rotating vertical loads up to 25 lbs. We recommend using the CR1-Z7 with the KDC101 DC Motor Controller.

[Hide Specs](#)

SPECS

Specification	Value
Travel	Continuous 360°
Max Load (Vertical)	25 lbs (11.3 kg)
Maximum Torque in Vertical Configuration	6.25 lbF-in.
Gear Type	Worm Gear, 96 Teeth
Gear Reduction	256:1
Worm	Double Thread
Motor Type	DC Servo
Motor Drive Voltage	12 V
Max Recommended Current	80 mA
Min Incremental Motion	2.19 arcsec
Wobble	<2 arcsec
Repeatability	<1 arcmin
Feedback	Motor Mounted Rotary Encoder 48 Points/Rev at the Motor
Encoder Counts per Revolution of the Leadscrew	12,288
Speed Range	22 arcsec/sec to 6 °/sec
Index Signal	None
Cable Length	9.0' (2.743 m)
Compatible Controllers	KDC101

How to Calculate the Rotational Displacement per Encoder Count

In order to explain the rotational displacement calculation we must first understand the gear train of the rotational stage. The main platform is fixed directly to a worm gear. This worm gear is actuated by the worm which is attached to the output shaft of the gearhead fixed to the motor.

There are 48 encoder counts per revolution of the motor. The output shaft of the motor goes into a 256:1 planetary gear head. This requires the motor to rotate 256 times to rotate the double thread worm one revolution. In return the worm must rotate 48 times to rotate the 96 pitch worm gear one full revolution.

Encoder Counts per Revolution of the Double-Threaded Worm:

48 x 256 = 12,288 Encoder Counts per Revolution of the Double-Threaded Worm
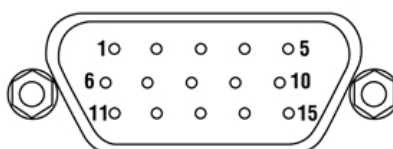
Calculate the Gear Ratio of the Worm to Worm Gear:

96 / 2 = 48 Revolutions of the Worm per One Revolution of the Worm Gear

360° / (12288 x 48) = 0.0006° x 3600 = 2.16 arcsec per Encoder Count

[Hide Pin Diagram](#)

PIN DIAGRAM

Controller Connection

Pin	Description	Pin	Description
1	Ground	9	39k Identification Resistor

2	Not Used	10	Vcc
3	Not Used	11	Encoder Channel B
4	Not Used	12	Not Used
5	Motor (+)	13	Encoder Channel A
6	Not Used	14	Not Used
7	Motor (-)	15	Not Used
8	Not Used	Case	Ground

Hide Smart Pack

SMART PACK

Smart Pack

- Reduce Weight of Packaging Materials
- Increase Usage of Recyclable Packing Materials
- Improve Packing Integrity
- Decrease Shipping Costs

Click to Enlarge
CR1-Z7
Packaging

Thorlabs' Smart Pack Initiative is aimed at waste minimization while still maintaining adequate protection for our products. By eliminating any unnecessary packaging, implementing packaging design changes, and utilizing eco-friendly packaging materials for our customers when possible, this initiative seeks to improve the environmental impact of our product packaging. Products listed above are now shipped in re-engineered packaging that

Item #	% Weight Reduction	CO_2-Equivalent Reduction[a]
CR1-Z7	15.79%	0.82 kg
CR1/M-Z7	15.79%	1.09 kg

minimizes the weight and the use of non-recyclable materials.[b] As we move through our product line, we will indicate re-engineered packages with our Smart Pack logo.

- Travel-based emissions reduction calculations are estimated based on the total weight reduction of packaging materials used for all of 2013's product sales, traveling 1,000 miles on an airplane, to provide general understanding of the impact of packaging material reduction. Calculations were made using the EPA's shipping emissions values for different modes of transport.
- Some Smart Pack products may show a negative weight reduction percentage as the substitution of greener packaging materials, such as the Greenwrap, at times slightly increases the weight of the product packaging.

Part Number	Description	Price	Availability
CR1/M-Z7	Motorized Continuous Rotation Stage, Metric	$839.00	Today
CR1-Z7	Motorized Continuous Rotation Stage	$839.00	3-5 Days

Hide Motorized Continuous Rotation Stage W/ Motor Controller

Motorized Continuous Rotation Stage W/ Motor Controller

Hide Overview

OVERVIEW

Rotating Stage Features

- 360° Continuous Motion Provided by Fine Pitch Worm Gear
- High-Torque DC Servo Motor with Gear Head and Optical Encoder
- High-Count Optical Encoder (12,288 pulses/rev)
- Vernier Scale Provides 5 arcmin Resolution
- Designed for Mounting MS1 and T12X Series Translation Stages (Using the CR1A Adapter Plate)
- Application Tested to 25 lbs Vertical Load
- KDC101 K-Cube DC Motor Controller Included

The CR1-Z7E offers high-precision continuous motion in a sturdy, compact package that includes a motorized rotation stage, DC Motor Controller, and power

supply. The reduced-backlash worm gear design coupled with a high-resolution optical encoder provides the rotational precision required in optical laboratories. The high torque 12 VDC servo motor supplies ample power for rotating vertical loads as high as 25 lbs. The position of the rotation stage can be zeroed using the home button in the Kinesis or APT control software, which sets the current position as the zero position; please see the *APT Tutorials* tab for details.

[Hide Specs](#)

S P E C S

Specification	Value
Travel	Continuous 360°
Max Load Vertical	25 lbs (11.3 kg)
Maximum Torque in Vertical Configuration	6.25 lbF-in.
Gear Type	Worm Gear, 96 Teeth
Gear Reduction	256:1
Worm	Double Thread
Motor Type	DC Servo
Motor Drive Voltage	12 V
Max Recommended Current	80 mA
Min Incremental Motion	2.19 arcsec
Wobble	<2 arcsec
Repeatability	<1 arcmin
Feedback	Motor Mounted Rotary Encoder 48 Points/Rev at the Motor
Encoder Counts per Revolution of the Leadscrew	12,288
Planetary Gearhead Ratio	256:1
Speed Range	22 arcsec/sec to 6 °/sec
Maximum Acceleration	$5.0°/\text{sec}^2$
Index Signal	None
Cable Length	9.0' (2.743 m)

How to Calculate the Rotational Displacement per Encoder Count

In order to explain the rotational displacement calculation we must first understand the gear train of the rotational stage. The main platform is fixed directly to a worm gear. This worm gear is actuated by the worm which is attached to the output shaft of the gearhead fixed to the motor.

There are 48 encoder counts per revolution of the motor. The output shaft of the motor goes into a 256:1 planetary gear head. This requires the motor to rotate 256 times to rotate the double thread worm one revolution. In return the worm must rotate 48 times to rotate the 96 pitch worm gear one full revolution.

Encoder Counts per Revolution of the Double-Threaded Worm Gear:

$$48 \times 256 = 12{,}288 \text{ Encoder Counts per Revolution}$$

Calculate the Gear Ratio of the Worm to Worm Gear:

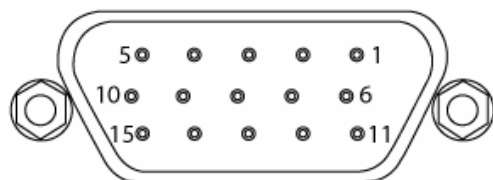$$96 / 2 = 48 \text{ Revolutions of the Worm per One Revolution of the Worm Gear}$$

$$360° / (12{,}288 \times 48) = 0.0006° \times 3{,}600 = 2.16 \text{ arcsec per Encoder Count}$$

[Hide Pin Diagrams](#)

P I N   D I A G R A M S

DC Controller Pin Diagrams

D-Type Female

TRIG 1
SMC Male

TRIG 2
SMC Male

+5 V TTL

+5 V TTL

Pin	Description	Pin	Description
1	Ground	9	Ident In
2	Forward Limit Switch	10	5 V Encoder Supply
3	Reverse Limit Switch	11	Encoder Channel A
4	Not Connected	12	Not Connected
5	Motor -	13	Encoder Channel B
6	Not Connected	14	Not Connected
7	Motor +	15	Not Connected
8	Not Connected		

Computer Connection*

USB 3.0 Port
(Shaded Region Used
For Micro B USB 2.0)
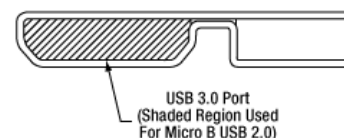
*The USB 3.0 port is compatible with a USB 2.0
Micro B connector if the Micro B connector is
plugged into the shaded region in the photo
above. A USB 3.0 type A to type Micro B cable is
included with the KDC101.

[Hide Software](#)

S O F T W A R E

The APT (Advanced Positioning Technology) family covers a wide range of motion controller products ranging from small low powered single channel optomechanical motor drivers (the 'Cube' drivers) to high power multi-channel modular 19" rack nanopositioning systems (the APT Rack System).

Typical APT User GUI

All controllers in the APT family share a common software platform, the APT System Software. The software CD supplied with all controllers contains an installation of this system software, together with a wealth of support information in the form of handbooks, help files, tutorial videos, FAQs and other relevant information on using and programming these Thorlabs products.

By providing this common software platform, Thorlabs has ensured that users can easily mix and match any of the APT controllers in a single application while only having to learn one single set of software tools. In this way it is perfectly feasible to combine any of the controllers from the low powered single axis to the high powered multi-axis systems and control all from a single PC based unified software interface.

The APT System Software allows two methods of usage - graphical user interface utilities (supplied) for direct interaction and control of the controllers out of the box, and a set of programming interfaces that allow custom integrated positioning and alignment solutions to be easily progammed in the development language of choice.

Detailed information on both usage modes is provided on the CD.
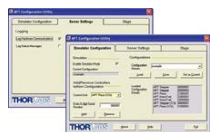
Typical Configuration Screen

Also of particular interest is the inclusion on the software CD of a range of software video tutorials (see the *Video Tutorials* tab). These videos illustrate some of the basics of using the APT System Software from both a non-programming and a programming point of view. There are videos that illustrate usage of the supplied APT utilities that allow immediate control of the APT controllers out of the box. There are also a number of videos that explain the basics of programming custom software applications using Visual Basic, LabView and Visual C++.

Click here to go direct to the Thorlabs Download Area to access the full APT software CD. Experiment with the software using the simulator mode - refer to the Tutorial Videos for the APTConfig utility to learn how to select simulator mode.

[Hide Motion Control Software](#)

MOTION CONTROL SOFTWARE

Thorlabs offers two platforms to drive our wide range of motion controllers: our legacy APT™ (Advanced Positioning Technology) software package or the new Kinesis software package. Either package can be used to control devices in the APT or Kinesis family, which covers a wide range of motion controllers ranging from small, low-powered, single-channel drivers (such as the K-Cubes and T-Cubes) to high-power, multi-channel, modular 19" rack nanopositioning systems (the APT Rack System).

Our legacy APT System Software platform is available by clicking on the link below. It features ActiveX-based controls which can be used by 3rd party developers working on C#, Visual Basic, LabVIEW or any Active-X compatible languages to create custom applications, and includes a simulator mode to assist in developing custom applications without requiring hardware.

The Kinesis Software features new .NET controls which can be used by 3rd party developers working in the latest C#, Visual Basic, LabVIEW or any .NET compatible languages to create custom applications. Low level DLL libraries are included for applications not expected to use the .NET framework. A Central Sequence Manager supports integration and synchronization of all Thorlabs motion control hardware.

By providing these common software platforms, Thorlabs has ensured that users can easily mix and match any of the APT and Kinesis controllers in a single application, while only having to learn a single set of software tools. In this way, it is perfectly feasible to combine any of the controllers from single-axis to multi-axis systems and control all from a single, PC-based unified software interface.

APT GUI Screen

The software packages allow two methods of usage: graphical user interface (GUI) utilities for direct interaction with and control of the controllers 'out of the box', and a set of programming interfaces that allow custom-integrated positioning and alignment solutions to be easily programmed in the development language of choice.

A range of video tutorials are available to help explain our APT system software. These tutorials provide an overview of the software and the APT Config utility. Additionally, a tutorial video is available to explain how to select simulator mode within the software, which allows the user to experiment with the software without a controller connected. Please select the *APT Tutorials* tab above to view these videos, which are also available on the software CD included with the controllers.

Software
APT Version 3.21.0

The APT Software Package, which includes a GUI for control of Thorlabs' APT™ and Kinesis® system controllers.
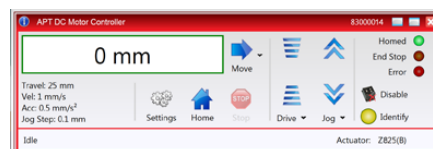
Also Available:

- Communications Protocol

Software
Kinesis Version 1.11.2

The Kinesis Software Package, which includes a GUI for control of Thorlabs' Kinesis and APT™ system controllers.

Also Available:

- Communications Protocol

Kinesis GUI Screen

[Hide APT Tutorials](#)

APT TUTORIALS

These videos illustrate some of the basics of using the APT System Software from both a non-programming and a programming point of view. There are videos that illustrate usage of the supplied APT utilities that allow immediate control of the APT controllers out of the box. There are also a number of videos that explain the basics of programming custom software applications using Visual Basic, LabView and Visual C++. Watch the videos now to see what we mean.

 Click here to view the video tutorial

To further assist programmers, a guide to programming the APT software in LabView is also available.

Click here to view the LabView guide

Part Number	Description	Price	Availability
CR1/M-Z7K	DC Servo Motorized Rotation Stage with Controller, Metric	$1,390.00	Lead Time
CR1-Z7K	DC Servo Motorized Rotation Stage with Controller	$1,390.00	3-5 Days

Hide Rotation Stage Adapter

Rotation Stage Adapter

Hide Overview

OVERVIEW

The CR1A adapter can be used to secure select Thorlabs mounts to the CR1 Rotation stage. The adpater is equipped with four 6-32 (M4) taps, one 1/4"-20 (M6) tap, six 4-40 taps (two 4-40 and four M3 on the metric version), eight 2-56 taps (four 2-56 and four M2 on the metric version), and four #6 (M4) clearance holes. The following table lists mounts that may be secured to the the CR1.

The CR1A adapter is attached to the CR1 stage via the #6 (M4) clearance holes with four 6-32 (M4) cap screws (included). The photo to the right shows a T12X translation stage mounted on the CR1A adapter through two #2 (M2) clearance holes in the bottom of the T12X stage.

Click to Enlarge
A CR1A Adapter is used to secure a T12X Mini Translator onto a CR1 Rotation Stage using two 2-56 (M2) cap screws.

Mount	Description
PM3 and PM4	Small and Large Clamping Arms
PH Series	Post Holders
T12 Series	1/2" Mini Translators
GN Series*	Small Platform Goniometers*

* Note: The CR1A adapter plate is not compatible with our GNL series Large Platform Goniometers.

Part Number	Description	Price	Availability
CR1A/M	CR1/M Adapter Plate	$24.50	Today
CR1A	CR1 Adapter Plate	$24.50	Today

Hide Clamping Arms

Clamping Arms

Hide Overview

OVERVIEW

Features

- Provides Clamping Force for Our Prism Mounts and V-Clamps
- Stackable 6-32 (M4) Threads on Top and Bottom of Post

Thorlabs' PM3(/M) and PM4(/M) clamping arms feature a cap screw-activated flexure mechanism to secure the clamping arm to the post, while a nylon-tipped setscrew secures the optic. A Ø0.09" (Ø2.3 mm) hole located near the top of the post allows for its initial tightening with a 5/64" (2 mm) balldriver or hex key. Both screws feature a 5/64" (2 mm) socket. The PM3(/M) arm offers 0.97" (24.6 mm) of vertical travel, while the PM4(/M) arm offers 1.61" (40.9 mm) of vertical travel.

Click to Enlarge
A PM4 Clamping Arm is Used to Hold an Equilateral Prism to the CR1 Rotation Mount

Part Number	Description	Price	Availability
PM3/M	Small Adjustable Clamping Arm, M4 Threaded Post	$18.40	Today
PM3SP/M	Customer Inspired!Extension Post for PM3/M Clamping Arm, M4 Threaded	$5.10	Today
PM4/M	Large Adjustable Clamping Arm, M4 Threaded Post	$22.50	Today
PM4SP/M	Customer Inspired!Extension Post for PM4/M Clamping Arm, M4 Threaded	$5.10	Today
PM3	Small Adjustable Clamping Arm, 6-32 Threaded Post	$18.40	Today
PM3SP	Customer Inspired!Extension Post for PM3 Clamping Arm, 6-32 Threaded	$5.10	Today
PM4	Large Adjustable Clamping Arm, 6-32 Threaded Post	$22.50	Today
PM4SP	Customer Inspired!Extension Post for PM4 Clamping Arm, 6-32 Threaded	$5.10	Today