

Mini2P

The Complete System for 2-Photon
Calcium Imaging in Freely Moving Mice



Mini2P

Brain Imaging in Freely Moving Mice

A New Paradigm

Traditional in-vivo brain imaging with multiphoton microscopy requires that the animal's head be fixed under a vast and heavy tabletop microscope. This severely limits the types of activities and behaviors that can be studied. As part of the **Mini2P**, PhenoSys introduces an ultralight head-staged miniature 2-Photon microscope weighing approx. 2.6g. This design enables stable and rapid brain imaging in freely moving mice, while maintaining the high resolution typical of tabletop microscopes – a revolutionary new paradigm for neuroscientific research.

Strong Innovation Partners

The **Mini2P** is designed and built based on the designs of the Kavli Institute for Neuroscience in Trondheim, Norway (Zong et al.¹). Our official partnership with the Kavli Institute and ongoing collaborations with renowned scientists in the worldwide multiphoton imaging community facilitate continuous engagement in productive discussions and leadership in advancing Mini2P technology. During the development of our Mini2P system, we encountered the significant time and complexity required for such advanced technology. Therefore, we ensured our solution is easy to use and turnkey, supporting scientists with diverse expertise to focus more on their research and less on the technology.



Clean 920 nm fs Laser

The 920 nm laser emits clean pulses < 120 fs, ideal for powerful excitation of various fluorophores such as GFP, TdTomato, and GECIs like GCaMPs.

Dual SiPM

Two onboard SiPMs enable high-speed dual-emission imaging with exceptional signal-to-noise ratio (SNR).

Modular Miniature Objectives

You are in control. Select the perfect objective for your experiment from our range of interchangeable options.

Why the Mini2P Complete Solution from PhenoSys?

- **Ready-to-Use:** Turnkey system with all necessary hard- & software components
- **Stable 2-Photon** calcium imaging in freely moving animals
- **Lightest** miniature 2-photon microscope with on-board detectors
- **High resolution:** 1.1 μm lateral, up to 4 mm^2 FOVs, and 240 μm scanning depth
- **Modular Design:** Continuous innovation with guaranteed integration and upgrades

Under 3g: The lightest available Miniature Microscope with on-board detectors

Weighing under 3g, the Mini 2P is the lightest available miniature 2 photon microscope on the market with on-board detectors. Its head-staged configuration, coupled with a highly flexible, 2.2m long connection cable, facilitates stable and high-speed imaging of neural structures like somata, dendrites, and axons in freely moving mice, even during dynamic activities like climbing and jumping.

Dual-Axis MEMS Scanner & z-scanning Module

Opt for one of our MEMS mirrors. Thanks to the high-speed dual-axis technology, they achieve swift imaging with minimal motion artifacts. Together with our $\mu\text{Tlenses}$, you can image 3D stacks up to 240 μm in moving animals.

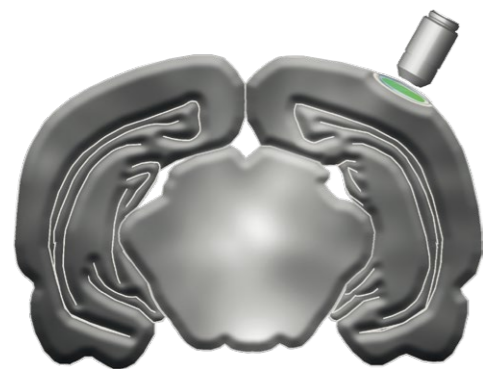
1) "Large-scale two-photon calcium imaging in freely moving mice" Cell (2022)

Mini2P

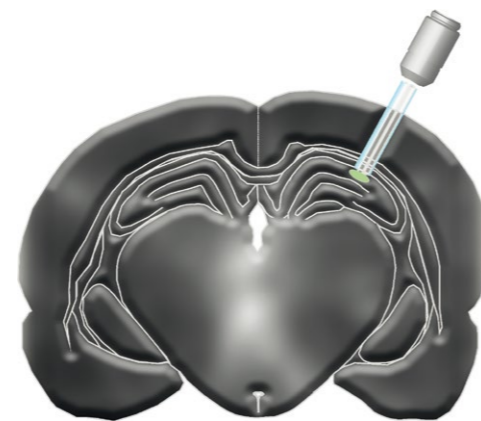
The Scope: Compact and Powerful

With a cutting-edge optical system detecting and separating two emitting wavelengths, the **Mini2P** enables stable simultaneous recordings of neuronal activity across various brain regions and depths.

This advancement empowers researchers to capture the simultaneous activity imaging of more than 1,000 neurons in one region or record more than 10,000 cells in adjacent field-of-views, unlocking deeper insights into neural function and behavior.



Imaging in visual cortices (VC) using coverglass implants (e.g. for L2/L3 neurons in VC)



Imaging in deeper brain regions e.g. CA1 using a GRIN lens

Precision Miniature Objectives

Our interchangeable miniature objectives with a diameter < 4 mm offer superior features including high resolution, large field of view, and chromatic aberration correction tailored for optimal performance in your applications.

Moreover, our objectives are compatible with both air and water as immersion liquids.

	D0213	D0254	D0309
Magnification	3x	3x	3x
NA	0.5	0.5	0.45
Immersion Liquid	Water + glass objective	Air (+ GRIN lens)	Water/air + Glass objective
Working band	530 - 1064 nm, R < 1 %	430 nm - 650 nm, R < 0.5 % 920 ± 30 nm, R < 1 % 1064 ± 30 nm, R < 1 %	430 nm - 650 nm, R < 0.5 % 920 ± 30 nm, R < 1 % 1064 ± 30 nm, R < 1 %
Working Distance	1.00 mm water + 0.17 mm glass	0.582 mm air	0 ~ 0.7 mm water/air + 1.5 ~ 2 mm glass
XY Resolution	1.15 ± 0.15 μm	1.21 ± 0.13 μm	1.24 ± 0.17 μm
Z- Resolution	17.80 ± 0.85 μm	14.53 ± 2.12 μm	12.8 ± 0.28 μm

High-Speed 2-D Imaging

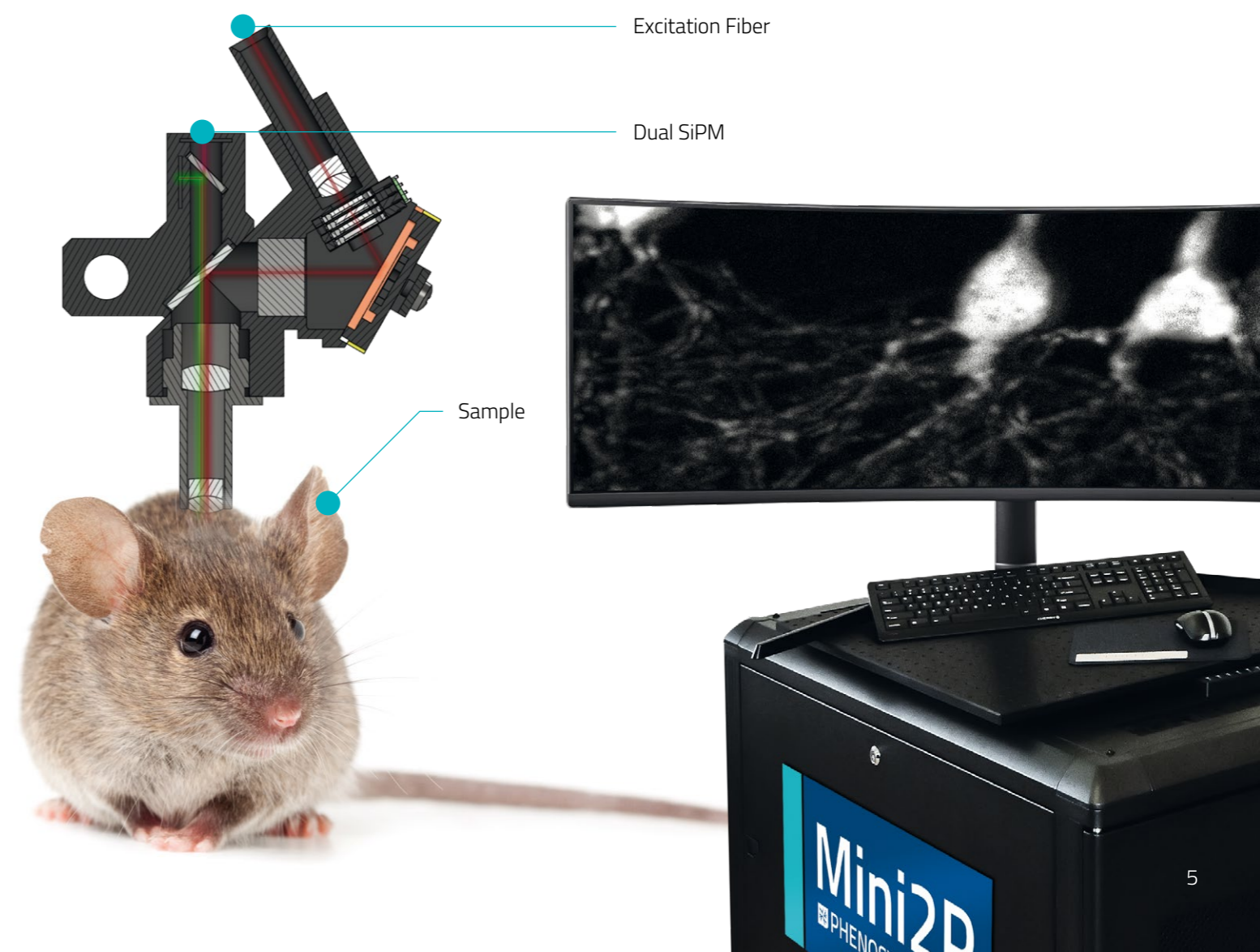
The MEMS Scanning Mirrors are an integrated part of our **Mini2P**, allowing dual-axis high-speed imaging.

The MEMS are selectable with a working resonant frequency of 2000 or 5600 Hz.

Make 2D to 4D

Our fully integrated z-scanning module based on a stack of lightweight μTlenses, with a response time of < **0.4 ms** permits the recording not only of single planes, but a full stack in the freely moving animal. The z-scanning module allows fast imaging across a range of 240 μm.

	Large-angle MEMS	Fast MEMS
Mirror size	1.2 mm	1.0 mm
Immersion Max scan angle	± 5.2 degree	± 4.5 degree
Working frequency	2 kHz	5.6 kHz
Imaging speed	15 Hz (256 × 256)	40 Hz (256 × 256)
FOV	500 × 500 μm ²	420 × 420 μm ²



Mini2P

Mini2P Hub: Plug and Play

All the components come to life in our turn-key and ready-to-use **Mini2P Hub** – a fully equipped yet compact trolley hosting all software and hardware. Its relatively small size (Height = 0.8 m × Width = 0.6 m × Depth = 1.0 m) allows for easy movement between behavioral setups and enables it to operate by plugging in just one electrical cord.

The breadboard on top allows to mount and carry needed equipment – everything at your fingertips.

vDAQ™

Control the Mini2P via the vDAQ™ from MBF, the most advanced and dependable microscope control and data acquisition solution. Its plentiful connections control and synchronize all desired applications.

Control Panel

Start the Mini2P Turnkey system via the control panel by pressing only two buttons. The system will be operational with all software preinstalled.

Laser Body

Our Turnkey system features a compact 920 nm laser, delivering clean fs pulses for optimal imaging results.

Powerful workstation

18 TB HDD and 1 TB SSD provide substantial storage capacity for your recordings. The 49" curved 4 K monitor supports parallel application viewing for enhanced productivity.

Laser Head

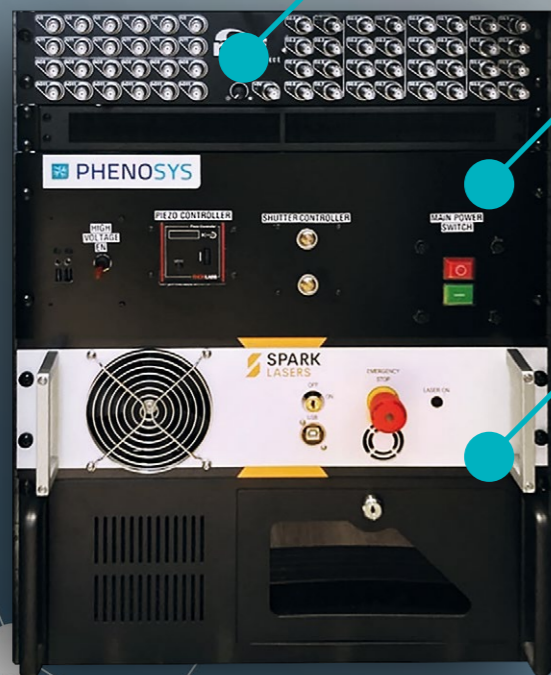
The included laser head allows for easy coupling of the 2.2-meter hollow core (HC) fiber, which connects directly to the scope.

Mini2P control box

The control Box allows for stable and acute communication between software, MEMS mirrors, and μ Tlens, via the thin cable harness (2.5 m long).

SiPM Amplifier

External signal amplification eliminates interference caused by heat buildup on the device.



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What is a Turnkey Hub?

The Turnkey Hub provides an efficient solution for researchers, eliminating the need for extensive technical expertise or the integration of individual components.

- **Fully Integrated:** All necessary components included
- **Easy to Use:** User-friendly "Plug & Play" system
- **Calcium Imaging Optimized:** Tailored for calcium imaging tasks
- **Preinstalled Software:** Ready-to-use out of the box
- **Expert Support:** Customization and expert consulting for Mini2P and related applications

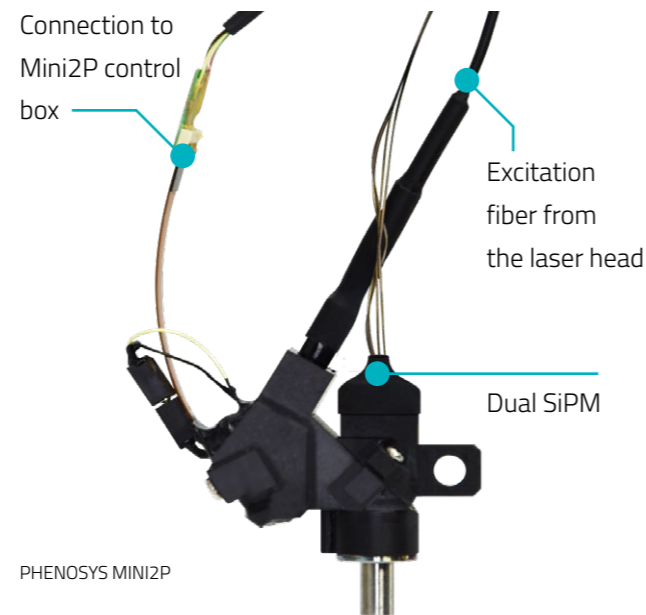
Not all LASERs are created equal!

Our turnkey solution includes the **SPARK LASERS ALCOR 920-Mini2P**. This specialized 920 nm femtosecond pulsed laser is designed for optimal excitation in two-photon imaging of freely moving animals, ensuring precise and clean excitation. The laser is fully integrated with our Mini2P Turnkey system; thus, no extra coupling is needed.

Are you already in possession of a suitable 2-Photon laser? Our Mini2P system may also be coupled to other 2-Photon femtosecond lasers. We gladly help to identify the best-customized solution.

Ready for the future

Mini2P Technology continues to evolve with remarkable innovations on the horizon. We are at the forefront of this wave of innovation, whether it is in hardware (e.g. scope and optics), software (e.g. analytics) or developing new add-ons that simplify and enhance experimental design and set-up.



PHENOSYS MINI2P



SPARK LASERS
ALCOR 920-MINI2P

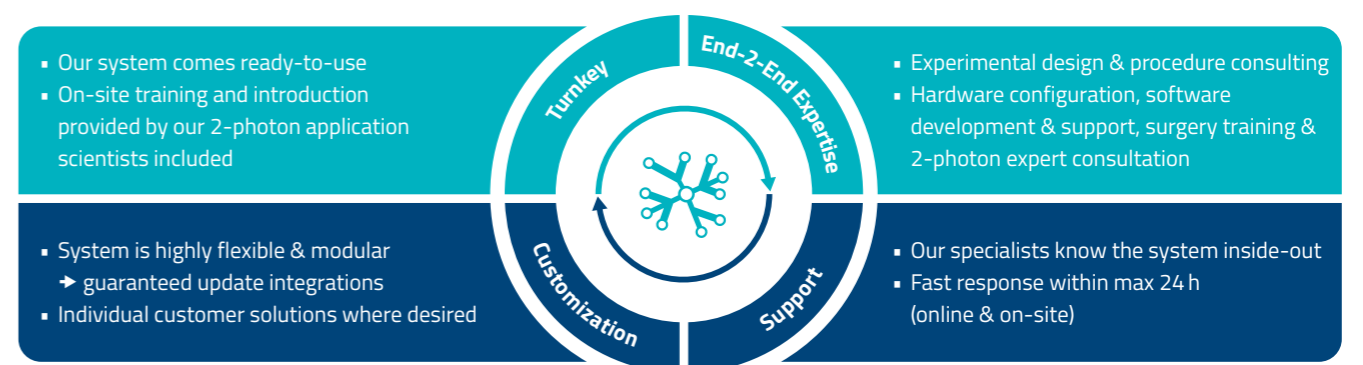
While we cannot predict all the future innovations, our flexible modular approach ensures that upgrades and innovations can be seamlessly integrated into your system. This approach guarantees that you always have access to the latest and most advanced equipment available.

Mini2P Hub (Complete System)	Components
Mini2P Body	Mini2P microscope v2023 with MEMS mirror (fast or large) and one objective (choose between D0213, D0254 or D0309)
Laser	Compact femtosecond laser (< 120 fs), 920 nm, 1.5 W, with integrated AOM for fine power control and fast power modulation (transmission > 85 %, > 1.27 W after AOM) Laser: ALCOR 920-Mini2P from SPARK Lasers
Detectors	2 SiPMs mounted directly on scope body
DAQ	PCIexpress Control card and breadboard
Hardware	PC-computer 49-inch 4 K monitor
Software	<ul style="list-style-type: none"> · DAQ computer with preinstalled and configured Matlab-based software (ScanImage). · DAQ-BNC interface board for flexible integration/synchronization of/with additional devices software · Raw data is fully accessible and the system is individually extendable.
Guarantee/Support	<ul style="list-style-type: none"> · Package comes ready-to-use · On-site installation and introduction included · Warranty 12 months

From Scientists for Scientists: We understand your needs

Our interdisciplinary team comprises microscopy-, neuroscience-, behavioral biology-, electrical- and mechanical engineering-, and computer science experts. At PhenoSys, our commitment to customer support extends beyond the sale. We offer accessible email and video conferencing assistance at every stage of your journey, and responses are guaranteed within 24 hours on business days.

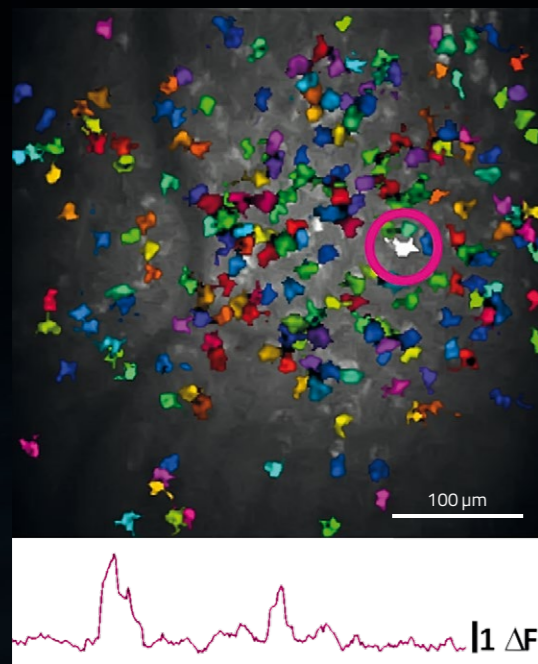
Collaborating with our internal and external consultants, we offer comprehensive support ranging from experimental design and technical inquiries to surgical training. Additionally, we assist with hardware configuration, software development, and ongoing support to ensure your success. Certainly, optional on-site training and guidance from our 2-photon application experts are available upon request.



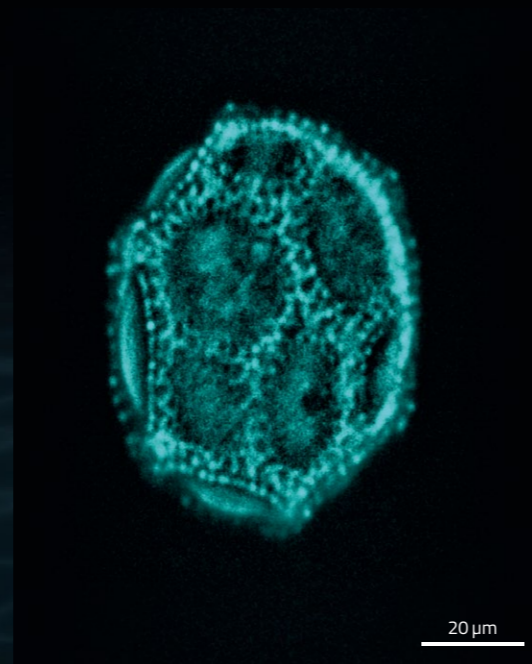
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Applications

Record several hundred cells at once and select single calcium traces (tetO-GCaMP6s transgenic mouse)



STD projection of a Z-Stack 2P fluorescence image of a mixed pollen grain (Carolina Biological Supply)



Visualize neuronal cell bodies and neurites
Transgenic mouse expressing Thy1-GFP.M
Fast MEMS, D0309 objective, air immersion

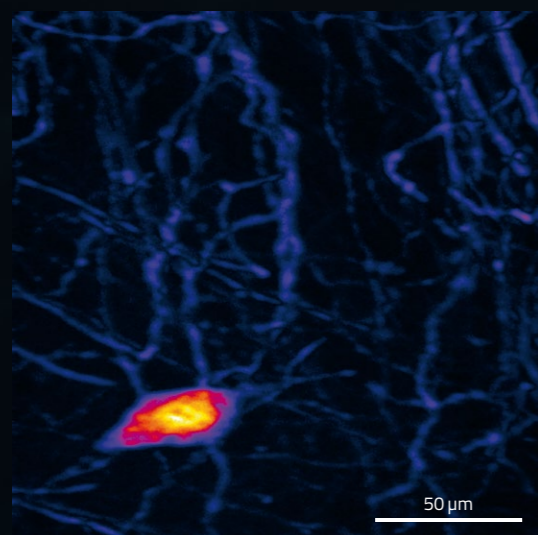
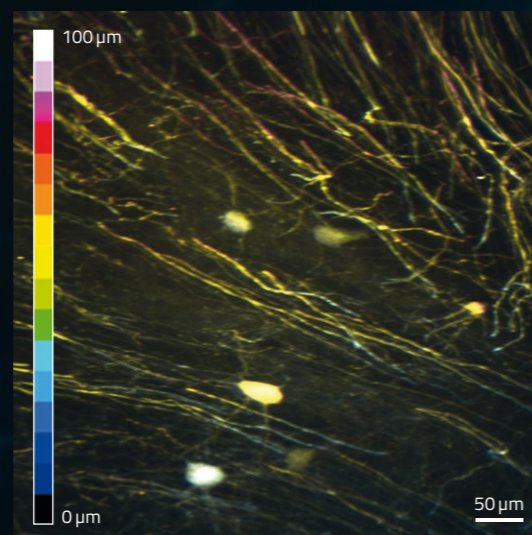


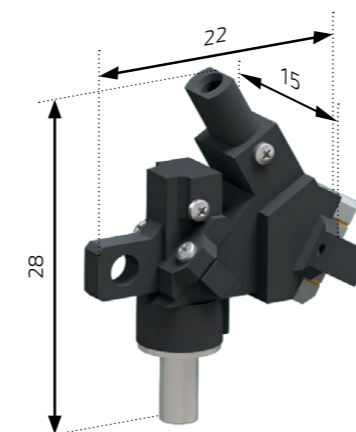
Image in different depths with one or several planes (2D, 3D or 4D). MAX projection of a Z-Stack, color coded for depth (Thy1-GFP.M)



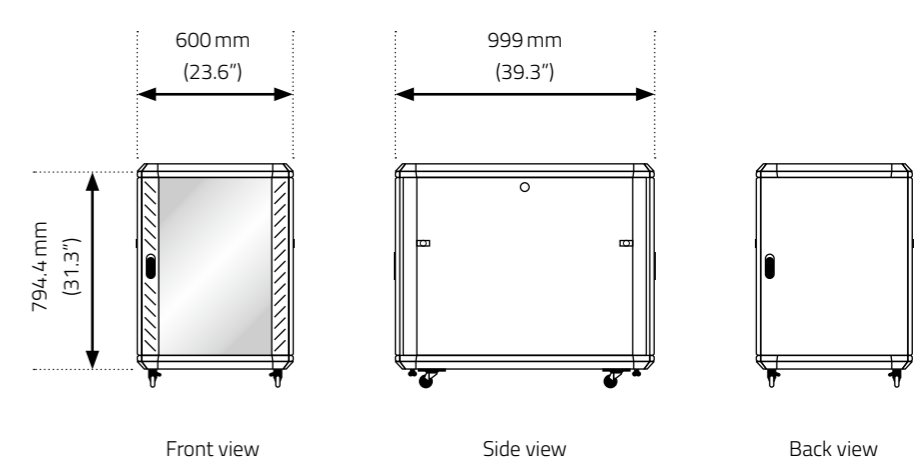
Specifications: Everything at a Glance

Mini2P – Body	MEMS – L	MEMS – F
Resolution	1.3 μm × 1.3 μm × 15 μm	
Max FOV (single FOV)	500 × 500 μm ²	420 × 420 μm ²
Field stitching ¹	> 4 mm ²	
Z-scanning module (μTlens)	240 μm	
Frame rate	15 Hz (256 × 256)	40 Hz (256 × 256)
Weight	2.6 g	
Dimension Scope	15 mm × 17.51 mm × 20.41 mm	
Interchangeable objectives	D0213 (with cover glass to image e.g. visual cortex) D0254 (with GRIN lens to image e.g. hippocampal CA1) D0309 (with a prism to image e.g., medial entorhinal cortex)	
Working distance	< 1 mm	
Z-scanning module (μTlens)	Range: 240 μm Response time: < 0.4 ms	
Two-photon laser (pulsed)	920 nm pulsed femtosecond laser (< 120 fs)	
Excitation fiber	Length: 2.2 m	
Cable Harness	6-wire bundle Length: 2.5 m	
Fluorescence detection module	Green channel: 535 ± 15 nm (GCaMP6/GFP) Red channel: 640 ± 60 nm (RCaMP/tdTomato/mCherry)	
System overall size	999 mm × 600 mm × 844 mm	
Workstation	Imaging Workstation (incl. 49" curved monitor): Windows 11, 32 GB RAM, 1 TB SSD, 18 TB HDD	
Software	ScanImage: System control and Image Acquisition Mounting stage integrated (optional)	

Dimensions of the Scope



Dimensions of the Hub



Turnkey Solutions To Unlock The Brain

Made in Berlin, Germany: Get in Touch

Founded in 2006 in Germany, PhenoSys is a dynamic technology and service company that provides solutions for animal behavior research. Our turnkey systems are mainly used for brain research, imaging, and behavioral phenotyping.

We regard our customers as partners at the center of everything we do. By fostering meaningful partnerships, we continuously innovate and refine our products to meet the evolving needs of the scientific community. At PhenoSys, we are committed to pushing the boundaries of possibility, revolutionizing research methodologies, and advancing scientific discovery through technology-driven solutions.

Are you interested in the Mini2P? Would you like to chat with us if the Mini2P is the right solution for you?

We are looking forward to hearing from you!
Get your quote today: info@phenosys.com



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