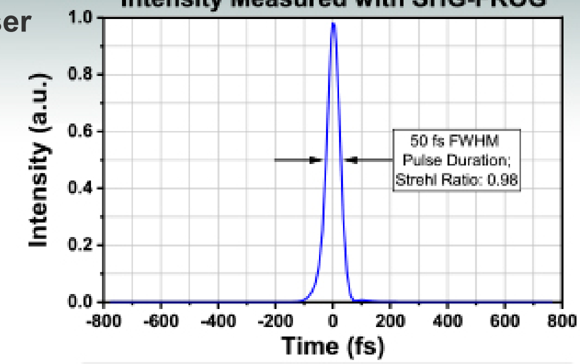
# FSLOPAX1 - JUNE 27, 2025

Item # FSLOPAX1 was discontinued on June 27, 2025. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

## FEMTOSECOND LASER FOR THREE-PHOTON (3P) AND NONLINEAR MICROSCOPY

- Designed for Three-Photon Microscopy and Harmonic Imaging
- Ruggedized Single Optical Head with Integrated Pump Laser
- Fixed Center Wavelength: 1650 nm
- User-Tunable Repetition Rate via Software

Typical FSLOPAX1 1650 nm Laser Pulse Intensity Measured with SHG-FROG




FSLOPAX1
Optical Parametric Amplifier with Integrated 1035 nm Ytterbium Femtosecond Fiber Laser


Hide Overview

## OVERVIEW

### Features

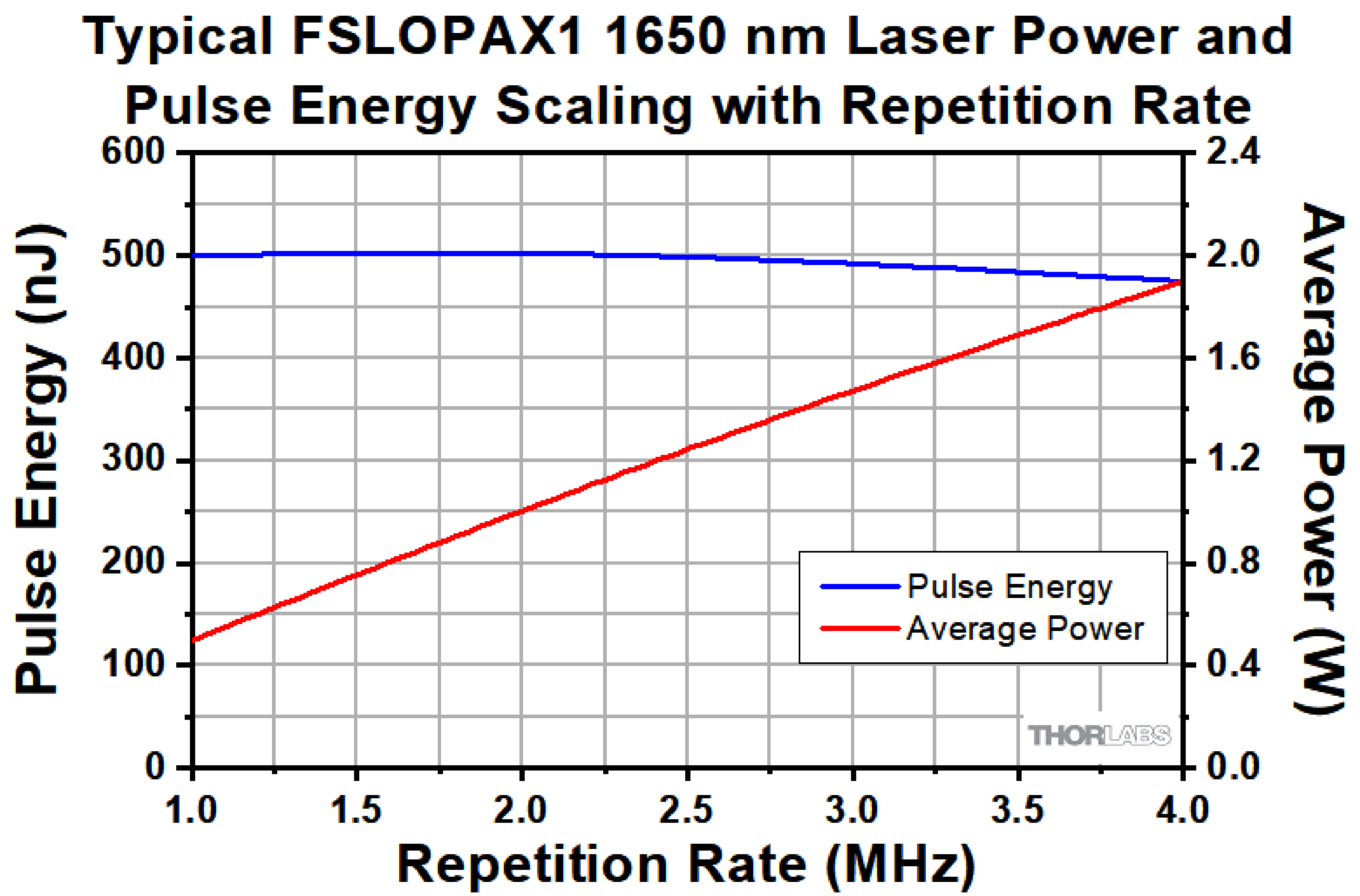

- Center Wavelength: 1650 ± 5 nm
  - Customizable between 1600 and 1700 nm
- Tunable Repetition Rate: 1 - 4 MHz
- Typical Pulse Energy: 500 nJ
- Flat Pulse Energy Scaling with Repetition Rate (See *Specs* Tab)
- Signal Output Pulses Down to 50 fs
- Integrated 1035 nm Ytterbium Femtosecond Fiber Laser for Increased Stability
- Bypass Port for Access to Full Ytterbium Femtosecond Fiber Laser Capabilities
- Control via Included Software for Hands-Free Operation (See *Software* Tab)
- Compact Footprint: 569.0 mm x 320.0 mm x 237.7 mm (22.40" x 12.60" x 9.36")

| Key Specifications[a] | |
|---|---|
| **Center Wavelength[b]** | 1650 ± 5 nm |
| **Pulse Duration (FWHM)[c]** | 65 fs (Typical) |
| **Pulse Energy** | 500 nJ (Typical)<br>>400 nJ (Min) |
| **Average Power at 4 MHz** | >1.6 W |
| **Repetition Rate (Tunable)** | 1 - 4 MHz |

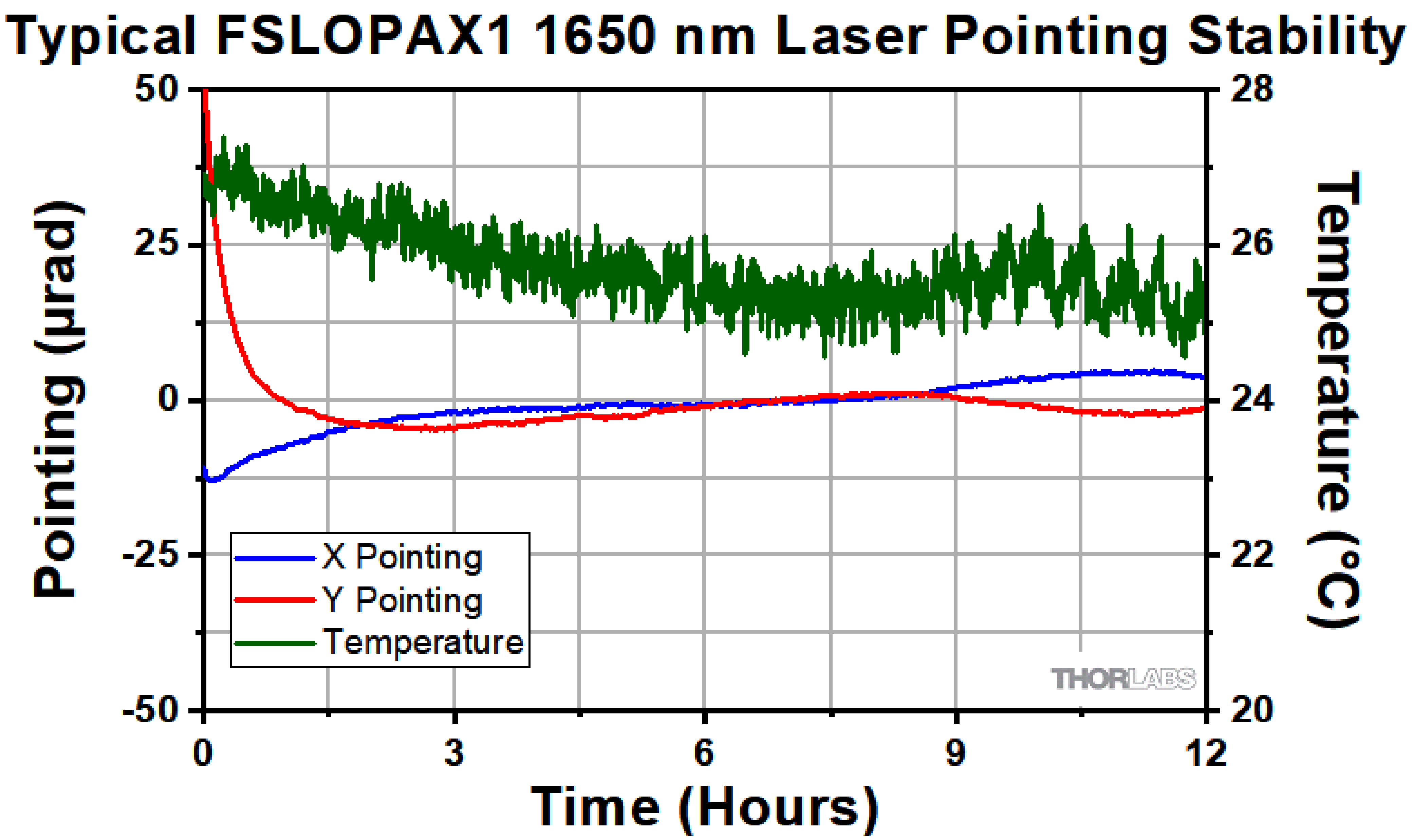
a. See the *Specs* tab for complete specifications.
b. Center wavelength is customizable between 1600 and 1700 nm.
c. Pulse duration can be configured as low as 50 fs.

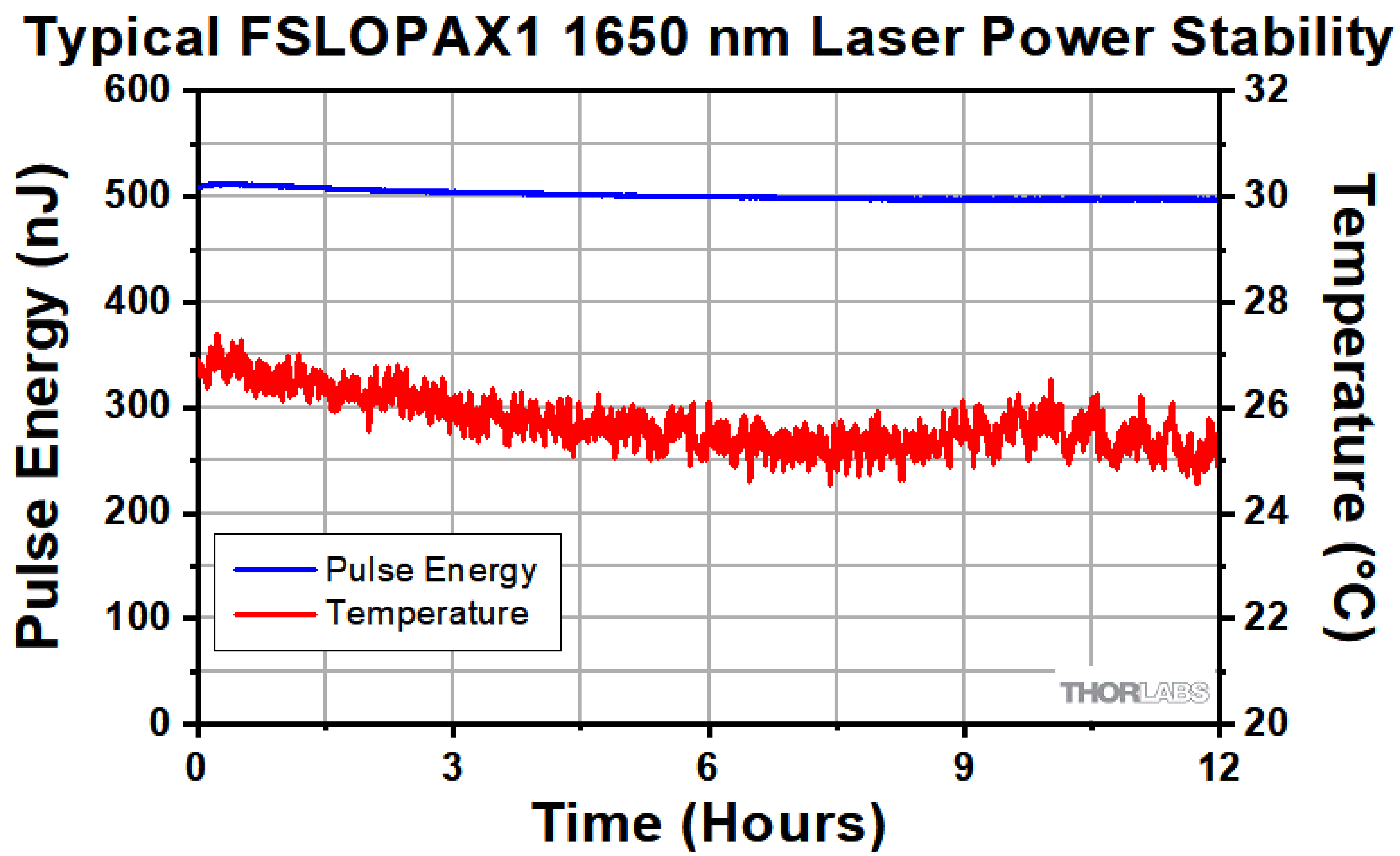
### Applications

- Three-Photon (3P) Microscopy of Fluorescent Proteins (e.g., RCaMP, RFP, mCherry, tdTomato)
- Label-Free Deep-Tissue Imaging with Second Harmonic Generation (SHG) and Third Harmonic Generation (THG) Microscopy

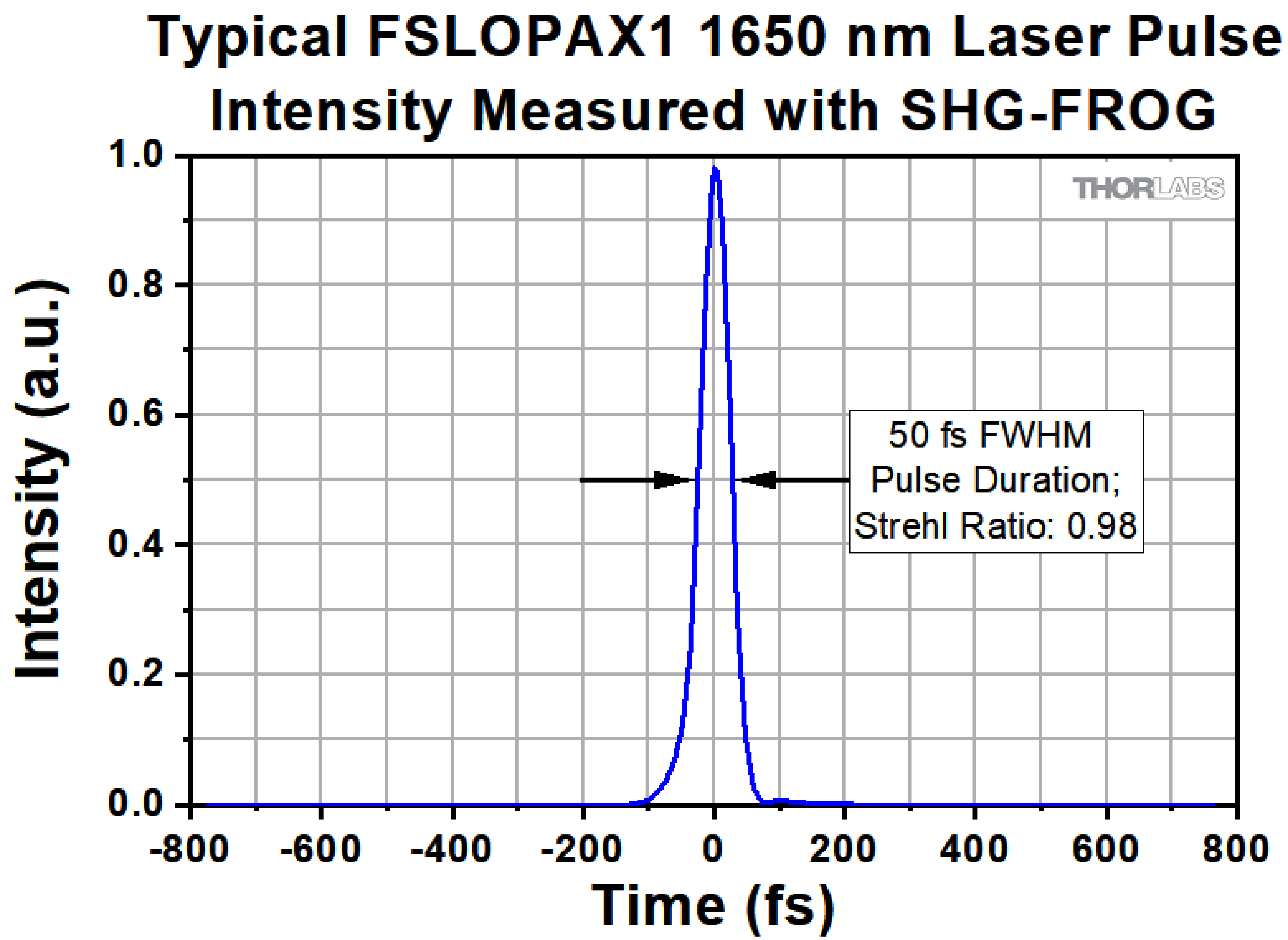


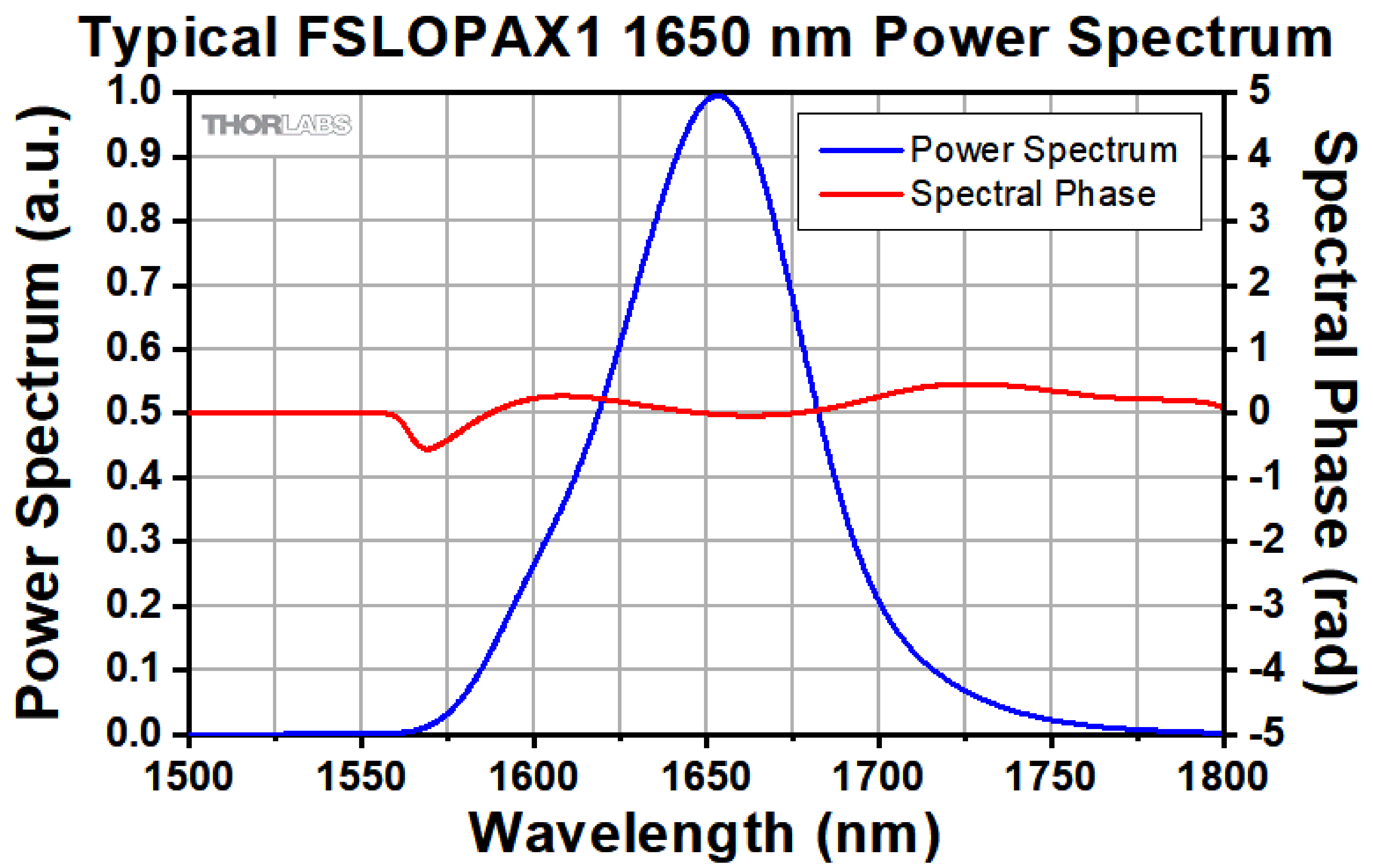
Typical FSLOPAX1 1650 nm Laser Power and Pulse Energy Scaling with Repetition Rate
Pulse Energy (nJ)
Average Power (W)
Repetition Rate (MHz)
0
100
200
300
400
500
600
0.0
0.4
0.8
1.2
1.6
2.0
2.4
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Pulse Energy
Average Power
THORLABS


Typical FSLOPAX1 1650 nm Laser Pointing Stability
Pointing (µrad)
50
25
0
-25
-50
Temperature (°C)
28
26
24
22
20
0
3
6
9
12
Time (Hours)
X Pointing
Y Pointing
Temperature
THORLABS

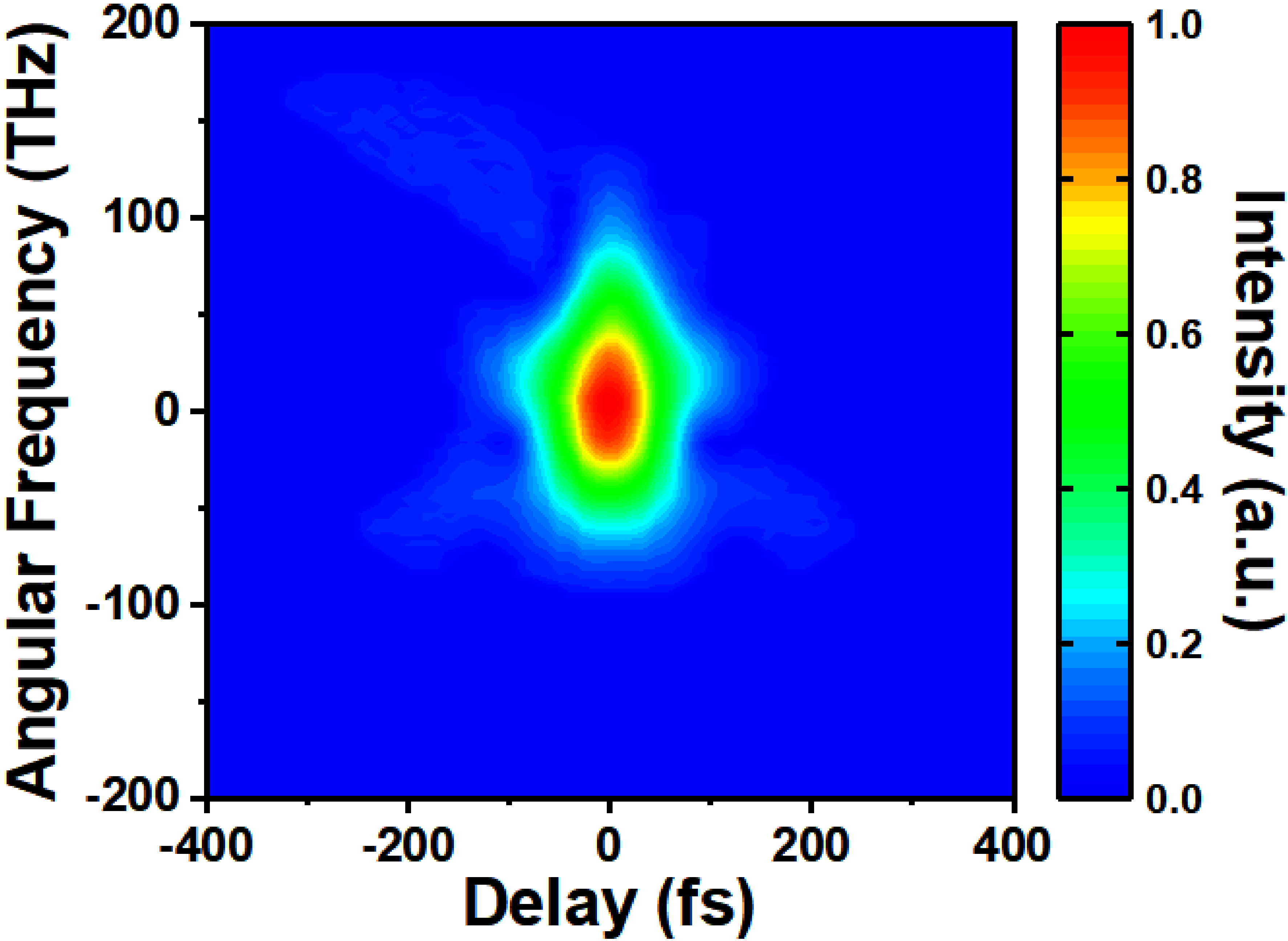


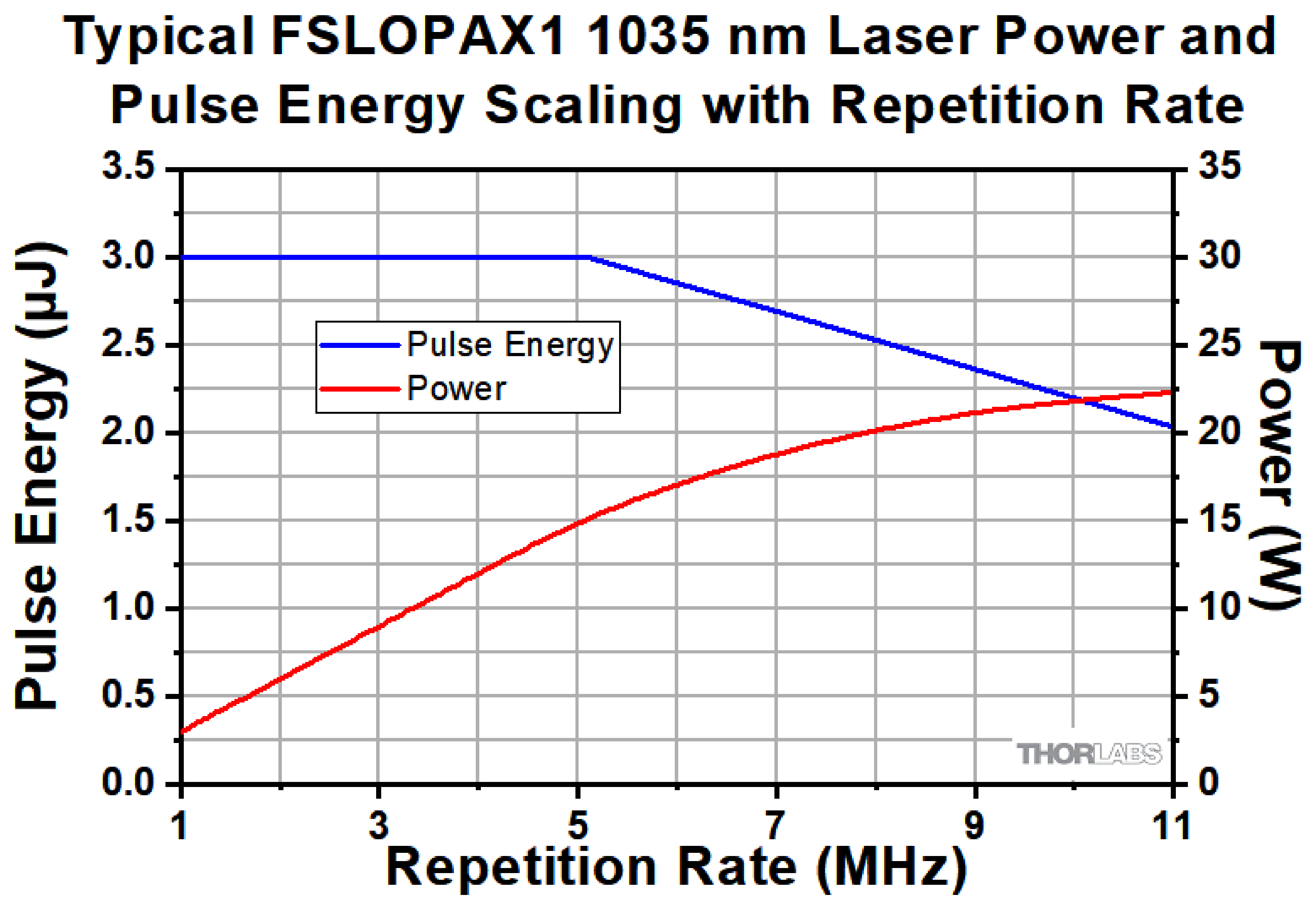
Typical FSLOPAX1 1650 nm Laser Power Stability
Pulse Energy (nJ)
Temperature (°C)
Time (Hours)
0
100
200
300
400
500
600
20
22
24
26
28
30
32
0
3
6
9
12
Pulse Energy
Temperature
THORLABS


Typical FSLOPAX1 1650 nm Laser Pulse
Intensity Measured with SHG-FROG
Intensity (a.u.)
1.0
0.8
0.6
0.4
0.2
0.0
-800
-600
-400
-200
0
200
400
600
800
Time (fs)
50 fs FWHM
Pulse Duration;
Strehl Ratio: 0.98

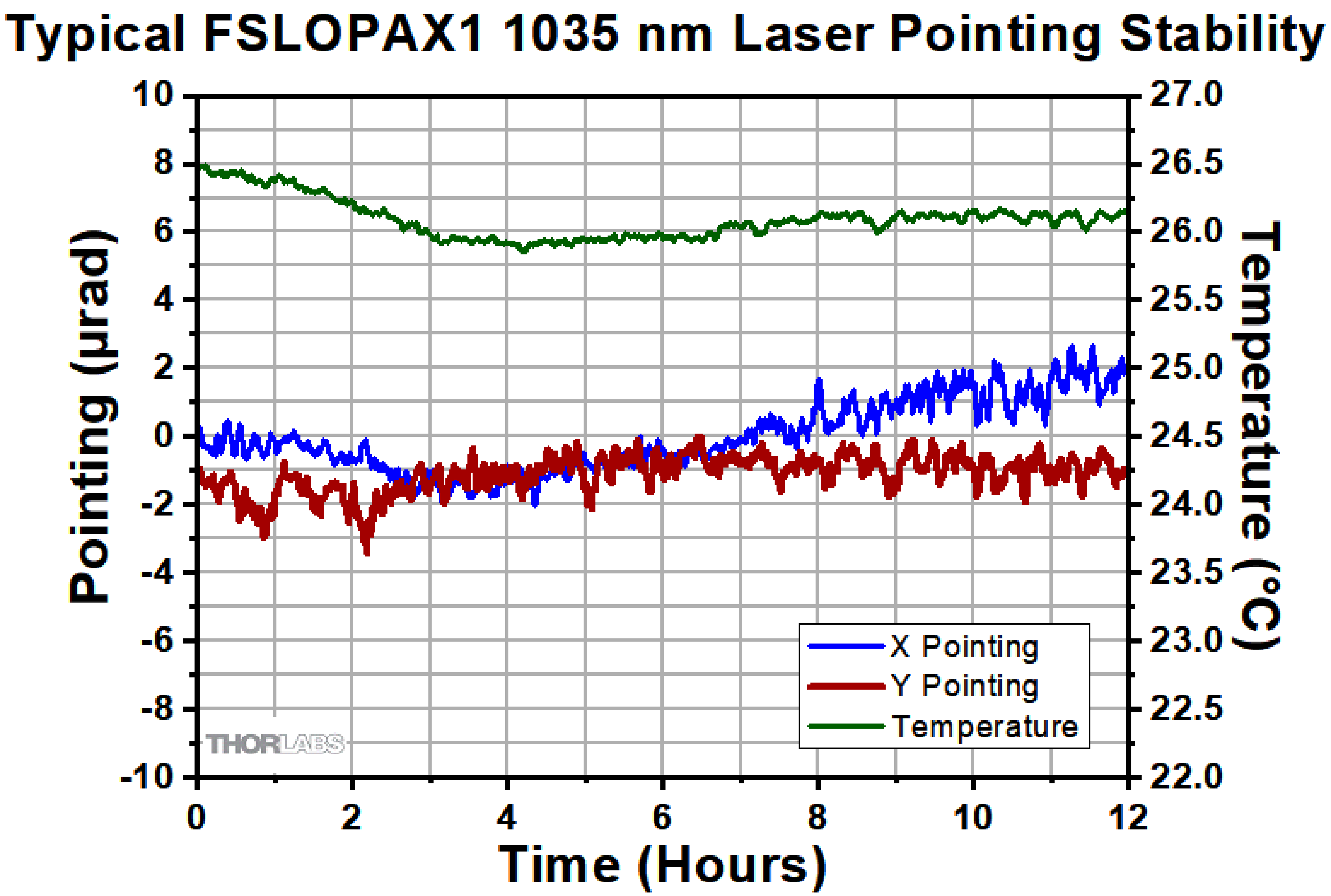

Typical FSLOPAX1 1650 nm Power Spectrum
THORLABS
Power Spectrum
Spectral Phase
Power Spectrum (a.u.)
Spectral Phase (rad)
Wavelength (nm)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
5
4
3
2
1
0
-1
-2
-3
-4
-5
1500
1550
1600
1650
1700
1750
1800

# Typical FSLOPAX1 1650 nm FROG Trace



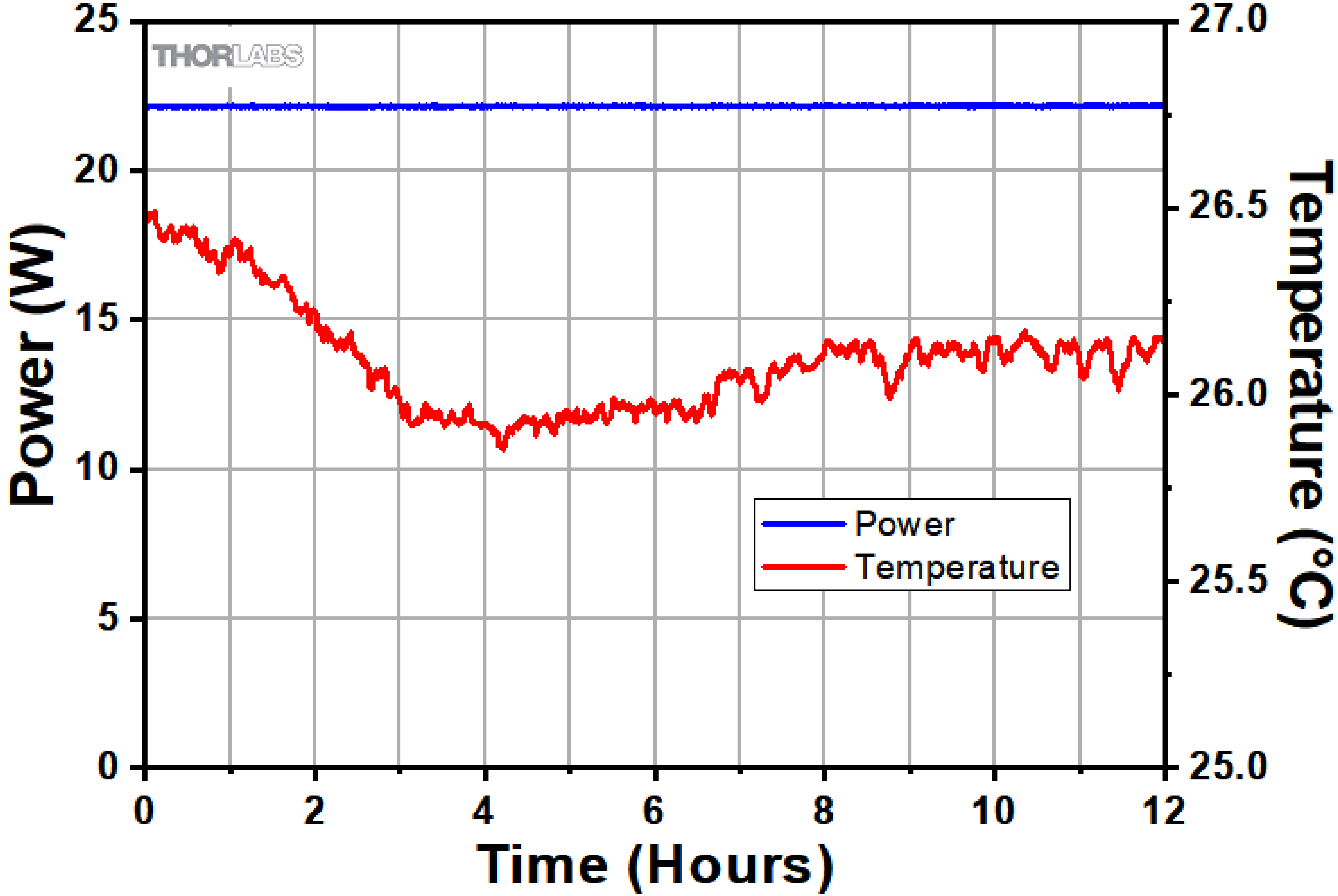


Typical FSLOPAX1 1035 nm Laser Power and Pulse Energy Scaling with Repetition Rate
Pulse Energy (μJ)
Power (W)
Repetition Rate (MHz)
Pulse Energy
Power
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
0
5
10
15
20
25
30
35
1
3
5
7
9
11
THORLABS

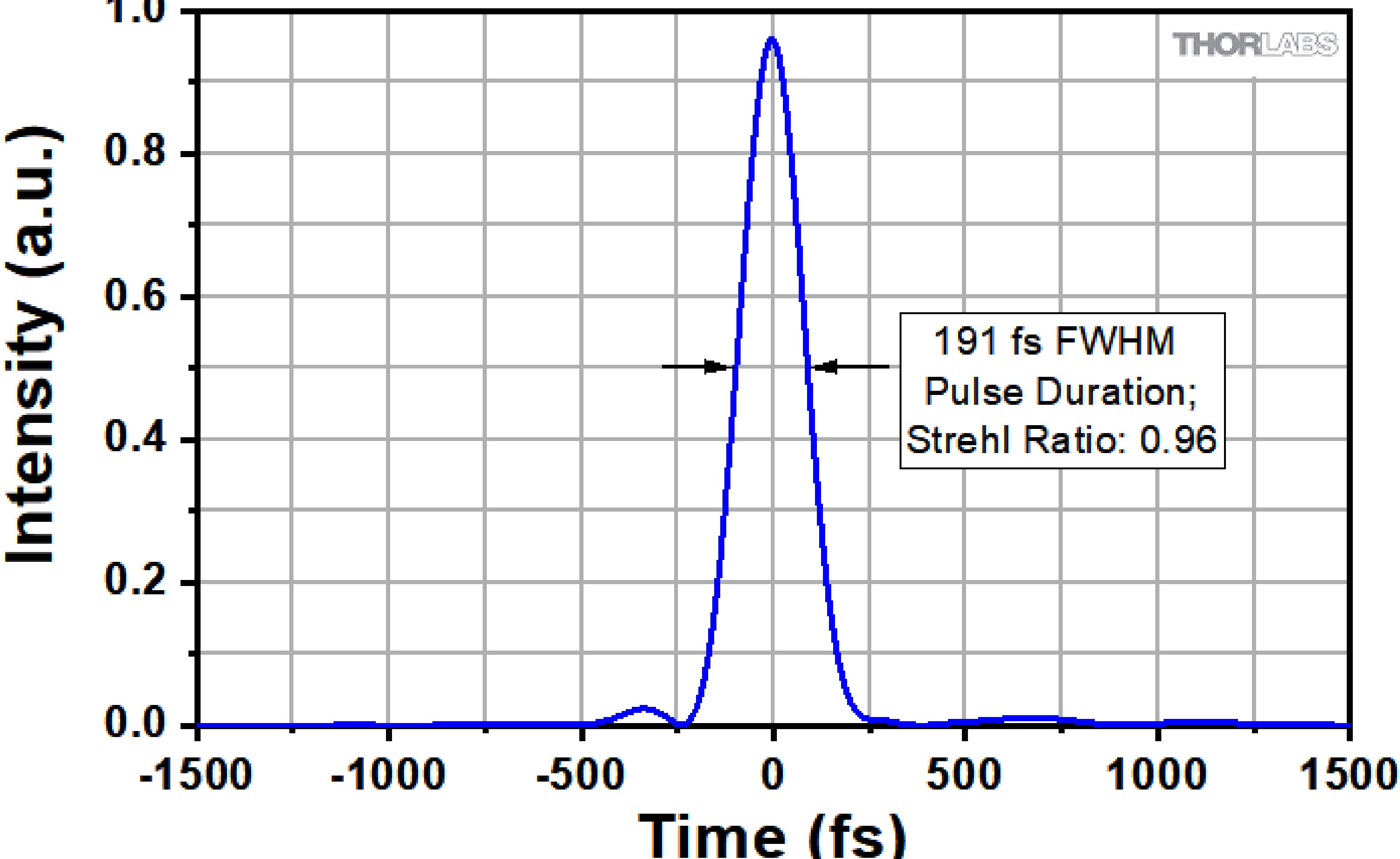


Typical FSLOPAX1 1035 nm Laser Pointing Stability
Pointing (µrad)
Temperature (°C)
Time (Hours)
10
8
6
4
2
0
-2
-4
-6
-8
-10
27.0
26.5
26.0
25.5
25.0
24.5
24.0
23.5
23.0
22.5
22.0
0
2
4
6
8
10
12
X Pointing
Y Pointing
Temperature
THORLABS

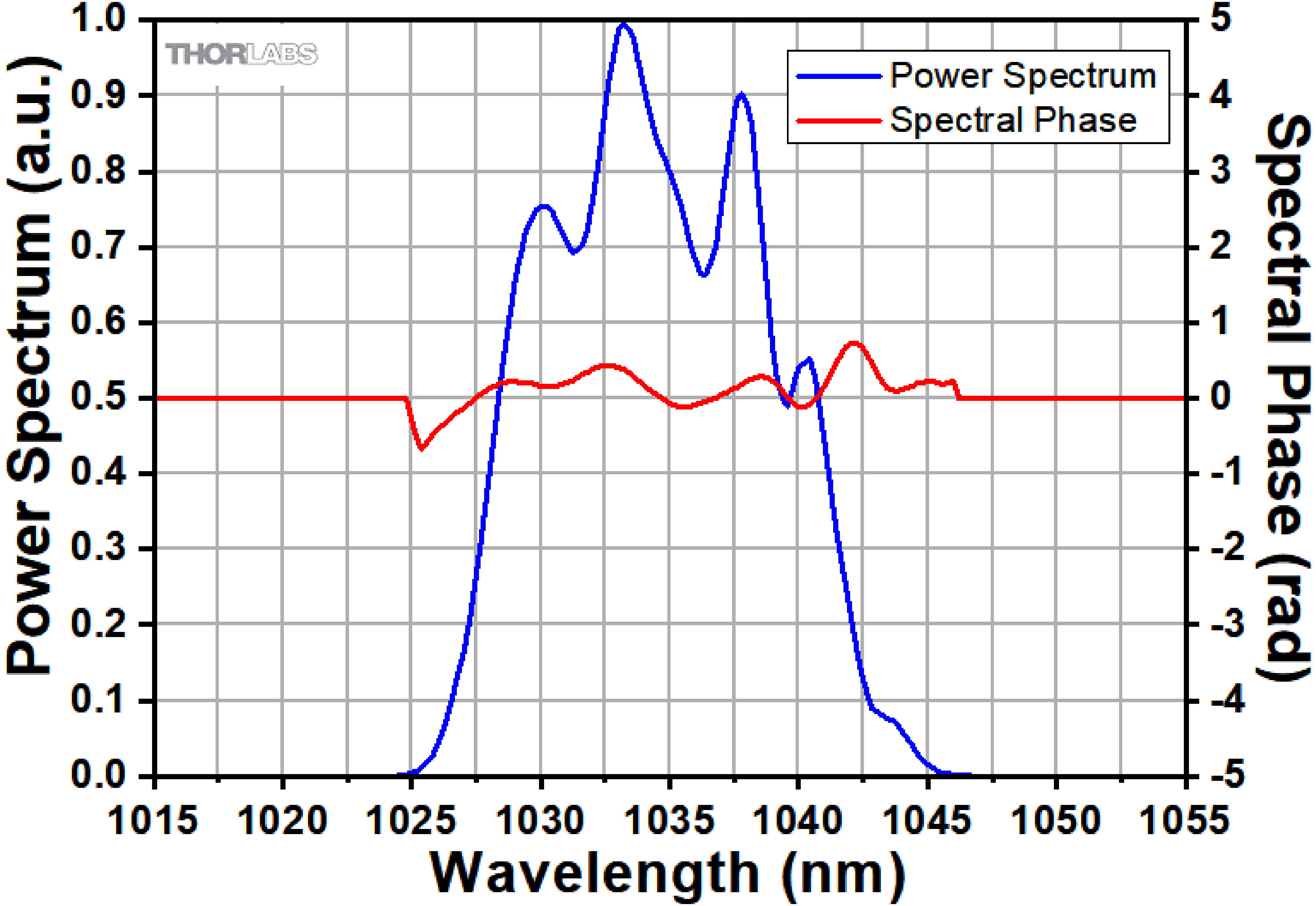
# Typical FSLOPAX1 1035 nm Laser Power Stability



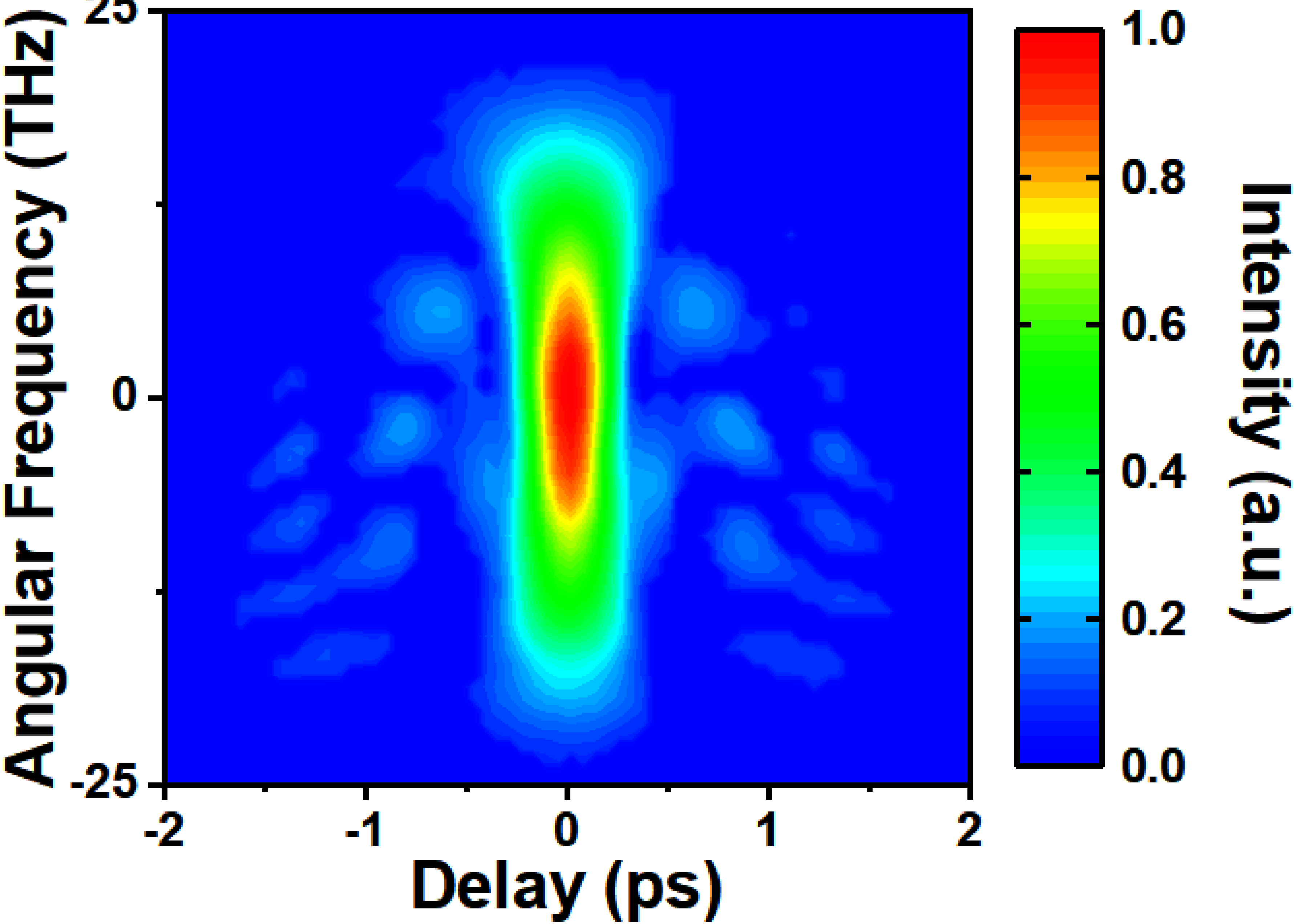
## Typical FSLOPAX1 1035 nm Laser Pulse Intensity Measured with SHG-FROG



# Typical FSLOPAX1 1035 nm Power Spectrum

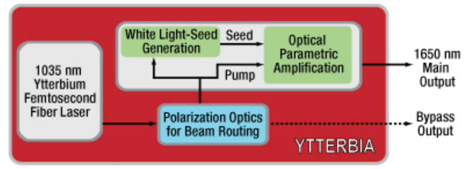


# Typical FSLOPAX1 1035 nm FROG Trace



- NIR Supercontinuum Generation
- Pump-Probe Spectroscopy

Thorlabs' Ytterbia Optical Parametric Amplifier (OPA) is a femtosecond laser ideal for life science applications, such as three-photon microscopy, that require deep imaging depths, high signal-to-noise ratios, and minimal phototoxicity. Designed to be a robust one-box solution, this OPA has an integrated ytterbium fiber pump laser that converts femtosecond pulses at 1035 nm into pulses at 1650 nm by using white-light continuum generated in bulk media and optical parametric amplification (see Figure 1.1); full access to the pump laser is also available. The OPA output beam, which has a tunable repetition rate from 1 to 4 MHz, delivers typical pulse energies of 500 nJ and pulse widths down to 50 fs at 1650 nm. Detailed specifications are available on the Specs tab.




Click to Enlarge

**Figure 1.1** The Ytterbia OPA, which has an integrated 1035 nm ump laser, amplifies a coherently generated white-light seed in a nonlinear crystal. The resulting output signal (Main Output) has a center wavelength of 1650 ± 5 nm, which is customizable between 1600 and 1700 nm. Polarizing optics are included in the system for beam routing, providing full access to the pump laser beam (Bypass Output).

The FSLOPAX1 OPA's fixed-wavelength output can be customized to have a center wavelength between 1600 and 1700 nm to target specific regions of the NIR imaging window. Please contact Tech Sales to discuss your specific needs. In contrast to a wavelength tunable source, the Ytterbia OPA has reduced mechanical complexity, making it less susceptible to mechanical and performance instabilities while providing a cost-effective imaging solution.

Click to Enlarge

**Figure 1.2** The FSLOPAX1 software provides a simple GUI to control the laser while providing system feedback. The GUI allows the user to select the laser mode, which either routes the 1035 nm light directly out of the box (Bypass mode) or through the OPA (OPA mode).

Designed to have a compact footprint, the Ytterbia OPA vertically stacks the 1035 nm pump laser and the OPA within a single housing. This eliminates the need for beam routing on the optical table, which creates an optical system (US Patent 10,303,040) that is less sensitive to environmental changes. The front panel of the Ytterbia OPA features an output port for the OPA signal, as well as a bypass port that provides full access to the 1035 nm pump beam (see Front & Back Panels tab). For detailed specifications for the bypass beam, please see Table 2.1 in the Specs tab.

Three CL5A mounting clamps are included with the laser head as well as two removable handles for easier set up. Both the OPA and bypass laser outputs have a beam height of 192.7 mm (7.58") marked on the side of the laser. Each laser also ships with a chiller and electronics unit, both of which are rack mountable. A full list of items shipped with each OPA can be found on the Shipping List tab.

**Software**

For hands-free operation and long-term reliability, the Ytterbia OPA features a user-friendly GUI that allows the user to power on the laser and easily switch between the Ytterbia OPA (OPA Mode) and 1035 nm femtosecond fiber laser (Bypass Mode). When operating in either mode, the repetition rate can be tuned via the software while the output pulse energy remains fixed. Please note when operating in the OPA mode the bypass output is disabled, and vice versa. See the *Software* tab for more information.

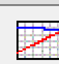
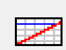
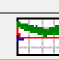
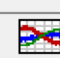
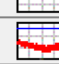
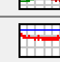
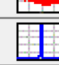
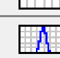
**Applications to Three-Photon Microscopy**

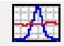
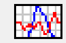
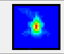
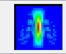
With a high peak power and tunable repetition rate, the Ytterbia OPA is optimized for three-photon microscopy, which requires efficient fluorescence excitation to achieve deep imaging depths. By including a tunable repetition rate, the user has the flexibility to adjust the imaging frame rate to accommodate the time scales of various processes or events, as well as control the average power incident on a sample to reduce heat-induced degradation.

**Please Note:** These lasers will ship direct from our Colorado facility.

Hide Specs

## SPECS

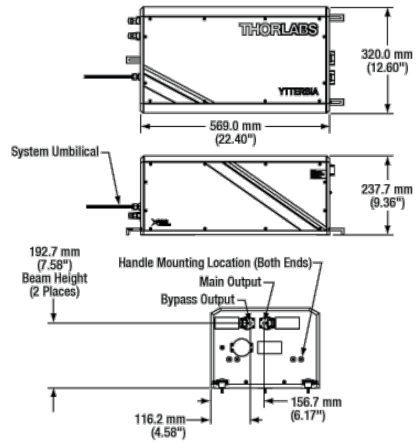
| Output Beam | Main[a] | Bypass[b] |
|---|---|---|
| Typical Performance Graphs (Click for Details) | | |
| Power and Pulse Energy Scaling with Repetition Rate |  |  |
| Pointing Stability |  |  |
| Power Stability |  |  |
| Pulse Intensity, Measured with SHG-FROG |  |  |
| Power Spectrum and Phase, Measured with SHG- | | |

| | | |
|---|---|---|
| **FROG** |  |  |
| **SHG-FROG Trace** |  |  |

a. Click Here for Raw Data for the Main Output Beam
b. Click Here for Raw Data for the Bypass Output Beam

| Table 2.1 Optical Specifications | | |
|---|---|---|
| **Output Beam** | **Main** | **Bypass** |
| **Center Wavelength** | 1650 ± 5 nm[a] | 1035 ± 5 nm |
| **Pulse Duration (FWHM)[b]** | 65 fs (Typical)[c] | <220 fs (Typical)<br><250 fs (Max) |
| **Temporal Strehl Ratio[d]** | >0.85 | >0.90 (Typical)<br>>0.85 (Min) |
| **Pulse Energy** | 500 nJ (Typical)<br>>400 nJ (Min) | 3 µJ[e] |
| **Repetition Rate (Tunable)[f]** | 1 - 4 MHz | 1 - 11 MHz[g] |
| **Average Power** | >0.4 W at 1 MHz<br>>0.8 W at 2 MHz<br>>1.2 W at 3 MHz<br>>1.6 W at 4 MHz | >20 W (Min) at Max Rep. Rate |
| **Beam Quality ($M^2$)** | <1.3 | <1.15 (Typical)<br><1.2 (Max) |
| **Beam Diameter ($1/e^2$), Typical** | 1.75 - 2.25 mm | 2.0 - 2.5 mm |
| **Power Stability[h]** | <2% RMS over 12 Hours | <1% RMS over 12 Hours |
| **Pointing Stability[h], Typical** | <10 µrad/°C | |
| **Polarization** | Linear, Vertical | |
| **Beam Height** | 192.7 mm (7.58") | |
| **Optical Head Dimensions (L x W x H)** | 569.0 mm x 320.0 mm x 237.7 mm<br>(22.40" x 12.60" x 9.36") | |
| **Optical Head Weight** | 47 kg (103 lbs) | |

a. The source can be customized to provide a fixed main output center wavelength between 1600 and 1700 nm. Please contact Tech Sales for more information.
b. Measured by Second Harmonic Generation Frequency Resolved Optical Gating (FROG)
c. Pulse duration can be configured as low as 50 fs.
d. The Temporal Strehl Ratio is the ratio between the maxima of the measured intensity profile and the transform-limited intensity profile as determined by the power spectrum.
e. Pulse energy for the bypass laser is 3 µJ for repetition rates of 1 - 5 MHz; the pulse energy decreases for repetition rates >5 MHz, but the average power of the laser remains above 20 W from 1 – 11 MHz.
f. User Tunable via Included Software GUI
g. The pulse-picked repetition rate is given by dividing the oscillator repetition rate, 56 ± 2 MHz, by an integer, with a minimum value of 1 MHz and a maximum value given by the oscillator repetition rate divided by 5.
h. After 30 Minute Warm Up

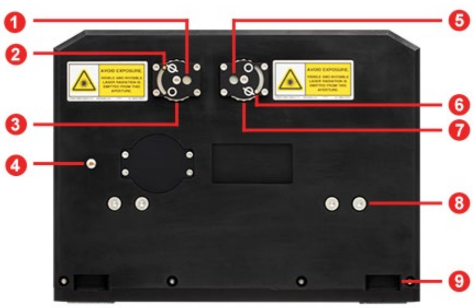



Click for Details
**Figure 2.2** Laser Head Dimensions

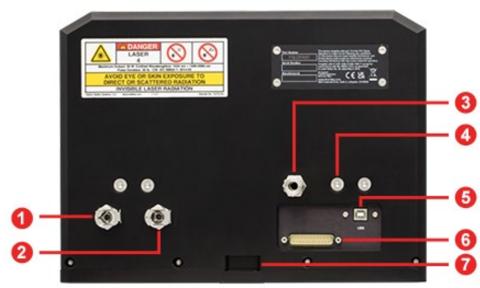
| Electrical and Environmental Specifications | |
|---|---|
| **Input Voltage** | 100 - 240 V |
| **Frequency** | 50 - 60 Hz |
| **Power Consumption** | Controller: 400 W (Max)<br>Chiller: 600 W (Max) |
| **Room Temperature Range** | 17 °C to 25 °C |
| **Room Temperature Stability** | <3 °C Over 24 Hours |

Hide Front & Back Panels

## FRONT & BACK PANELS



Click to Enlarge
**Figure 3.1** Laser Head Front Panel

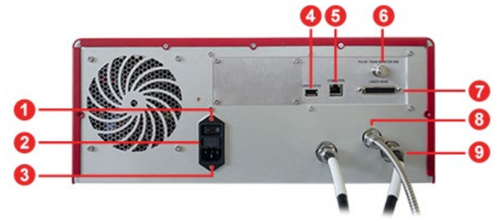


Click to Enlarge
**Figure 3.2** Laser Head Back Panel

| Front Panel | |
|---|---|
| **Callout** | **Description** |
| 1 | Bypass Output Aperture |
| 2 | Aperture Shutter Position Indicator for Bypass Output |
| 3 | Manual Aperture Wheel to Open/Close Shutter for Bypass Output |
| 4 | Emission Indicator |
| 5 | Main Output Aperture |
| 6 | Aperture Shutter Position Indicator for Main Output |
| 7 | Manual Aperture Wheel to Open/Close Shutter for Main Output |
| 8 | Mounting Location for Removable Handles (4 Places) |
| 9 | Included CL5A Clamp Location (2 Places) |

| Back Panel | |
|---|---|
| **Callout** | **Description** |
| 1 | Water In |
| 2 | Water Out |
| 3 | Fixed Optical Umbilical |
| 4 | Mounting Location for Removable Handles (4 Places) |
| 5 | USB 2.0 Type-B Connector |
| 6 | Sub-D 25 Pin Umbilical to Controller |
| 7 | Included CL5A Clamp Location |


Click to Enlarge
**Figure 3.3** Laser Controller Front Panel




Click to Enlarge
**Figure 3.4** Laser Controller Back Panel

| Front Panel | |
|---|---|
| **Callout** | **Description** |
| 1 | Emission Indicator |
| 2 | Laser Enable Switch |
| 3 | Laser Synchronization Signal (BNC Female, TTL) |
| 4 | Remote Interlock (BNC Female, Open/Closed) |

| Back Panel | |
|---|---|
| **Callout** | **Description** |
| 1 | AC Power On/Off Switch |
| 2 | Fuse Tray |
| 3 | AC Power Cord Connector |
| 4 | USB 2.0 Type A Connector to Laser |
| 5 | Ethernet Port to Computer |
| 6 | Oscillator Pulse Train Monitor (BNC Female, 50 Ω, <1 V) |
| 7 | Sub-D 25 Umbilical to Laser |
| 8 | Fixed Optical Umbilical to Laser |
| 9 | Fixed Water Lines (2 Places) |

Hide Shipping List

## SHIPPING LIST

The FSLOPAX1 femtosecond optical parametric amplifier includes the following components:

- Laser Head and Electronics Unit (Connected via Non-Detachable Umbilical, 2.5 m)
- Air-to-Water Chiller and Water Lines, with Valved Quick-Disconnect Fittings, 2.5 m
- Pre-Mixed Anti-Corrosion Fluid for the Chiller (Item # CDTX)
- Two Region-Specific Power Cords, 1.8 m
- Ethernet Cable, 2.5 m
- USB 2.0 Type-A to Type-B Cable, 2.5 m
- Ethernet to USB Converter
- Three CL5A Table Clamps for Mounting
- Two Handles for Carrying
- USB Stick with Software and System Performance Data

An uninterruptable power supply (UPS) is available as an add-on to the laser purchase upon request.

Hide Software

## SOFTWARE

### Software for the FSLOPAX1 Femtosecond Optical Parametric Amplifier

| Recommended System Requirements | |
|---|---|
| **Operating System** | Windows® 10 (64 Bit) |
| **Memory (RAM)** | 5 GB |

### Software

**Version 1.8.1.4**

**(OPA)**

| Hard Drive | 30 MB (Min) of Available Disk Space |
| --- | --- |
| Interface | Ethernet or USB 2.0 |

The Ytterbia Software is a Windows®-based software package designed for straightforward control of the FSLOPAX1 Ytterbia OPA. The user-friendly GUI allows the user to turn the seeder and laser power on and off, as well as set parameters such as the repetition rate and diode current. The laser mode is also selected within the software; the Bypass and OPA modes provide 1035 nm and 1650 nm output beams, respectively. More information on the software can be found in the manual.

The GUI interface also features several diagnostic outputs for each laser operation mode; see Figures 5.1 and 5.2 for details.

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### Laser Operation Modes

Click to Enlarge

**Figure 5.1** *Bypass Mode* allows the user to turn on the amplifier and provides information about the amplified 1035 nm output. Readouts are included for the 1030 energy and power, as well as the repetition rate. The 1030 spectrometer displays the live spectrum of the pulse being sent to the 1035 nm amplifier (white), as well as a reference spectrum (red).

Click to Enlarge

**Figure 5.2** *OPA Mode* allows the user to turn on the amplifier and provides information about the 1650 nm OPA power and energy. Readouts are included for the 1030 energy and power, OPA power, and repetition rate. The OPA spectrometer displays the live spectrum of the second harmonic of the OPA output as a proxy for the 1650 nm signal (white), as well as a reference spectrum (red).

Hide Pulse Calculations

**PULSE CALCULATIONS**

## Pulsed Laser Emission: Power and Energy Calculations

Determining whether emission from a pulsed laser is compatible with a device or application can require referencing parameters that are not supplied by the laser's manufacturer. When this is the case, the necessary parameters can typically be calculated from the available information. Calculating peak pulse power, average power, pulse energy, and related parameters can be necessary to achieve desired outcomes including:


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- Protecting biological samples from harm.
- Measuring the pulsed laser emission without damaging photodetectors and other sensors.
- Exciting fluorescence and non-linear effects in materials.

Pulsed laser radiation parameters are illustrated in Figure 170A and described in Table 170B. For quick reference, a list of equations is provided below. The document available for download provides this information, as well as an introduction to pulsed laser emission, an overview of relationships among the different parameters, and guidance for applying the calculations.

**Equations:**

***Period* and *repetition rate* are reciprocal:** $\Delta t = \frac{1}{f_{rep}}$ and $f_{rep} = \frac{1}{\Delta t}$

***Pulse energy* calculated from *average power*:** $E = \frac{P_{avg}}{f_{rep}} = P_{avg} \cdot \Delta t$

***Average power* calculated from *pulse energy*:** $P_{avg} = \frac{E}{\Delta t} = E \cdot f_{rep}$

***Peak pulse power* estimated from *pulse energy*:** $P_{peak} \approx \frac{E}{\tau}$

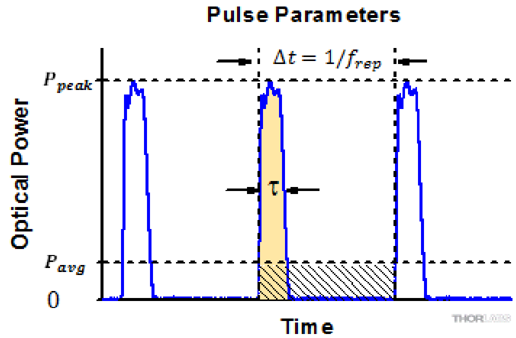

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**Figure 170A** Parameters used to describe pulsed laser emission are indicated in this plot and described in Table 170B. **Pulse energy** (**E**) is the shaded area under the pulse curve. Pulse energy is, equivalently, the area of the diagonally hashed region.

***Peak power*** **and** ***average power*** **calculated from each other:**

$$P_{peak} = \frac{P_{avg}}{f_{rep} \cdot \tau} = \frac{P_{avg} \cdot \Delta t}{\tau}$$ and $$P_{avg} = P_{peak} \cdot f_{rep} \cdot \tau = \frac{P_{peak} \cdot \tau}{\Delta t}$$

***Peak power*** **calculated from** ***average power*** **and** ***duty cycle******:**

$$P_{peak} = \frac{P_{avg}}{\tau/\Delta t} = \frac{P_{avg}}{duty\ cycle}$$

*Duty cycle ($\tau/\Delta t$) is the fraction of time during which there is laser pulse emission.

| Table 170B Pulse Parameters | | | |
|---|---|---|---|
| **Parameter** | **Symbol** | **Units** | **Description** |
| **Pulse Energy** | **E** | Joules [J] | A measure of one pulse's total emission, which is the only light emitted by the laser over the entire period. The pulse energy equals the shaded area, which is equivalent to the area covered by diagonal hash marks. |
| **Period** | **Δt** | Seconds [s] | The amount of time between the start of one pulse and the start of the next. |
| **Average Power** | $P_{avg}$ | Watts [W] | The height on the optical power axis, if the energy emitted by the pulse were uniformly spread over the entire period. |
| **Instantaneous Power** | **P** | Watts [W] | The optical power at a single, specific point in time. |
| **Peak Power** | $P_{peak}$ | Watts [W] | The maximum instantaneous optical power output by the laser. |
| **Pulse Width** | $\tau$ | Seconds [s] | A measure of the time between the beginning and end of the pulse, typically based on the full width half maximum (FWHM) of the pulse shape. Also called **pulse duration**. |
| **Repetition Rate** | $f_{rep}$ | Hertz [Hz] | The frequency with which pulses are emitted. Equal to the reciprocal of the period. |

**Example Calculation:**

Is it safe to use a detector with a specified maximum peak optical input power of **75 mW** to measure the following pulsed laser emission?

- Average Power: 1 mW
- Repetition Rate: 85 MHz
- Pulse Width: 10 fs

The energy per pulse:

$$E = \frac{P_{avg}}{f_{rep}} = \frac{1\ mW}{85\ MHz} = \frac{1\ x\ 10^{-3} W}{85\ x\ 10^{6} Hz} = 1.18\ x\ 10^{-11} J = 11.8\ pJ$$

seems low, but the peak pulse power is:

$$P_{peak} = \frac{P_{avg}}{f_{rep} \cdot \tau} = \frac{1\ mW}{85\ MHz\ \cdot 10\ fs} = 1.18\ x\ 10^3\ W = \mathbf{1.18\ kW}$$

It is ***not safe*** to use the detector to measure this pulsed laser emission, since the peak power of the pulses is >5 orders of magnitude higher than the detector's maximum peak optical input power.

Hide Laser Safety

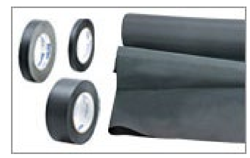
LASER SAFETY

## Laser Safety and Classification

Safe practices and proper usage of safety equipment should be taken into consideration when operating lasers. The eye is susceptible to injury, even from very low levels of laser light. Thorlabs offers a range of laser safety accessories that can be used to reduce the risk of accidents or injuries. Laser emission in the visible and near infrared spectral ranges has the greatest potential for retinal injury, as the cornea and lens are transparent to those wavelengths, and the lens can focus the laser energy onto the retina.

### Safe Practices and Light Safety Accessories







- Laser safety eyewear must be worn whenever working with Class 3 or 4 lasers.
- Regardless of laser class, Thorlabs recommends the use of laser safety eyewear whenever working with laser beams with non-negligible powers, since metallic tools such as screwdrivers can accidentally redirect a beam.
- Laser goggles designed for specific wavelengths should be clearly available near laser setups to protect the wearer from unintentional laser reflections.
- Goggles are marked with the wavelength range over which protection is afforded and the minimum optical density within that range.
- Laser Safety Curtains and Laser Safety Fabric shield other parts of the lab from high energy lasers.
- Blackout Materials can prevent direct or reflected light from leaving the experimental setup area.
- Thorlabs' Enclosure Systems can be used to contain optical setups to isolate or minimize laser hazards.
- A fiber-pigtailed laser should always be turned off before connecting it to or disconnecting it from another fiber, especially when the laser is at power levels above 10 mW.
- All beams should be terminated at the edge of the table, and laboratory doors should be closed whenever a laser is in use.
- Do not place laser beams at eye level.
- Carry out experiments on an optical table such that all laser beams travel horizontally.
- Remove unnecessary reflective items such as reflective jewelry (e.g., rings, watches, etc.) while working near the beam path.
- Be aware that lenses and other optical devices may reflect a portion of the incident beam from the front or rear surface.
- Operate a laser at the minimum power necessary for any operation.
- If possible, reduce the output power of a laser during alignment procedures.
- Use beam shutters and filters to reduce the beam power.
- Post appropriate warning signs or labels near laser setups or rooms.
- Use a laser sign with a lightbox if operating Class 3R or 4 lasers (i.e., lasers requiring the use of a safety interlock).
- Do not use Laser Viewing Cards in place of a proper Beam Trap.

### Laser Classification

Lasers are categorized into different classes according to their ability to cause eye and other damage. The International Electrotechnical Commission (IEC) is a global organization that prepares and publishes international standards for all electrical, electronic, and related technologies. The IEC document 60825-1 outlines the safety of laser products. A description of each class of laser is given below:

| Class | Description | Warning Label |
|---|---|---|
| 1 | This class of laser is safe under all conditions of normal use, including use with optical instruments for intrabeam viewing. Lasers in this class do not emit radiation at levels that may cause injury during normal operation, and therefore the maximum permissible exposure (MPE) cannot be exceeded. Class 1 lasers can also include enclosed, high-power lasers where exposure to the radiation is not possible without opening or shutting down the laser. |   |
| 1M | Class 1M lasers are safe except when used in conjunction with optical components such as telescopes and microscopes. Lasers belonging to this class emit large-diameter or divergent beams, and the MPE cannot normally be exceeded unless focusing or imaging optics are used to narrow the beam. However, if the beam is refocused, the hazard may be increased and the class may be changed accordingly. |   |
| 2 | Class 2 lasers, which are limited to 1 mW of visible continuous-wave radiation, are safe because the blink reflex will limit the exposure in the eye to 0.25 seconds. This category only applies to visible radiation (400 - 700 nm). |   |
| 2M | Because of the blink reflex, this class of laser is classified as safe as long as the beam is not viewed through optical instruments. This laser class also applies to larger-diameter or diverging laser beams. |   |
| 3R | Class 3R lasers produce visible and invisible light that is hazardous under direct and specular-reflection viewing conditions. Eye injuries may occur if you directly view the beam, especially when using optical instruments. Lasers in this class are considered safe as long as they are handled with restricted beam viewing. The MPE can be exceeded with this class of laser; however, this presents a low risk level to injury. Visible, continuous-wave lasers in this class are limited to 5 mW of output power. |   |
| 3B | Class 3B lasers are hazardous to the eye if exposed directly. Diffuse reflections are usually not harmful, but may be when using higher-power Class 3B lasers. Safe handling of devices in this class includes wearing protective eyewear where direct viewing of the laser beam may occur. Lasers of this class must be equipped with a key switch and a safety interlock; moreover, laser safety signs should be used, such that the laser cannot be used without the safety light turning on. Laser products with power output near the upper range of Class 3B may also cause skin burns. |   |
| 4 | This class of laser may cause damage to the skin, and also to the eye, even from the viewing of diffuse reflections. These hazards may also apply to indirect or non-specular reflections of the beam, even from apparently matte surfaces. Great care must be taken when handling these lasers. They also represent a fire risk, because they may ignite combustible material. Class 4 lasers must be equipped with a key switch and a safety interlock. |   |
| All class 2 lasers (and higher) must display, in addition to the corresponding sign above, this triangular warning sign. | |  |

Hide Femtosecond Optical Parametric Amplifier

## Femtosecond Optical Parametric Amplifier

FSLOPAX1

| Part Number | Description | Price | Availability |
|---|---|---|---|
| FSLOPAX1 | Femtosecond Optical Parametric Amplifier, 1650 nm, 65 fs Typ. Pulse Width | $0.00 | Lead Time |