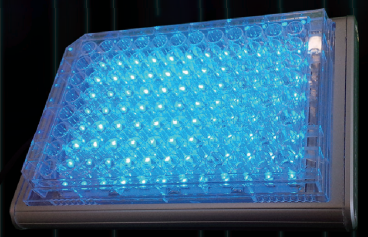
LED Array System

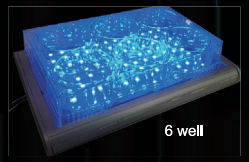
Optogenetics became explosively popular for controlling animal behaviour in-vivo, however, recently this technology was applied for in-vitro cells or tissues for controlling gene expression.
For this purpose, long-term and time-controlled light stimulation in a culture incubator is required..
This full waterproof LED array fulfills all the requirements for the in-vitro optogenetics experiments

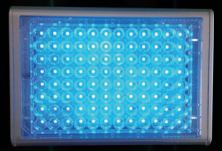


LED Array
model: **LEDA-x**
x: coler code, see bottom-left of this page

LED Array Driver
model: **LAD-1**

• Fits perfectly for multi-well plate





Upper view with 96 well plate

It' s designed for any of commercial multi-well plates so can be used together with e.g. 6, 12, 24, 48 and 96 well plates.
Especially it' s perfectly fits for 96 well plate because each LED element comes just under each well.

• Trigger input

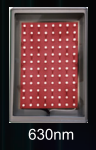
By the mode switch of LAD-1 LED Array Driver you can choose constant mode or trigger mode. In trigger mode, the Trg In BNC on the back panel is used for receiving trigger TTL pulses from a stimulator so that it enables time-controlled pulsed stimulation in-vitro.

• Many color options


470nm

530nm


590nm

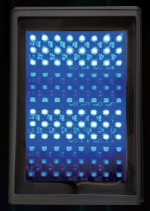

630nm

Two color LED Array
model: **LEDA2-BY**

Color code
V: 400nm / **B**: 470nm / **G**: 530nm / **Y**: 590nm / **R**: 630nm / **I**: 940nm

* contact us for other colors

4 Section LED Array System


model: **LEDA4-x**

model: **LAD-4**

LED4-x has 4 independently controllable sections each having 24 LED. LAD-4 is independent 4ch LED array driver designed for controlling LEDA4-x.

In US & Canada:

AMUZA INC
10060 Carroll Canyon Road, Suite 100, San Diego, California, USA, 92131
URL: https://amuzainc.com
Tel: (858) 225-6869 Fax (858) 560-8040

Other Countries:

Bio Research Center
Towa-Takaoka Bldg. 4F, 2-28-24 Izumi, Higashi-ku, Nagoya, Japan 461-0001
URL: http://www.teleopto.com Mail: sales-Intl@brck.co.jp
Tel: +81-52-932-6421 Fax: +81-52-932-6755

Teleopto

Wireless Optogenetic Stimulator

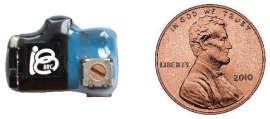
Updated on Sep 2019

Teleopto

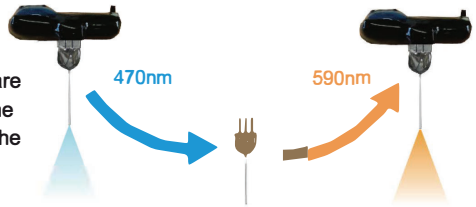
Wireless Optogenetic Stimulator

Best Solution in Optogenetic Stimulation for Freely Moving Animals !

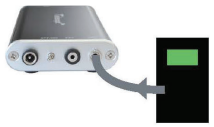
In optogenetics experiment, an optic fiber connected to the head of an animal restricts animal behavior especially in test cages with high walls, gates and other obstacles. Teleopto breaks this wall by enabling complete wireless environment for optogenetic stimulation, using very light receivers sitting perched on animal' s head.

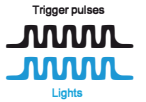


Extra small, extra light recievers even suitable for mice.

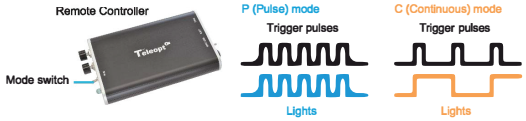


High brightness LED and optic fiber cannula are coupled to achieve mW order light power at the tip. Colors can be changed just by swapping the LED cannula component.





Remote controller accepts trigger signals from a stimulator, and sends the signals to the receiver. Synchronized light pulses are generated from the tip of the LED cannula (in pulse mode).



Receiver has two types, pulse and continuous, each for high frequency and continuous stimulation. The remote controller is compatible for both receivers, by switching the mode switch. Pulse receiver flashes at the same timing with trigger pulses, whereas continuous receiver alternates on and off upon a new pulse.

Some opsins are activated by blue light and inactivated by yellow light. Together with the 2 channel receiver and two color LED cannula, you can stimulate by two different colors at the same position. The remote controller accepts two independent triggers.

Receiver can be charged and re-used repeatedly, by a dedicated charger.

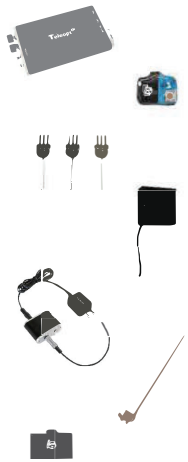
Bilateral stimulation is possible.
If you want to stimulate both hemisphere simultaneously please use 1ch receiver.
If you want to stimulate each hemisphere one by one, please use 2ch receiver.

Two color LED probe for surface stimulation

Teleopto Standard Set

model: **Teleopto-set**

- 1x Teleopto remote controller
- 1x Teleopto receiver
  *Please specify receiver type.
  2g/pulse will come without specifying.
- 3x LED cannula
  *Please specify cannula type.
  Blue/10mm/φ250 will come without specifying.
- 1x Infrared emitter
- 1x Teleopto charger
- 1x Cannula insertion tool
- 1x Dummy receiver
- 1x Trigger Cable



Specifications	
Communication	Infrared
Transmission Range	Controller: 1m, directional
	Infrared Emitter: 3m, directional
Receiver	
1g Receiver	approx. 1.4g, standby time: 17h
2g Receiver	approx. 2.0g, standby time: 28h
3g Receiver	approx. 3.0g, standby time: 49h
Controller I/O	
Trgger Input	3-5V TTL, 2ch
	P/2P mode: On@Hi, Off@Lo
	C mode: Toggle On/Off@rising
Ext Port	For extending Infrared emitter or TeleHub6
LED Cannula Size	φ250, 500 or 750μm
Power Source	Controller: DC6V
	Charger: DC5V

Teleopto Receivers

size: 13 x 18 x 7mm
weight (approx.): 1.4g
standby time: 17h

Teleopto receiver 1g / pulse
model: **TeleR-1-P**

size: 17 x 19 x 7mm
weight (approx.): 2.0g
standby time: 28h

Teleopto receiver 2g / pulse
model: **TeleR-2-P**

size: 18 x 22 x 8mm
weight (approx.): 3.0g
standby time: 49h

Teleopto receiver 3g / pulse
model: **TeleR-3-P**

size: 13 x 18 x 7mm
weight (approx.): 1.5g
standby time: 17h

Teleopto receiver 1g / 2ch pulse
model: **TeleR-1-2P**

size: 17 x 19 x 7mm
weight (approx.): 2.1g
standby time: 28h

Teleopto receiver 2g / 2ch pulse
model: **TeleR-2-2P**

size: 18 x 22 x 8mm
weight (approx.): 3.1g
standby time: 49h

Teleopto receiver 3g / 2ch pulse
model: **TeleR-3-2P**

size: 13 x 18 x 7mm
weight (approx.): 1.4g
standby time: 17h

Teleopto receiver 1g / continuous
model: **TeleR-1-C**

size: 17 x 19 x 7mm
weight (approx.): 2.0g
standby time: 28h

Teleopto receiver 2g / continuous
model: **TeleR-2-C**

size: 18 x 22 x 8mm
weight (approx.): 3.0g
standby time: 49h

Teleopto receiver 3g / continuous
model: **TeleR-3-C**

size: 17 x 19 x 7mm
weight (approx.): 2.1g
standby time: 28h

Teleopto receiver 2g / 2ch continuous
model: **TeleR-2-2C**

typical power (tested with **TeleR-2-P, TeleLC, LPM-100**)

Blue / φ250μm	5.5mW (=121.6mW/mm²)
Blue / φ500μm	16.0mW (=88.5mW/mm²)
Green / φ250μm	2.0mW (=40.8mW/mm²)
Green / φ500μm	4.0mW (=22.1mW/mm²)
Yellow / φ250μm	2.0mW (=40.8mW/mm²)
Yellow / φ500μm	4.0mW (=22.1mW/mm²)
Red / φ250μm	6.5mW (=144.3mW/mm²)
Red / φ500μm	16.0mW (=88.5mW/mm²)

LED Cannulas

LED cannula
model: **TeleLC-c-l-d**

Single cannula.
Hard enough for insertion without a guide.

Bilateral LED cannula
model: **TeleLCD-c-l-d-i**

For bilateral stimulation.

Two color LED cannula
model: **TeleLCT-c/c-l**

Two 250μm cannulas are bundled like one cannula.

Note: how to identify specifications from the model number:

c: color. **B** (blue 470nm) / **G** (green 530nm) / **Y** (yellow 590nm) / **R** (red 630nm) ... for other colors please contact us.
l: Length. Specify in mm.
d: Fiber diameter. **250** (φ250μm) / **500** (φ500μm) / **750** (φ750nm)
i: Fiber interval. Specify in mm. **-Glass**: Glass fiber instead of the regular plastic fiber. Only available for φ250μm Fiber.
f: Ferrule OD (LED ferrule only). **1.25mm** / **2.5mm**

LED probe
model: **TeleLP-c**

LED without cannula.
For brain surface stimulation.

Two color LED probe
model: **TeleLPD-c/c**

Two coloer version of the LED probe.

LED Ferrule
model: **TeleLF-c-d-f**

Universal ferrule for connection with ferruled cannula.

Accessories

Teleopto Charger
model: **TeleCharger**
TeleCharger-4 (4ch)
Additional chargers would be useful if you use several receivers.

Infrared Emitter
model: **TeleEmitter**
Longer transmission, 3m.

Infrared Emitter (Clip type)
model: **TeleEmitter-C**
1m transmission.

Cannula Insertion tool
model: **TeleTool**
For use with a steleotaxic for insertion. φ1.3mm.

Dummy Receiver
model: **TeleDummy**
For habituation.

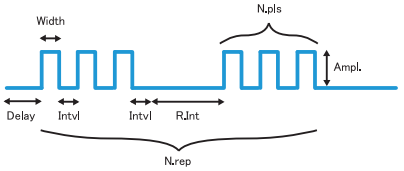
STO mk-II
STIMULATOR FOR OPTOGENETICS

Specification	
Stim Channel	2ch (Independent)
Trigger In	2ch (Independent)
Parameter	
Delay	100μs - 9990s
Width	100μs - 9990s
Interval	100μs - 9990s
Pulse number	1 - 999
Repeat interval	100μs - 9990s
Repeat number	1 - 999
Amplitude	0.1 - 5.0V
Memory	Yes
Endless Repeat	Yes
Power	DC5V

Stimulator for optogenetics

model: **STOmk-2**

STO mk-II is a pulse generator developed for optogenetics. By connecting the STO mk-II to TRG port on the Teleopto Remote Controller via a trigger cable, you can control the timing of light stimulation by TTL pulses. Pulses are defined by the parameters illustrated below.



LPM-100
LIGHT POWER METER FOR OPTOGENETICS

Specification	
Wavelength	470nm (blue) 530nm (green) 590nm (yellow) 630nm (red)
Display	Liquid crystal
Resolution	0.01mW
Analog out	0 - 5V
Power	2x AA batteries

Light power meter

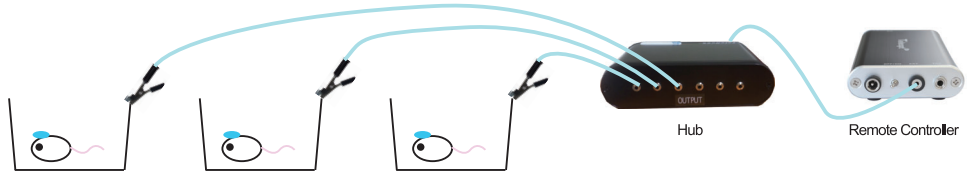
model: **LPM-100**

In optogenetics, it is important to measure the light power at the tip of optic fiber cannula, and the LPM-100 is best suited for this purpose. LPM-100 covers three colors, blue, green, yellow and red which are commonly used in optogenetics.
Easy to use, mobilable by the battery-powered design.

6 channel Hub

model: **TeleHub6**

By connecting the TeleHub6 to the EXT port on the Teleopto Remote controller, you can use up to 6 infrared emitters at the same time so that you can increase the throughput of your experiment. This device is also useful if you use a maze with many branches or high walls which block infrared signal and prevent a good transmission. By putting several infrared emitters at several positions, it ensures more stable light stimulation.
Note: All infrared emitters send a signal at the same timing.



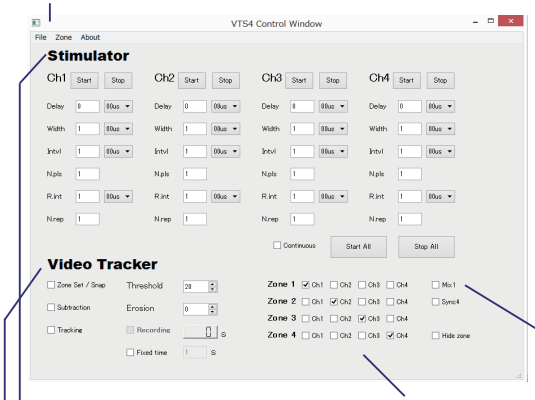
Video Tracking Stimulator

model: **VTS-4**

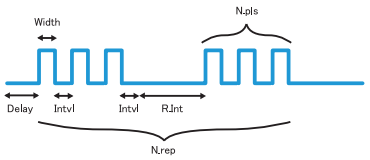
VTS-4 Video Tracking Stimulator is literaly a USB stimulator equipped with a video tracking function, developed for optogenetics experiment. By defining Zones on the video image from a general USB camera, it tracks an animal and outputs pulse trains defined by a dedicated software. Pluse trains can be easily designed by manipulating the stimulation parameters (Delay, Width, Interval, Number of Pulses, etc.) This also can be used as a PC controlled universal 4 channel stimulator. You can establish closed-loop optogenetic stimlation system by combining Teleopto or wired optogenetics system from any third parties.

● Software

Control Window: Controls for stimulation and video tracking



Stimulator Panel: Defines stimulation parameters.

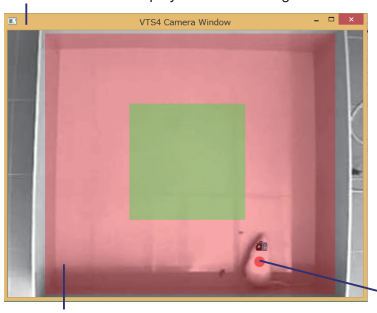


Video Tracker Panel: Zone, snapshot, detection threshold and erosion settings, tracking on/off etc.

Stimulation Assignment: Assign stimulation for each Zone.

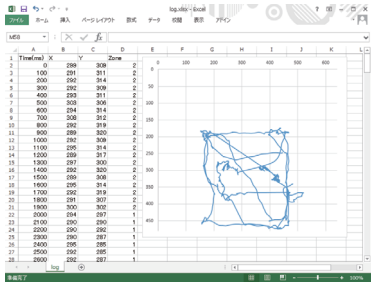
Mix Mode: Uses only one output port for stimulation, and stimulation will be swiched in each zone by refering the stimulation parameteres from the same number of channel.

Camera Window: Display for camera images and Zones



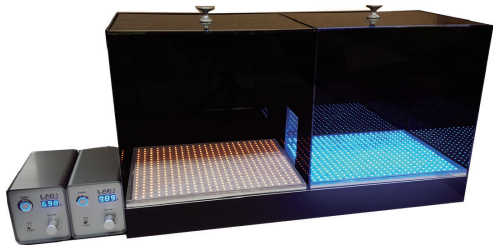
Zones: Up to 4 zones can be defined as polygon by clicking the Camera Window.

Track Mark: A red dot is put on the center of the animal detected by background subtraction.

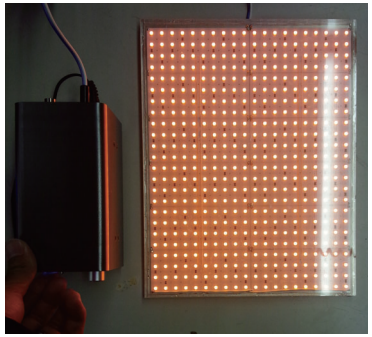


Elapsed time, X & Y axis, Zone data can be recorded by ASCII. Tracks can be visualized by XY plot in Excel etc.

Optogenetic Place Aversion System

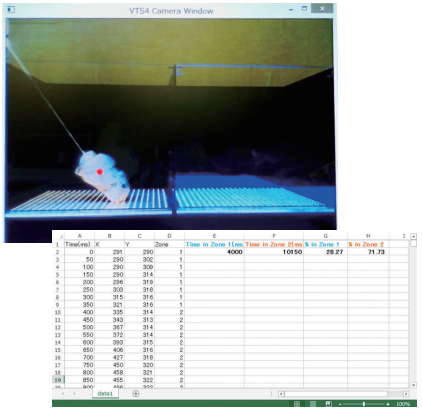


In 2014, Lyer et al. published a work using a new pain test model, combining optogenetics technique and conventional place aversion test:
Virally mediated optogenetic excitation and inhibition of pain in freely moving nontransgenic mice. Nat Biotechnol
In this Optogenetic Place Aversion (=OPA) test, the result does not depend on experimenters skill unlike the traditional Von-Frey test. In addition, you can evaluate pain sensory neuron-specifically (e.g. A-beta, A-delta, C fiber, etc.), by expressing ChR2 on specific neurons. Our OPA system uses 480 pieces of high power LED for each array so that enough light can reaches sensory neuron under animals' skin, thus enables non-invasive and objective test.



●LED Array for OPA

- 480 pieces LED per array
- Dedicated high-power LED Array driver (LAD-1-OPA)
- Minimized heat generation: the "air layer" between LED and top plate blocks heat. Most heat goes to alminum body under the LED array, maximizing heat dissipation.
- Blue (470nm) and Yellow (590nm) by default. Other colors are possible on request.



●Data Recording

Using a camera from side or top of the test box, animal position is continuously tracked and recorded. Total time in each side, the time ratio between blue and yellow zone can be caluculated. These are main parameters which can be used as quantified pain evaluation index.

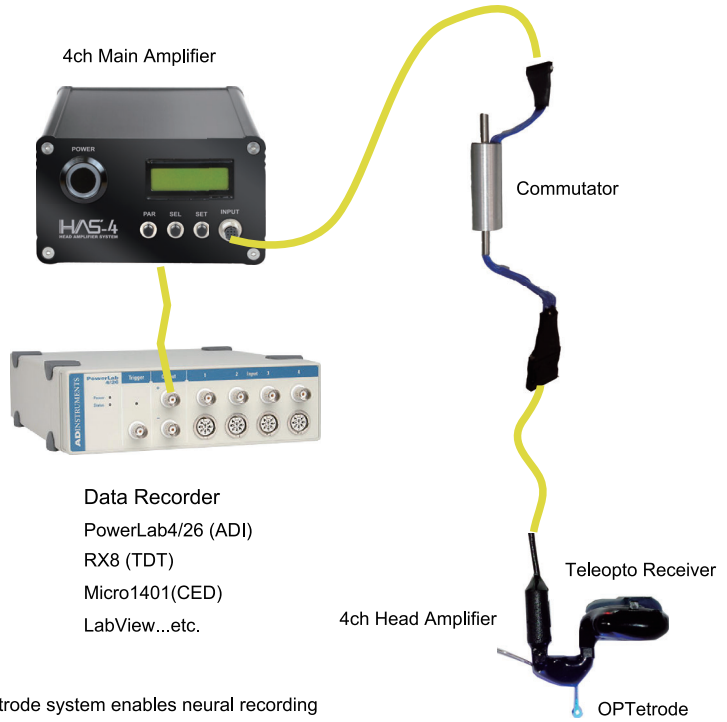
●Contents

OPA-SYSTEM Optogenetic Place Aversion System
(includes:)
- OPA-BOX OPA test box
- LAD-1-OPA LED Arrray Driver for OPA x2
- LEDA-B-OPA LED Array for OPA, Blue
- LEDA-Y-OPA LED Array for OPA, Yellow
- VTS-4 Video Tracking Stimulator

model: **OPA-SYSTEM**
OPA-BOX
LAD-1-OPA
LEDA-B-OPA
LEDA-Y-OPA

Opto-Tetrode System

OPTetrode



This Opto-Tetrode system enables neural recording during in-vivo optogenetic experiment. The OPTetrode consists of an optic fiber and a tetrode, bundled together for making one integrated probe. OPTetrode has a connector for Teleopto receiver and another connector for head amplifier. Our 4ch head amplifier consists of extremely light body (0.3g) and thin cable, so in conbination with the Teleopto 1g receiver the total weight is still under 2g. Perfect for mice.

Model: **OPTetrode-sys**

(includes:)

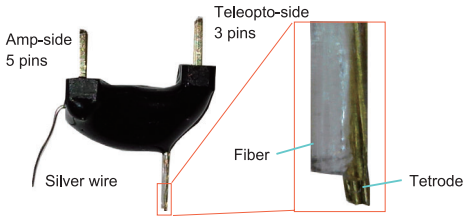
- OPTR-c-l OPTetrode, 3 pcs
- Teleopto-set Teleopto standard set
- HAS-4 4ch Head Amplifier System (includes 1x main amp and 1x head amp)
- SL-OPTR Commutator for OPTetrode

* Data Recorder is optional.

OPTetrode

model: OPTR-c-l ***c**: color **B/G/Y/R**, **l**: length in mm

Bundled probe consisting of φ250um fiber and 4x φ50um stainless wires.



4ch Head Amplifier System

Front

Back

Logo Side

This HAS-4 head amplifier system can amplify up to 4 channel of neural signals (spikes, LFP, EEG) or EMG signal from animals. It consists of a head amplifier and a main amplifier. The head amplifier has gain 1x enabling low noise recording even from high impedance electrode. Main amplifier has variable gain / high pass / low pass filter enabling flexible control for each experiment design, and flexible compatibility for each experimental setup.

- Gain: 10 steps（x1.2 / x5 / x10 / x50 / x100 / x500 / x1000 / x2000 / x5000 / x10000）
- High pass 10 steps（0.1Hz / 1Hz / 3Hz / 5Hz / 10Hz / 30Hz / 50Hz / 100Hz / 200Hz / 300Hz）
- Low pass 10 steps（30Hz / 50Hz / 100Hz / 300Hz / 500Hz / 1000Hz / 2000Hz / 3000Hz / 4000Hz / 7000Hz）
- 4ch single-end input / 3ch input - 1ch reference, differential

●HAS4-HEAD 4ch Head Amplifier

- Extra light weight, 0.3g
- Gain: x1 (Voltage follower)
- Single-end 4ch (If you select “Enable” in “CH4 REF” in the main amplifier, it goes in differential mode with CH1~3 + / CH4 -
- Cable length customizable (1m by default)
- Commutator option

●HAS4-MAIN 4ch Main Amplifier

- Power supply for head amp / amplification / filtering
- Low noise DC power source
- Output: 4x BNC

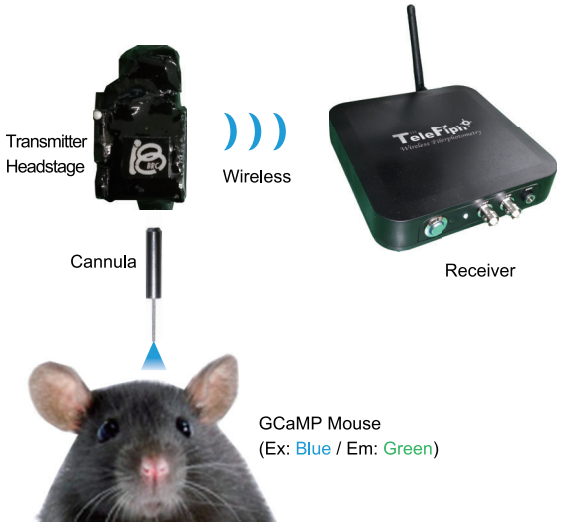
●Input Connector

- Standard 1.27mm pitch, round pin, female
- The pin arrangement is compatible with the Q-trode from NeuroNexus. Note: you need to put a male pin header (HAS-4-CON-R) in between our head amplifier and Q-trode.

model: **HAS-4**
HAS-4-HEAD
HAS-4-MAIN
HAS-4-CON-R

TeleFipho

Wireless Fiberphotometry



Fiber photometry is a powerful technique to detect calcium signal from specific neuron in awake animals using calcium indicator protein represented by GCaMP. In freely moving condition, the long optic fiber attached to the head of the animal can interfere with experimental setup, therefore can be a limitation factor of your project. Our innovative new product, TeleFipho, includes all required components for fiber photometry - optic fiber, filter cube, light source, photo detector - and also wireless transmission circuit, in the very small 3g body. TeleFipho definitely will not block free behavior of your animals, enabling novel experimental approach using fiber photometry.

Features

- World first commercial wireless fiber photometry
- Small headstage / good for mice, rats, marmosets, etc.
- Standard 2.5mm ferrule cannula
- Rechargable by a dedicated charger
- Adjustable excitation LED power
- Adjustable signal offset
- For GCaMP or GFP-like indicators

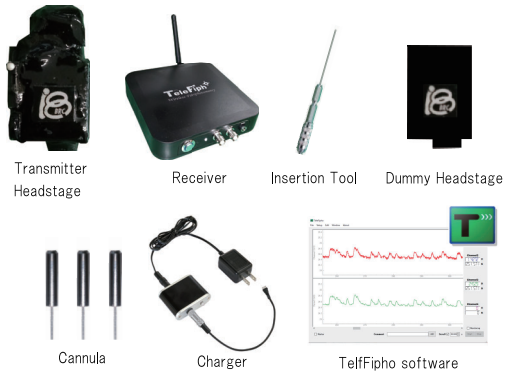
Specification	
Headstage weight	3g
Headstage size	12 x 12 x 22 mm
Excitation wavelength	LED peak 470nm, Filter band 445～490nm
Emission wavelength	Filter band 500～550nm
Excitation power	10～300μW@Fiber end (Adjustable)
Sampling rate	100Hz
AD resolution	16bit
Photo sensor	Photo diode
Gain	10^{10} V/A
Battery life	2hours@Excitation power 30μW
Transmission band	2.4GHz
Transmission distance	2m
Power	Battery powered, rechargable
Receiver I/O	1x Photometry analog out, 1x Geneal purpose analog In (0~5V)
PC Interface	USB / TeleFipho software (for Windows10)
Cannula	core: 400μm/NA0.39, Cladding: 425μm, Ferrule: 2.5mm

TeleFipho Standard Set

TeleFipho-set consists of the following items :

TeleFiT	1x TeleFipho Transmitter Headstage
TeleFiR	1x TeleFipho Receiver
TeleFiCharger	1x TeleFipho Charger
TeleFiC_x (※)	3x TeleFipho Cannula
TeleFiTool	1x Insertion Tool for TeleFipho
	1x TeleFipho software installer

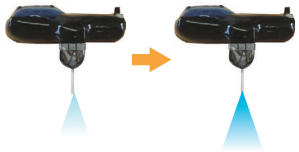
(※) Please specify cannula length. 5mm cannula will come without specifying.
e.g. Cannula length 3.5mm: TeleFic_3.5 (in mm, resolution 0.1mm)



Teleopt Custom Order Examples

We can provide customized products for each of your application. Please feel free to ask any ideas!

High Power Receiver



2g or larger receiver can enhance max output power ~1.5x. Note there is higher lisk for damaging cannula and internal circuit in high power receiver - use pulse width <100ms in duty cycle less than 1:10.

Vertical Receiver

Normal receiver has cannula connector on long side of the receiver, but this receiver has it on short side. Customized for easier nose-poking into small hole.

Upright Receiver

The direction of cannula connector is in parallel with the receiver. It can save space on the head so useful if you want to put another headstage for recording.

Selected publications using Teleopt

Science

REM sleep-active MCH neurons are involved in forgetting hippocampus dependent memories
Izawa D, Chowdhury S, Miyazaki T, Mukai Y, Ono D, Inoue R. Ohmura Y, Mizoguchi H, Kimura K, Yoshida M, Terao A, Kilduff TS, Yamanaka A
Science (2019) 365(6459):1308-1313. DOI: 10.1126/science.aax9238

nature neuroscience

Excitatory connections between the prelimbic and infralimbic medial prefrontal cortex show a role for the prelimbic cortex in fear extinction
Roger Marek, Li Xu, Robert K. P. Sullivan, Pankaj Sah
Nature Neuroscience (2018) 21(5):654-658. DOI: 10.1038

Science

Top-down cortical input during NREM sleep consolidates perceptual memory
Miyamoto D, Hirai D, Fung CCA, Inutsuka A, Odagawa M, Suzuki T, Boehringer R, Adaikkan C, Matsubara C, Matsuki N, Fukai T, McHugh TJ, Yamanaka A, Murayama M
Science (2016) 352(6291):1315-8. DOI: 10.1126

Cell

Htr2a-Expressing Cells in the Central Amygdala Control the Hierarchy between Innate and Learned Fear
Isosaka T, Matsuo T, Yamaguchi T, Funabiki K, Nakanishi S, Kobayakawa R, Kobayakawa K
Cell (2015) 163(5):1153-64

Neuron

A Top-Down Cortical Circuit for Accurate Sensory Perception
Manita S, Suzuki T, Homma C, Matsumoto T, Odagawara M, Yamada K, Ota K, Matsubara C, Inutsuka A, Sato M, Ohkura M, Yamanaka A, Yanagawa Y, Nakai J, Hayashi Y, Larkum ME, Murayama M
Neuron (2015) 86:1304-16

Selected publications using our LED Array

PNAS

Controlling the material properties and rRNA processing function of the nucleolus using light
Zhu L, Richardson TM, Wacheul L, Wei MT, Feric M, Whitney G, Lafontaine DLJ, Brangwynne CP
Science (2019) 365(6459):1308-1313. DOI: 10.1126/science.aax9238

EMBO Molecular Medicine

Repeat-associated non-AUG translation in C9orf72-ALS/FTD is driven by neuronal excitation and stress
Westergard T, McAvoy K, Russell K, Wen X, Pang Y, Morris B, Pasinelli P, Trotti D, Haeusler A
EMBO Mol Med. 2019 Feb; 11(2). pii:e9423. DOI:10.15252/emmm.201809423