# OM6 Series
# Fast Laser Power Modulators

# User Guide

# Table of Contents

# Chapter 1 Warning Symbol Definitions

Below is a list of warning symbols you may encounter in this manual or on your device.

| Symbol | Description |
|---|---|
|  | Direct Current |
|  | Alternating Current |
|  | Both Direct and Alternating Current |
|  | Earth Ground Terminal |
|  | Protective Conductor Terminal |
|  | Frame or Chassis Terminal |
|  | Equipotentiality |
|  | On (Supply) |
|  | Off (Supply) |
|  | Caution: Risk of Electric Shock |
|  | Caution: Hot Surface |
|  | Caution: Risk of Danger |
|  | Warning: Laser Radiation |
|  | Caution: Spinning Blades May Cause Harm |

# Chapter 2 Safety

All statements regarding operational safety and technical data in this manual will only apply when the unit is operated correctly.

**CAUTION**

**Except for the photodetector, which is accessible from the outside of the housing, the modulator has no user-serviceable parts.**

# Chapter 3 Description

## 3.1. Introduction

Thorlabs' fast laser power modulators rely on deformable mirror technology instead of Pockels cells or acousto-optic modulators. They are designed for optical modulation applications, such as beam attenuation and high speed modulation in the temporal domain.

In contrast to a Pockels cell, each modulator can be used for DC power control as well as high-speed modulation for fly-back blanking or region of interest selection, which makes it ideal for imaging applications. The advantages of these modulators include continuous sustained operation, near-zero dispersion, and polarization independence. The mechanical and electrical design does not require active cooling, eliminating fan vibrations.

The analog 0 V to 1 V input voltage allows for easy control of the modulation depth from any user-provided DAC device.

Inside each modulator, a gold-coated MEMS mirror is deformed into a diffractive grating when voltage is applied to the device. The zeroth-order beam is selected by an aperture of Ø3.8 mm placed in the far field. The intensity of the zeroth-order beam is continuously tuned by the level of the input voltage. This all-reflective-device has minimal (<100 $fs^2$) dispersion and is polarization independent.

## 3.2. Shipping List

- Fast Laser Power Modulator
- Power Supply Meanwell GST160A24-R7B
- Power Supply LDS12B

# Chapter 4 Setup and Operation

The modulator is intended for use in a laboratory setting. It should be mounted on an optical bench and operated under controlled conditions. Review the information in Chapter 7 Specifications before using the device.

The modulator is passively cooled. Ensure that it is positioned in a way that allows adequate airflow.

## 4.1. Optical Alignment

Position the modulator as desired and secure it to the optical table using appropriate hardware. The modulator can be mounted directly to an optical table using clamps or raised using hardware attached to the threaded holes on the underside.

Align the beam to the input aperture using the appropriate additional optics (not included). Make sure that the input beam parameters match the specifications in Chapter 7. The modulator is a directional device and will not work properly if the beam is aligned in the opposite direction.

The modulator is factory aligned to accept a beam centered and perpendicular to the input port. Figure 1 below shows a diagram of the internal beam path. The input port is compatible with Thorlabs' SM05 lens tubes and 30 mm cage systems, allowing a variety of optomechanical hardware to be attached to aid in alignment.

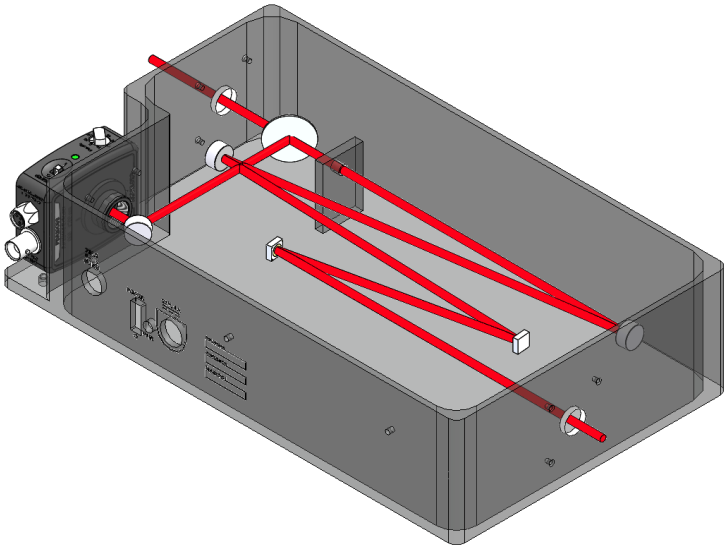


***Figure 1 Internal beam path (red line) of the optical modulator. Shown only to aid in understanding. No internal optics are adjustable, and the lid should not be removed.***

A variety of strategies can be used to align the input beam. One example is shown in Figures Figure 2 and Figure 3 using a pair of mirrors. The first, farther mirror is used primarily to set the **position** of the beam at the input aperture. The second, closer mirror is used primarily to set the **angle** of the beam into the input aperture, which is equivalent to setting the position at the output (Figure 3).

If the initial input angle is significantly off, no output may be visible. In such a case, the input angle can be freely and safely adjusted over a large range to find the output beam.

If a large adjustment is required to the input angle, iterate the process to maintain the centration of the input at the input aperture. In general, the closer the second mirror is to the device, the fewer iterations will be required.

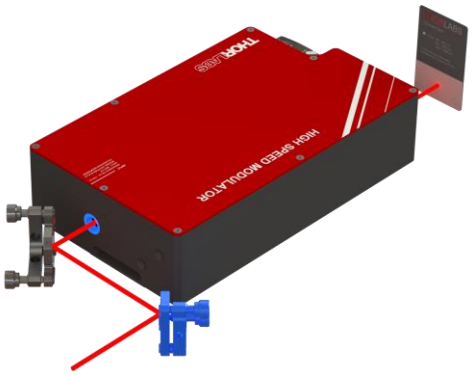



***Figure 2 Position two mirror mounts before the device, one as close as possible to the input. Use the farther mirror (highlighted) to center the input beam on the input aperture (highlighted).***

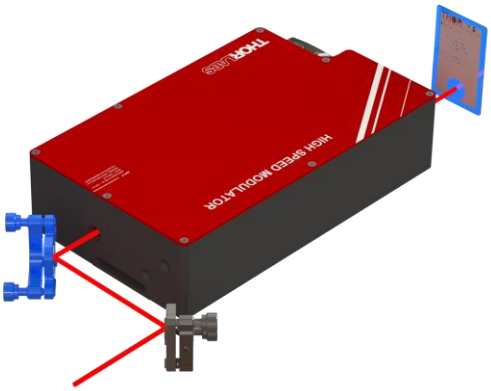



***Figure 3 Use the closer mirror (highlighted) to align the beam through the output port. The output beam is shown for effect. Only part of the pattern passes through the 3.8 mm internal aperture at any time (see Figures 4 and 5). Use an appropriate viewing surface for the laser wavelength and power.***

The diffractive optical elements inside the device will produce residual beams whose pattern depends on the modulator and the transmission settings (Figures 4 and 5). The central, useful beam is most prominent and easiest to align when the device is powered off or set to maximum transmission (0 V input).

a b

***Figure 4 Output beam patterns of the standard contrast OM6N(/M) modulator: (a) powered off or powered on and set to high transmission, (b) powered on and set to low transmission. Only the central beam passes through the output aperture when the beam is properly aligned.***

a b

***Figure 5 Output beam patterns of the high contrast OM6NH(/M) and OM6ENH(/M) modulators: (a) powered off or powered on and set to high transmission, (b) powered on and set to low transmission. Only the central beam passes through the output aperture when the beam is properly aligned.***

Before alignment of the input beam, or if the initial alignment is too poor to find the output beam, the mirrors can be coarsely aligned by illuminating the device in reverse with a bright, diffuse light source (e.g. an LED flashlight).

## 4.2. Modulation

The transmission, which is a function of both input voltage and wavelength, is modulated by an external input voltage signal. See the figures below for typical transmission and extinction voltage curves.

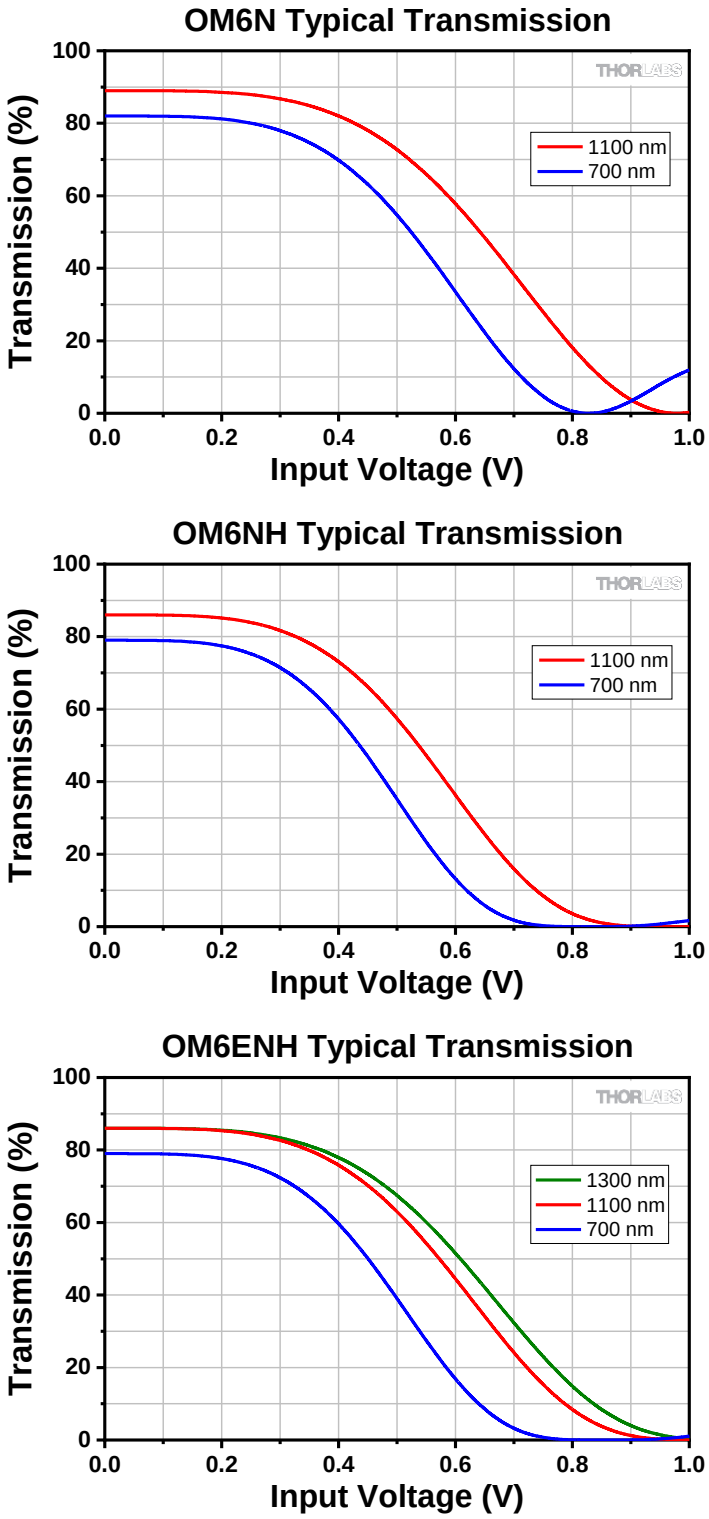



***Figure 6 Typical transmission for OM6 series modulators at select wavelengths. Full transmission (at 0 V) differs due to the reflectance of the gold mirrors.***

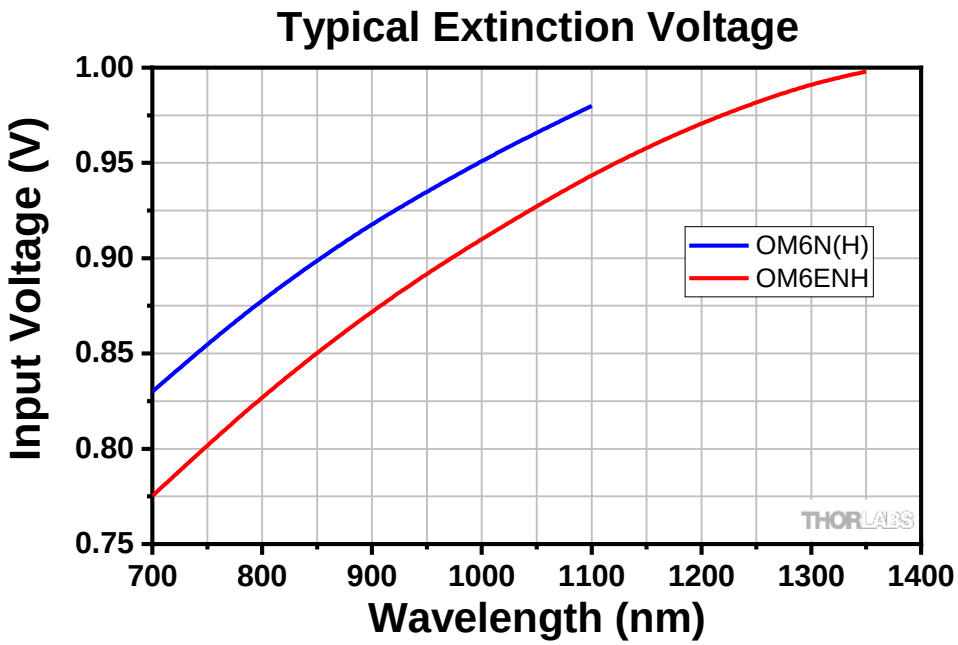



***Figure 7 Typical Extinction Voltages as a Function of Input Wavelength***

The exact voltage for maximum extinction varies from device to device. In addition, the actual applied voltage will depend on both the accuracy of the voltage source and the output impedance of the voltage source. Errors of several percent are typical. Therefore, in general, a source with adjustable voltage will be necessary to achieve maximum extinction.

## 4.3. Photodiode Operation

Each OM6N & OM6NH modulator is shipped with a preinstalled Thorlabs PDA100A2 silicon switchable gain detector. Each OM6ENH modulator is shipped with a Thorlabs PDA20CS2 silicon switchable gain detector. Refer to the respective detector manual for detailed information about its responsivity and bandwidth.

A beamsplitter inside the modulator redirects a small amount of output light (<1%) to the photodetector output port. This provides an optional, convenient signal for characterizing and calibrating the transmission.

Note that for longer wavelengths and higher gain settings the bandwidth of the included detector is below the maximum modulation frequency of the modulator, i.e. the detector may not be fast enough to fully capture the optical modulation.

The photodetector can be easily removed and replaced with a user-supplied detector if the included detector is inappropriate for the operating conditions (longer wavelengths, lower powers, or shorter pulses). The detector is secured with a single 8-32 cap screw (9/64" hex), accessible from the underside of the modulator. Similar Thorlabs detectors can be secured using the same screw. 30 mm cage features are also available for mounting a variety of other detectors.

# Chapter 5 Maintenance

The internal optical surfaces of the modulator are sensitive and inaccessible for cleaning. To protect them from dust and other contamination, the input and output ports should be covered when the modulator is stored or unused for extended periods of time.

**CAUTION**

**Except for the photodetector, which is accessible from the outside of the housing, the modulator has no user-serviceable parts. Service should only be performed by trained service personnel.**

# Chapter 6 Troubleshooting

| Description | Possible cause | Solution |
|---|---|---|
| No transmission | The modulator is active | Reduce the input voltage |
| | The input beam is misaligned | Repeat the alignment procedure |
| The beam is clipped | The input beam is misaligned | Repeat the alignment procedure |
| | The beam is too large or too divergent | Reduce the beam size and/or divergence |
| No modulation of the light | The modulator is not turned on | Ensure the power switch is in the on position and the power LED is lit |
| | The input signal is set incorrectly | Check the input signal with an oscilloscope |
| No signal from the photodetector | The detector is not turned on | Ensure the photodetector power switch is in the on position and the photodetector LED is lit. |
| | The gain setting is too low or too high | Slowly increase the gain from 0 to higher dB |
| Low extinction | The modulation input voltage is incorrect | Find the voltage corresponding to the wavelength of interest |
| | The wavelength is outside the operating wavelength range | Restrict the wavelength to the operating range |
| | The modulation frequency is too high | Refer to the specifications and reduce the modulation frequency |

# Chapter 7 Specifications

| Item # | OM6N(/M) | OM6NH(/M) | OM6ENH(/M) |
|---|---|---|---|
| **Contrast Ratio** | >250:1 | >2500:1 | >2500:1 |
| **Operating Range**[a] | 700 - 1100 nm | | 700 - 1350 nm |
| **Included Photodetector** | PDA100A2 | | PDA20CS2 |
| **Input Polarization** | Any | | |
| **Rise Time**[b] | 1.5 - 5 µs | | |
| **Fall Time** | <2 µs | | |
| **Modulation Frequency** | 0 - 20 kHz | | |
| **Modulation Voltage**[c] | 0 - 1 V | | |
| **Input Impedance**[c] | 10 kΩ | | |
| **Transmission @ 800 nm** | >80% | | |
| **Maximum Input Pulse Energy** | 500 nJ | | |
| **Maximum Input Optical Power** | 10 W | | |
| **Internal Aperture**[d] | Ø3.8 mm | | |
| **Internal Optical Path Length** | 1000 mm | | |
| **Dispersion** | <100 $fs^2$ | | |
| **Transmitted Wavefront Error**[e] | <λ/4 (at 633 nm) | | |
| **Power Supply** | 24 V, 1 A | | |
| **Operating Temperature** | 15 - 35 ˚C | | |
| **Operating Humidity** | 20 - 60% | | |
| **Storage Temperature** | -25 - 70 °C | | |
| **Housing Dimensions** | 11.45" x 6.83" x 2.80" (290.8 mm x 173.4 mm x 71.1 mm) | | |

a. The modulator can be used outside the specified wavelength range. However, the damage threshold for wavelengths outside this range is unspecified and may be lower, especially for shorter wavelengths. The modulator may not be able to achieve full extinction for wavelengths higher than the max operating wavelength (1100 nm for OM6N & OM6NH; 1350 nm for OM6ENH).
b. The time required for the transmission to rise from 10% to 90%. Response depends on DC attenuation level.
c. A 10 kΩ internal pull-down resistor holds the input voltage at 0 V if no input is provided.
d. The recommended collimated input beam diameter ($1/e^2$) is 1 - 2 mm.
e. Independent of modulation level.

## 7.1. Mechanical Drawings

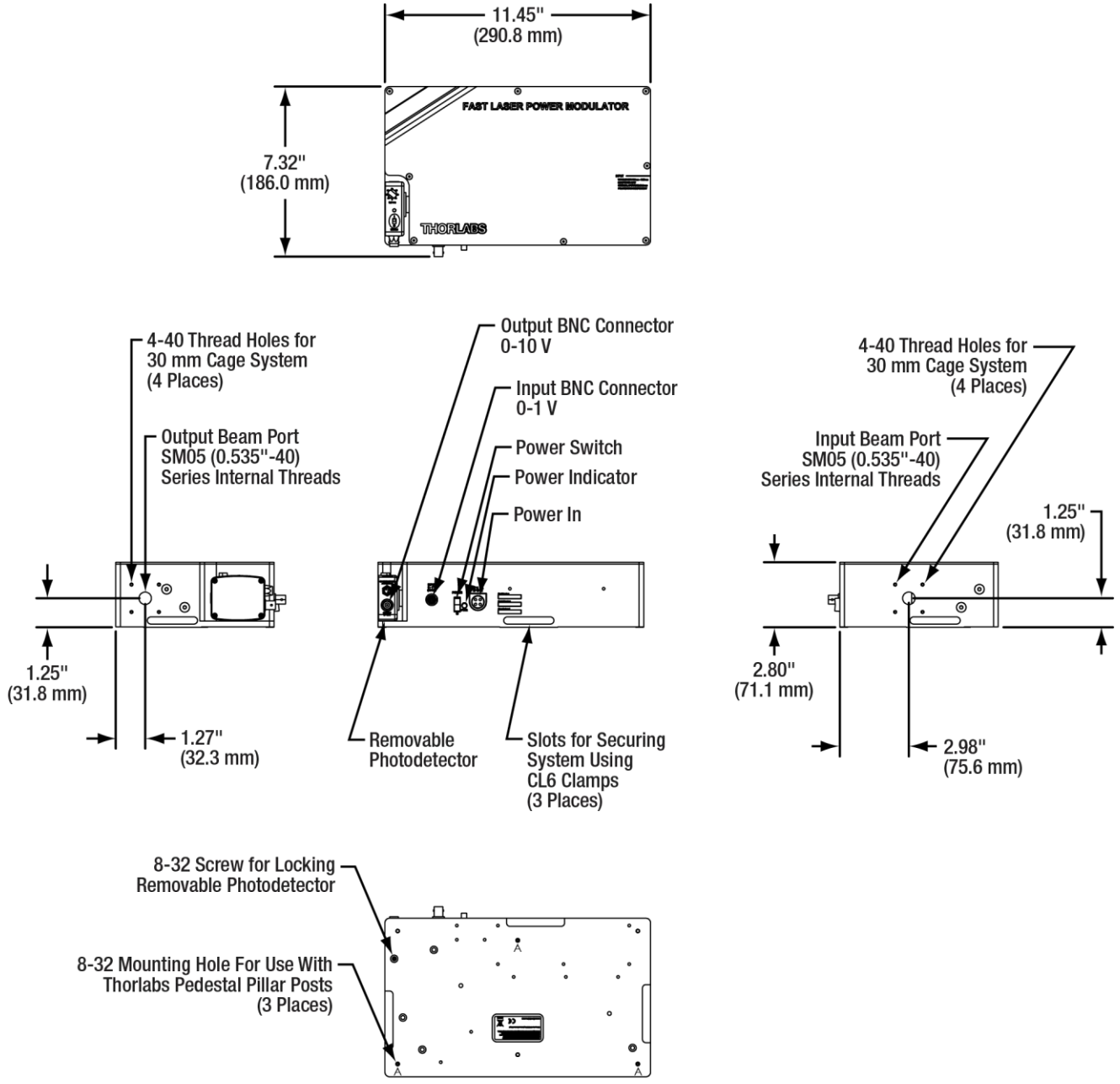



***Figure 8 Mechanical drawings for OM6N, OM6NH, & OM6ENH modulators.***

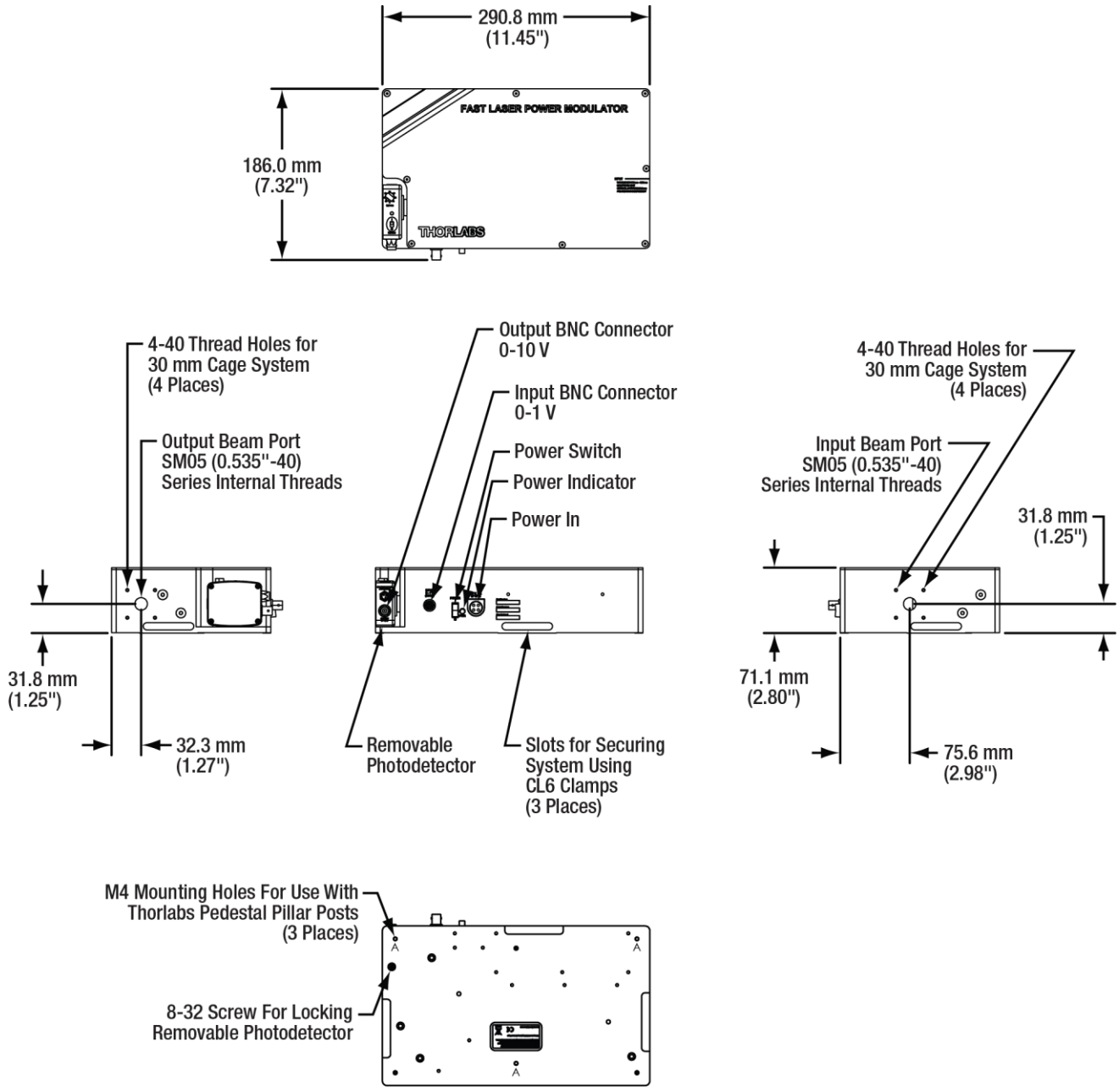
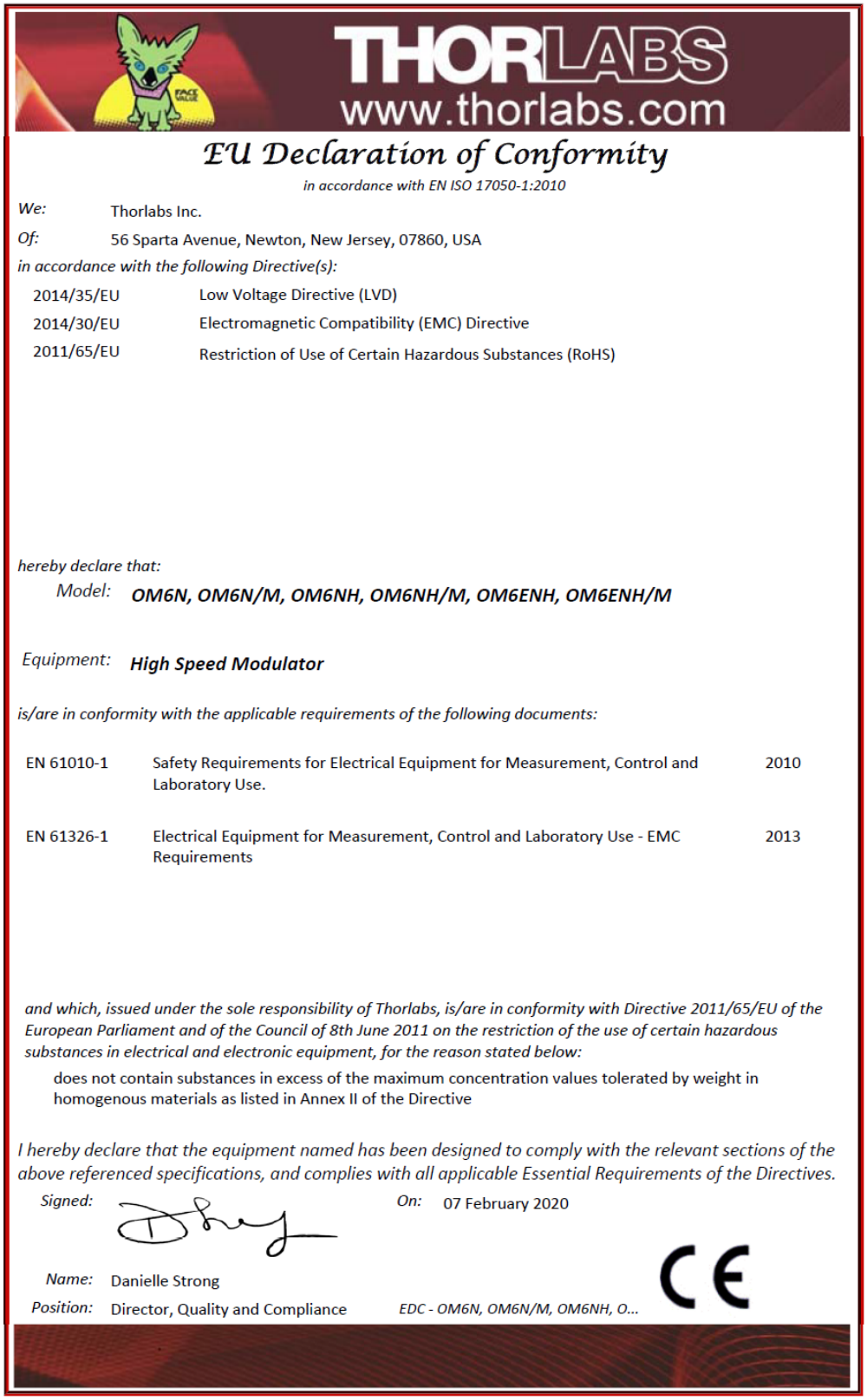



***Figure 9 Mechanical drawings for OM6N/M, OM6NH/M, & OM6ENH/M modulators.***

# Chapter 8 Declaration of Conformity

## 8.1. EU



THORLABS
www.thorlabs.com

*EU Declaration of Conformity*

*in accordance with EN ISO 17050-1:2010*

*We:* Thorlabs Inc.

*Of:* 56 Sparta Avenue, Newton, New Jersey, 07860, USA

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

| | |
|---|---|
| 2014/35/EU | Low Voltage Directive (LVD) |
| 2014/30/EU | Electromagnetic Compatibility (EMC) Directive |
| 2011/65/EU | Restriction of Use of Certain Hazardous Substances (RoHS) |

*hereby declare that:*

*Model:* ***OM6N, OM6N/M, OM6NH, OM6NH/M, OM6ENH, OM6ENH/M***

*Equipment:* ***High Speed Modulator***

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

| | | |
|---|---|---|
| EN 61010-1 | Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use. | 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/are 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.*

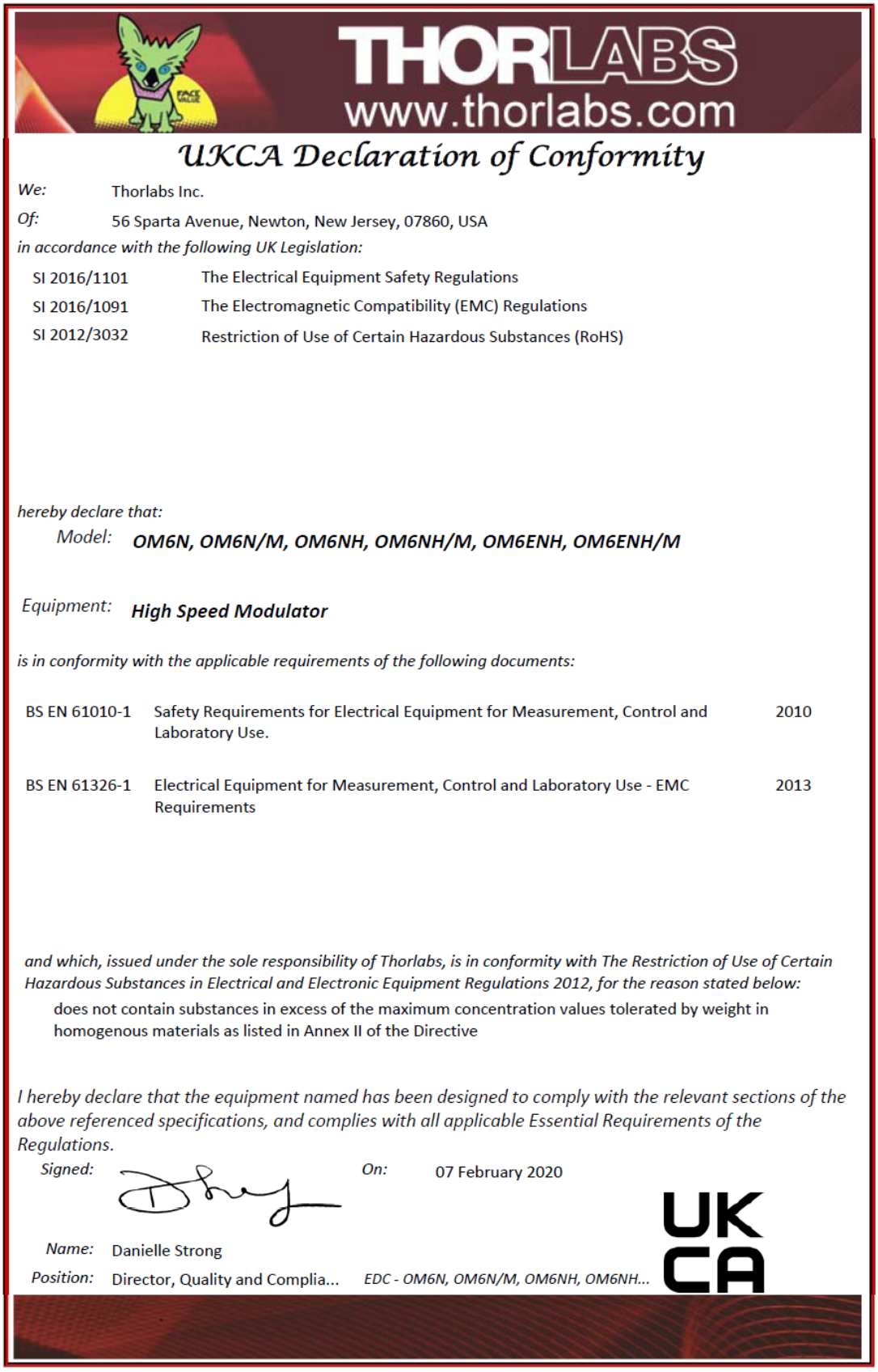
*Signed:* *On:* 07 February 2020

*Name:* Danielle Strong

*Position:* Director, Quality and Compliance *EDC - OM6N, OM6N/M, OM6NH, O...*

CE

## 8.2. UK



THORLABS
www.thorlabs.com

# UKCA Declaration of Conformity

*We:* Thorlabs Inc.

*Of:* 56 Sparta Avenue, Newton, New Jersey, 07860, USA

*in accordance with the following UK Legislation:*

| | |
|---|---|
| SI 2016/1101 | The Electrical Equipment Safety Regulations |
| SI 2016/1091 | The Electromagnetic Compatibility (EMC) Regulations |
| SI 2012/3032 | Restriction of Use of Certain Hazardous Substances (RoHS) |

*hereby declare that:*

*Model:* ***OM6N, OM6N/M, OM6NH, OM6NH/M, OM6ENH, OM6ENH/M***

*Equipment:* ***High Speed Modulator***

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

| | | |
|---|---|---|
| BS EN 61010-1 | Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use. | 2010 |
| BS 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 The Restriction of Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012, 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 Regulations.*

*Signed:* *On:* 07 February 2020

*Name:* Danielle Strong

*Position:* Director, Quality and Complia... *EDC - OM6N, OM6N/M, OM6NH, OM6NH...*

UK CA

## 8.3. FCC Statement

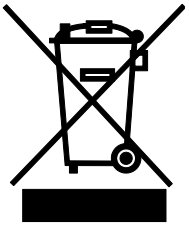
This device complies with part 15 of the FCC rules. Operation is subject to the following conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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 their own expense.

Modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment under FCC rules.

# Chapter 9 Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.



- This offer is valid for Thorlabs electrical and electronic equipment:
- Sold after August 13, 2005
- Marked correspondingly with the crossed out “wheelie bin” logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated

As the WEEE directive applies to self-contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

***Waste Treatment is Your Own Responsibility***
If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

***Ecological Background***
It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

# Chapter 10 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at **www.thorlabs.com/contact** for our most up-to-date contact information.

**USA, Canada, and South America**
Thorlabs, Inc.
sales@thorlabs.com
techsupport@thorlabs.com

**UK and Ireland**
Thorlabs Ltd.
sales.uk@thorlabs.com
techsupport.uk@thorlabs.com

**Europe**
Thorlabs GmbH
europe@thorlabs.com

**Scandinavia**
Thorlabs Sweden AB
scandinavia@thorlabs.com

**France**
Thorlabs SAS
sales.fr@thorlabs.com

**Brazil**
Thorlabs Vendas de Fotônicos Ltda.
brasil@thorlabs.com

**Japan**
Thorlabs Japan, Inc.
sales@thorlabs.jp

**China**
Thorlabs China
chinasales@thorlabs.com


UNLEASHED