

# **HDR50 and HDR50/M Motorized 360° Rotation Stage**

## **User Guide**



Original Instructions

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## Chapter 1 Overview

### 1.1 Description

The HDR50 motorized rotation stage provides arc-second resolution when driven from a microstepping stepper motor controller. The low profile design, measuring just 44 mm high, is made possible by the use of two compact precision bearings. The rotating carriage of the stage provides continuous rotation of loads up to 50 kg and has a 50 mm clear aperture to allow the passage of the optical path directly through the stage. The main body of the stage is made from lightweight aluminum and can attach directly to an optical table, or be mounted at any orientation via the 10 mounting holes provided along four surfaces of the device. A worm gear assembly is used to transfer the rotary motion of the stepper motor into rotary motion of the carriage. There is a mechanical reduction in this gear assembly that provides one revolution of the carriage for every 66 turns of the stepper motor.

An electrical limit switch has been fitted to allow the user to datum the stage but this limit switch is only active in the negative direction. This means that the stage will run to infinity in the positive direction, but will not pass zero in the negative direction. If a movement is programmed that takes the manipulator past its negative limit, the limit switch will trip and stop the motor. It is then only possible to execute moves in the positive direction until the limit switch is no longer tripped.

The HDR50 is designed specifically to operate with the BSC20x benchtop stepper motor controllers or the MST602 modular stepper motor control unit.

For further information on these controllers, please refer to the relevant manuals.

### 1.2 Accessories

Several mounting plates are available which allow the stage to be fixed to an optical table in either horizontal or vertical configurations. The adapter plates allow device holders to be fitted to the rotating platform. The stage can also be mounted onto one of our NST or TravelMax long travel stages.

*NR360SP2 - Vertical Mounting Bracket:* Allows the HDR50 rotation stage to be mounted in a vertical orientation.

*NR360SP4 (M) - Grooved Carriage Plate:* This adapter plate provides an easy means to integrate all of the miscellaneous accessories from our fiber launch systems product line. These accessories include optical mounts, tip-tilt mounts, as well as fiber holders.

*NR360SP5 - Mounting Plate:* This mounting plate allows the HDR50 stage to be attached to a LNR50 TravelMax, or NRT stage.

*NR360SP8 - SM1 Adapter Plate:* This mounting plate features an SM1 threaded through hole and allows 1" optics and our SM1 product line to be mounted to the HDR50. It also provides compatibility with our 30 mm cage system.

*NR360SP9(M) - 1/4"-20 (M6) Threaded Adapter Plate:* Features 17 1/4"-20 (M6) Mounting holes, providing numerous options for attaching devices to the HDR50.

Please see the HDR50 stage web page at [www.thorlabs.com](http://www.thorlabs.com) for more details on the range of accessories available.

## Chapter 2 Safety

### 2.1 Safety Information

For the continuing safety of the operators of this equipment, and the protection of the equipment itself, the operator should take note of the **Warnings**, **Cautions** and **Notes** throughout this handbook and, where visible, on the product itself.

The following safety symbols may be used throughout the handbook and on the equipment itself.



**Warning: Risk of Electrical Shock**

Given when there is a risk of injury from electrical shock.



**Warning**

Given when there is a risk of injury to users.



**Caution**

Given when there is a risk of damage to the product.

**Note**

Clarification of an instruction or additional information.

### 2.2 General Warnings and Cautions



**Warning**

If this equipment is used in a manner not specified in the handbook, the protection provided by the equipment may be impaired. In particular, excessive moisture may impair operation.

Spillage of fluid, such as sample solutions, should be avoided. If spillage does occur, clean up immediately using absorbent tissue. Do not allow spilled fluid to enter the internal mechanism.

The equipment is for indoor use only.



**Warning**

To avoid injury never put any part of your body in the gap between the moving platform and a rigid structure.

## Chapter 3 Operation

### 3.1 Using the HDR50

#### 3.1.1 Background

The hybrid stepper motor used in the actuator, with its rotor that consists of 50 individual magnetic teeth, is ideally suited for micro-stepping applications. Aside from the obvious increase in resolution provided by increasing the steps per revolution from 200 to 409,600, micro-stepping also ensures smoother low speed motion by allowing the discrete  $1.8^\circ$  step size, which produces vibrational noise, to be reduced to much smaller steps with inherently lower resultant vibrational noise.

The rotation stage utilizes a worm gear assembly which provides one complete rotation of the platform for every 66 turns of the stepper motor. When used with the BSC20x series or MST602 controllers, the stepper motor provides 409,600 steps per revolution resulting in  $66 \times 409,600$  steps per revolution of the stage. This results in a  $360/(66 \times 409,600)^\circ$  or  $13.3 \times 10^{-6}$  degrees of platform rotation per microstep.

The HDR50 stage is connected to the Stepper Motor Controller via a flying lead terminated in a D-type type connector. A 3m extension cable (PAA613) is also supplied.

**Caution**

Before the HDR50 is plugged in or unplugged, the relevant stepper motor controller must be switched off or the associated drive channel disabled. Failure to do this may result in damage to the controller, the stage, or both.

Manual control of the stage can be achieved by switching off the drive to the motors and turning the knob on the motor housing. Please refer to the relevant controller manual.

**Caution**

The electrical limit switch does not operate when the motor is being turned by hand. Care must be taken to avoid fouling if the drive is turned past the limit switch.

### 3.2 Selecting the Stage Type

To ensure that a particular stage is driven properly by the system, a number of parameters must first be set. These parameters relate to the physical characteristics of the stage being driven (e.g. min and max positions, leadscrew pitch, homing direction etc.).

To assist in setting these parameters correctly, it is possible to associate a specific stage type and axis with the motor controller channel. Once this association has been made, the server applies automatically, suitable default parameter values on boot up of the software.

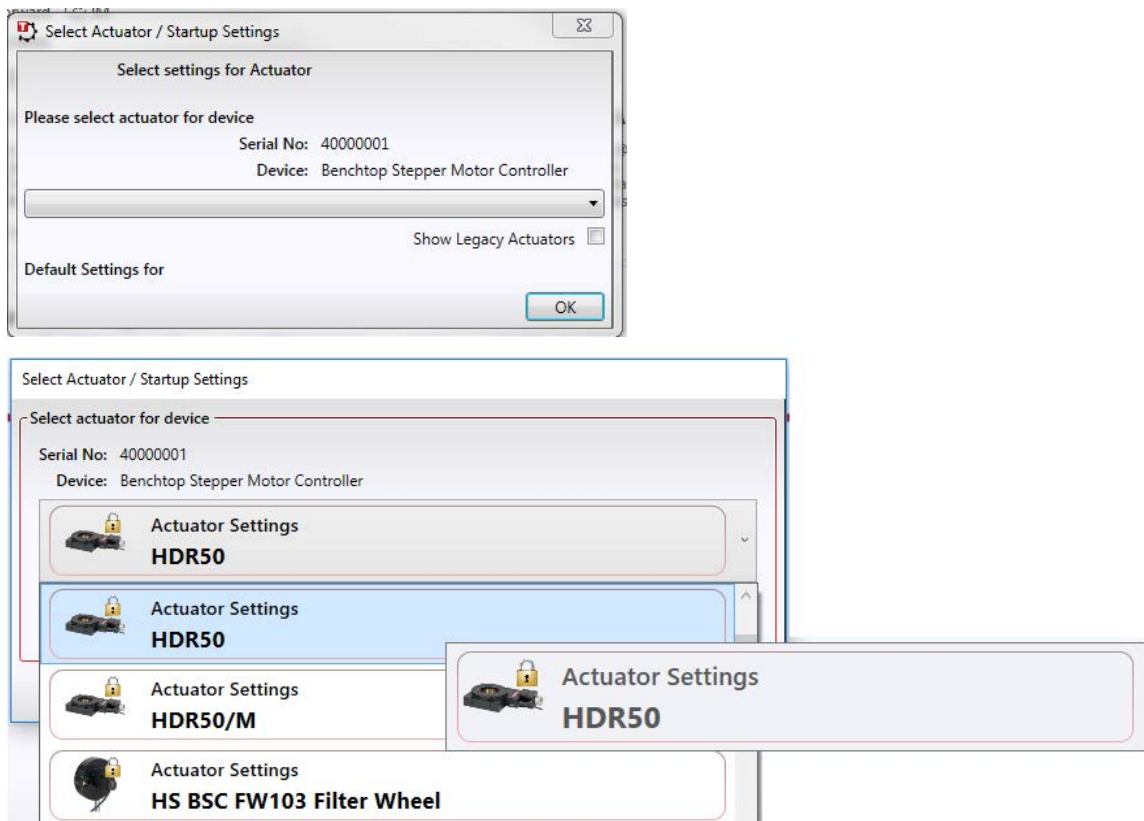
### Using Kinesis Software



**Caution**

The host PC must be running Kinesis v1.14.16 or higher.

- 1) Install the electronic hardware and connect the modules to the relevant axes of the associated stages (see the handbooks for the associated controller).
- 2) For each Stepper Motor Controller in your system, fit the interlock plug (supplied) to the MOTOR CONTROL connector on the rear panel.
- 3) Ensure that the device is connected to the PC and powered up.
- 4) Run the Kinesis software - Start/All Programs/Thorlabs/Kinesis/Kinesis.
- 5) On start-up, the 'Actuator/Startup Settings' window is displayed. This window allows the correct actuator to be selected.



**Fig. 3.1 Stage Configuration Window**

- 6) Select your actuator type (i.e. HDR50 or HDR50/M).
- 7) Click OK.
- 8) The server reads in the stage and controller information automatically.  
Refer to the handbook for the associated controller for more information on driving the actuator/stage.

**Note**

In applications where continuous rotation is necessary for prolonged periods, it is possible that the position register inside the controller could overflow. In this case, the stage will continue to operate, but the position readout is no longer accurate. Homing the stage will restore the positional accuracy.

## Using APT Software

**Caution**

The host PC must be running APT v3.21.3 or higher.

- 1) Install the electronic hardware and connect the modules to the relevant axes of the associated stages (see the handbooks for the associated controller).
- 2) For each Stepper Motor Controller in your system, fit the interlock plug (supplied) to the MOTOR CONTROL connector on the rear panel.
- 3) Shut down all applications using the APT server (e.g. APT User or your own custom application).
- 4) Run the APT Config utility - Start/All Programs/Thorlabs/APT Config/APT Config.
- 5) From the 'APT Configuration Utility' window, click the 'Stage' tab.

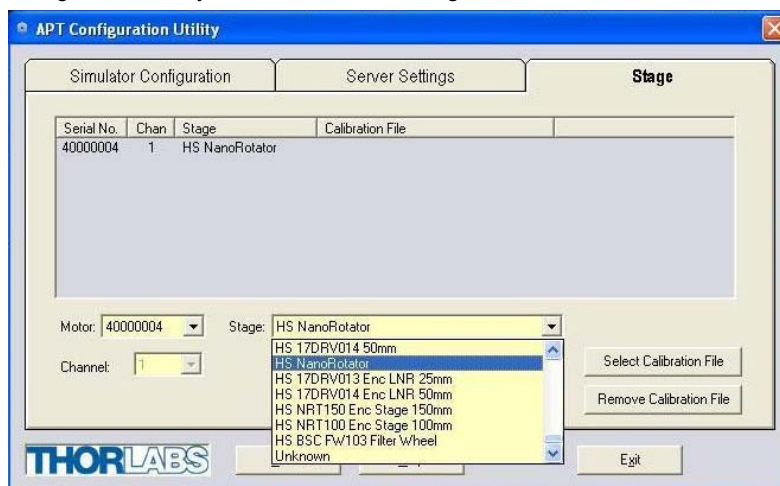


Fig. 3.2 APT Configuration Utility - Stage Tab

- 6) In the 'Motor' field, select the serial number of the stepper motor controller to be configured (this number can be found on the rear panel of the controller unit).

**Note**

To ensure correct operation, it is important to select the correct stage and axis type as described previously. Selecting an incompatible stage/axis type could result in reduced velocity and resolution. The HDR50 is a direct replacement for our legacy NanoRotator stage and has identical operating parameters.


- 7) In the 'Stage' field, select 'HS NanoRotator' from the list displayed.
- 8) Click the 'Add Stage Association' button.
- 9) A default configuration is set at the factory and stored in the non-volatile memory of the motor controller. The server reads in the stage and controller information on start up. Refer to the handbook for the associated controller for more information on driving the actuator/stage.

**Note**

In applications where continuous rotation is necessary for prolonged periods, it is possible that the position register inside the controller could overflow. In this case, the stage will continue to operate, but the position readout is no longer accurate. Homing the stage will restore the positional accuracy.


## Chapter 4 Installation

### 4.1 Unpacking

**Caution**  Once removed from its packaging, the stage is easily damaged by mishandling. The unit should only be handled by its base, not by the top platform or any attachments to the top platform.

Do not carry the stage by the drive actuator. Serious damage may occur if excessive force is applied to the drive.


### 4.2 Environmental Conditions

**Caution**  This unit is design for operation within normal operating conditions. It is not recommended to use this equipment outside the following limits.

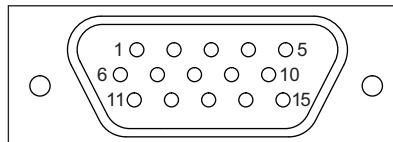
Location	Indoor use only
Maximum altitude	2000 m
Temperature range	5 to 40°C (41 to 104°F)
Maximum Humidity	Less than 80% RH (non-condensing) at 31°C

To ensure reliable operation the unit should not be exposed to corrosive agents or excessive moisture, heat or dust. If the unit has been stored at a low temperature or in an environment of high humidity, it must be allowed to reach ambient conditions before being powered up. The unit must not be used in an explosive environment.

### 4.3 Transportation

**Caution**  When packing the unit for shipping, use the original packing. If this is not available, use a strong box and surround the stage with at least 100 mm of shock absorbent material.

### 4.4 Electrical Connections



Pin	Description
1*	Limit Switch Ground *
2	Not Used
3	CW Limit Switch
4	Ph B -ve
5	Ph B +ve
6	Ph A -ve
7	Ph A +ve
8 and 9	Not Used
10**	5 V
11 and 12	Not Used
13**	5 V
14	Not Used
15	Earth

Note.  
 \* The limit switch ground is connected to the motor body.  
 \*\* Pins 10 and 13 are connected inside the D-Type shell



## 4.5 Mounting to the Work Surface

The stage bolts directly to the work surface as shown below.

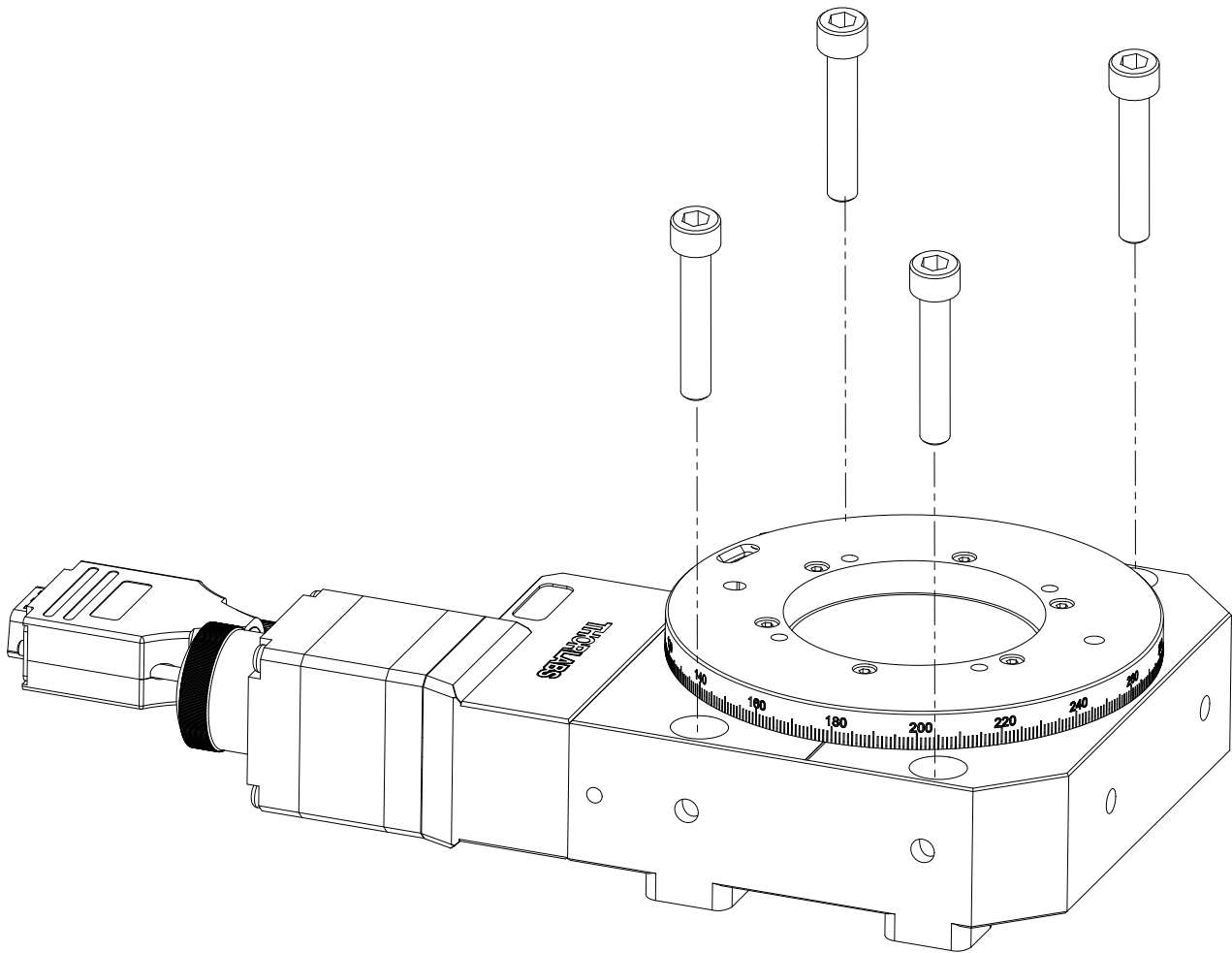


Fig. 4.1 Mounting the Stage to the Work Surface

## 4.6 Attaching Components and Devices



### Caution

Users must ensure that components and devices fitted to the unit are properly secured to the moving platform.

## Chapter 5 Specification and Dimensions

### 5.1 Specification

Parameter	Value
<b>General Specifications</b>	
Construction	Aluminum Body and Platform Black Anodised
Travel	360° Continuous Rotation
Max Load Capacity (On-Rotation-Axis)	50 kg (110 lbs)
Drive Mechanism	Worm Drive
Gear Ratio	66:1
Homing Sensor	Hall Effect, Non-Contact
Motor Type	2 Phase Stepper
Stage Bidirectional Repeatability	±350 µrad
Stage Bidirectional Accuracy	±820 µrad
Minimum Incremental Motion	0.8 µrad
Homing Bidirectional Repeatability	±203 µrad
Axis Wobble	65 µrad
Maximum Speed	50°/ sec (If used with BSC201)
Maximum Acceleration	80°/ sec/sec (If used with BSC201)
Maximum Torque	6 N•m
Operating Temperature Range	5° to 40° C
Humidity range	Less than 80% RH at 31° C
Recommended Controller	BSC201
Weight	1.52 kg (3.34 lb)
<b>Motor Specifications</b>	
Step Angle	1.8° (200 major steps per revolution)
Micro-stepping	2048 micro-steps per major step for a total of 409,600 per revolution
Rated Phase Current	0.85 A
Resistance / Phase	3.6 Ω
Inductance / Phase	4.6 mH

5.2 Dimensions

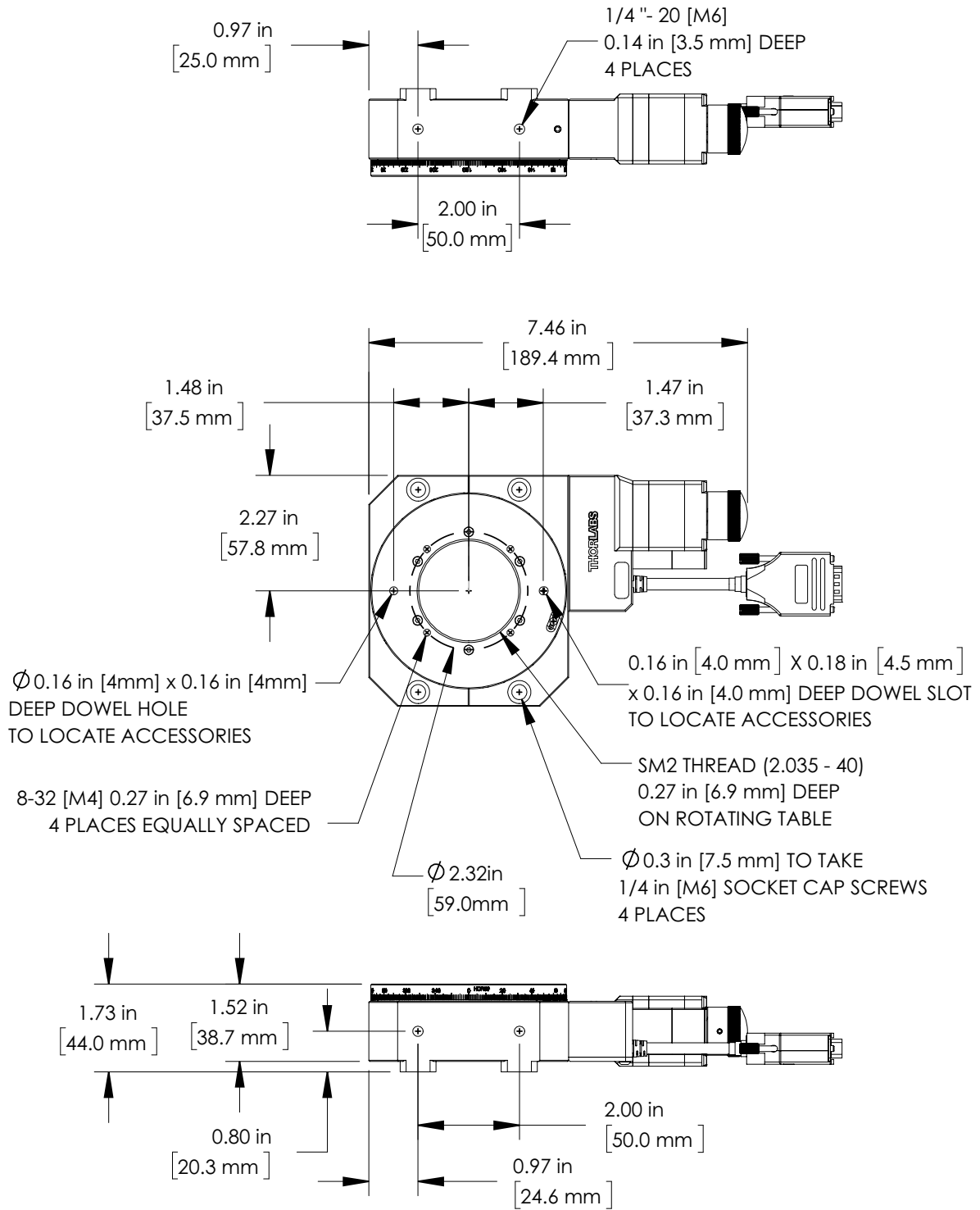



Fig. 5.1 HDR50(M) Dimensions

## Chapter 6 Regulatory

### 6.1 Declarations Of Conformity

#### 6.1.1 For Customers in Europe



# THORLABS

www.thorlabs.com

## EU Declaration of Conformity

in accordance with EN ISO 17050-1:2010

**We:** Thorlabs Ltd.

**Of:** 1 St. Thomas Place, Ely, CB7 4EX, United Kingdom

*in accordance with the following Directive(s):*

2006/42/EC	Machinery Directive (MD)
2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS)

*hereby declare that:*

**Model:** *HDR50 and HDR50/M*

**Equipment:** *Heavy Duty Rotation Stage*


*is in conformity with the applicable requirements of the following documents:*

EN ISO 12100	Safety of Machinery. General Principles for Design. Risk Assessment and Risk Reduction	2010
EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013

*and which, issued under the sole responsibility of Thorlabs, is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8th June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, for the reason stated below:*

does not contain substances in excess of the maximum concentration values tolerated by weight in homogenous materials as listed in Annex II of the Directive


*I hereby declare that the equipment named has been designed to comply with the relevant sections of the above referenced specifications, and complies with all applicable Essential Requirements of the Directives.*

**Signed:**  **On:** 25 April 2019

**Name:** Keith Dhese

**Position:** General Manager

EDC - HDR50 and HDR50/M -2019-04-25



#### 6.1.2 For Customers In The USA

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the company could void the user's authority to operate the equipment.

## Chapter 7 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at [www.thorlabs.com/contact](http://www.thorlabs.com/contact) for our most up-to-date contact information.



### USA, Canada, and South America

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### Brazil

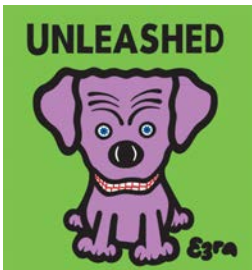
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### China

Thorlabs China  
[chinasales@thorlabs.com](mailto:chinasales@thorlabs.com)

Thorlabs verifies our compliance with the WEEE (Waste Electrical and Electronic Equipment) directive of the European Community and the corresponding national laws. Accordingly, all end users in the EC may return "end of life" Annex I category electrical and electronic equipment sold after August 13, 2005 to Thorlabs, without incurring disposal charges. Eligible units are marked with the crossed out "wheelie bin" logo (see right), were sold to and are currently owned by a company or institute within the EC, and are not disassembled or contaminated. Contact Thorlabs for more information. Waste treatment is your own responsibility. "End of life" units must be returned to Thorlabs or handed to a company specializing in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.





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