THORLABS

Corporate Deck

July 2023

Company Profile

OUR MISSION:
“We transform the world by identifying, enabling, and accelerating key photonics technologies.”

FOUNDED

1989 by Alex Cable

HEADQUARTERS

Newton, NJ

EMPLOYEES

>2,700 Worldwide*

GLOBAL FOOTPRINT

22 Locations

>1.1 million Square-Feet*

THORLABS

*As of Q3 2023.

Thorlabs' Headquarters in Newton, NJ

Company Profile

ANNUAL SALES (2022)

$607M across 364k sales orders

SELF-FUNDED

100% of Profits Invested Back into the Company

PRODUCT PORTFOLIO

~ 22,000 Products;
20% Customer Inspired

CERTIFICATION

ISO 9001:2015, ITAR, and CE

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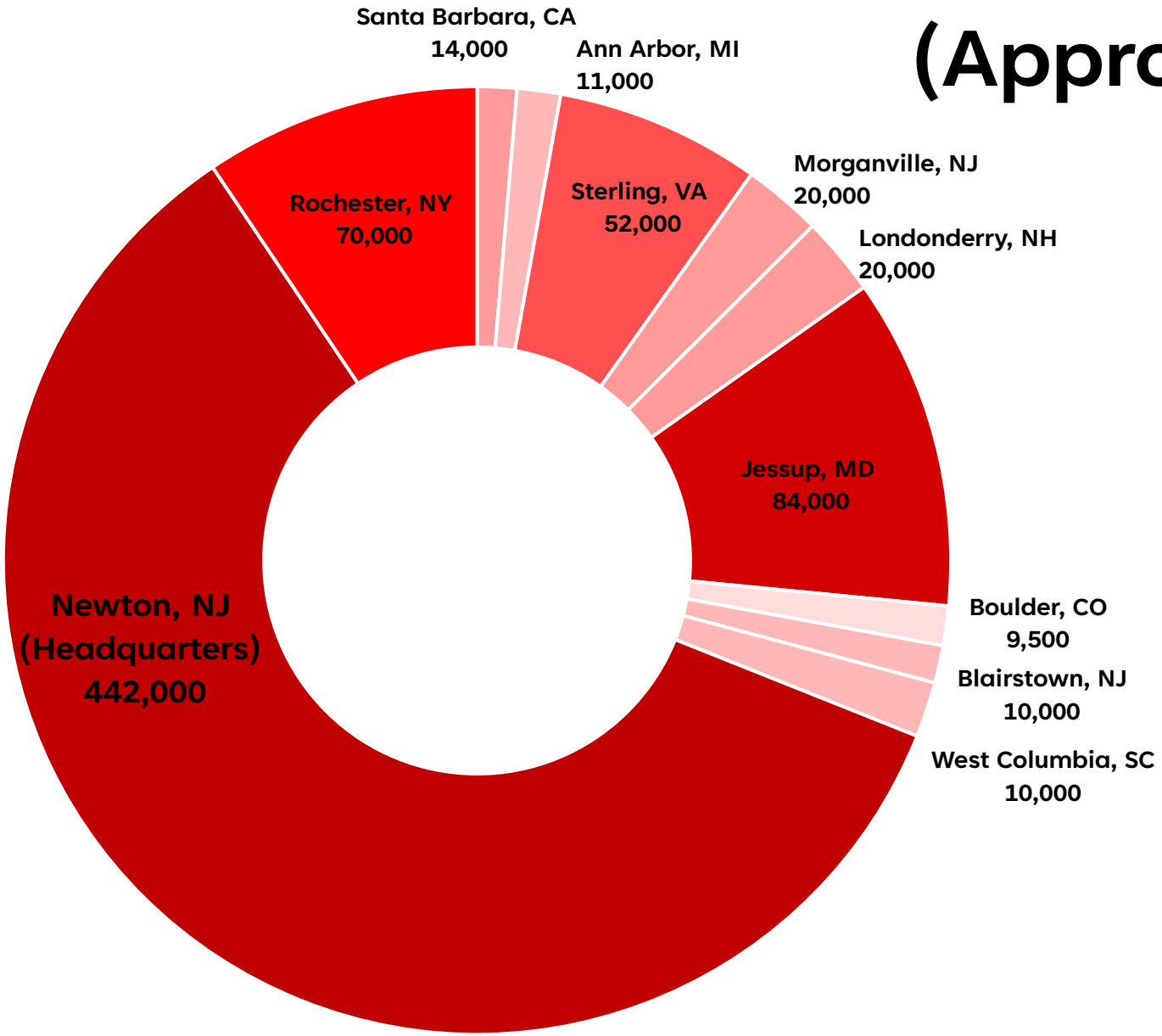
Thorlabs U.S. Locations (Approx. Size in Square Feet)



Our U.S. manufacturing capabilities include optomechanics, fiber, optics, lasers, electronics, imaging systems, semiconductor devices, and more.

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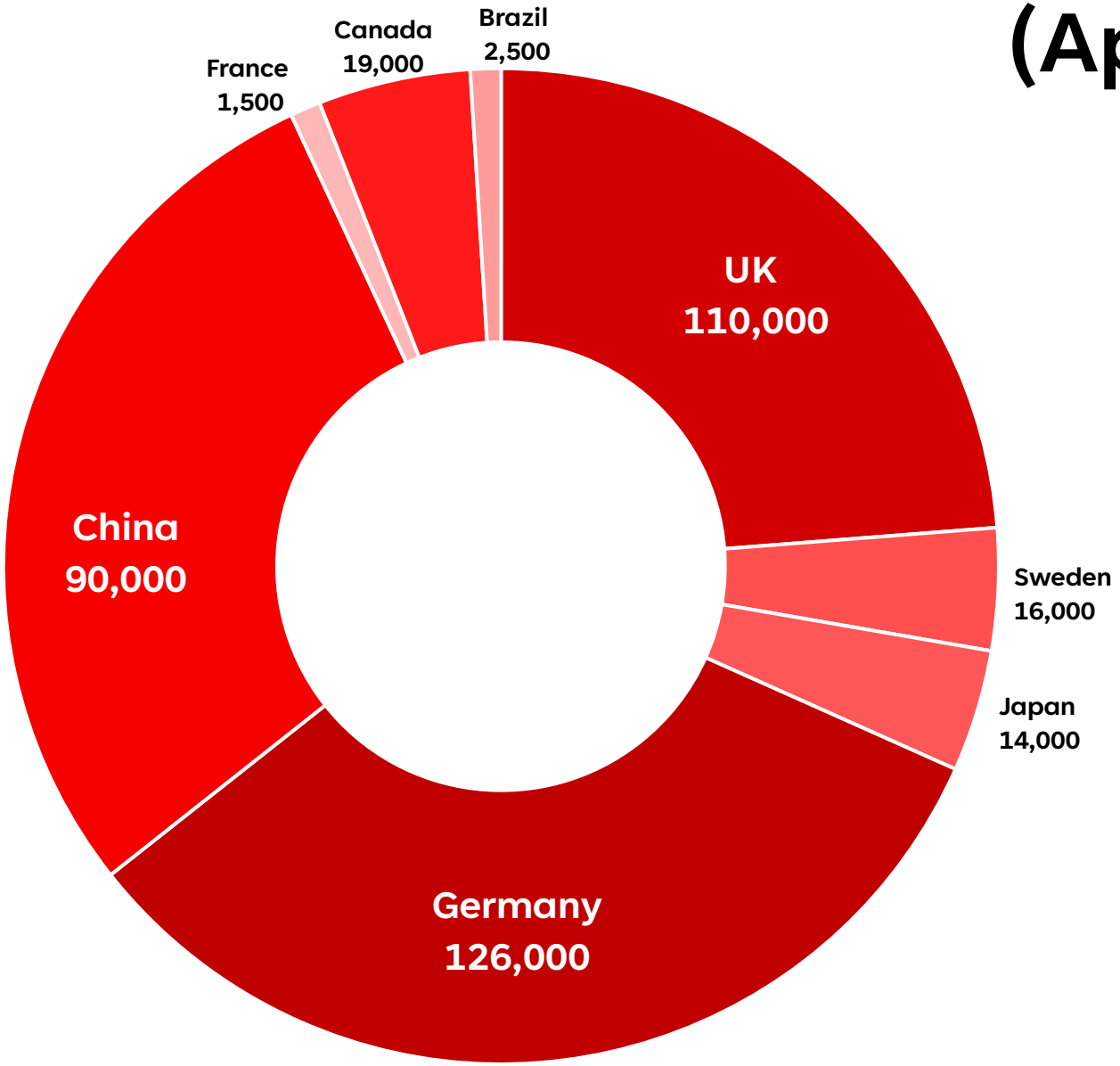
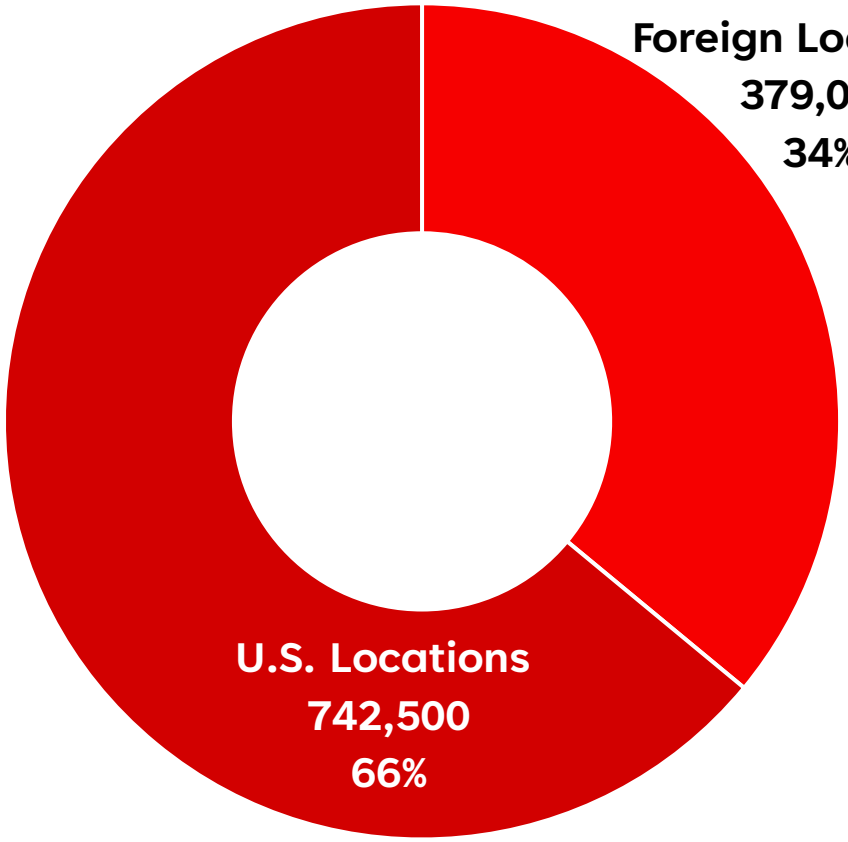
Thorlabs Foreign Entities (Approx. Size in Square Feet)





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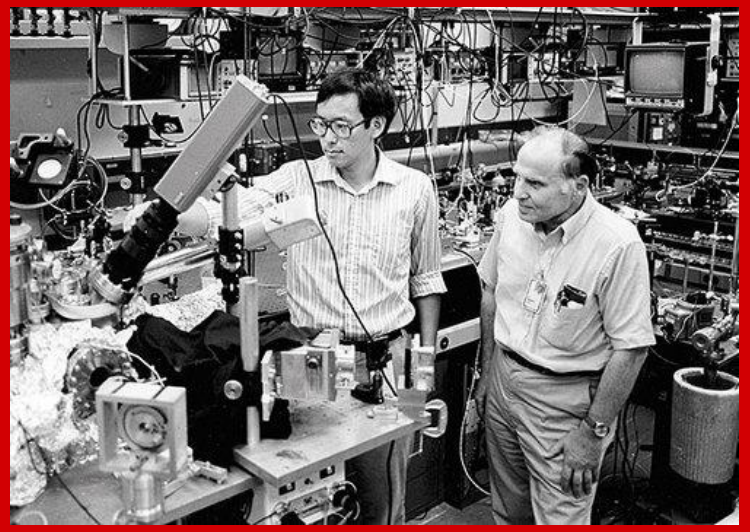


1986 Photo of Steven Chu and Arthur Ashkin, Nobel Laureates, and Two of Cable's Bell Labs Colleagues.

Our Founding Story

1984

Alex Cable Begins Career at Bell Labs

Thorlabs Founder and CEO starts work in the Area 11 research and development division of AT&T with Dr. Steven Chu, former US Secretary of Energy and recipient of the 1997 Nobel Prize in Physics.

1985

Lab Presents Pioneering Work on Laser Cooling

Bell Labs team demonstrates confinement and cooling of neutral sodium atoms in three dimensions via the application of radiation pressure from laser beams.

1987

Research Challenges

While at Bell Labs, Cable had trouble obtaining tools for his experiments. He found that most photonics companies didn't see value in selling to graduate students or junior professors. As a result, costs were high and lead times were long.

Our Founding Story

1989

Thorlabs Is Founded

Cable founds Thorlabs with a focus on selling to this underserved market.

His initial capital comes from designing two scanning tunneling microscopes for DuPont.

First-year profits come from selling 23,500 table clamps, a product made for $3.50 and sold for $7.

These $7 table clamps were originally fabricated from unanodized aluminum with stick-on labels.

1990

First Office Building

Thorlabs grew to a staff of 10 and moved into a warehouse basement on Mill St. in Newton, NJ.

Early brand promises and ideas led to continued success with our customers.

First Thorlabs Headquarters.

Our Founding Story

"I made a few thousand clamps in the early months...shop time at this time was $1/min.
I could make these simple parts in my 'spare time' and generate capital. The funds then allowed me to design, produce, inventory, market the next incremental product. As I advertised same day shipping, I felt compelled to stock large quantities to ensure I kept that critical customer promise."

Alex Cable
Thorlabs Founder and CEO

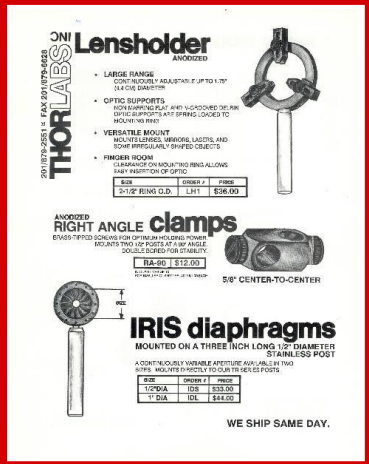
Cable at Newton Headquarters in 2018.

Our Founding Story

"The entire company in the early 1990s fit into one large room, and we were all trained to take orders. If the phone rang twice, then all of us not on the phones would dive for the call. A sense of urgency was maintained with this very clear message of, "answer the phones," where everyone knew what that meant—not the 4th ring. The message specific to the phones was of course critical, but the message was somehow broader, it created a culture of being accountable to our customers."

Alex Cable
Thorlabs Founder and CEO

Early Thorlabs HQ is Now a Machine Shop.



Flyers like this were sent to Cable's colleagues. Bell Labs was one of Thorlabs' first customers!

Our Founding Story

Dec 1989

Thorlabs Publishes First Catalog

Catalog begins as a one-page flyer with hand drawn product illustrations to lower costs.

In the early years, catalogs are mailed to authors of Physics and Photonics publications to build a customer base of 30,000 prospects.

1995

New Building Purchased

40,000 sq. ft. facility is used for manufacturing and other business processes.

1999

Thorlabs Website Is Released

The Thorlabs catalog and website coexist for over a decade.

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Our Founding Story

2011

V21 Catalog is Published

The final Thorlabs catalog contains 1,904 pages and nearly 15,000 products. It weighed 11 pounds.

2012

New Headquarters is Completed

This building is designed with enough room to accompany 10 years of growth.

2019

Anodization Facility Opens

Thorlabs brings metal finishing in-house to reduce lead times, improve consistency, and create new prototyping capabilities.

2020

New Buildings Completed Globally

New manufacturing facilities are completed in Germany and the UK to better serve our customers in Europe.

Final Print Catalog.

Headquarters Completed in 2012.

Jenn Cable

Peter Fendel

New Headquarters Building.

Our Founding Story

2021

Jennifer Cable Named President

Jenn transitions into the role previously held by Alex Cable. Alex maintains his role as CEO.

2021

Peter Fendel Named Global CTO

Fendel becomes the first Chief Technology Officer in Thorlabs' history.

2022

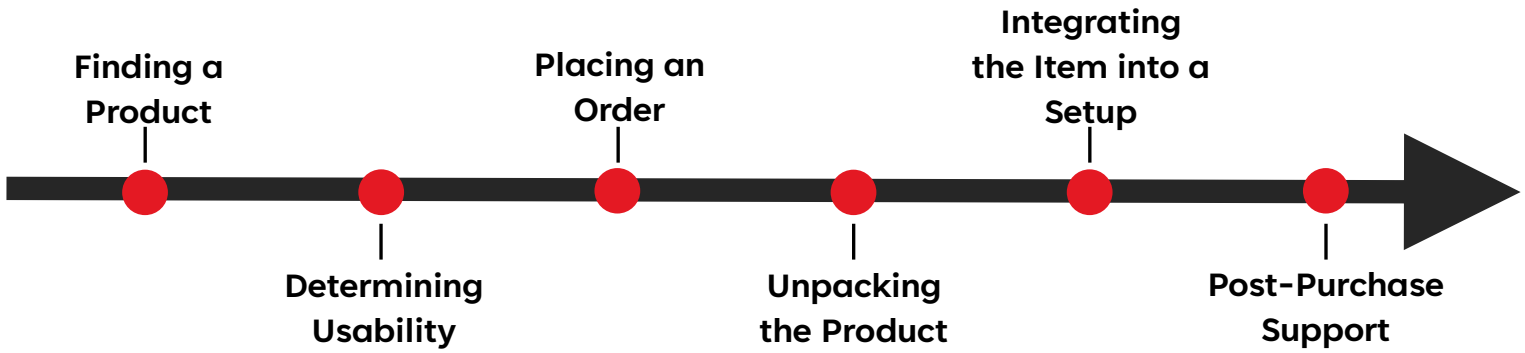
New Headquarters is Completed

Thorlabs grows more quickly than expected; a new manufacturing center is completed in 2022. It houses optomechanics, electronics, and administrative groups. Optics expands to fill the previous headquarters.

Our Company Promise

- ✓ We promise speed without compromising the quality of our products or services.
- ✓ We constantly look for ways to increase Customer efficiency at every step in the value chain.

Value Chain



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Our Vision

Enable Customers to be More Efficient and Successful by Valuing Their Time / Efforts and Anticipating Their Needs

Raise the Bar on Current Industry Standards Concerning Information Availability, Fair Pricing, and Good Value

Impact the World by Contributing to the Advancement of Photonics and Other Sciences with Quality Products, Services, and Technologies that are Easy to Access, Use, and Select

Identify and Master Emerging Technologies, Business Models, and Relationships to Ensure Future Growth

Partner Plus and Customer Centricity

Our Belief in the Importance of Our Customers' Work and Our Respect for Their Time is Manifested through Our People, Processes, Structure, and Systems

Authentic, Low Friction, Intelligent Interfaces Encourage Dialog between the Company and Our Customers

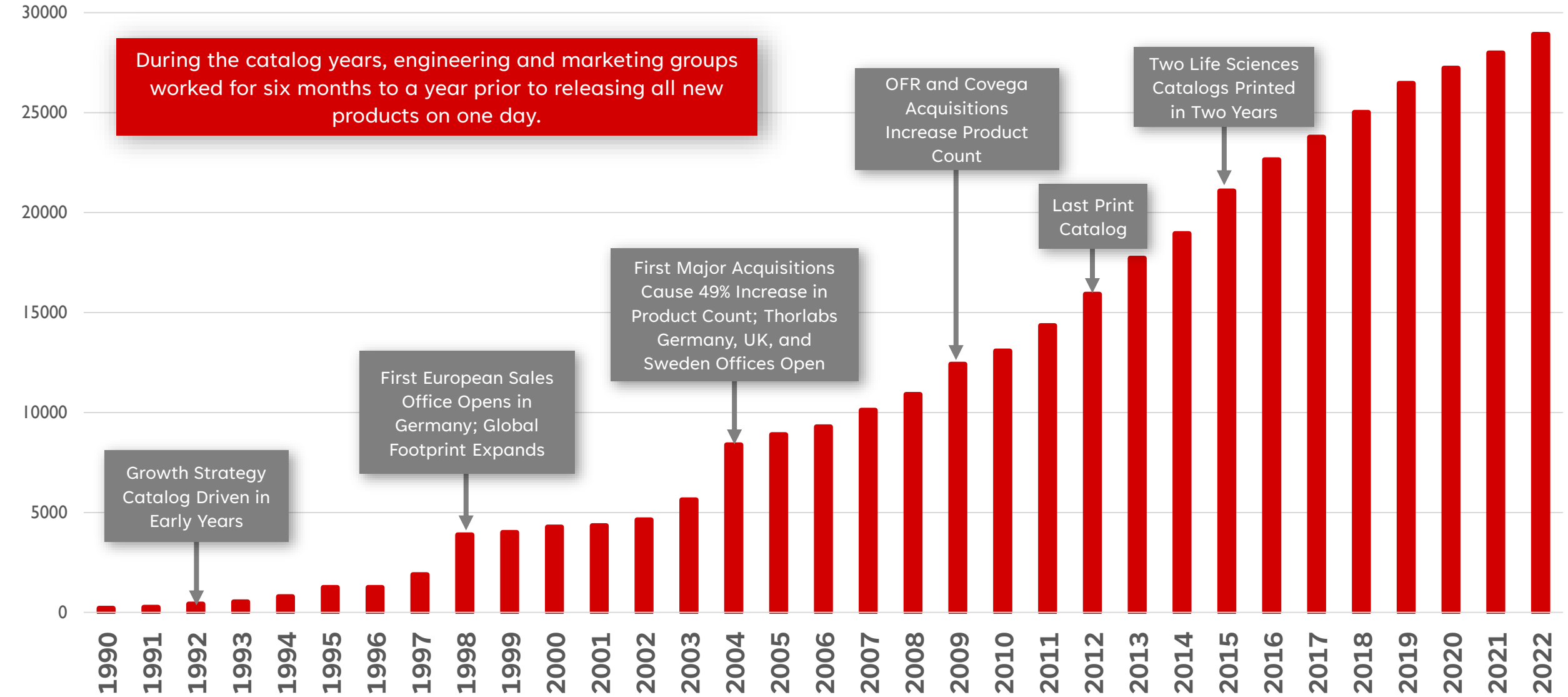
Detailed Presentations Facilitate Product Selection

We Offer Fast Delivery of Products and Services, Easy to Open Packaging, Simple Returns, and Usable Products

Our Portfolio is Diverse and Reliable

Customer Feedback is Used to Improve the Business

Number of Catalog Items per Year (Cumulative)



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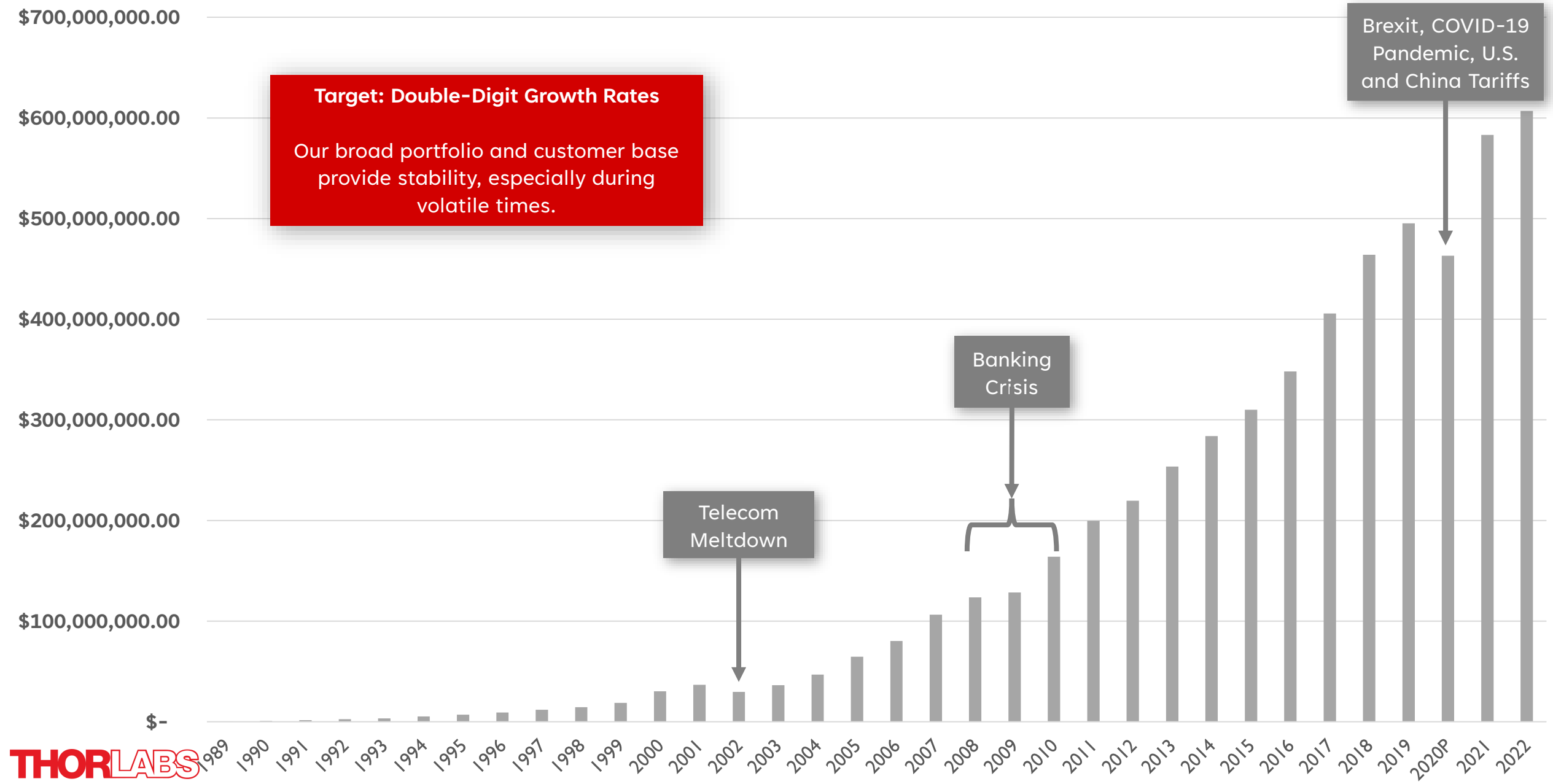
Thorlabs Sales (% Indicate Y/Y Growth)



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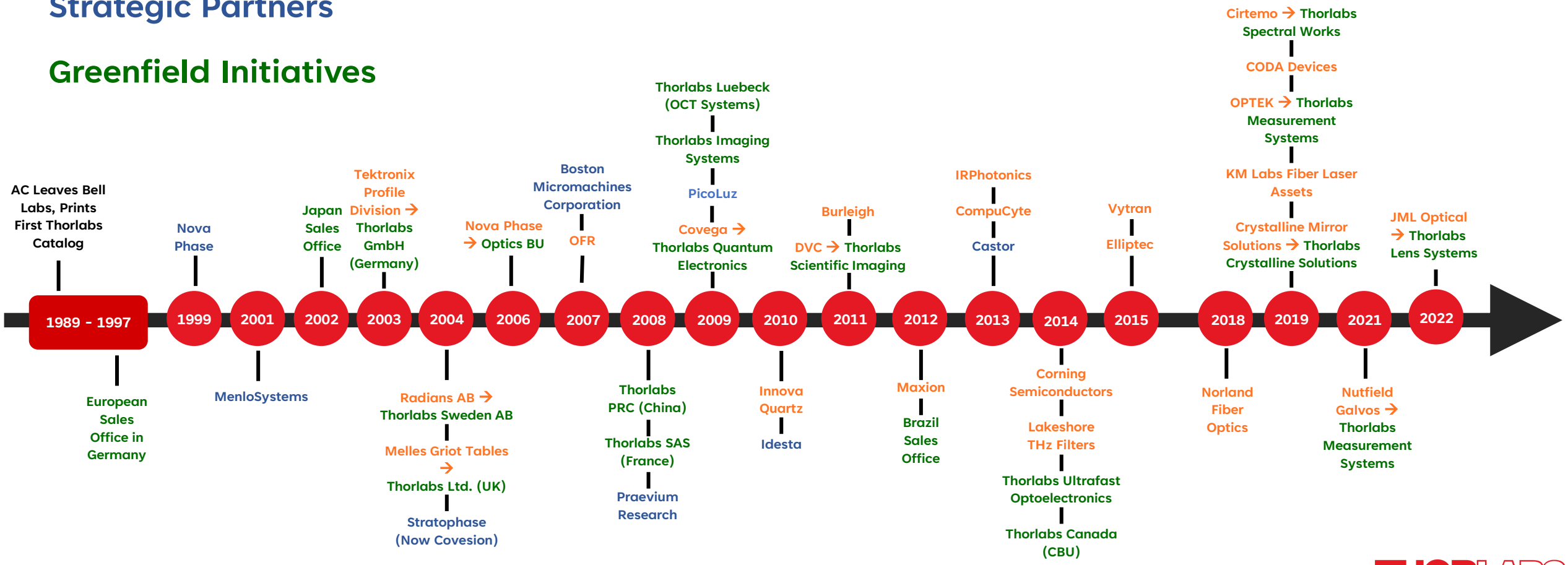
Thorlabs Growth Timeline

Acquisitions

Strategic Partners

Greenfield Initiatives



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Strategic Partners (SP) and Acquisitions (A)

Name	Year	Technology Then	Technology Now
Menlo Systems (SP)	2001	Optical Frequency Combs	OFC's, plus fs Fiber Lasers, Ultrastable Lasers, Optical Clocks, and THz Systems
Tektronix Profile Division (A)	2003	PMDs, Laser Diodes, and DWDM Sources	Became Thorlabs GmbH; Diode Light and Drivers, Spectroscopy and Tunable Lasers, Light Detection and Analysis, Fast Scanning Mirrors, OCT, and Educational Kits
Radians AB (A)	2004	Tunable Lasers	Became Thorlabs Sweden AB; Optical Spectrum Analyzers (OSA's) and Optical Systems
Melles Griot Ltd. Tables Line (A)	2004	Optical Tables, Motion Control	Became Thorlabs Ltd.; Motion Control Systems and Vibration Isolation Products/Optical Tables
Stratophase, now Covesion (SP)	2004	Optical Circuits and PPLN Crystals	OEM PPLN Crystals and Solutions
Nova Phase (A)	2006	Optics	Became the Optics BU; Lenses, Mirrors, Filters, Beamsplitters, Prisms, and Polarization Optics

Strategic Partners (SP) and Acquisitions (A)

Name	Year	Technology Then	Technology Now
OFR (A)	2007	Optical Isolators and Circulators	Products Integrated into Optics BU
Boston Micromachines (SP)	2007	Microelectromechanical System (MEMS)-Based Deformable Mirrors	
Praevium Research (SP)	2008	Miniature Optoelectronic Devices	Semiconductor Lasers, Detectors, and VCSEL Laser Sources
Covega (A)	2009	Superluminescent Light Emitting Diodes, Fabry-Perot Lasers, Tunable Laser Gain Chips, Semiconductor Optical Amplifiers, and Lithium Niobate Modulators	Became TQE; Product Lines Integrated into Thorlabs Portfolio
PicoLuz (SP)	2009	Ultrafast Optical Signal Processing Based on Time Lens Technology	
Innova Quartz (A)	2010	Gas Chromatography, Fiber Optics	Acquired Fiber Draw Towers

Strategic Partners (SP) and Acquisitions (A)

Name	Year	Technology Then	Technology Now
IdestaQE (SP, A)	2010, 2012	Ultrafast Lasers	Became Thorlabs Laser Division; Femtosecond Lasers
Burleigh Product Line (A)	2011	Electrophysiology Stages	Products Integrated into Imaging Systems Portfolio
DVC (A)	2011	Cameras	Became TSI; Cameras for Life Science Applications
Maxion (A)	2012	MIR Lasers	Integrated into TQE; Semiconductor Lasers and MEMS-Tunable VCSEL Laser Sources
IRphotonics (A)	2013	MIR and IR, Fluoride-Based Optical Fibers	Integrated into Fiber BU; ZrF_4 and InF_3 Fibers
CompuCyte (A)	2013	Laser Scanning Cytometry	Integrated into Imaging Systems Group

Strategic Partners (SP) and Acquisitions (A)

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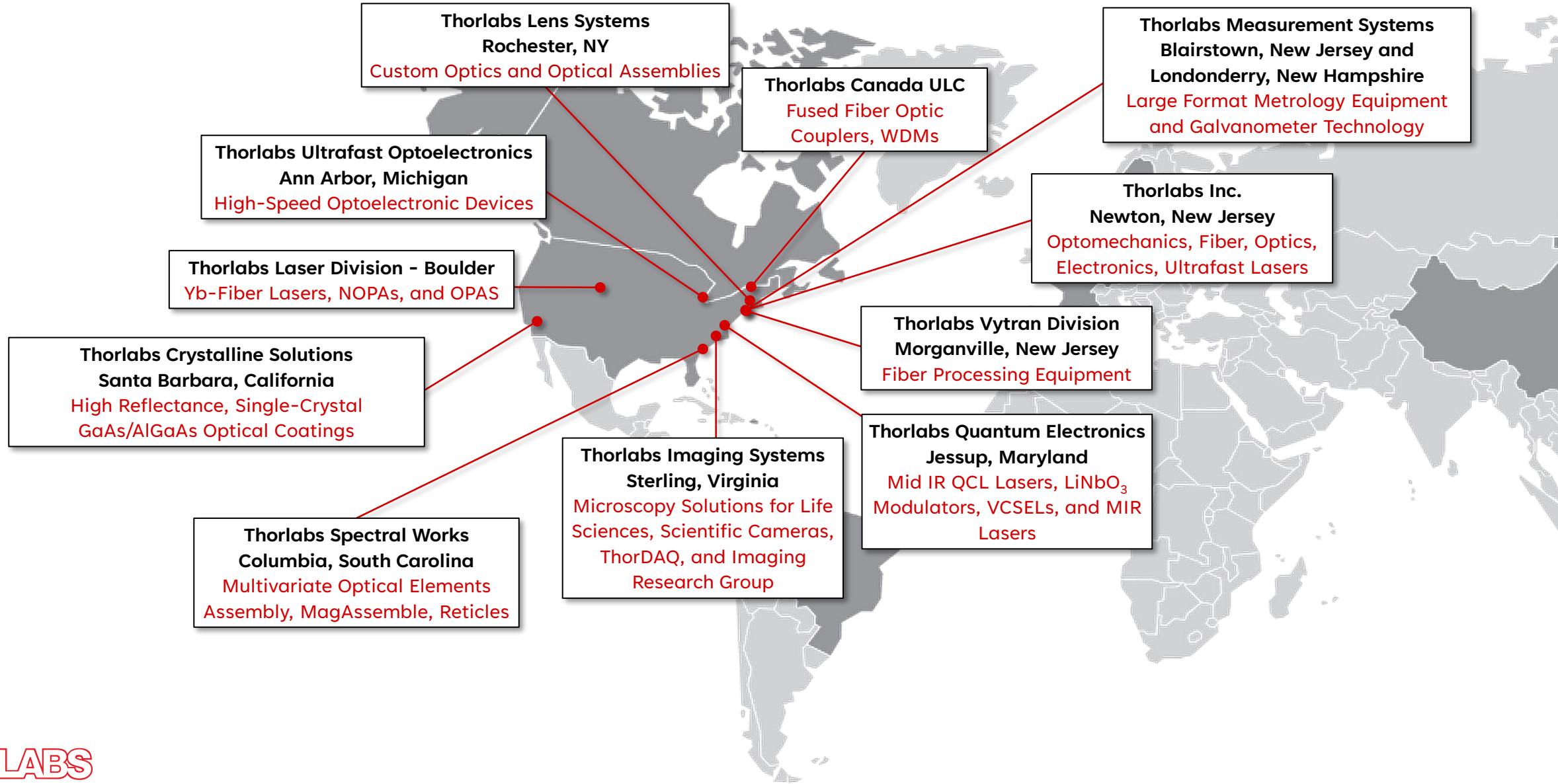
Strategic Partners (SP) and Acquisitions (A)

Name	Year	Technology Then	Technology Now
Cirtemo (A)	2019	Multivariate Optical Elements and Pattern Transfer Nanomanufacturing	Became Thorlabs Spectral Works; Integrated into Optics BU
CODA Devices (A)	2019	Raman Spectroscopy Equipment	Integrated into Thorlabs GmbH
Operations Technology Inc. (OPTEK) (A)	2019	Video Metrology Equipment	Became Thorlabs Measurement Systems
Fiber Laser Assets of KMLabs (A)	2019	Yb-Fiber Laser Product Line	Integrated into Laser Division
Crystalline Mirror Solutions (CMS) (A)	2019	Custom Low-Noise, Precision Optics (Semiconductor Supermirrors)	Became Thorlabs Crystalline Solutions; Integrated into Optics BU
Nutfield Technology (A)	2021	Galvo-Based Scanning Technology	Integrated into Thorlabs Measurement Systems
JML Optical (A)	2022		

North America Design and Manufacturing



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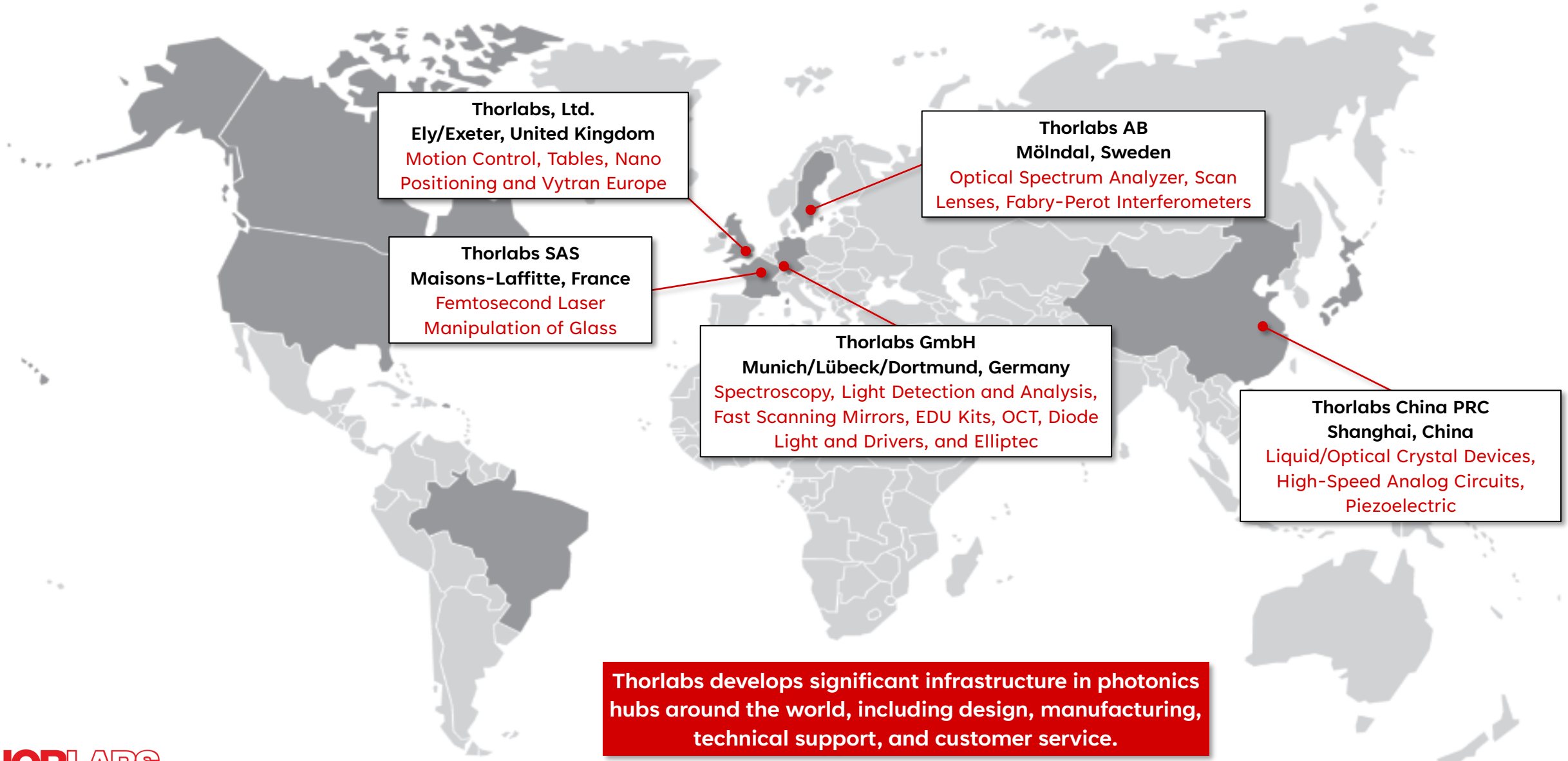
WW Design and Manufacturing



Thorlabs develops significant infrastructure in photonics hubs around the world, including design, manufacturing, technical support, and customer service.

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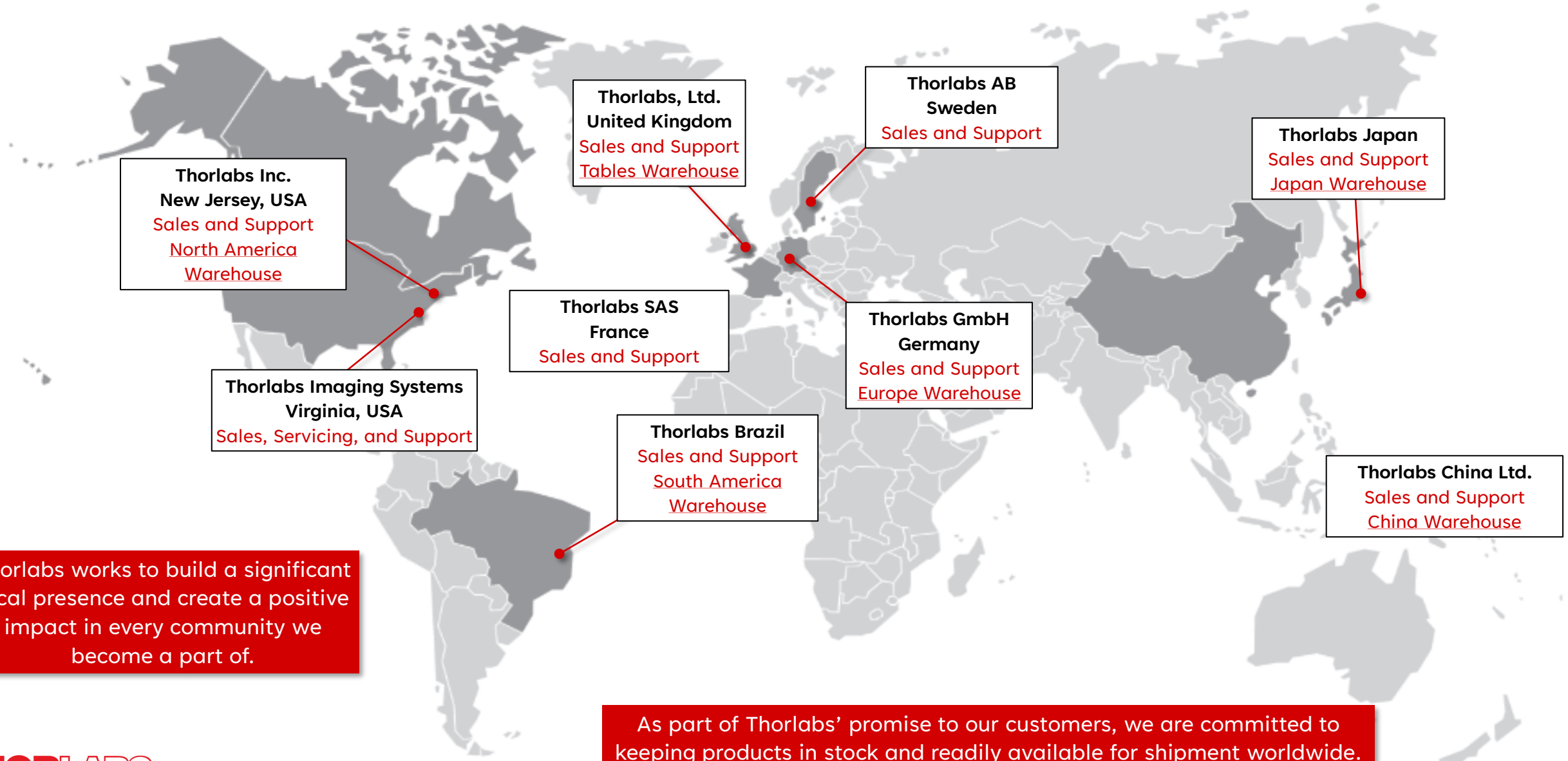
WW Sales Offices and Distribution Warehouses



Thorlabs works to build a significant local presence and create a positive impact in every community we become a part of.

As part of Thorlabs' promise to our customers, we are committed to keeping products in stock and readily available for shipment worldwide.

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Thorlabs' C-Suite

Alex Cable

CEO

Serves as a founder and/or board member of Castor Optics, Boston Micromachines, Praevium, and Menlo Systems.

Jenn Cable

President

Worked in Global Health and Healthcare Consulting Fields prior to joining Thorlabs in 2015.

Robert Regimbal

CFO & General Counsel

Worked as an attorney at Graham Curtin prior to joining Thorlabs in 2011.

Peter Fendel

Chief Technology Officer

Has 20 years of applicable research and industry experience, including tenures at MenloSystems and Coherent.

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BU Leaders and Managers

UNITED STATES

VP of North America
Tyler Morgus

Advanced Photonics
Bill Donovan

Optomechanics
Scott Barry

Electronics
Pauline Non

Laser Division
Peter Fendel

Quantum Electronics
Peter Heim

Lens Systems
Anthony Giordano

Crystalline Solutions
Garrett Cole

Imaging Systems
Sam Tesfai

Ultrafast Optoelectronics
Janis Valdmanis

Vytran Fiber Processing
Robert Walz

Measurement Systems
Ike Jariel

Spectral Works
Ryan Priore

INTERNATIONAL

VP of Europe
Bruno Gross

Germany
Julien Vigroux

United Kingdom
Keith Dhese

Sweden
Jonas Olsson

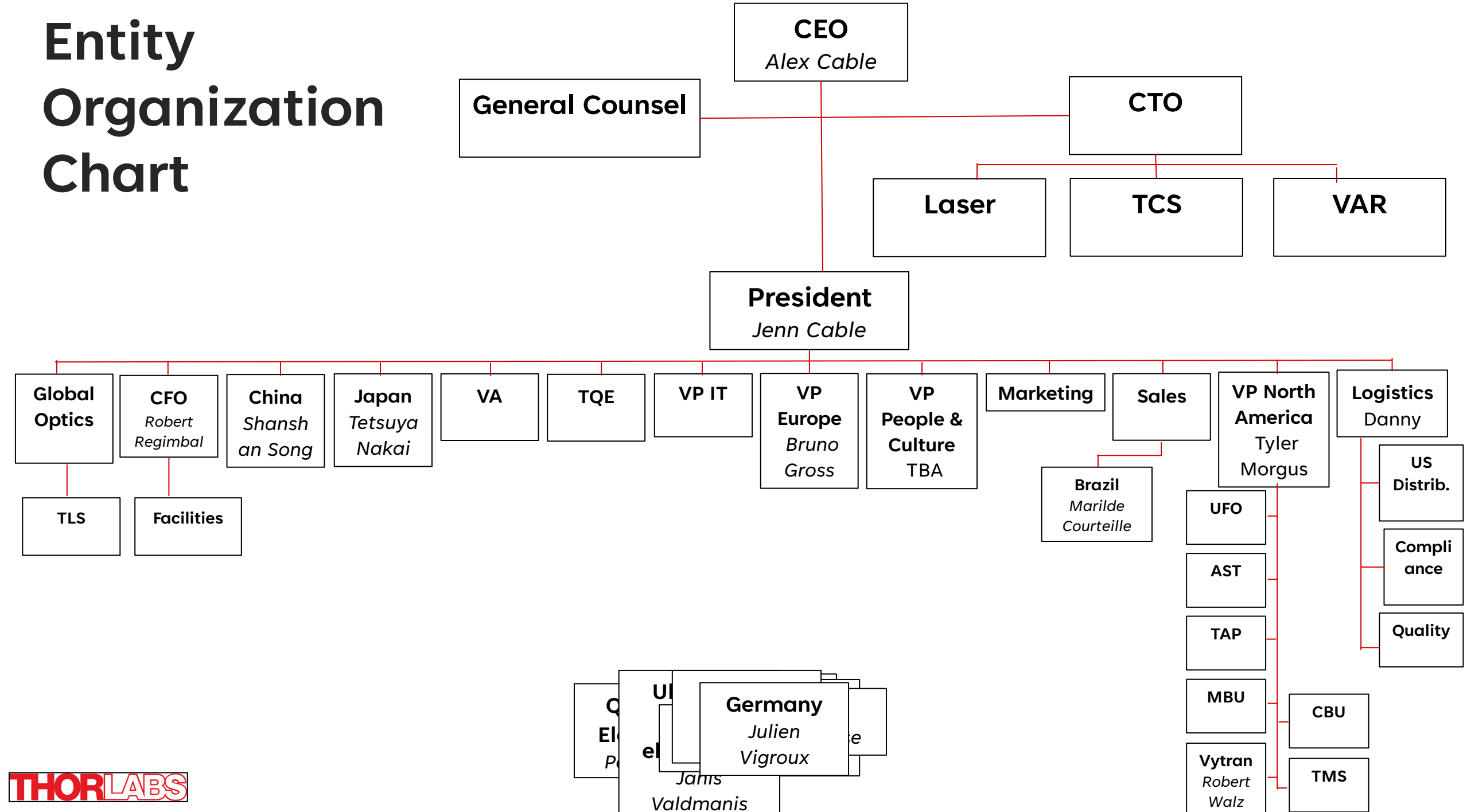
Canada
Eric Geoffrion

Brazil
Marilde Courteille

China
Shanshan Song

Japan
Tetsuya Nakai

Entity Organization Chart



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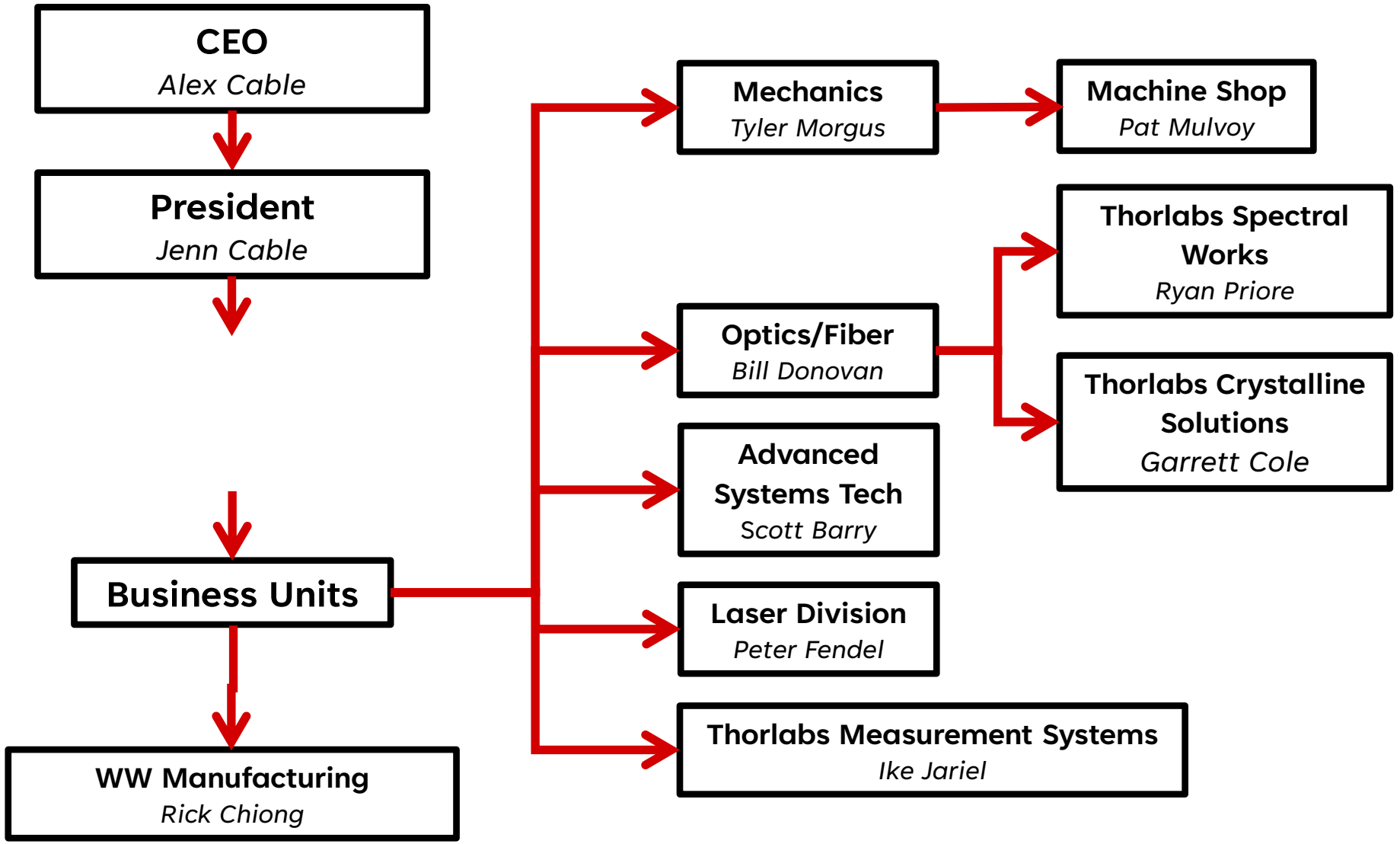
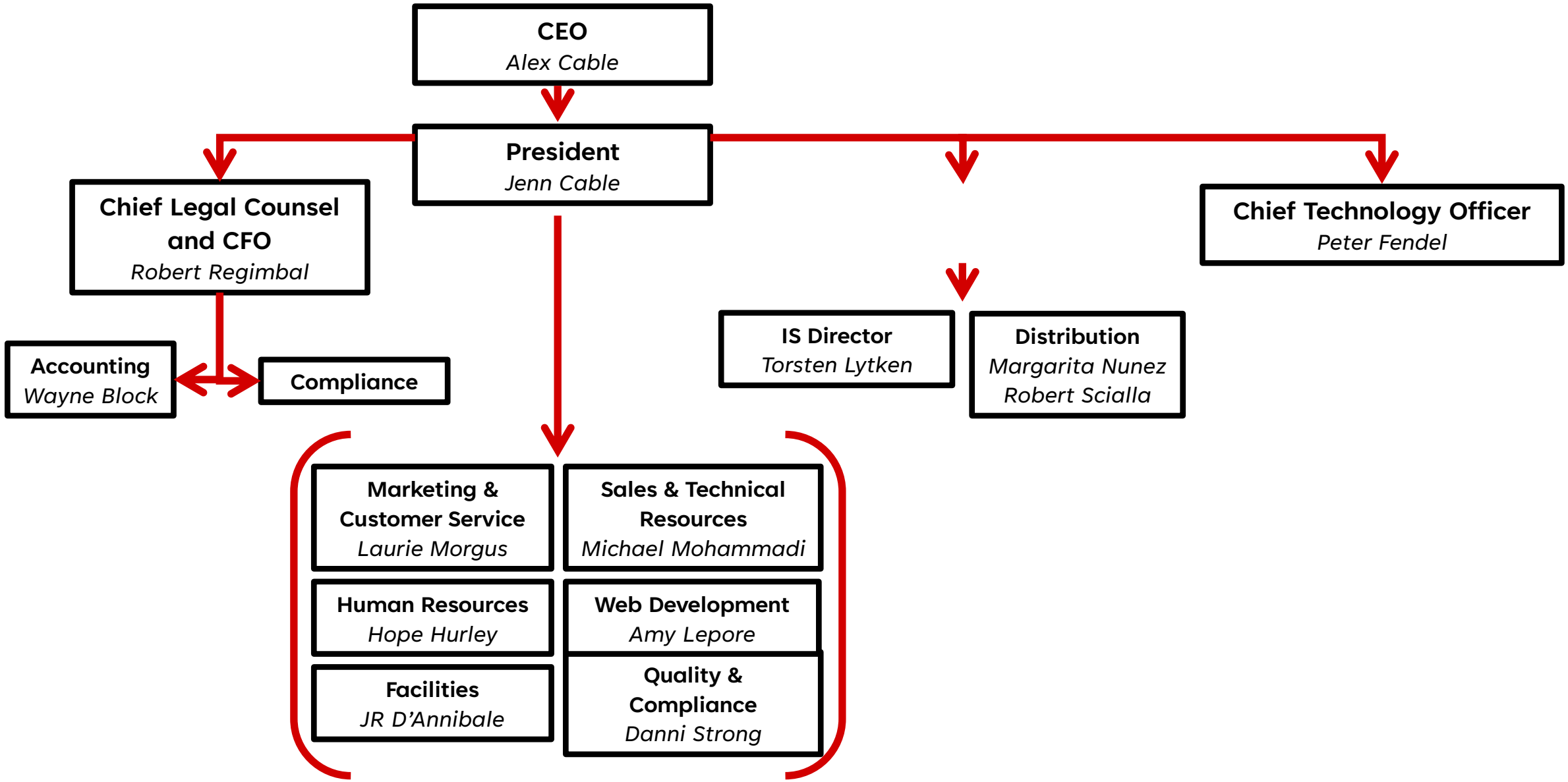
Newton Business Unit Organization Chart



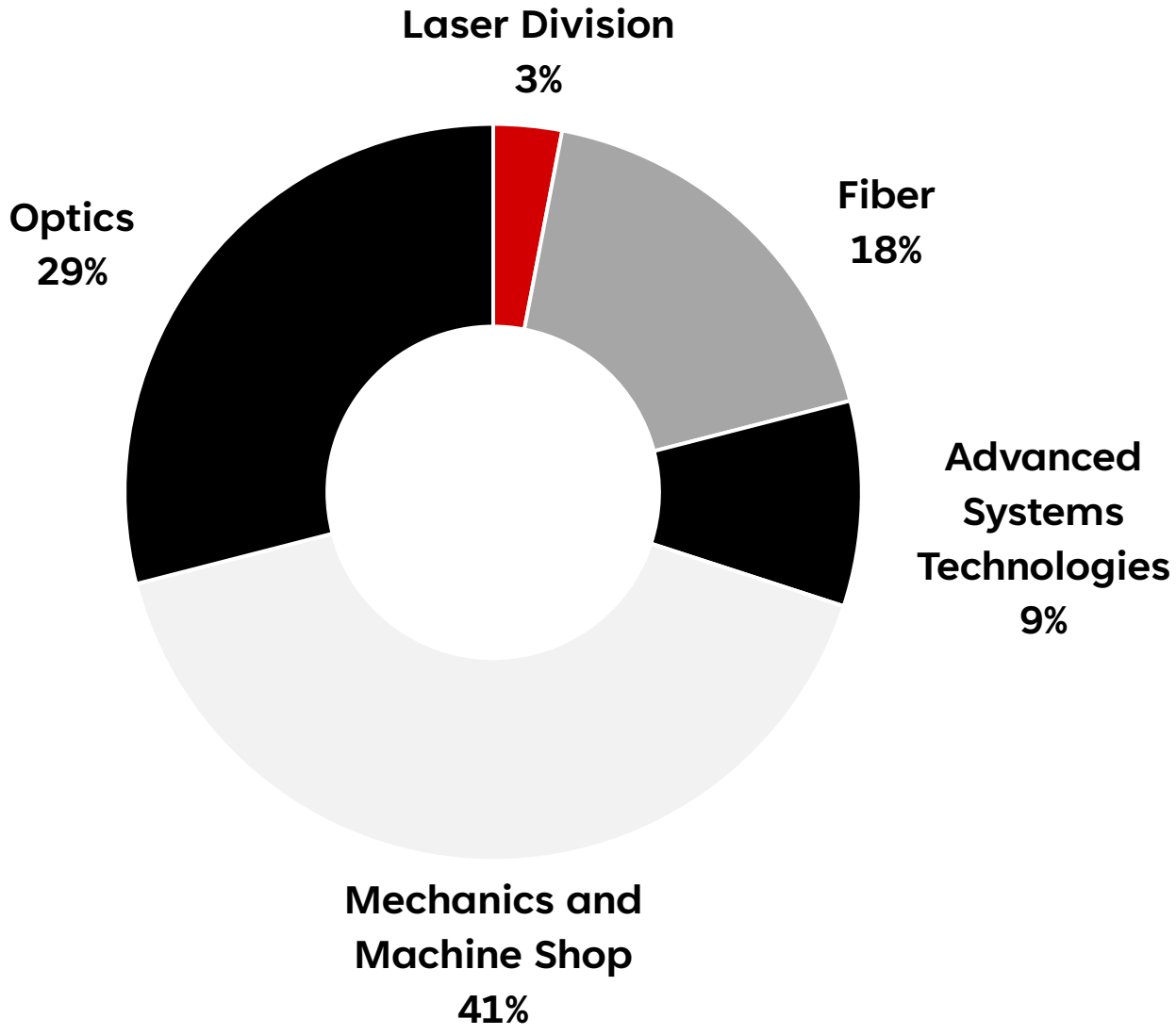
Headquarters Department Organization Chart



Thorlabs Global Headcount

Location	Number of Employees
USA	1,768
Germany	342
United Kingdom	309
China	213
Sweden	60
Canada	61
Japan	23
France	18
Brazil	4
Total (July 2023)	**2,798**

Employees by Business Unit, Newton, NJ



MBU Employee Working with a Gantry Mill

Fiber Team Supports Breast Cancer Awareness Month by Wearing Pink

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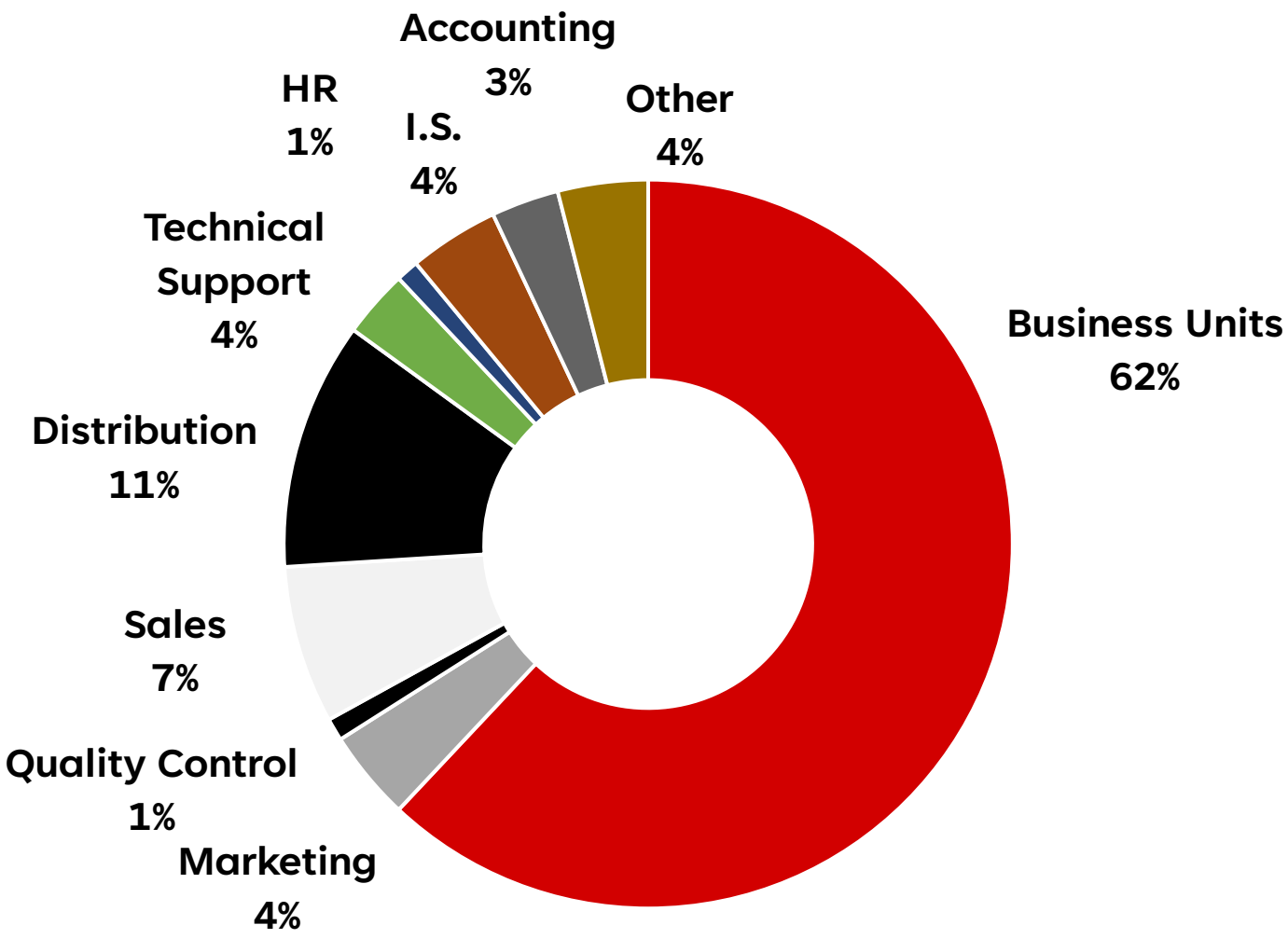
Employees by Department, Newton, NJ



OBU Employee Inspects a Lens

Thorlabs' OEM Sales Team

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Fiber Assembly Area on Second Floor

Optics Fabrication Capabilities in Newton

Newton, New Jersey

MANUFACTURING EPICENTER AND AMERICAN DISTRIBUTION HUB

- Manufacturing: Mechanics, Optics, Fiber, Electronics, and Lasers
- Sales and Technical Support
- Marketing and Web Development

  Machine Shop, Coating Chambers, Fiber Draw Towers, and Research Labs
- Lean Manufacturing Principles Implemented and Synchronized Supply Chain

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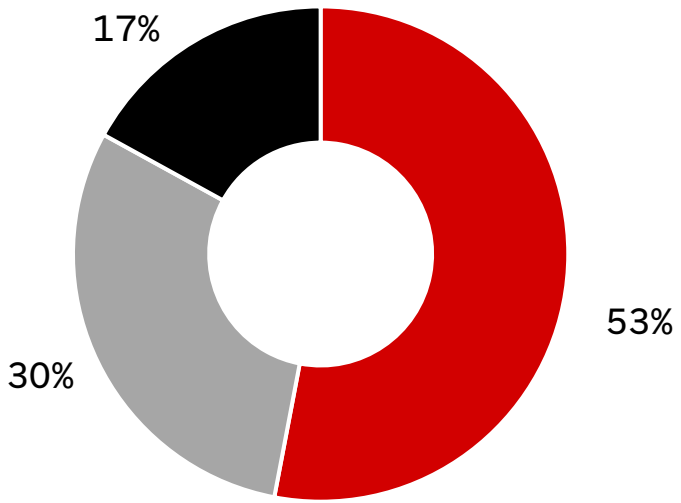
Employees by Location

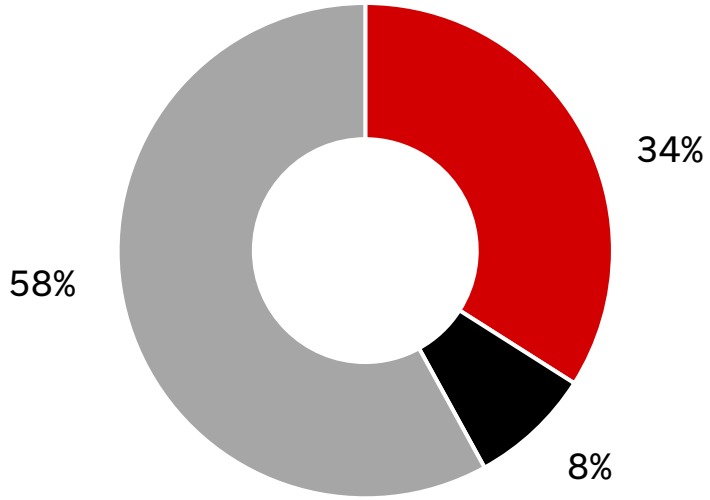
Thorlabs Inc.

1,227 Employees



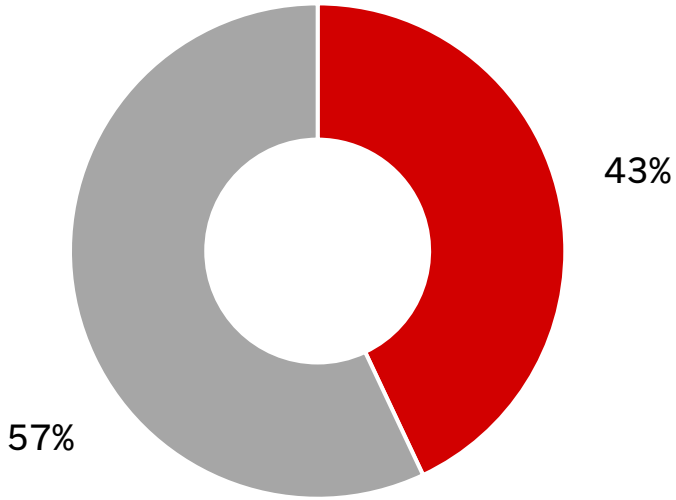
Thorlabs Vytran® Division

47 Employees



Thorlabs Ultrafast Electronics

28 Employees

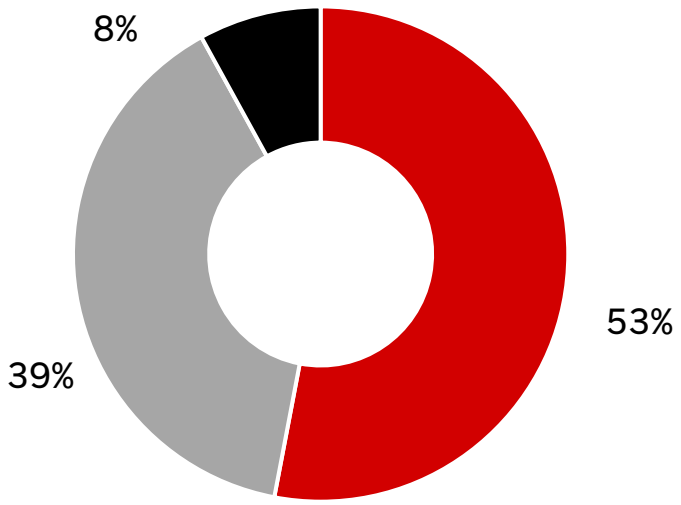


Administrative Technical Manufacturing

Employees by Location

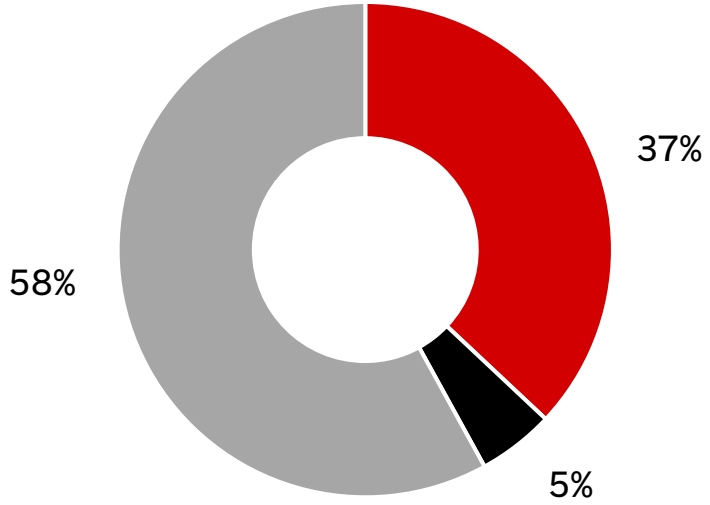
Thorlabs Imaging Systems

86 Employees



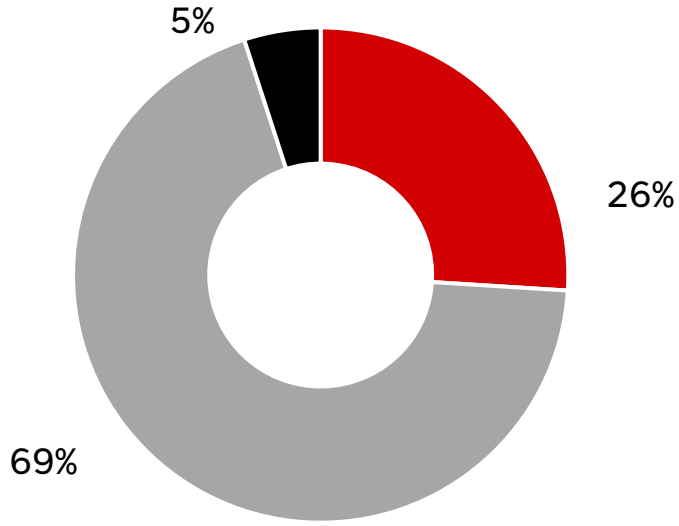
Thorlabs Quantum Electronics

192 Employees



Thorlabs Measurement Systems

33 Employees



Administrative Technical Manufacturing

Employees by Location

Thorlabs Lens Systems

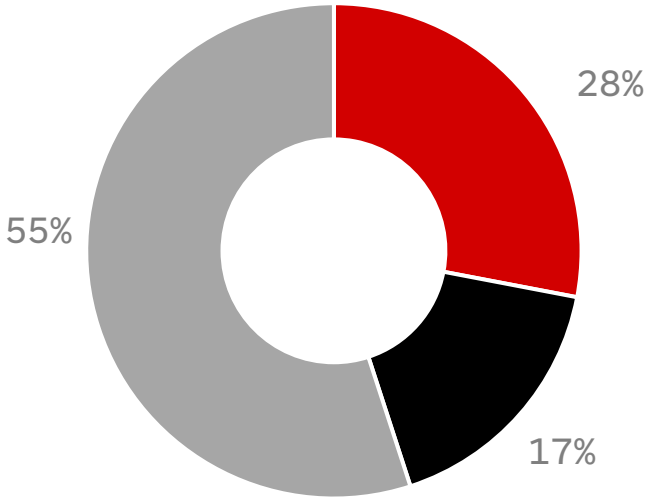
82 Employees

■ Administrative ■ Technical ■ Manufacturing

Staff Demographics: Europe

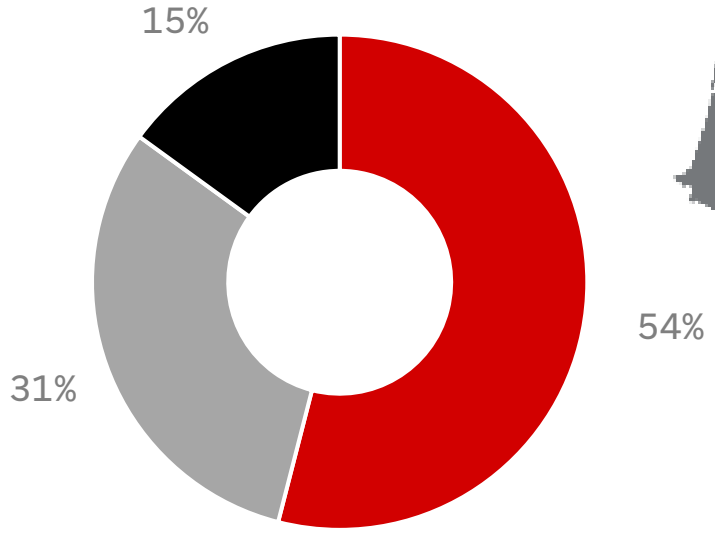
Administrative
Technical
Manufacturing

United Kingdom



279 Employees

France

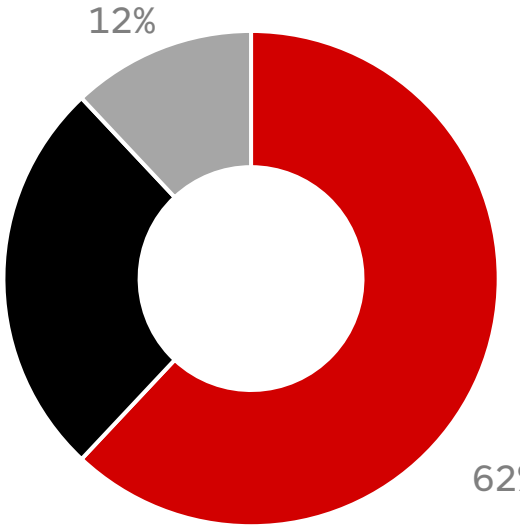


18 Employees

Staff Demographics: Europe

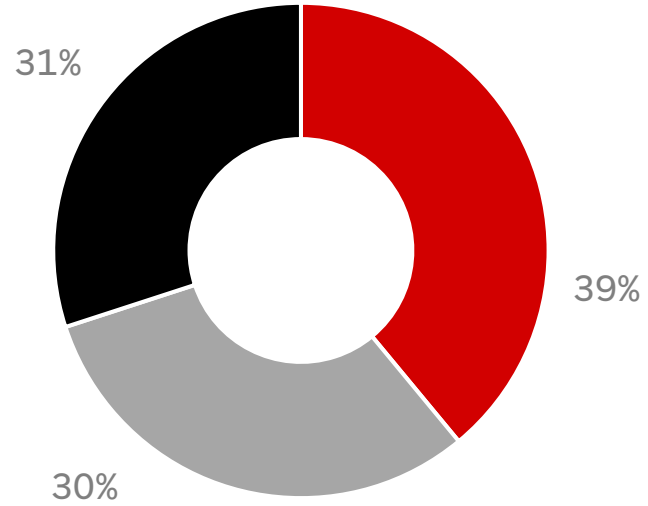
Administrative
Technical
Manufacturing

Germany



270 Employees

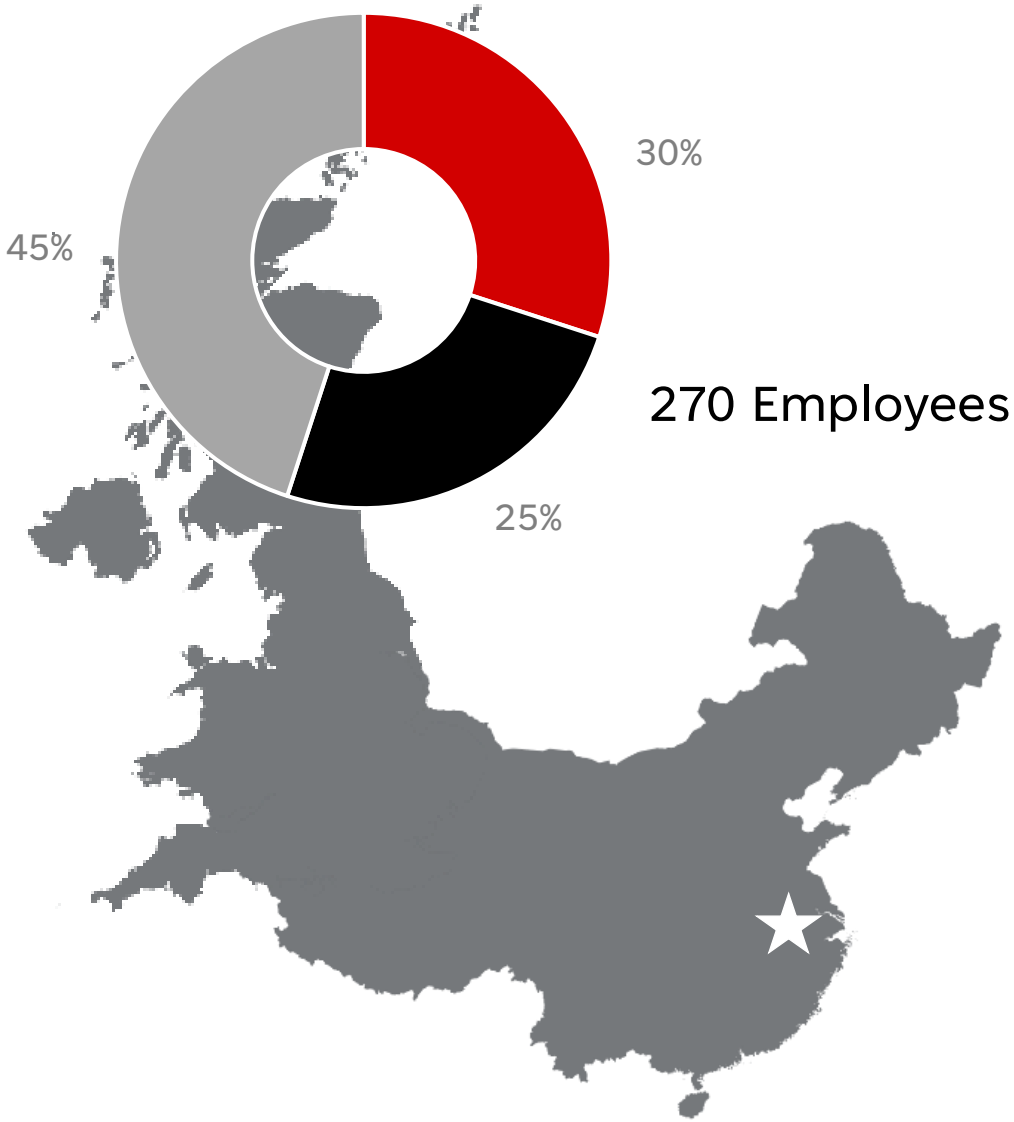
Sweden



53 Employees

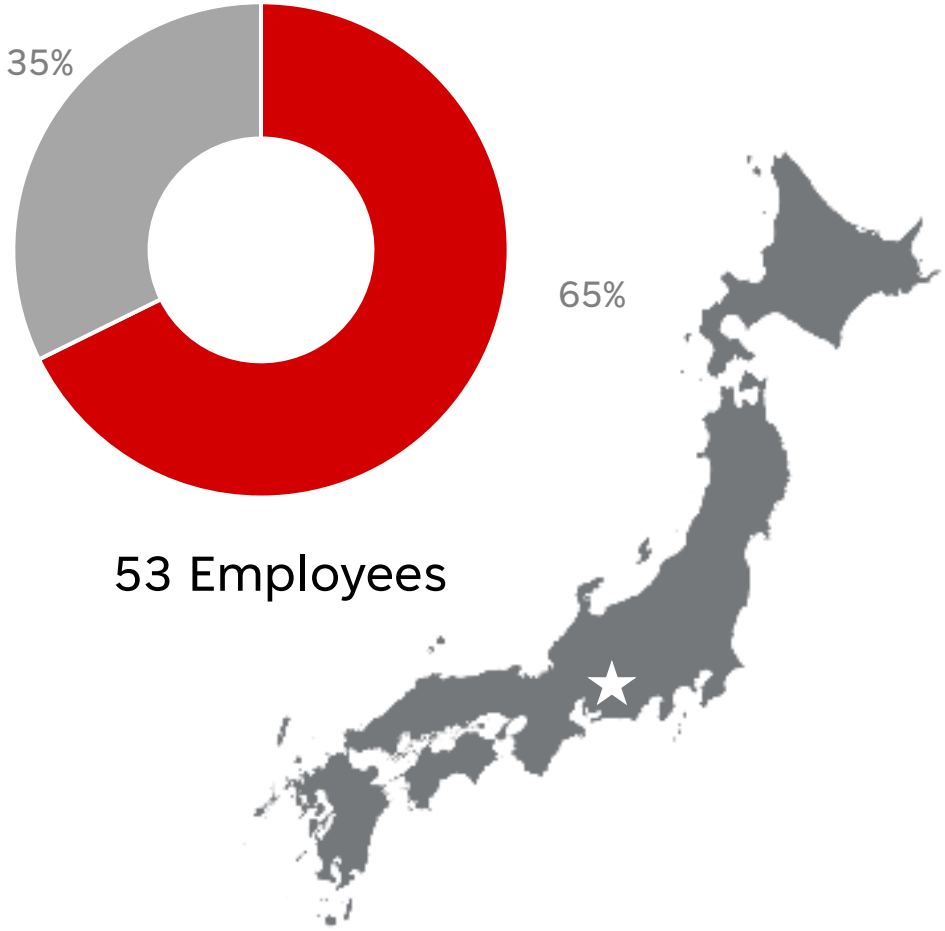
Staff Demographics: Asia

China



270 Employees

Japan



53 Employees

Administrative

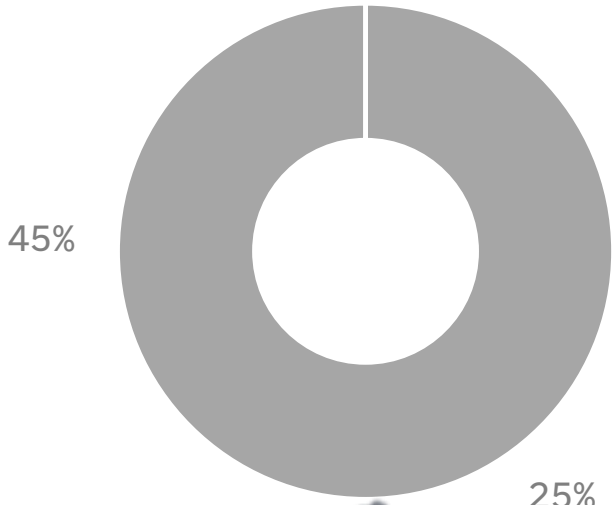
Technical

Manufacturing

Staff Demographics: North & South America

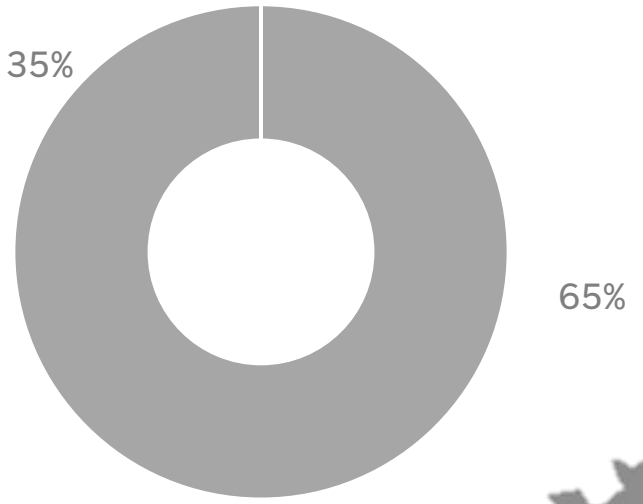
Administrative
Technical
Manufacturing

Canada



61 Employees

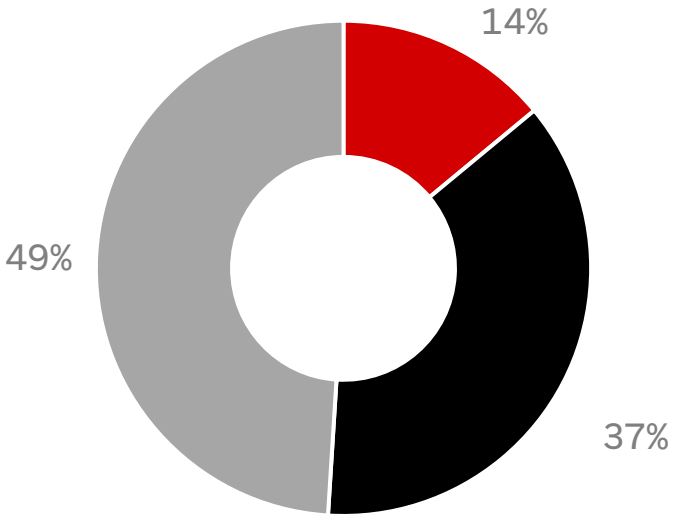
Brazil



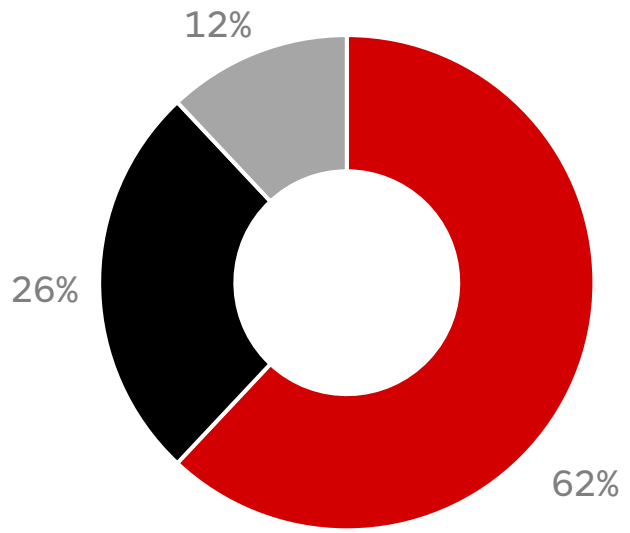
4 Employees

Staff Demographics: United States of America

THO: Headquarters
TMS: Measurement Solutions
Vytran: Laser Processing
TIS: Imaging Systems
TSW: Spectral Works
UFO: Ultrafast Optoelectronics
LD: Laser Division – Boulder
TCS: Crystalline Solutions



1,414 Employees



Company Totals

2,361 Employees

Building into the Future: Newton

New Machine Tool Works and Headquarters

- Maximizes Efficiency and Improves Production Flow
- Provides Space for Doubling of Current Newton Workforce over Next Decade
- Engineering, Manufacturing, and Assembly
- Class 10,000 Cleanroom, Passivation Area, and Scientific Glass Blowing Facility
- Completed in 2022

158,000 Square Feet
>250 Employees

3rd Floor:
Administration Offices

2nd Floor:
Mechanics and Advanced Systems Technologies Departments

1st Floor:
Machine Shop

Renderings of New Manufacturing Facility

THORLABS

Building into the Future: Newton

Architectural Renderings of New Anodization Facility

In-House Metal Finishing

- 12,000 Square Feet New, In-House Anodizing Facility for the Mechanics Business Unit
- Many Thorlabs Products are Red or Black Anodized Anodization
- Line Brings this Competency In-House, Improving Quality Control and Decreasing Lead Times

Red Anodized Camera Housing with Black Anodized Cage Plate

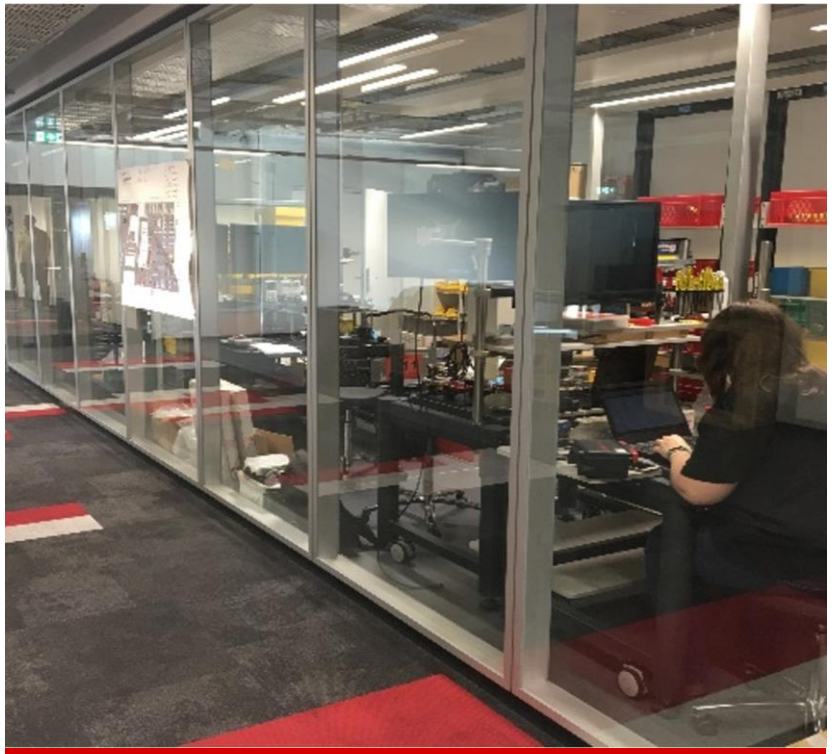
Building into the Future: Munich, Germany

In-House Technology Groups

- Diode Light and Drivers
- Tunable Lasers and Spectroscopy
- Light Detection and Analysis
- Fast Scanning Mirrors
- Groundbreaking in Q4 2018, Completed December 17, 2019

115,000 Square Feet
>230 Employees

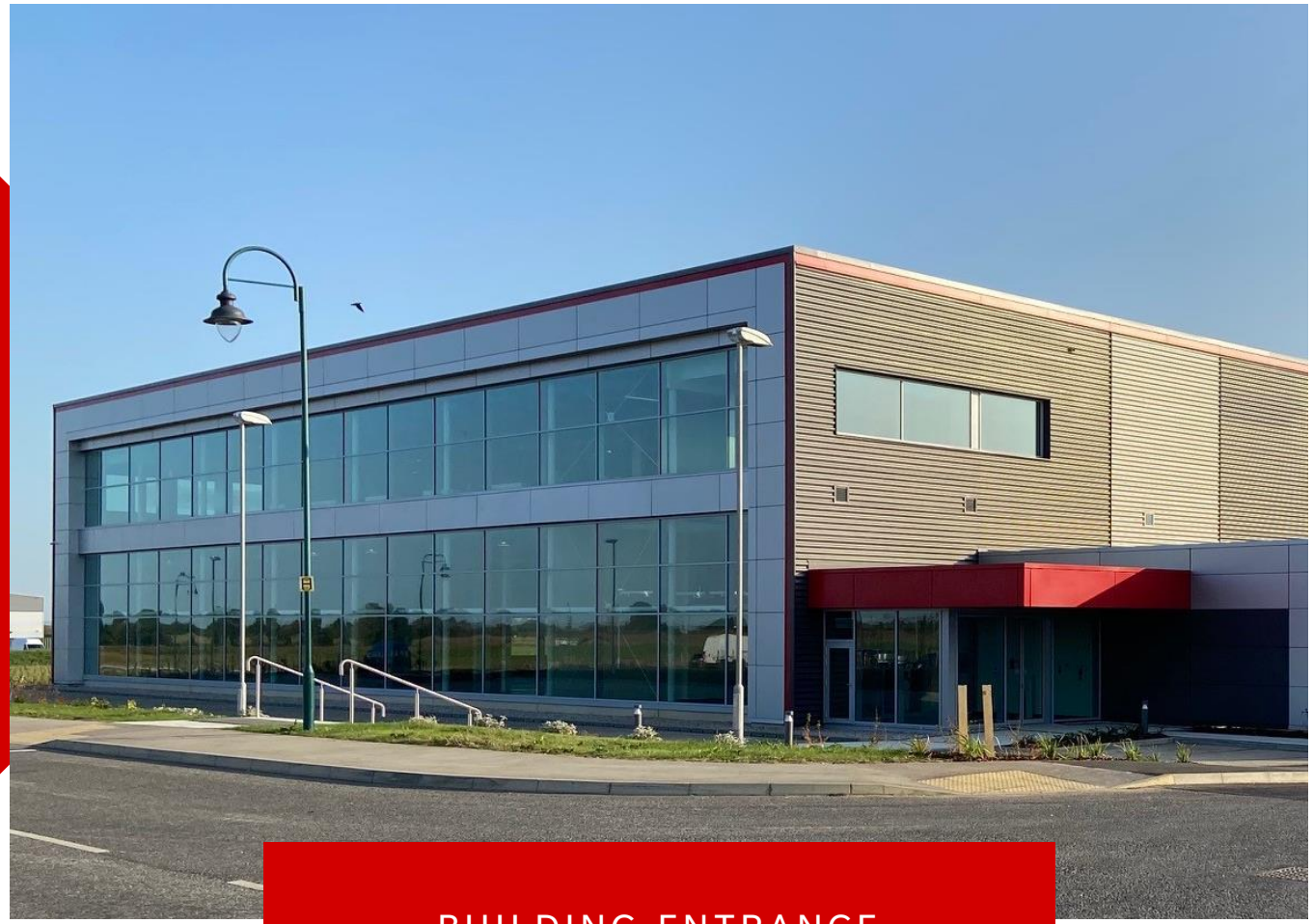
BUILDING ENTRANCE



ENGINEERING SPACE

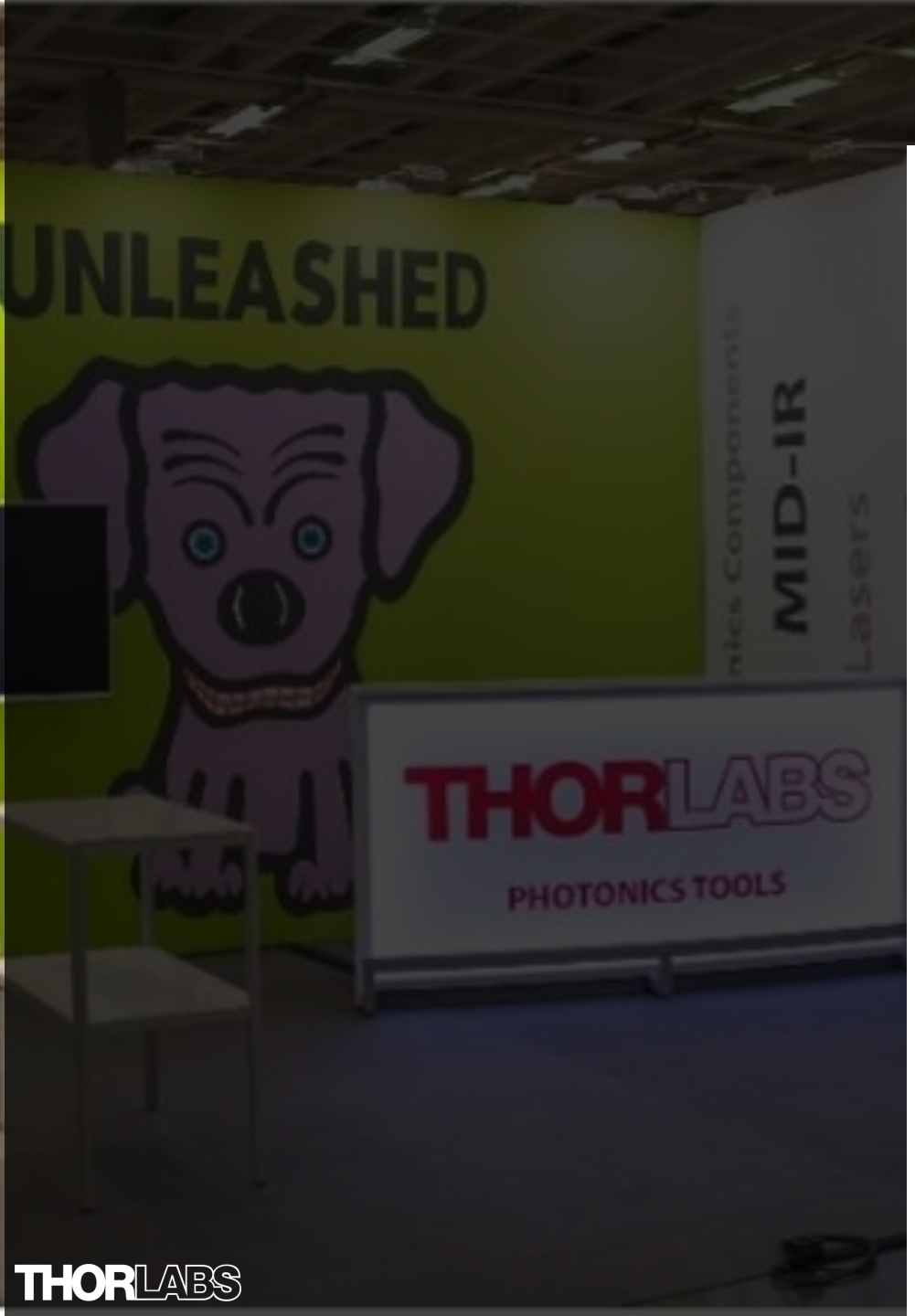
BUILDING EXTERIOR

Building into the Future: Ely, UK



BUILDING ENTRANCE

- New Building Doubled Space to 110,000 Square-Feet
- Building Holds up to 500 Employees
- First Floor: Tables Production and Warehouse
- Second Floor: Motion Control and Office Space



Looking Toward 2025

CONTINUE TO

- Reinvest in Business and Infrastructure to Create a Positive Feedback Loop that Accelerates Success
- Enable Customer Success through Strong, Consistent Supply Chains
- Develop and Maintain Strategic Partnerships within the Academic Community
- Advance toward Target Sales of $1 Billion

BECOME

1. The Global Influential Brand in the Photonics Industry
2. Part of the Big 5 in the Advanced Microscopy Market

Our Portfolio

- **Imaging and Optical Coherence Tomography**
- **Optomechanics and Optical Tables**
- **Motion Control**
- **Optics**
- **Fiber**
- **Light**
- **Light Analysis**
- **Advanced Applications and Kits**

- >22,000 Products
- 25% Customer Inspired
- 95% Thorlabs Designs

THORLABS

Optomechanics

- High-Quality Optomechanical Components are **Machined In-House** and can be Customized
- 3,600 Unique SKUs
  - Polaris® High-Performance Optical Mounts
  - Mounts, Optical Post Assemblies, Cage Systems, Optical Rails and More
- Manufacturing Process
  - Design and Engineering
  - Prototyping
  - Testing
  - Component Production
  - Assembly

THORLABS

Optics

- Standard and Custom Optical Components are **Designed** and **Manufactured In-House**
  - Plano Optic Fabrication
  - CNC Lens Fabrication
  - Thin Coating Lab
  - Gratings Lab
- 7,500 Unique SKUs
- Unique Capabilities
  - Crystalline Mirror Coatings
  - Multivariate Optical Elements
  - Pattern-Transfer Nanomanufacturing

THORLABS

Tables and Breadboards

- Wide Selection of Breadboards
  - Temperature-Controlled
  - Vacuum Compatible
  - Water Cooled
  - Rotating
- State-of-the-Art Nexus® Optical Tables
  - Excellent Thermal Stability
  - Optimal Vibration Isolation
  - Each Table is Individually Optimized, Tested, and Shipped with Test Data
  - ScienceDesk™ Workstations and Laminar Flow HEPA Enclosures

THORLABS

Stages

- Manual, Motorized, and Multi-Axis Stages Available
- Manual Translation Stages Feature a Range of Maximum Travel Distances from less than ¼” to 2” and can Provide XY or XYZ Translation
- Motorized Linear Translation Stages Provide over 23” of Travel
- We also Offer Manual and Motorized Rotation Mounts, Goniometers, Microscopy Stages, and Pitch and Yaw Platforms

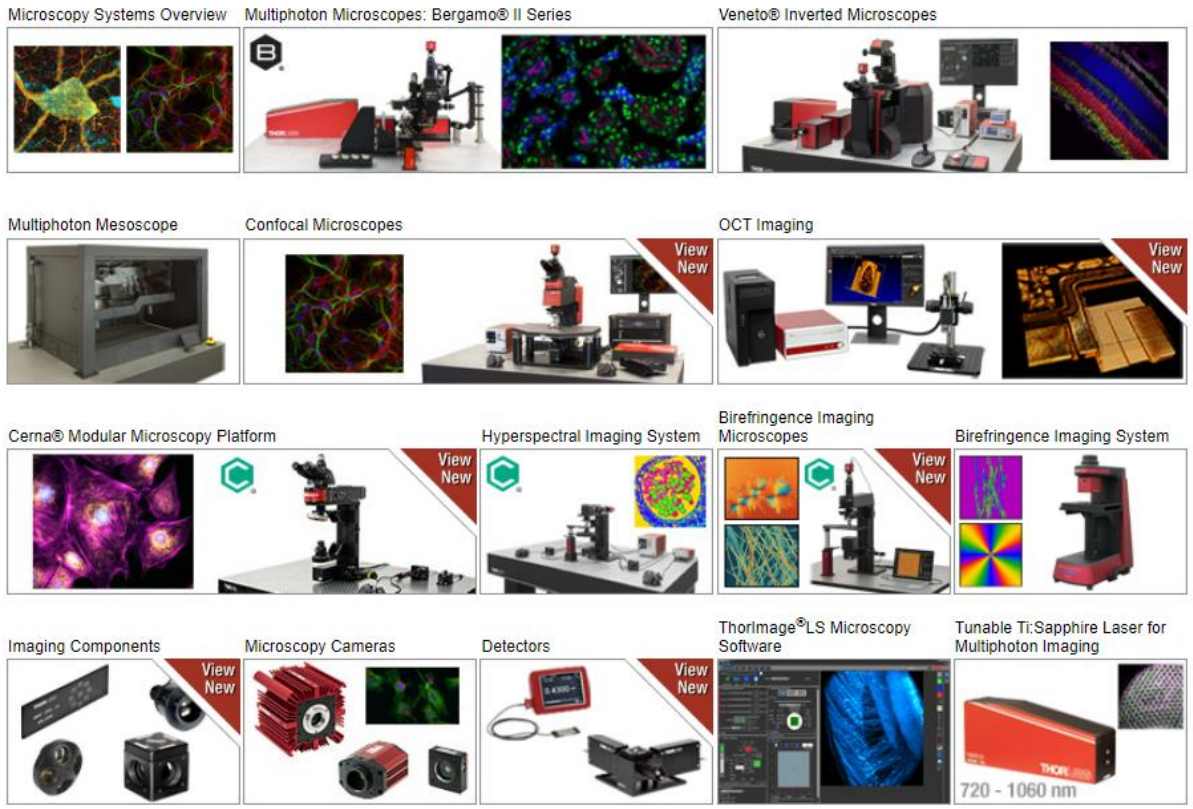
Piezoelectric Devices

- **Custom In-House** Capabilities Available via the Thorlabs China Facility
- Chips, Stacks, Tubes Actuators, Motors, and Controllers
- Piezoelectric Materials Produce a Voltage in Response to Mechanical Stress (Direct Mode) or a Physical Displacement as a Result of an Applied Electrical Field (Indirect Mode)
- Drive Mechanical Devices for Precise Positioning

THORLABS

Imaging Systems

- Advanced Imaging Systems
  - Support Multiphoton, Confocal, OCT, Hyperspectral, Birefringence, and Widefield Imaging Techniques
- Fully Customizable Platforms and Components for Everything from Standard Microscopy Techniques to Advanced Optical System Development
- Inverted Microscopy Platform, Fully Rotational Multiphoton Microscope, and Multiphoton Mesoscope Available



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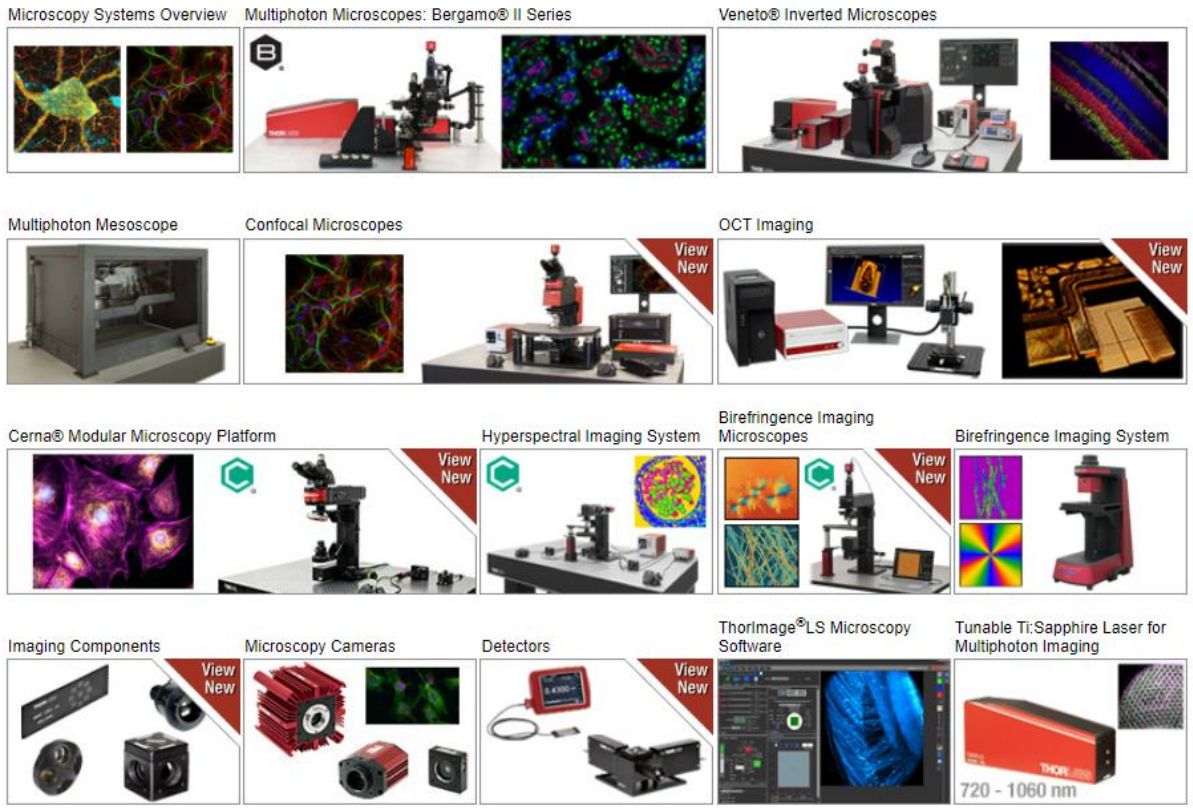


Optogenetics

- Photonics Tools for *In Vivo* Stimulation of Neurons for Neuroscience Research Applications
- Implantable Fiber Optic Cannulae, Multimode Patch Cables with Optional Rotary Joints, Stereotaxic Cannula Holders, Implant Guides, Fiber-Coupled Light Sources, and Complete Optogenetics Experiment Kits Available

THORLABS

Fiber Processing

- The Vytran® Product Family is Designed for Fusion Splicing, Optical Fiber Processing, and End Face Geometry Inspection
- Our Equipment Performs Various Fiber Processing Tasks including Stripping, Cleaning, Cleaving, Splicing, Recoating, and Proof Testing
- Systems for Testing, Manufacturing, and Other Factory Floor Applications

THORLABS

Fiber and Patch Cables

- Our Range of Optical Fibers and Patch Cables includes Single Mode (SM), Polarization Maintaining (PM), Multimode (MM), or Specialty Fibers
- Specialty Fibers include Fluoride, Photonic Crystal (PCF), Double Clad, and Rare-Earth Doped
- Cables include FC/PC, FC/APC, or SMA Connectors
- We Offer **Same-Day Manufacture** and **Shipment** of Some Custom Fiber Patch Cables

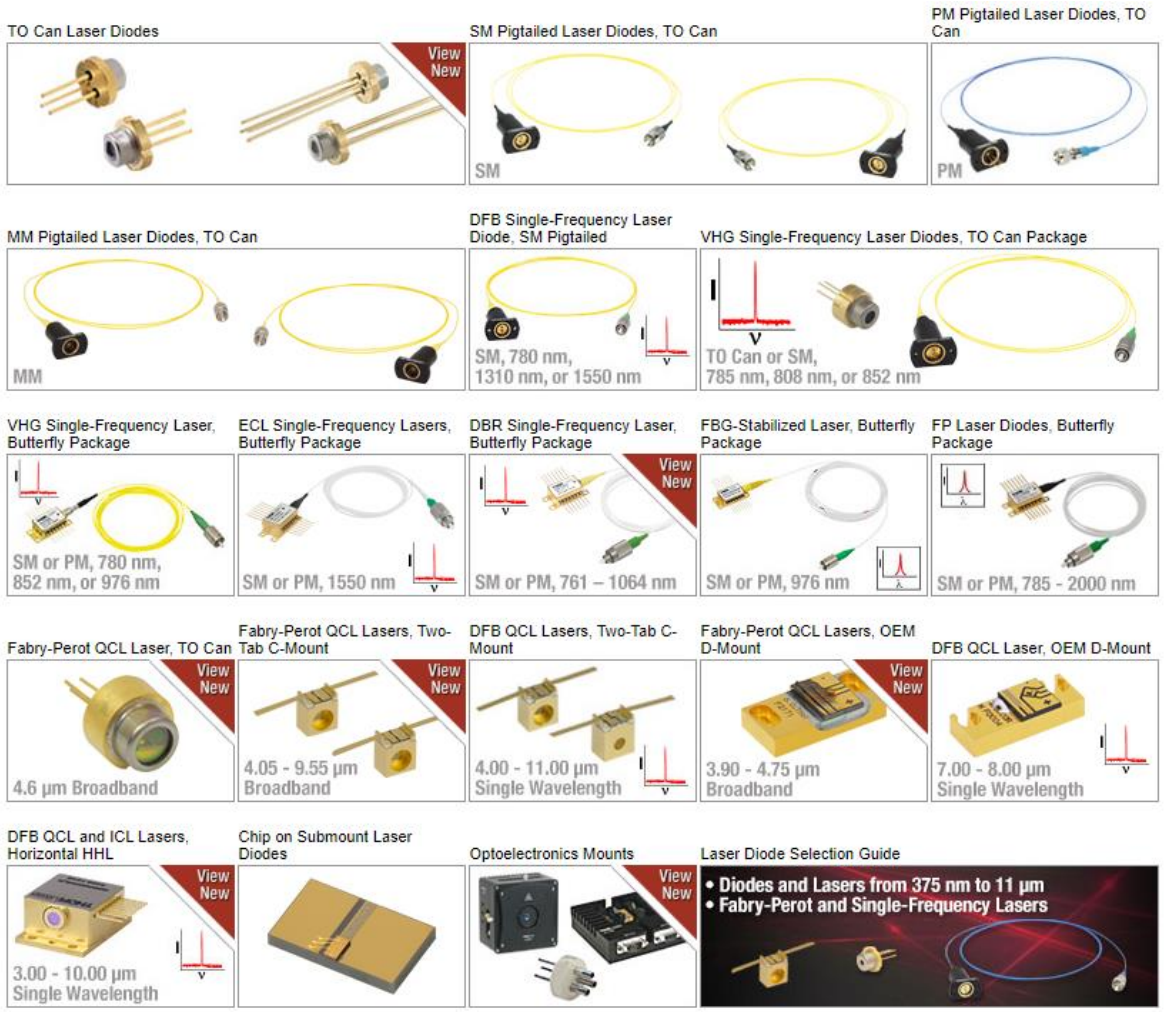
THORLABS

Lasers

- Fiber-Coupled, HeNe, Tunable, Fiber, Femtosecond, Nanosecond Pulsed, MIR, Frequency-Locked, and Femtosecond (fs) Lasers
- Fs Lasers include Ti:Sapphire Tunable and Fixed Lasers, Ytterbium Fiber Lasers and Parametric Optical Amplifier, MIR Supercontinuum Source, and 2 µm Fiber Laser
- Narrow-Linewidth Single-Frequency Laser and Picosecond Pulsed Laser Available

Laser Diodes

- Our Laser Diodes include Fabry-Perot Lasers and Several Single Frequency Laser (SFL) Types: Distributed Bragg Reflector (DBR), Distributed Feedback (DFB), and External Cavity (ECL)
- TO Can, Butterfly, Laser Pigtail, Chip on Submount, C-Mount, D-Mount, and High Heat Load (HHL) Packages Available
- Diodes and Lasers cover 375 nm – 11 µm Range

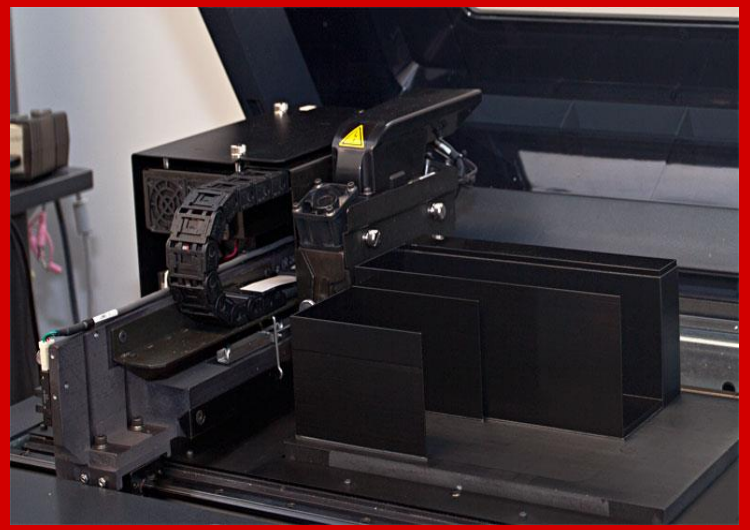


THORLABS

THORLABS

U.S. BUSINESS UNITS AND ENTITIES

Mechanics Business Unit



The MBU Shop Contains the Latest Machinery, Including 3D Printers for Component Prototyping.

In-House Component-Level Manufacturing Advantages

- Expansive Knowledge of Machining
- Short Supply Line
- Fast, Cost-Efficient Prototyping
- Close Interaction with Design and Engineering Teams

1989

MECHANICS MANUFACTURING BEGINS

Alex Cable machines Thorlabs' first parts. Some are still manufactured today.

2010

POLARIS® MIRROR MOUNT IS RELEASED

Industry-leading stability proves Thorlabs can compete with larger photonics companies in R&D.

2012

RT. 435 BUILDING ALLOCATED TO MACHINING

39,000 sq. ft. building is converted to a machine shop. Over 40 CNC machines are added from 2012-2019.

Mechanics Business Unit

2019

ANODIZATION FACILITY

Building is renovated to house a custom-designed anodization line. This equipment will bring mechanics anodization in-house

2019

SIGNIFICANT GROWTH

The mechanics machine shop and assembly area have doubled in growth over the past five years.

2021

NEW MANUFACTURING CENTER

100,000 out of 158,000 square feet are dedicated to a best-in-class manufacturing facility for Thorlabs' Mechanics BU.

Polaris Mounts are Anodized to Provide Thermal Stability.

Thorlabs' Headquarters that houses the MBU.

Fiber Drawing on a Thorlabs Tower.

Fiber Business Unit

Mid-1990's

FIBER OPTICS BUSINESS UNIT FOUNDED

Business unit started within Optics. The fiber portfolio consists of 160 SKU's and one employee who produces roughly 20 cables per week.

Early 2000's

3M PARTNERSHIP

Cable forms a partnership with 3M to be the exclusive supplier of small quantities of fiber. These are cut to length in-house, then sold in our catalog.

2006

24 HOUR CABLE POLICY

Thorlabs commits to manufacturing standard custom fiber patch cables within 24 hours.

Fiber Business Unit

2010

Innova Quartz Fiber Towers Acquisition
Thorlabs masters fiber draw process in Arizona and later moves the draw towers to Newton.

2013

Acquisition of IRPhotonics
Canadian-based company with long history of MIR-fiber research and development is integrated into FBU.

2018

Record Shipments
A record 55,000 cables are shipped worldwide.
Fiber portfolio contains >1,600 SKU's.

2019

Research Continues; Portfolio Expands
Recent R&D efforts focus on bare multimode and fluoride fiber manufacturing.

Glass Preforms are Made In-House.

Inspecting a Custom PM Fiber.

Original Nova Phase Building.

Thin Film Coating Chamber.

Optics Business Unit

2006

NOVA PHASE ACQUISTITION

Optics supplier is integrated into Thorlabs' Newton headquarters as the Optics Business Unit.

2007

OFR ACQUISITION

OFR's free space and fiber based optical isolators and circulators, high performance objective lenses, and Fiber Benches are integrated into Thorlabs.

2008

NEW COATING FACILITIES

Precision thin film coating facilities are installed at Nova Phase and OFR locations. These chambers enable HR and multi-layer AR coating for catalog and OEM components.

Optics Business Unit

2019

CIRTEMO ACQUISITION

South Carolina-based creator of Multivariate Optical Elements (MOEs) becomes Thorlabs Spectral Works and is integrated into the Optics BU.

2019

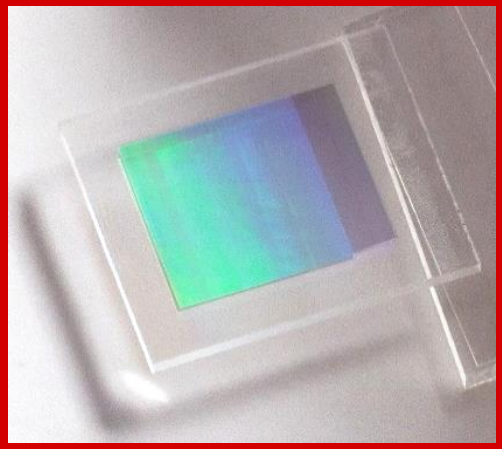
OPTICS TECHNOLOGY COURSE OFFERED

Several optics experts at Thorlabs teach a community college course for future optics technicians.

2019

CMS ACQUISITION

Santa Barbara-based Crystalline Mirror Solutions is integrated into the Optics BU. Their portfolio includes ultra-precise, high resolution semiconductor mirrors.



Optical Grating Created by Cirtemo.

CMS' XTAL MIR Mirrors Won a Prism Award in 2017.

Thorlabs Imaging Systems

Thorlabs Imaging Systems Building.

Cerna Rig.

Bergamo II System.

2009

FOUNDED IN STERLING, VA

Thorlabs enters the microscopy market. Releases first multiphoton system: the A-Scope.

2015

TWO GROUPS FORM

Thorlabs Imaging Research group focuses on R&D of novel technologies. These are later transferred to the production group for catalog release.

2016

ADVANCED SYSTEMS ADDED TO PORTFOLIO

Bergamo® II multiphoton microscope and Cerna® DIY imaging platform are released. These systems are used in research labs worldwide.

Thorlabs Imaging Systems

2017

TWO-PHOTON MESOSCOPE TECHNOLOGY LICENSED

We commercialize the 2-photon random access Mesoscope developed in the Svoboda Lab at HHMI.

2018

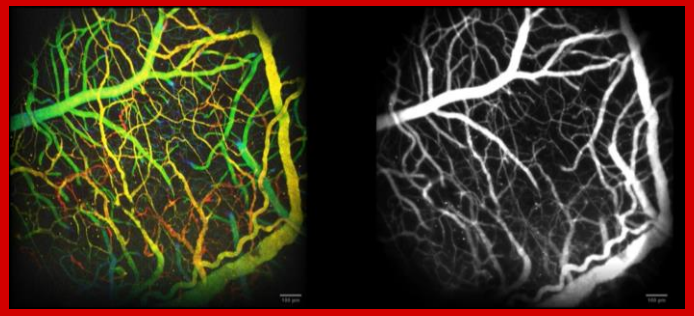
BESSEL BEAM TECHNIQUE LICENSED

Acquire exclusive rights to Bessel beam-based multiphoton volumetric imaging technique.

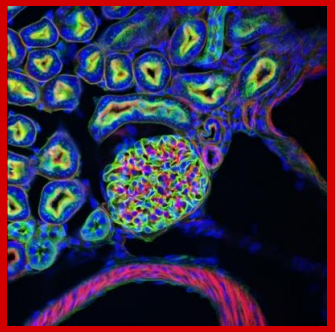
2019

INVERTED CONFOCAL MICROSCOPE REVEALED

First shown at Neuroscience 2019 tradeshow.
The system is scheduled for release in early 2020.



Left: Stacked Gaussian Images Colored by Depth.
Right: Single Image Acquired with Bessel Beam.



Left: Inverted Confocal Microscope.
Right: Composite Image of Mouse Kidney Taken with System.

QCL Wire Bonding on a Butterfly Mount.

OEM MEMS-VCSEL Swept Laser Source.

Thorlabs Quantum Electronics

2009

COVEGA ACQUISITION

Covega becomes Thorlabs Quantum Electronics. The company has full InP and $LiNbO_3$ manufacturing capabilities, including device design, wafer growth and fabrication, and advanced device packaging.

2012

MAXION ACQUISITION

Mid-Infrared (MIR) interband and quantum cascade lasers (ICLs and QCLs) are added to the portfolio.

2013

NEW RESEARCH DIRECTIONS

TQE begins R&D on new MIR laser technologies and state-of-the art MEMS-based tunable vertical cavity surface emitting lasers (VCSELs).

Thorlabs Quantum Electronics

2014

CORNING SEMICONDUCTORS ACQUISITION

Corning's quantum cascade lasers business and other semiconductor technologies are integrated into TQE.

2014

THORLABS AND PRAEVIUM AWARDED ARPA-E CONTRACT

The goal is to reduce methane emissions through advanced gas sensing/measurement techniques.

TQE demonstrated the world's first VCSEL for the detection of methane gas in 2019 for this contract.

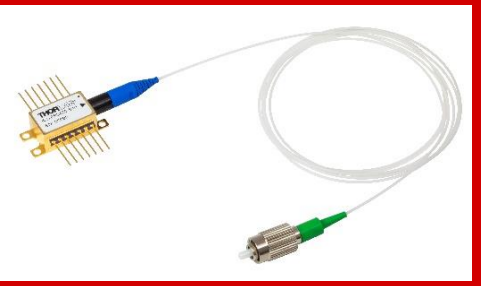
2019

QCL FREQUENCY COMB TESTING

Collaboration with MIT and Princeton to develop an MIR comb for threat sensing as part of a Defense Advanced Research Projects Agency (DARPA) contract.

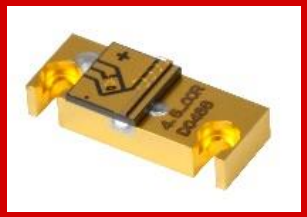
Various ICL and QCL Packages.

Butterfly.

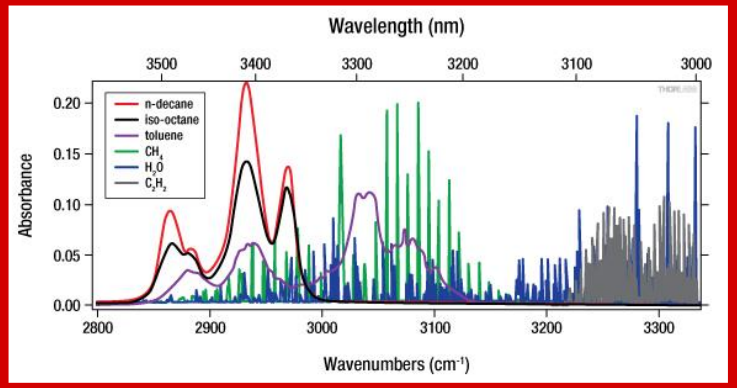


C-Mount.

High Heat Load.



D-Mount.



Methane (CH_4) Absorption vs Common Gases.

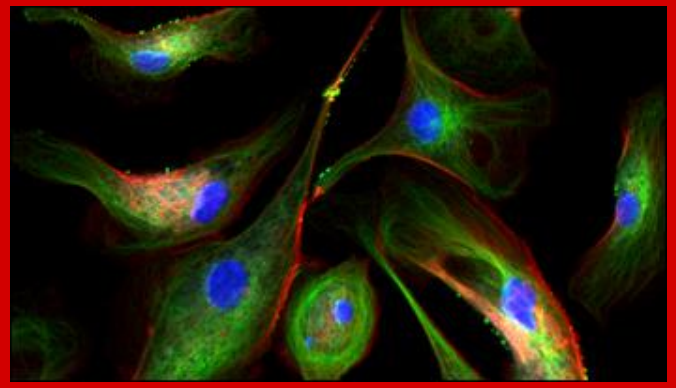
Cooled sCMOS Camera.

Two Stage Cooled CCD Camera.

sCMOS Camera.

Non-Cooled CCD Camera.

Thorlabs Scientific Cameras are Ideal for a Variety of Microscopy Applications.



Fluorescence Image of BPAE Cells.

Thorlabs Scientific Imaging

2011

DIGITAL VIDEO CAMERA COMPANY ACQUISITION

Thorlabs adds design and manufacture of high-performance digital imaging solutions for scientific and industrial applications to its portfolio.

2017

NEW sCMOS CAMERA LINE

Compact Quantalux® cameras are released for demanding imaging applications such as cell biology and neuroscience research.

2019

POLARIZATION CAMERA ADDED TO PORTFOLIO

Kiralux™ polarization-sensitive monochrome CMOS camera is released for stress-induced birefringence detection and materials inspection.

Laser Division

2012

IdestaQE ACQUIRED; LASER DIVISION FOUNDED

Created with the mission to develop advanced, ultrafast laser systems for the photonics and life sciences research markets.

2015

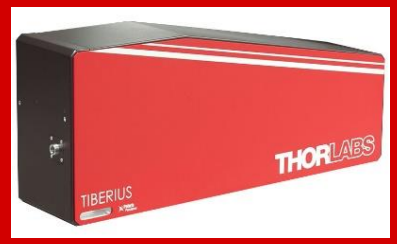
RELEASE OF TIBERIUS® TUNABLE fs TiSa LASER

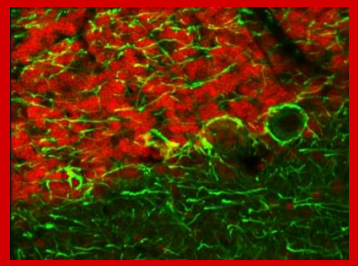
Industry-leading tuning speed is ideal for multiphoton microscopy applications.

2017

RELEASE OF SC4500 SUPERCONTINUUM LASER

First commercially available femtosecond-laser-pumped MIR supercontinuum source. Developed using Thorlabs' InF_3 fiber.





Left: Tiberius Laser.
Right: Image Produced by Fast Switching Between Optimal Excitation Wavelengths.

The SC4500 was a 2017 Prism Award Winner in the Category of Scientific Lasers.

Ultrafast Mirror in a Polaris® Mount.

KMLabs' Y-Fi OPA Laser was a 2018 Prism Awards Finalist in the Laser Category

Laser Division

2017

RELEASE OF PDFA

Praseodymium-Doped O-Band Fiber Amplifier created as a collaboration between FBU and the Laser Division.

2019

PORTFOLIO EXPANDS

Nine products are added for 12% SKU growth, including new ultrafast optics and dispersion compensating fiber patch cables.

2019

ACQUISITION OF KMLabs Y-Fi™ LASER LINE

Ultrafast ytterbium-doped fiber lasers for MIR-IR-VIS supercontinuum generations, Raman scattering, and 2-photon imaging.

Thorlabs Ultrafast Optoelectronics

2014

ULTRAFAST OPTOELECTRONICS FOUNDED IN MI

This greenfield initiative allowed Thorlas to enter the high-speed optoelectronics market.

2015

CUSTOM SOLUTIONS

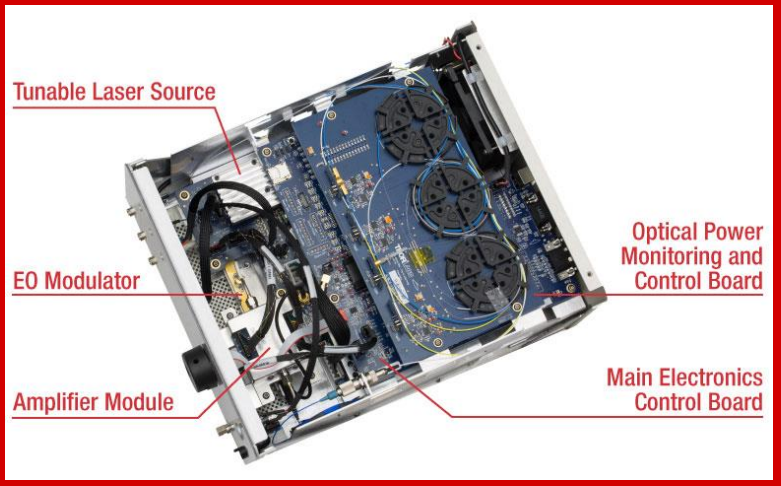
R&D capabilities enable location to design and manufacture ultrafast detectors, modulators, and transmitters for OEM customers.

2019

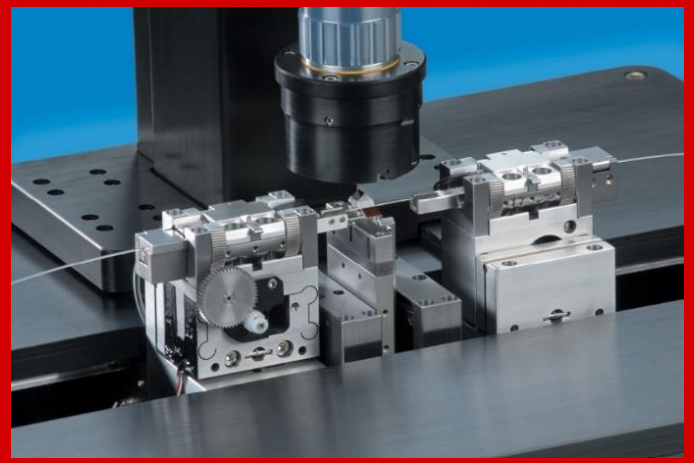
SIGNIFICATION CATALOG GROWTH

Added 22 products for 20% portfolio growth. New electro-optic benchtop systems, nanosecond pulsed lasers, and photo receivers.

Transmitters and Receivers up to 70 GHz.



Inside View of Digital Reference Transmitter.



Vytran Automated Fiber Glass Processor.

GLI6 Interferometer.

Thorlabs Vytran®

2015

VYTRAN IS ACQUIRED

Fiber processing company remains in Morganville with offices in the UK and China. Technology is utilized in telecommunications, fiber lasers, and sensing systems.

2015

FIBER OPTIC PRODUCT LINE IS ACQUIRED

Norland's interferometers and other fiber optics assets are integrated into Vytran.

2019

NEW PORTFOLIO GOALS

Vytran plans to expand portfolio to include all equipment needed to operate a factory floor.

THORLABS

INTERNATIONAL BUSINESS UNITS AND ENTITIES

MenloSystems' Optical Frequency Comb.

Thorlabs Lübeck Building.

Thorlabs GmbH

1997

SALES OFFICE OPENED

First European sales office is opened in Germany.

2001

THORLABS PARTNERS WITH MenloSystems GmbH

Spin-off company from the Max Planck Institute for Quantum Optics develops techniques and applications for optical frequency measurement.

2003

TEKTRONIX MUNICH ACQUISITION

Tektronix becomes Thorlabs GmbH. Products include PMDs, DWDM sources and laser diodes.

2005

THORLABS HL FOUNDED IN LÜBECK

Group develops OCT systems and components.

THORLABS

Thorlabs GmbH

2013

EDUCATIONAL BUSINESS UNIT FOUNDED

Develop educational kits for physics and photonics.

2015

ELLIPTEC ACQUISITION

Thorlabs Elliptec manufacturers piezoelectric motor technology for catalog and OEM customers.

2018

THORLABS GmbH INTO TECHNOLOGY GROUPS

In addition to the EDU and OCT groups, spectroscopy and tunable lasers, diode light and drivers, light detection and analysis, and fast scanning mirror groups are formed.

2019

CODA DEVICES ACQUISITION

Raman spectrometers integrated into spectroscopy group.

Optical Power Meters are Assembled at Thorlabs GmbH.

CODA Devices Manufacturers Handheld and Mobile Benchtop Raman Spectrometers.

T-Cube Controller Hub.

MLS203 Scanning Stage.

Thorlabs Ltd.

2004

MELLES GRIOT LTD. TABLES DIVISION ACQUISITION

Thorlabs acquires UK manufacturing facility. Portfolio includes nano-positioning systems along with optical tables and full vibration isolation systems.

2006

LAUNCH OF T-CUBES

Innovative and versatile compact scientific “Cube” controllers designed for a wide variety of lab experiments where benchtop controllers are not required.

2014

MLS203 XY SCANNING STAGE RELEASED

First in the industry to deploy brushless induction motors into the design of a slim, silent, and high-speed positioning stage for microscopy applications.

THORLABS

Thorlabs Ltd.

2011

BRUSHLESS STAGES

Began developing high speed motion control products using brushless motor technology.

2013

NEXUS® OPTICAL TABLES AND BREADBOARDS RELEASE

Nexus products are individually optimized and tensed for photonics, imaging and microscopy applications. Each product is shipped with a unique test certificate.

2014

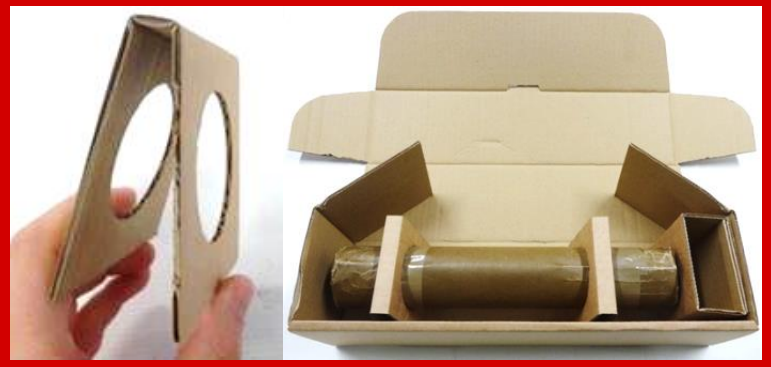
NEW CAPABILITIES

Expansion allows for purchase of a custom laser machine for cutting steel optical table skins. It enables faster fulfillment of standard and OEM orders.

Optical Table Testing.

Custom Laser Cutting Table Skins.

DYSS X5-630 Box Cutter.



In-House, Custom Cut Packaging.

Thorlabs Ltd.

2017

ADDITIONAL COMPETENCIES

Coordinate Measuring Machine improves speed, accuracy and range of components. Aids in maintaining specifications for high-precision alignment products.

2019

LEAN AND GREEN INITIATIVES

Office improves green manufacturing capabilities via the purchase of a custom box cutter to eliminate foam and plastic fillers, create packaging in-house and reduce excess inventory of cardboard boxes.

THORLABS

Thorlabs Sweden AB

2004

RADIANS INNOVA, AB ACQUIRED

Swedish OEM provider of modular, continuously tunable laser sources for optical telecom, sensing and spectroscopy applications.

2015

OFFICE MOVES TO Mölndal

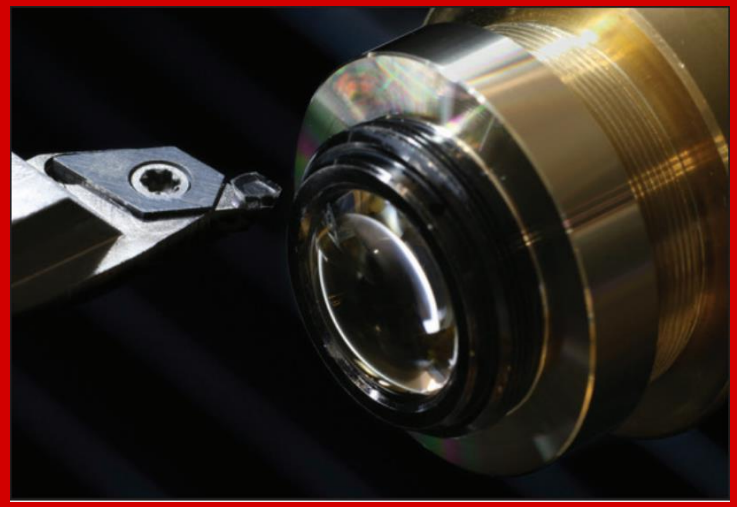
New location includes a Class 10,000 clean room that houses both manufacturing and assembly processes.

2017

NEW MANUFACTURING COMPETENCY

Ultra-precise Innolite alignment turning machine platform allows for the manufacture of complex mounted lenses.

Office in MölIndal.



Lenses are Ultra-Precision Turned.

Thorlabs SAS Building.

Functional Depolarizer Created at Thorlabs SAS and New Lab Area.

Thorlabs SAS

2008

FRANCE LOCATION OPENS

In response to a growing European customer base, Thorlabs expanded its global presence to Maisons-Lafitte, France. The office provides technical support, sales and order processing in French.

2019

MANUFACTURING RESEARCH BEGINS

Office looks into fs laser processing of bulk glass to form new optical components. First tests performed with local research partners.
In-house Thorlabs SAS lab setup began in September.

Thorlabs China

2009

THORLABS CHINA ESTABLISHED

Thorlabs PRC serves as Thorlabs' first sales office in China. The office is founded with two employees.

2010

OPTICS GROUND FOUNDED

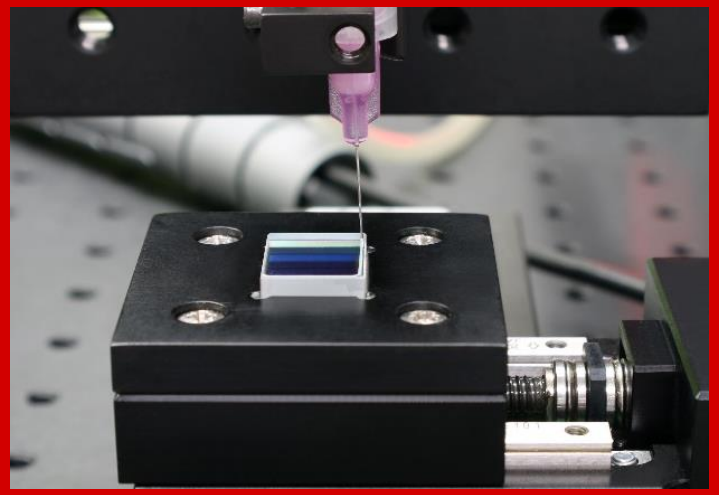
Their early responsibilities include optics purchasing and quality control. In 2011, in-house production of some optics was added.

2011

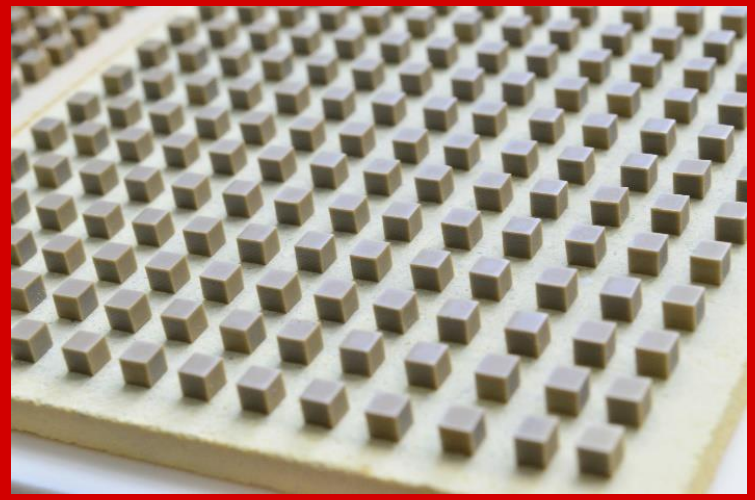
MANUFACTURING BEGINS

First manufacturing and R&D efforts involve liquid crystals and devices.

Thorlabs China Office.



Liquid Crystal Epoxy Application.



Piezo Chip Manufacturing.

PRC Demo Lab.

Thorlabs China

2011

THORLABS CHINA WEBSITE

The Thorlabs website is translated to Chinese and moved to a separate domain.

2012

PIEZO GROUP ESTABLISHED

PRC begins manufacturing piezo chips and stacks for microscopic and nanoscopic applications.

2013

DEMO LAB OPENED

The demo lab offers courses, lectures and demonstrations of Thorlabs systems.

Thorlabs China

2015

ELECTRONICS ENCLSURES RELEASED

PRC’s electronics group manufactures distinctive red housings for Thorlabs instruments an offers customizable enclosures for customers.

2019

10 YEARS OF GROWTH

Thorlabs China celebrates 10 years of business. The location has grown from two employees to 200 and from one floor to four.

MIR Supercontinuum Source Laser.

MEMS-VCSEL Swept-Wavelength Laser Source.

Employees Celebrating 10 Years.

Thorlabs Educational Business Unit

Karlsruhe Institute of Technology is One of the EDU Groups' Primary Collaborators.

Award-Winning Polarization and 3D-Cinema Kit.

2013

THORLABS EDUCATIONAL BUSINESS UNIT FOUNDED

Created with the goal of giving back to the photonics community. Located at the Karlsruhe Institute of Technology. First kit released.

2016

KIT WINS INNOVATIVE PHYSICAL EXPERIMENT AWARD

The Association of Physics Undergraduate Laboratories (AGPP) selects Thorlabs' Polarization and 3D-Cinema Experiment kit for award.

2019

OPTICAL MICROSCOPY KIT RELEASED

Collaborative course with professors from the University of California Berkeley.
About two new kits are released every year.

Thorlabs Canada ULC

2014

IRP ACQUIRED; NEW LOCATIONS FOUNDED

IRPhotonics acquisition leads to founding of Thorlabs ULC in Montreal. They conduct R&D and manufacture fiber-based optical components.
Coupler manufacturing is brought in-house.

2017

ACADEMIC AND CORPORATE PARTNERSHIPS

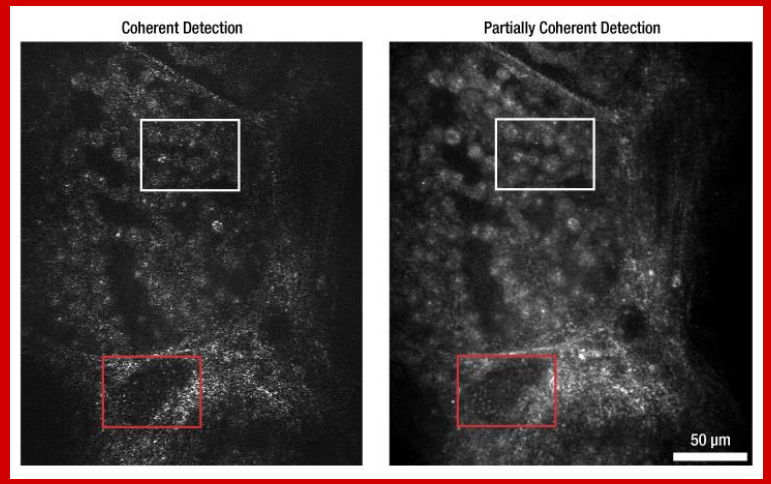
Thorlabs ULC performs collaborative research with local universities and Canadian-based strategic partner, Castor Optics.

2019

SIGNIFICANT CATALOG GROWTH

Added 160 new products for 21% portfolio growth. New single mode and multimode fiber couplers plus pump and signal combiners.

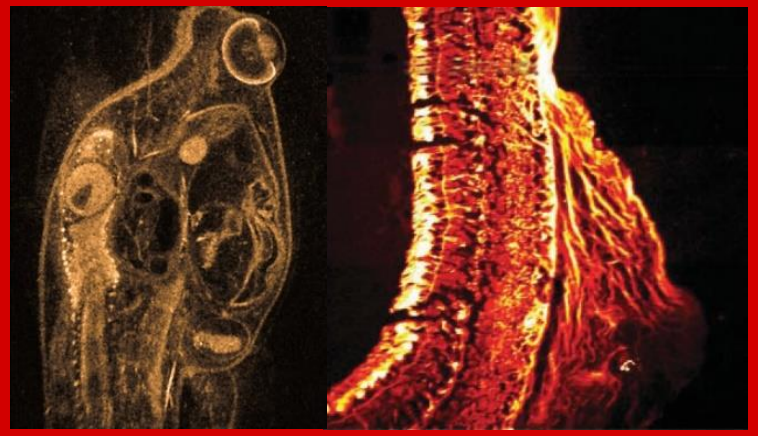
Thorlabs ULC Building.



Double-Clad Couplers are Idea for OCT and Fluorescence Imaging and Offer Improved Imaging Over Single Mode Couplers.

OCT Imaging

Prototype of First Microscopy-Based Swept-Source OCT System Circa 2007.



Left: OCT is Ideal for Small Animal.
Right: OCT is Also Ideal for Retinal Imaging.

2004

OCT RESEARCH BEGINS

Cable determines fundamental requirements for OCT, works with James Fujimoto at MIT. Develops Benchtop Supercontinuum Source specifically for OCT market.

2005

THORLABS HL IS FOUNDED

The group focuses on OCT development in Lübeck, Germany, while collaborating with OCT software group in New Jersey. Complete system development succeeds.

2006

WORLD'S FIRST REAL-TIME OCT SYSTEM REVEALED

Thorlabs' system is demonstrated at a symposium. It is 10x faster than MIT and Harvard's prototypes.

OCT Imaging

2006

THORLABS WINS INNOVATION AWARD

Thorlabs' swept-source OCT system wins the second place PhAST/laser Focus World Innovation Award.

2012

MEMS-VCSEL SWEPT LASER DEVELOPMENT

This laser had record-breaking coherence lengths for high-speed, long-range applications, such as gas spectroscopy, metrology and medical imaging.

2013

IMAGE ACQUISITION SOFTWARE FOR ALL SYSTEMS

Thorimage® is the first Thorlabs-developed software for OCT imaging. It allows fast, real-time acquisition.

Left: Thorlabs OCT Researcher, Scott Barry with Award.

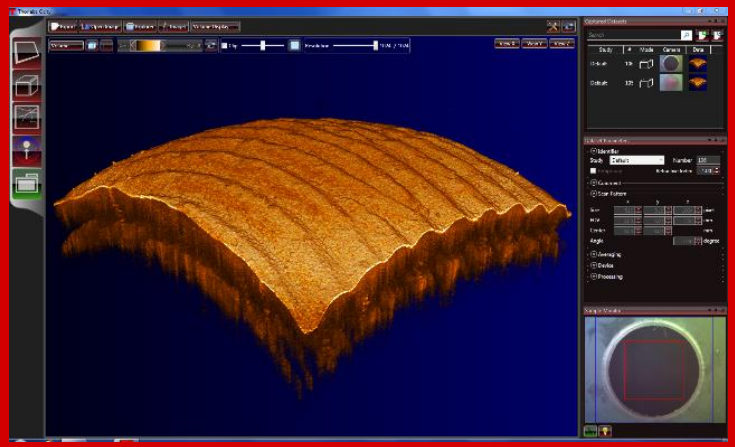
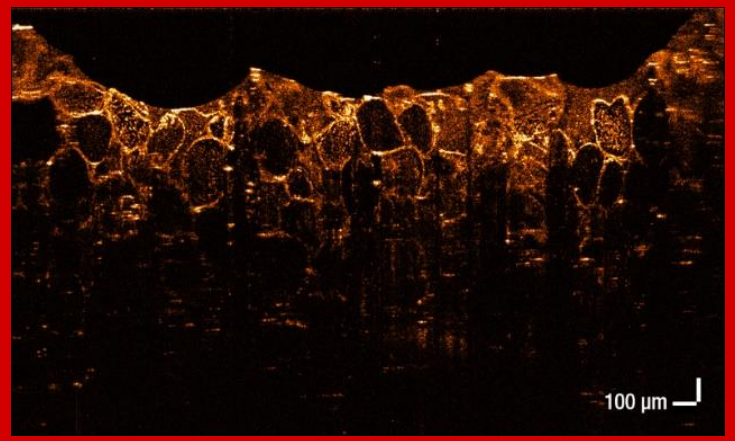


Image of a Fingertip Shown in the Thorimage Software Interface.

OEM OCT System for Contact Lens Quality Assurance.



Cell Imaging, 10x Magnification.

OCT Imaging

2016

OEM MARKET EXPANDS

Thorlabs produces a greater number of OEM OCT systems each year. They are used by ophthalmology practices, small electronics manufacturers and more.

2017

ALL OCT R&D MOVES TO LÜBECK

Prior to this year, OCT researchers and development was also performed at Thorlabs' New Jersey and Maryland locations, as well as MIT and the University of Lübeck.

2018

NEW TECHNOLOGICAL ADVANCEMENTS

Thorlabs releases fastest commercially available Spectral-Domain OCT system and first commercially available Polarization-Sensitive Spectral-Domain OCT system.

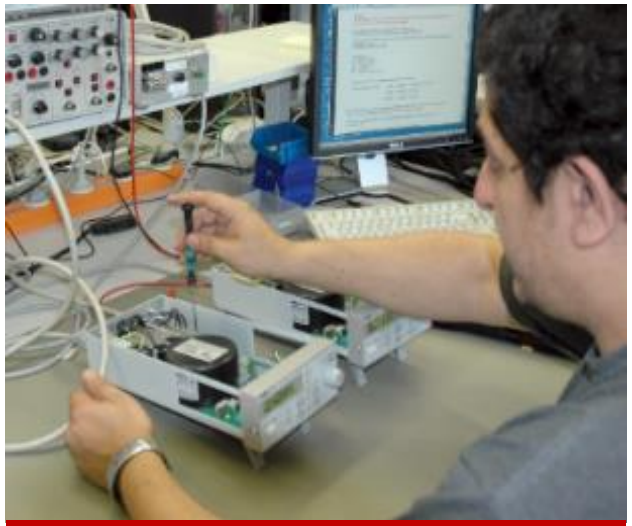
THORLABS

Technologies

Manufacturing Competencies

Motion Control

- Motorized Motion Control and Stages
- Piezo Components and Piezo-Based Motion Systems



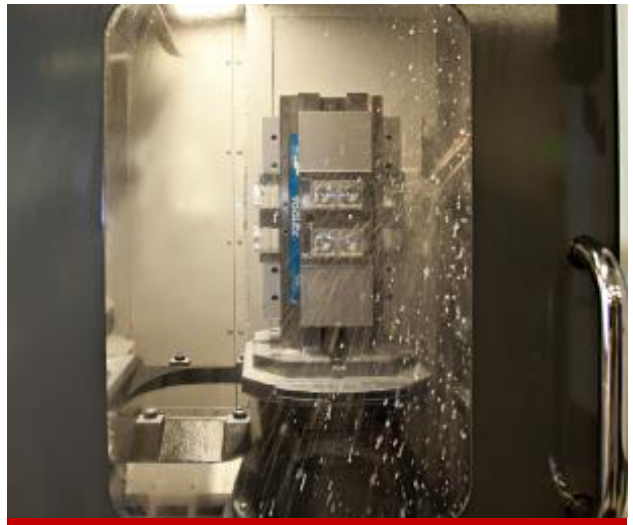
Optoelectronics

- Low Noise Drivers
- Light Analysis Systems
- EO Modulators
- High-Speed (GHz) Devices

Tables

- Optical Tables and Breadboards
- Vibration Isolation
- Science Desks
- Custom Designs and Manufacturing

Manufacturing Competencies



Mechanics

- Precision Optomechanic Mounts
- Design and Manufacturing
- Linear Stages

Fiber

- Fiber Design and Manufacturing
- Fused Fiber Coupling
- Fiber Processing and Inspection Equipment

Optics

- Optic Design and Manufacturing
- Coatings
- Complex Lens Assemblies
- Isolators

Manufacturing Competencies

Semiconductors

- Gaas, Linb, Inp Wafer Fabrication
- Semiconductor/ Quantum Well Structure Design
- OEM Module Design
- Photolithography
- MEMS-VCSEL

Light Sources

- Fiber Coupled
- Frequency Swept
- Ultra-Fast
- Diodes
- Supercontinuum Source

Imaging Research

- Microscopy Systems for Life Science Applications
- OCT
- While Slide Imaging Systems
- Cytometry Systems

THORLABS

Mechanics

PRODUCTS
>3,600 SKUs including Optical Post Assemblies, Lens Tubes, Cage Systems, Optical Rails, Vacuum Components, Optic Mounts, Irises and Apertures, Mechanical Stages, Platforms, Bases, Enclosure Systems and More.

EMPLOYEES
178 machinists, 116 assemblers, 27 engineers, 21 MFGs, 21 quality.

CAPABILITIES
Type II and III Aluminum Anodization, Stainless Steel passivation, Scientific Glass Blowing, Hermetic Sealing, Optomechanical Subassemblies, Instrumentation, Prototyping and Laser Engraving.

Polaris® Mirror Mounts

- ½” to 3” Mounts
- Cleanroom and Vacuum Compatible
- Ideal for High Power Laser Applications
- 4” and 6” Mounts Coming Soon

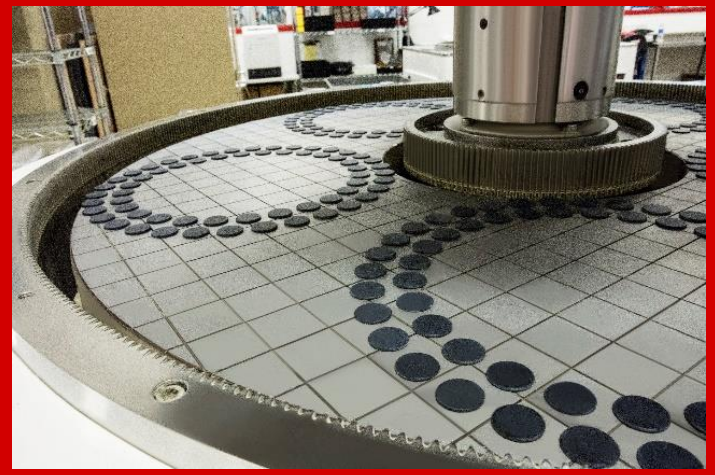
Component Prototyping.

Optics

- Manufactured in US, Sweden, Germany and China Locations.
- >6,500 catalog SKUs.
- 18 CNC Cells, Metrology Assets, Ion Beam Sputtering Chambers, Coating Labs and a Class 10,000 Cleanroom.

MIRRORS
Broadband Dielectric, Metal, Off-Axis Parabolic (OAP) and Dichroic.
FILTERS
Bandpass, Longpass, Neutral Density and Multivariate Optical Elements.
POLARIZATION OPTICS
Wave Plates and Polarizers.

Finished Aspheric Lenses.

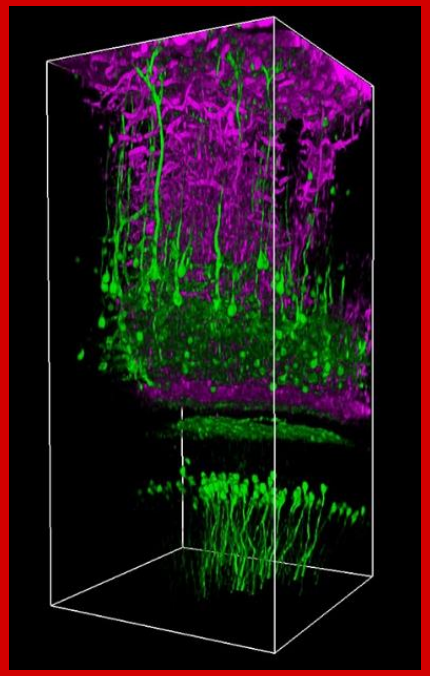


Neutral Density Filter Fabrication.

Imaging Systems

- Multiphoton, Confocal and Whole-Slide-Scanning Microscopes, plus Swept-Source and Spectral-Domain OCT Systems.
- In-House Design and Fabrication Capabilities Allow us to Minimize Design Trade-Offs, Develop Targeted Solutions and Customize Each Individual System to our Customers' Specifications.
- Research Partnerships with Leading Universities and Institutions Enable us to Develop New Technologies, such as Bessel-Beam-Based Volumetric Imaging and All-Digital Fluorescence Lifetime Imaging.

Volumetric Imaging with Bergamo® II Multiphoton System.

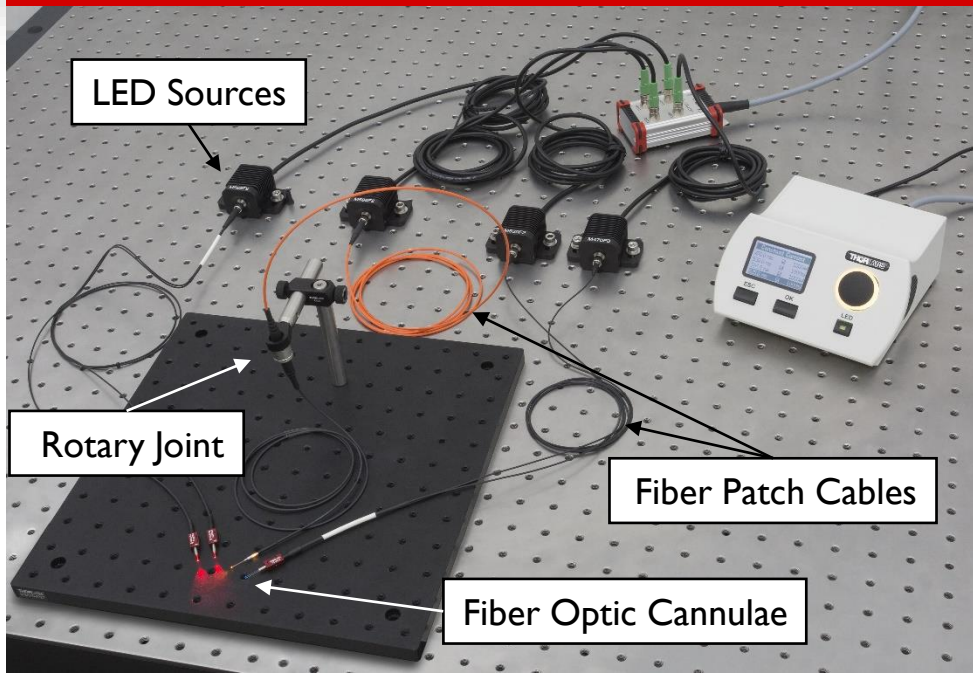


4-Channel, Confocal Microscope.

Optogenetics Equipment

- Our Optogenetics Products are used in Leading Optogenetics Labs.
- Equipment for *In Vivo* Stimulation, including Implantable Fiber Optic Cannulae, Stereotaxic Cannula Holders and Adapter Arms, Fiber Optic Patch Cables and Rotary Joints and LED and Laser Light Sources.
- Custom Options for Fiber-Coupled Light Sources and Cannulae.

Example Optogenetics Experimental Setup



Tables and Workstations

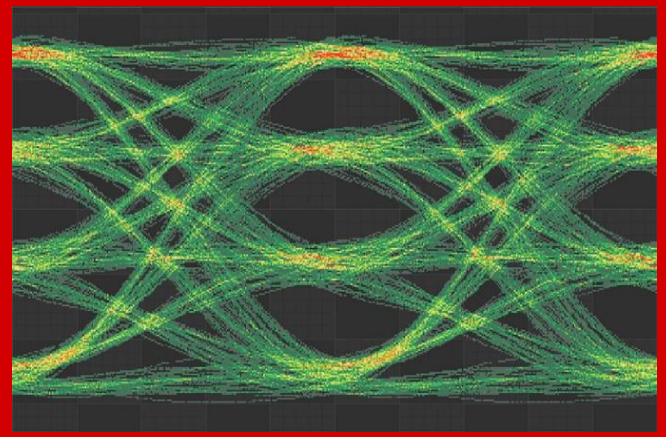
- Workstations, Optical Tables, Table Supports and Honeycomb Breadboards Designed to Dampen or Isolate Vibrations Created by an Experimental Apparatus or External Lab Source.
- Workstation and Table Supports include Active-Air, Self-Leveling Isolators to Meet the Most Demanding Experimental Needs.
- Nexus® Optical Tables Feature All-Steel Construction, Excellent Thermal Stability and Optimized Broadband Vibration Damping.
- ScienceDesks are Ergonomic, Customizable and Portable Vibrationally Isolated Workstations.

Nexus® Optical Table with Shelving.

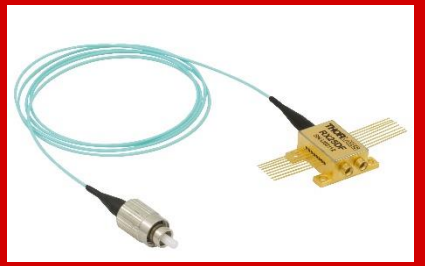
ScienceDesk with Accessories.

High-Speed Transmitters and Receivers

- Ideal for Telecom and Datacom Applications, such as Communications Testing and Measurement.
- For Use in the 850 nm, C-, L-, or O- Band Instruments and OEM Components.
- Electro-to-Optical Converters up to 70 GHz.
- Digital and Linear reference Transmitters up to 65 GHz.
- Detectors and Receivers up to 40 GHz.



25 GBaud/s PAM4 Eye Diagram from MX35E Linear transmitter.

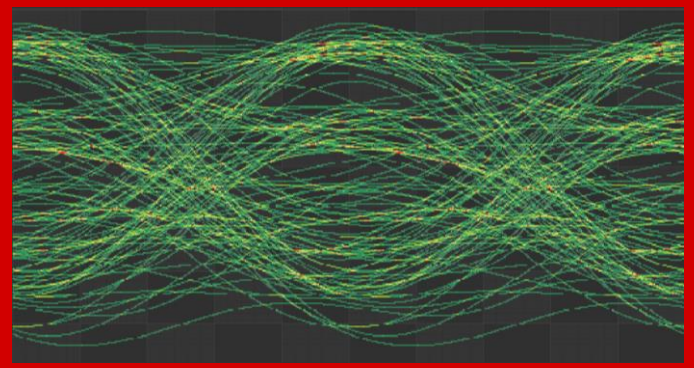


RX25DF High-Speed Photoreceiver Module in OEM Package.

MX Optical Transmitters Family.

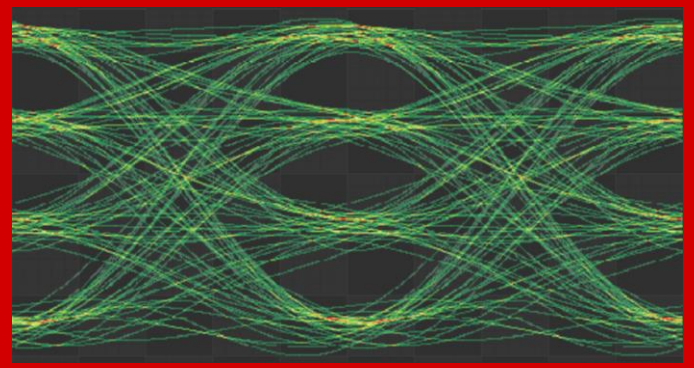
Fiber Amplifiers

- Pigtailed Butterfly Packaged Semiconductor Optical Amplifiers (SOAs) and Booster Optical Amplifiers (BOAs).
- Benchtop Erbium-, Ytterbium or Praseodymium-Doped Fiber Amplifiers.
- For Use in the O-, E-, C-, or L- Bands.
- PDFA O-Band Amplifier Eliminates Typical SOA Distortion Effects such as Cross-Gain Modulation and Pattern Dependence.



50 GBaud/s PAM4 Eye Diagram from SOA.

Praseodymium-Doped Fluoride Fiber Amplifier (PDFA) for Use as a Preamplifier or Booster Amplifier.

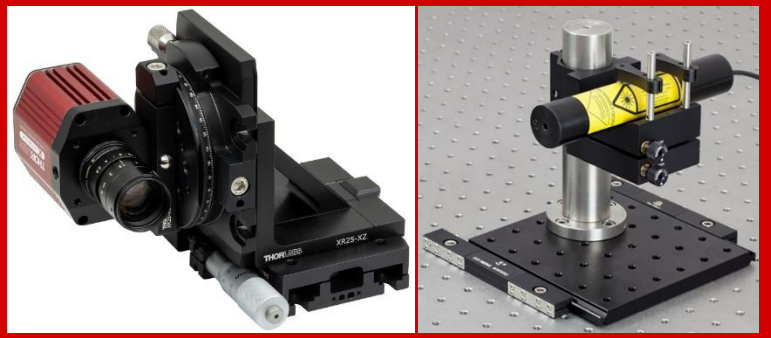


50 GBaud/s PAM4 Eye Diagram from PDFA.

Motion Control

- Manual and Motorized Stages, Multiaxis Platforms, Actuators and Controllers.
- Machined to Precise Tolerances.
- Include Electronics Customized for Specific Applications.
- Employ Software that has been Stress Tested In-House and Proven in Customer Deployments.
- Custom Solutions for Photonics, Bioscience and Industrial OEMs.

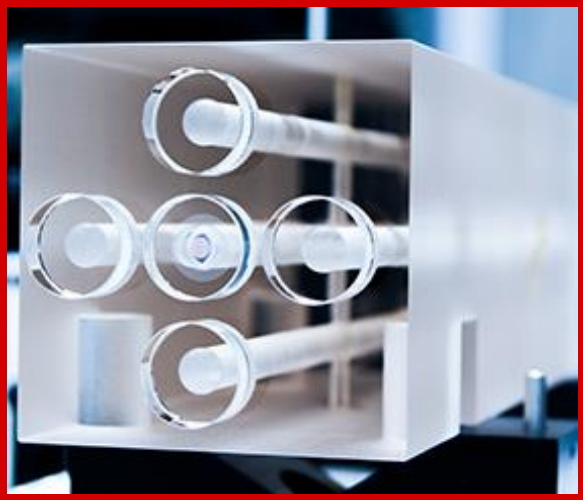
Testing Rig Uses T-Cube Controllers to Repeatedly Drive Actuators, Checking for Continual Use Faults.



Stages Offer Customizable Solutions for Set-Ups.

Crystalline Mirror Coatings

- High-Performance, Single-Crystal Mirror Coatings:
    - xtal stable™ for Low Brownian Noise.
    - xtal mir™ for Low Mid-Infrared Absorption.
    - xtal therm™ for Low Thermal Resistivity.
    - xtal custom™ for Coating Geometries of Any Shape and Direct, Adhesive-Free Bonding to Various Substrates.
- Crystalline Coatings can be used to Create Individual Laser Optics as well as Complete Laser Cavities.
- Applications Include Ultra-Precise Measurements of Space and Time, High-Power Laser Cavity Construction and High-Resolution Trace Gas Sensing.



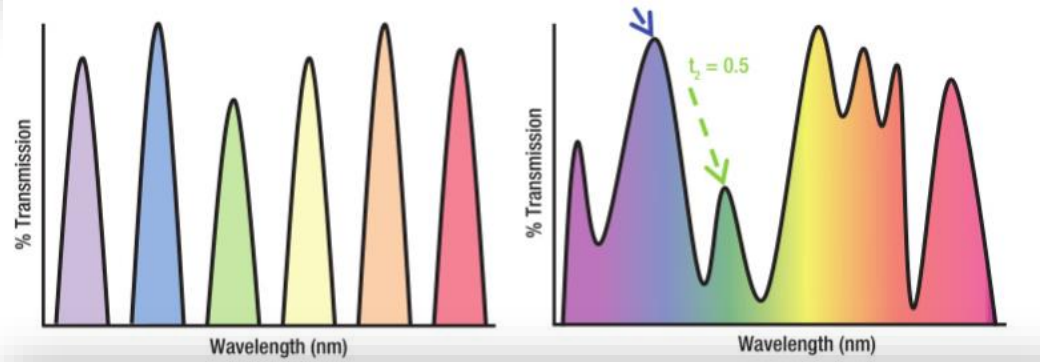
Laser Cavity Assembled with Crystalline Mirrors.

Ultralow Loss Mid-IR Mirror.

MOEs and PTNM

- Pattern Transfer Nanomanufacturing (PTNM) and Multivariate Optical Element (MOE) Technology.
- PTNM Process Creates Photolithographic Masks with <25 nm Feature Resolution.
    - Ideal for Producing Custom Diffractive Optical Elements for Use in the UV to IR.
- MOEs are Wide-Band Optical Spectral Filters Capable of Sampling More Spectral Wavelengths than Discrete Bandpass Filters.
    - Offer a Higher Level of Sensitivity and Specificity, Ideal for Imaging and Sensing Applications.

Transmission Curves for Multiple Bandpass Filters versus a Single MOE Filter.



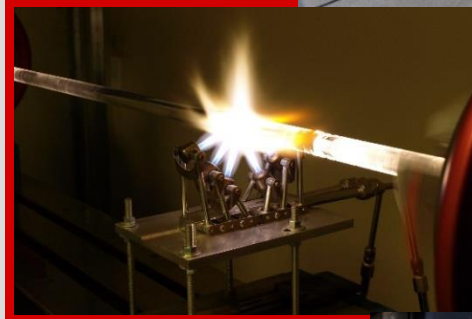
Individual Bandpass Filters.

One MOE Filter.

Optical Fiber

- Largest Selection of Stocked Fibers in the Industry.
- 24 Hour Turnaround for Custom Patch Cables.
- Manufacturing In-House Enables OEM Solutions for Spectroscopy, Light Delivery, Defense, Fiber Lasers and More.
- Internal Processing, Testing and Inspection Equipment.

Silica Fiber Draw Tower



Fiber Fusion

Fiber Draw

Measurement Systems

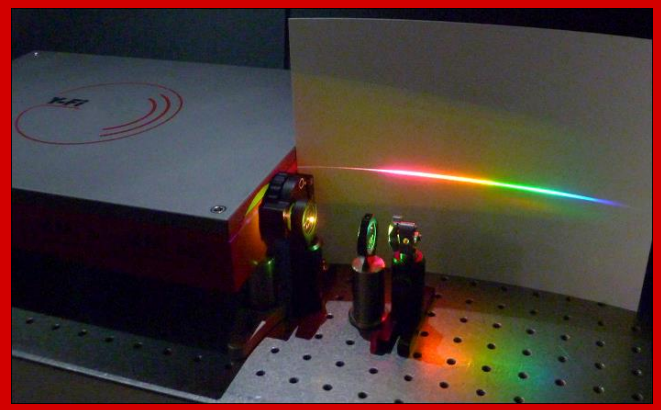
- Large-Format, Granite-Based Video and X-Ray Dimensional Measurement Systems, plus a Differential Pressure Laminator and Precision Stages.
- VideoMic Systems Provide High-Speed, Non-Contact, 3-Axis Coordinate Measurement.
    - Superior Stability and Accuracy Provided by Granite Base and Gantry.
    - Multiple Sensors include Video, Touch and Laser.
- Applications include Metrology and Quality Assurance Inspection for Electronics, Semiconductor, Automotive and Medical Industries.

VideoMic Coordinate Measurement System.

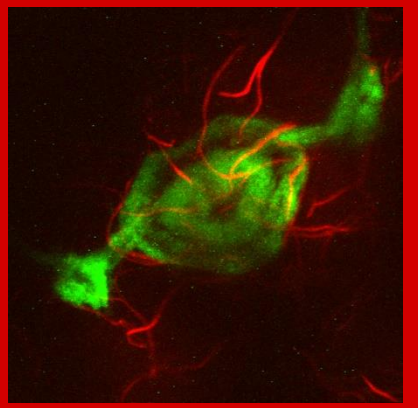
Triangular Laser Used to Measure Surface Flatness.

Y-Fi™ Ytterbium Fiber Lasers

- Tunable, High Average Power, High Repetition Rate NIR/MIR Ultrafast Fiber Laser and Optical Parametric Amplifier (OPA).
- Applications include Multiphoton Microscopy, Photosimulated Optogenetics, Chemical Spectroscopy and Precision Micromachining.



Bulk White-Light Generation with Y-Fi HP Fiber Laser.

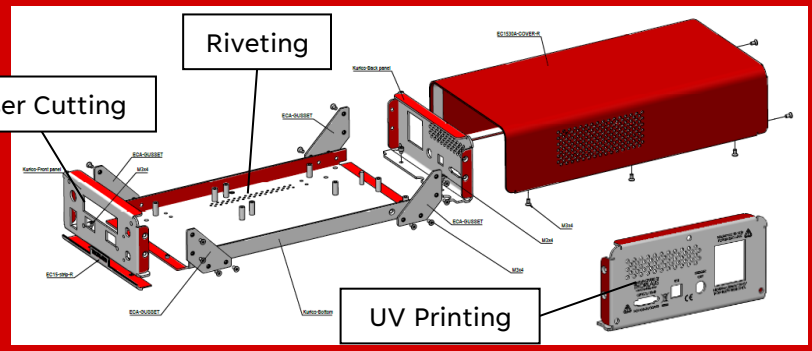


Dropsophila Brain Excited with Y-Fi OPA.

Y-Fi OPA.

Benchtop Enclosures

- Novel Design Allows Complete Enclosure Customization, With or Without Pre-Installed Electronics.
- Customers can Build Instruments to Meet Their Exact Needs.
- Our Enclosures Give all Thorlabs Electronic Instruments a Distinctive Look.

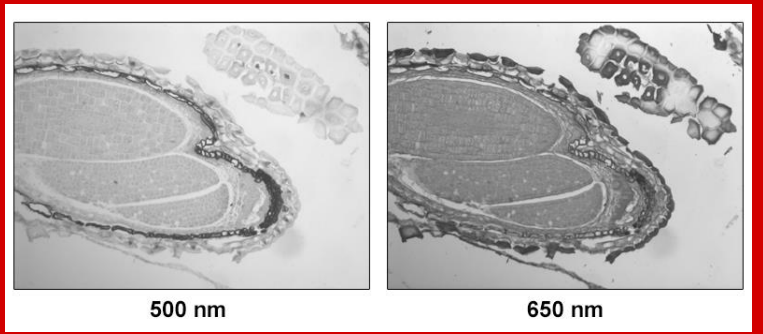


Customizable Front/Rear Panels, Mounting Board and Overlay.

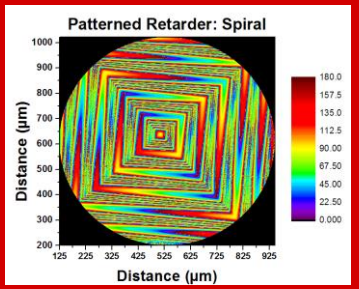
UV Printing of Enclosure Faces.

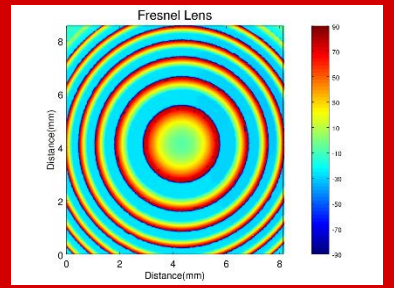
Liquid Crystals and Devices

- Liquid Crystals Tunable Filters Used for Hyperspectral Imaging.
- LC Polymer Vortex Retarders are Used in Super-Resolution Biological Imaging Requiring Stimulation Emission Depletion.
- LC Patterns can be Created for any Device or Experimental Need, such as Lensing, Circular Polarization and Diffraction Applications.



LC Tunable Filters Enable Hyperspectral Imaging at Different Center Wavelengths.





LC Patterned Retarder Options.

Scientific Cameras

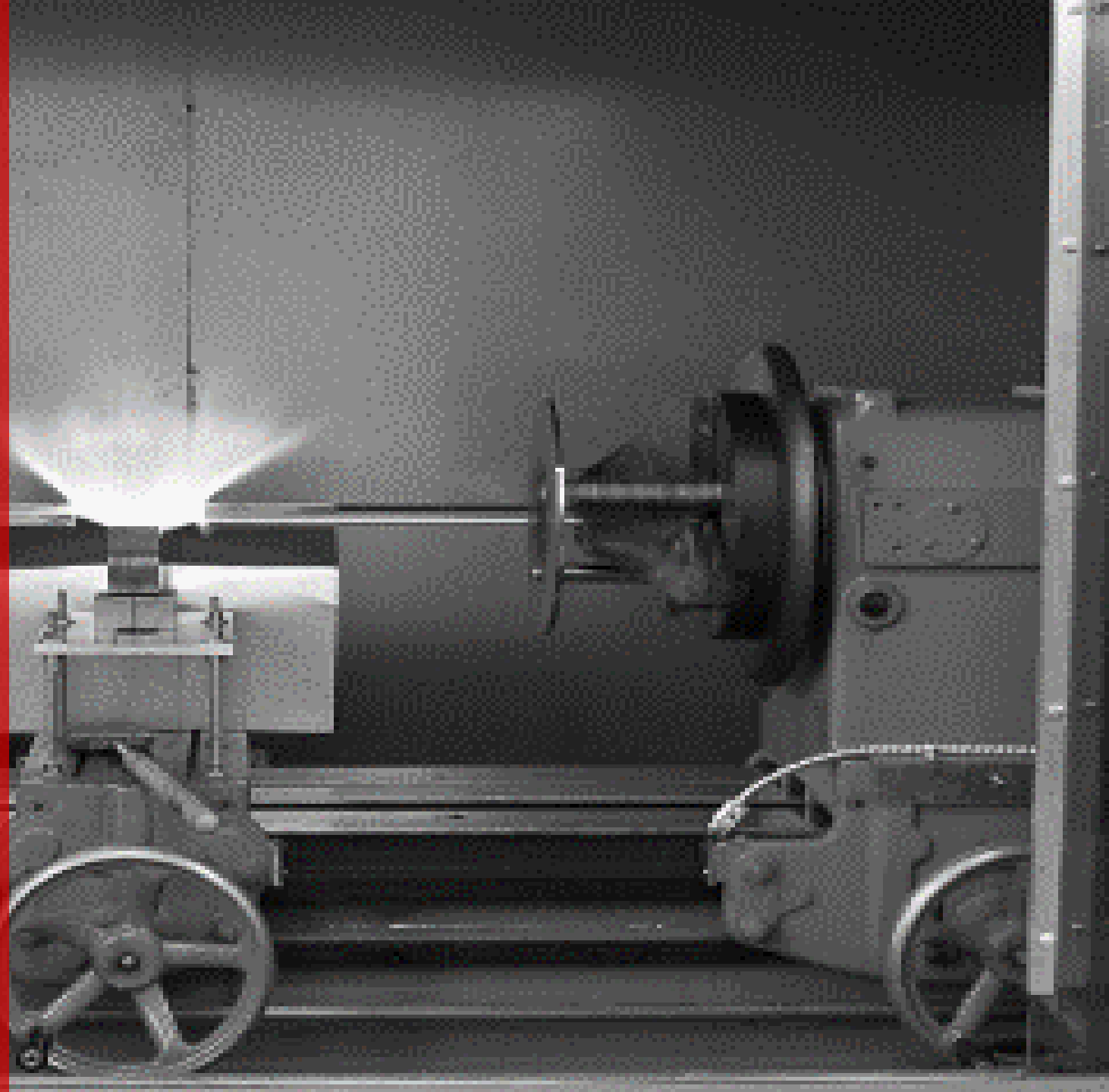
- Low-Noise, High-Performance Scientific Cameras, Interfaces, and Software.
- Cooled, Color, Monochrome and Polarization Cameras.
- Ideal for Brightfield Microscopy, Fluorescence Microscopy, Multispectral Imaging, Electron Microscopy and NIR Imaging.
- Materials Inspection, Cellular Studies, Ophthalmology and Neuroscience Applications.

A Scientific CCD Camera Mounted to a Bergamo II Multiphoton Microscope.

Our CMOS Polarization Camera for Materials Inspection Applications.

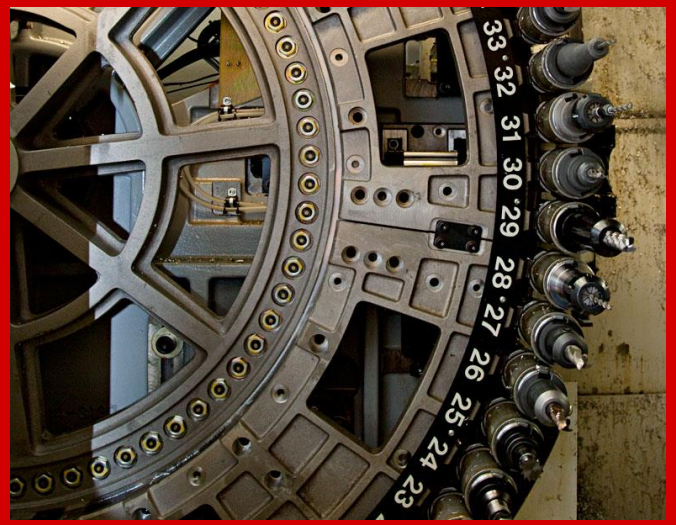
THORLABS

Manufacturing



Vertical Integration

- Through a combination of organic growth, acquisitions and greenfield initiatives, Thorlabs is able to provide a wide range of manufacturing capabilities and large product portfolio.
- A high degree of vertical integration lowers costs to our customers and ensures that every aspect of the product performs optimally, delivering superior value and return on investment.
- We have invested in a variety of capital equipment and metrology systems to control the quality of our products throughout the manufacturing process.



The EC400 Pallet Pool is Capable of Producing 300 Parts in 24 Hours and Features 72 Tools.

Machine Shop

PRODUCTS

Optics Mounts, Bases, Lens Tubes, Manual Stages, Optical Posts, Screws, Cage Systems, Enclosures, Rails and Vacuum Components.

MACHINES

54 CNC Machines (55 Spindles), Laser Engravers, Precision Screw Machines and a Tumbling Center.

- Dedicated Cells Feature Custom Tooling.
- 114 Active Machining Hours completed per Week per Machine.
- 3 Week Lead Time for Prototyping and Initial Production.

NEW

Wire EDM Machine, CNC Grinder, Twin Spindle and Twin Turret Multi-Tasking Lathe, and 5-Axis Machining Center.

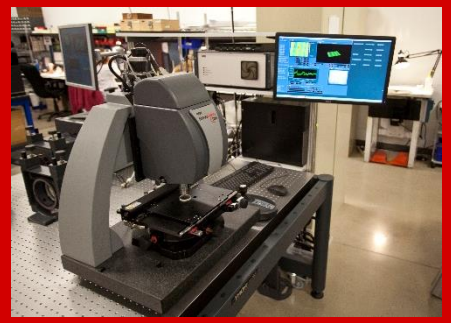
THORLABS

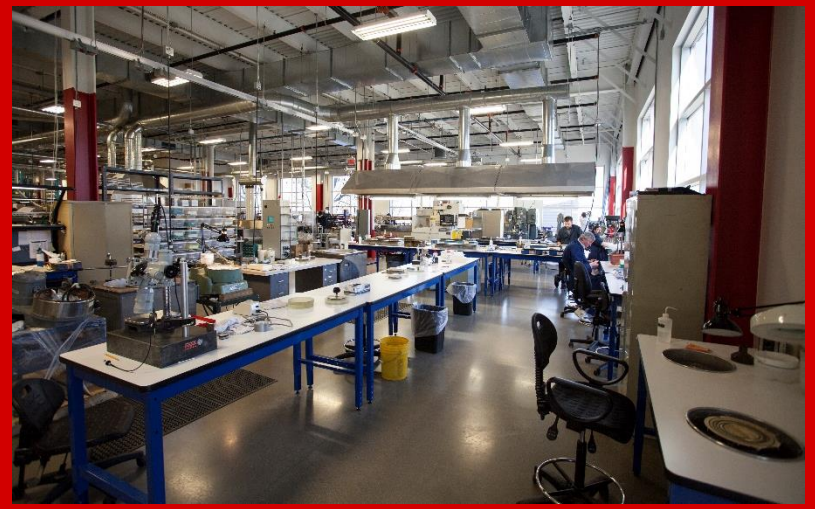
Fiber Manufacturing

- Silica and Fluoride Glass.
- Transmission from UV to MIR (200 nm to 5.5 µm).
- 2 µm SM to 1500 µm MM Fiber Cores, N.A.'s from 0.10 to 0.48.
- UV Coating Including Acrylate and Optical Polymers.
- Extrusion of Tefzel and Nylon Buffer Materials.
- Active Fluoride Fibers with a Variety of Core and Cladding Geometries and Dopants such as Erbium, Thulium and Holmium.
- Prototyping and Volume Production Capabilities.

TESTING

- Metrology Lab
- Tensile Strength
- Static and Dynamic Fatigue
- Spectral Attenuation
- Bend Loss and NA
- Fiber Glass/Coating Geometry





Optics Shop

DESIGN AND ENGINEERING

- SolidWorks
- ZEMAX
- TF Calc and OptiLayer for Coating Design

PRODUCTION

- Spherical and Asphere Optics
- Satisloh Grinding and Polishing
- Nanotech 450UPL Diamond Point Turning Machines
- In Process Metrology Usin Zygo Verifire™ Asphere Interferometer

FABRICATION

- Diamond Wheel Surface Grinding
- Bridgeport Coring Machine for Round Optics
- Dicing Machines for Polished/Unpolished Pates
- Inner Diameter Saws for Polarized Optics
- 16B/9B Speedfam Grinders and Polishers
- Strasbaugh Polishing Spindles (30)

Optics Shop

COATING

- 2 Dedicated Metal Coating Chambers
- Tecport 6 and 7 Chambers with Ion-Assisted Deposition
- Tecport Plasma Assist 54” Box Coater
- Veeco Spector with Ion Beam Sputtering
- In Process Testing Using Cary 5000 Spectrophotometer

TESTING

- Zygo GPI Interferometer for Surface Quality
- Zygo NewView 7100 Non-Contact Surface Profiler for Surface Roughness
- Nikon Autocollimators for Parallelism and Angled Surfaces
- Spectrophometers for R/T Measurement from 200 nm to 55.5 µm
- Optospheric Lens Testing for Powered Optics Measurements

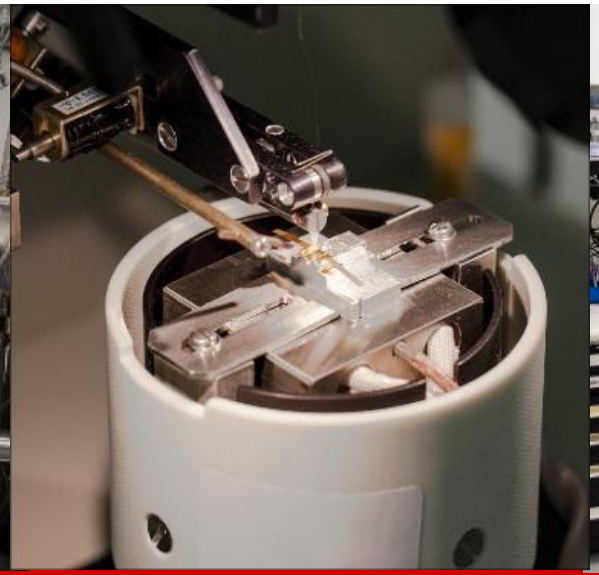
Semiconductor Manufacturing

DESIGN

- Waveguide Modeling: OptiBPM (Optiwave), BeamPROP (RSoft) and FIMMPROP (Photon Design)
- Laser Simulation: PICS3D (Crosslight) and Proprietary In-House Software
- Extensive Epitaxial Wafer Design, Mechanical Design (SolidWorks), Optical Design (Zemax), Thermal Modeling (Comson) and Electrical Design (Altium) Capabilities

WAFER AND DEVICE FABRICATION

- Molecular Beam Epitaxy (MBE) for II-V wafer growth Sub-Micron Photolithography
- Thin-Film Deposition: PECVD, Electron Beam Evaporation, RF Sputter Deposition
- Dry Etching: RIE and ICP
- Metal Disposition: E-beam Evaporation and Plating
- Thermal Process: Diffusion, Rapid Annealing, Curing
- Anti-Reflection and High-Reflection Coatings



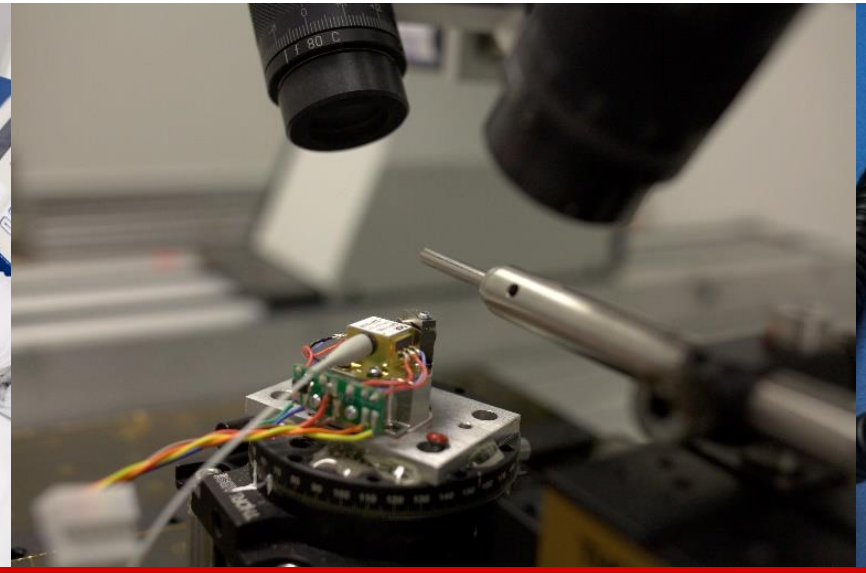
Semiconductor Manufacturing

PACKAGING

- Die and Wire Bonding
- Laser Welding
- Fiber Pigtailing
- Hermetic Sealing

TESTING

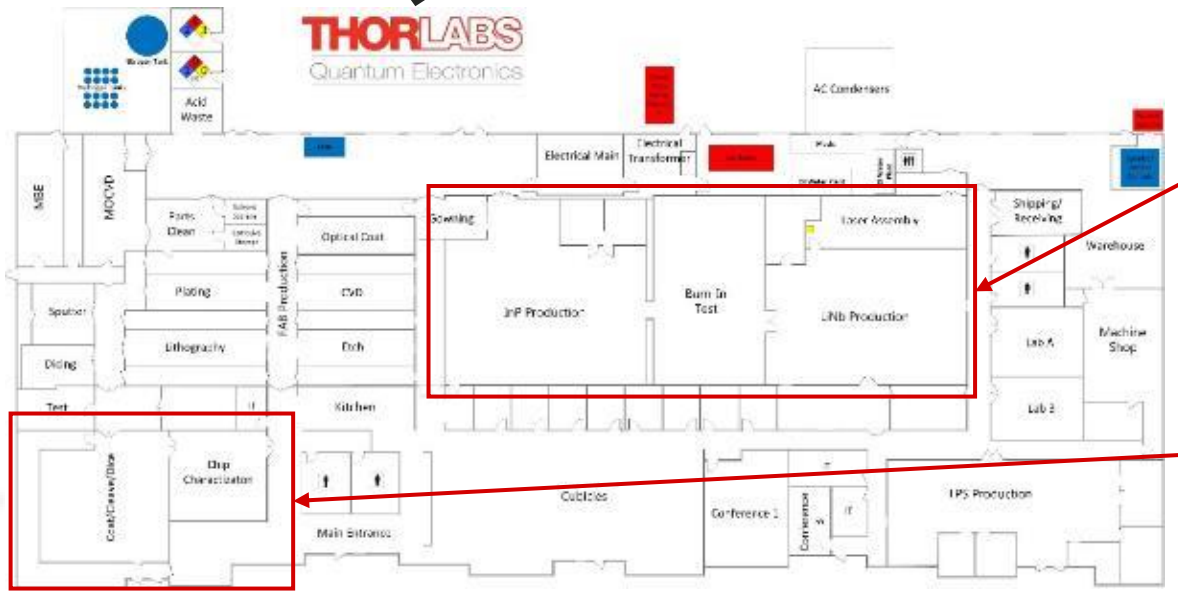
- High-Volume Testing to Telecordia, Defense, and Medical Standards
- Output Power, Spectral Characteristics, RIN, Linewidth, Bit-Error-Rate, Chirp, etc.
- Burn-In Stations
- Reliability/Lifetime Testing
- Environmental Chambers



Expansions at Thorlabs Quantum Electronics (TQE)

Above: 44,000 Sq. Ft. Expansion
8300 Stayton Drive, Jessup, MD.

Above: Original 40,000 Sq. Ft. TQE Building
10335 Guilford Road, Jessup MD.



Additional Equipment Installed for Capacity Expansion.

New 10K Clean Room for VCSEL In-House Coating.

New 10K Clean Room for Epi-Wafer Growth.

100K Clean Room for Module Assembly and Testing.

THORLABS

Lean Team

Thorlabs Lean Department Assists the Ultrafast Optoelectronics Group with Improving Inventory Accuracy.

WHO ARE THE LEAN TEAM?

A dedicated internal consulting group of engineers that help to identify, document, create and execute business process improvements in all our facilities worldwide.

WHAT IS LEAN MANUFACTURING?

A group of strategies for the identification and elimination of waste (non-value adding activities) inside an organization.

The Value of Lean

"Our team is successful through the sharing of knowledge, collaboration and support of team members and other entities. We identify and support operational needs throughout the company to serve out customer-centric philosophy. The diversity, depth and breadth of the work we do makes us a very strong team and a great learning platform for the company."

Margarita Nunez
Lean Department Manager

Margarita (Right) and Team in Sweden.

THORLABS

Lean Project Timeline

2007

LEAN DEPARTMENT IS FOUNDED

Developed cellular manufacturing process for MBU. Implemented same process for Menlo Systems in Germany when they transitioned from R&D to manufacturing.

2011

U.S. DISTRIBUTION MOVE

Implemented serpentine picking and packing process to increase efficiency. Moved inventory from 3,500 sq. ft. to 10,000 sq. ft. building within 3 days in 2011. In 2018, upgraded to 40,000 sq. ft. building over 1.5 days.

2018

TQE BUSINESS DEVELOPMENT

Standardized procedures in the following areas: Purchasing, Planning, Inventory and Vertical Cavity Surface Emitting Laser (VCSEL) Yield Improvement.

The Lean Department was Instrumental in Improving Order Processing Efficiency in Thorlabs main Distribution Warehouse.

Left: Lean Special Project Leader, Jackie. Right: Ultrafast Optoelectronics General Manager, Janis.

Current Lean Projects

THORLABS GmbH, GERMANY

Recently supported production and distribution move to new facility. Techniques were based on the successful U.S. Distribution move from a 10,000 sq. ft. to 40,000 sq. ft. warehouse in 2018.

THORLABS AB, SWEDEN

Developing strategies for fast-moving products that often hit zero stock, including planning for every part and automated production for intercompany orders.

ULTRAFAST OPTOELECTRONICS, MI

Executing manufacturing readiness initiatives, such as data clean-up, inventory accuracy/organization and setting purchasing/planning parameters.

THORLABS

Sustainability

Packaging and Shipping

Recent projects include:

- Transitioning optics packaging from plastic and Styrofoam to recyclable aluminum and paper.
- Redesigning fiber spools and creating a return program.
- Introducing paper-based clamshells for pigtailed fiber devices and short cables.
- Researching and quoting reusable plastic shipping bins for intercompany shipments.
- Testing robust paper mailers for use with international customer shipping of small orders.
- Transitioning from plastic packaging to paper for individual items and components that are shipped with more complex devices.
- Offering a “ship complete” option for customers.

We are Transitioning to Recyclable and Reusable Packaging Across Our Portfolio.

Manufacturing and Facilities

- We Conduct an Annual Greenhouse Gas (GHG) Emissions Survey
- Energy Efficient Solutions are Evaluated and Implemented in All New Manufacturing Facilities
- We are Transitioning to 100% Renewable Energy in our Largest Newton, New Jersey Facility
- Our Virtual IT Services Save 167 Metric Tons of Carbon Dioxide Equivalent (MTCO2e) Annually
- We Use Native Plants and Incorporate Rain Gardens into Our Landscaping

Our New Global HQ is the Most Sustainable and Energy Efficient Building Yet.

THORLABS

Community Involvement

Volunteer Initiatives

- In the Fall of 2018, Thorlabs initiated a volunteer PTO policy for all employees.
- Each year, employees are encouraged to volunteer within the community for up to 8 hours in place of their regularly scheduled work time.
- Thorlabs also sponsors athletic events that benefit local organizations.

2022 DATA

- >100 volunteer hours completed.
- Locations included: The Nature Conservancy, SCARC, Karen Ann Quinlan Hospice, DASI, McKeown Elementary School, South Carolina State Fair Midway Physics Day, North Hills Food Bank, Sparta Community Food Pantry, Mollard Hospitality Center, and Sussex County Chamber of Commerce.
- ~30 employees from NJ and SC participated.

2023 DATA (SO FAR)

- >130 volunteer hours completed as of June.
  - Locations included: Sussex County Trails Partnership, Bristol Glen, The Nature Conservancy, Foodshed Alliance, SCARC, Sussex County Chamber of Commerce, Windsor School, FIRST Robotics, and Link Community Charter School.
- 30 employees from NJ participated.

Community-Focused Volunteer Work and Financial Support.

THORLABS

Our Impact on Education and Hiring

University Partnerships & Student Internships

- STEM degrees lead to quality jobs and meaningful work.
- We partner with more than 30 universities: teaching joint courses, guest lecturing, collaborating on research, and developing new programs.
- We offer paid internships.

Education Opportunities for All Employees

- Educating employees fills STEM roles and improves job satisfaction.
- We provide 100% tuition reimbursement.
- We provide access to ESL courses and internal Physics, Optics, and Engineering classes.

Promoting Career Advancement

- We share new internal job opportunities weekly.
- We offer an “Investors in People” program in Europe.
- We actively find ways to identify talent, train, and promote from within.

SCCC Involvement

Thorlabs is a major partner of the Sussex County Community College.

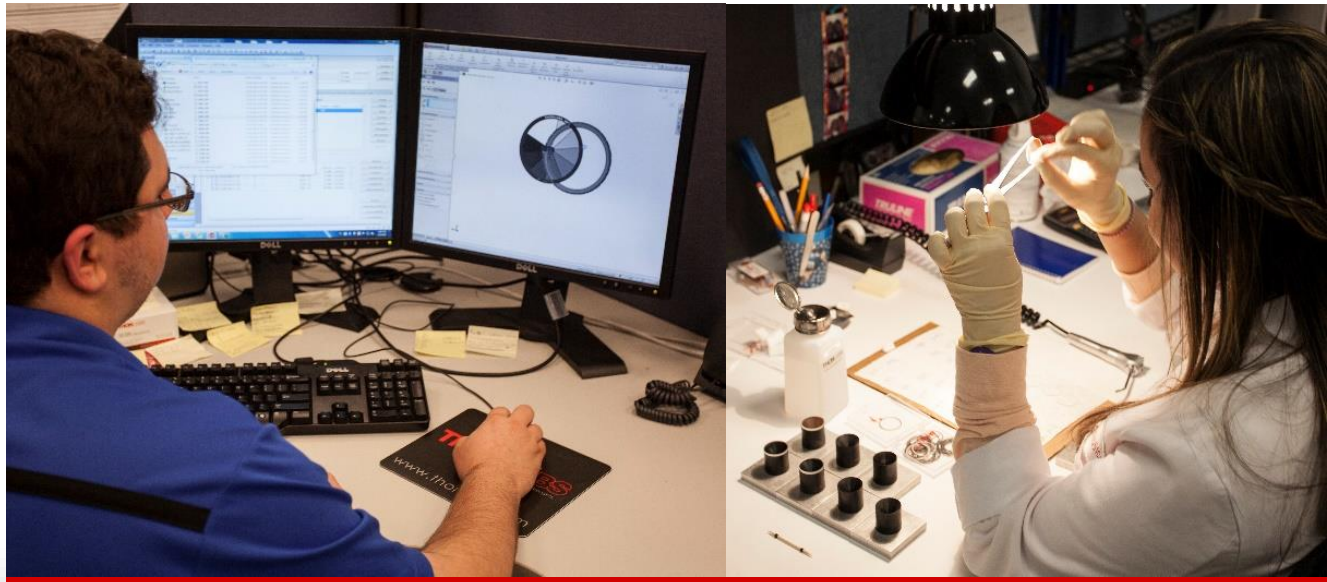
- We maintain STEM and Children of Veterans scholarships for both semesters.
- In 2018, SCCC launched a Machine Tools program, developed with the help of Thorlabs' machine shop and mechanics team.
- Thorlabs employees are on the Board of Trustees and the Foundation Board.
- In 2019, we committed $400,000 to optics and mechanics programs.
- We also fund diesel and culinary programs at SCCC.

Hands-On Student Learning is Provided in the Machine Tool Technology Course.

SCCC Optics Technology Program

- Thorlabs is Collaborating with SCCC to Prepare Students for Careers in Optical Coating and Manufacturing, Quality Control, Laser Fabrication, and Fiber Optics.

- Skills Taught Include CNC Machining, Technical Drawing, Metrology, Machine Setup and Testing, Assembly, and Inspection.

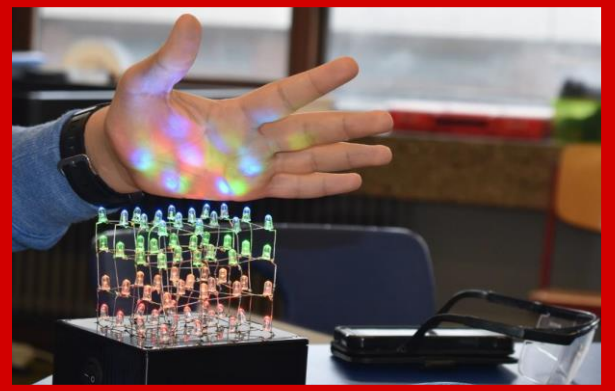


We’re Training the Next Generation of Optics Technicians!

THORLABS

MINT Campus Student Courses – Dachau

- In 2019, Thorlabs GmbH employees began providing courses to students in Dachau, Germany at the Mathematics, Informatics, Natural Sciences, and Technics center.
- Project goals include sharing of knowledge, increasing Thorlabs community presence, and educating local students.
- The first course combined electrical wiring of LEDs, soldering, microcontroller integration, and programming.



Finished 4x4x4 LED Cube.

Student Designs Light Patters.

Thorlabs Employees Assist Students.

SCCC Optics Technology Program

Bouncing Laser Light Between Mirrors.

Using a Lens to Form an Image on a Screen.

- Thorlabs GmbH also developed an educational course for Thorlabs employees in 2019.
- The four-day program allows sales, distribution, and other staff to become acquainted with Thorlabs products and their applications in order to better serve customers.
- Topics include lasers and LEDs, spectrometry, optomechanics, and fiber optics.

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