info@biopac.com
support@biopac.com
www.biopac.com

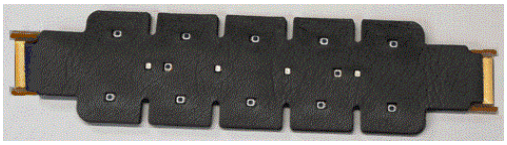
fNIRS FUNCTIONAL NEAR INFRARED OPTICAL BRAIN IMAGING SYSTEMS

fNIR 3000C Imager Systems

fNIR 2000E Imager Systems

fNIR2000S Imager Systems

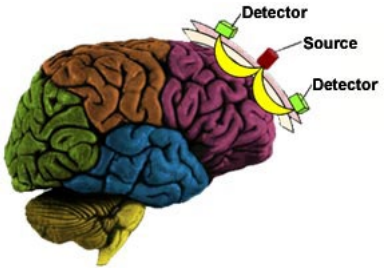
fNIR2000M Imager Systems



fNIRS Sensor Transducers

Accessories

***f*NIRS** functional near infrared optical imaging systems measure oxygen level changes in the prefrontal cortex of human subjects. Each *f*NIRS system provides real-time monitoring of tissue oxygenation in the brain as subjects take tests, perform tasks, or receive stimulation and allows researchers to quantitatively assess brain functions—such as attention, memory, planning, and problem solving—while individuals perform cognitive tasks. The *f*NIRS device provides relative change in hemoglobin levels, calculated using a modified Beer-Lambert law.



Subjects wear an *f*NIRS sensor (IR light sources and detectors mounted in a flexible band) on the forehead that detects oxygen levels in the prefrontal cortex and provides real-time values for oxy-hemoglobin and deoxygenated hemoglobin. It provides a continuous and real-time display of the oxygen changes as the subject performs different tasks. The subject can sit in front of a computer and take a test or perform mobile tasks. It integrates with stimulus presentation systems and BIOPAC's virtual reality products.

The powerful *f*NIR spectroscopy imaging tool measures NIR light absorbance in blood of hemoglobin with and without oxygen and provides information about ongoing brain activity similar to functional MRI studies. It eliminates many of the drawbacks of *f*MRI and provides a safe, affordable, noninvasive solution for cognitive function assessment. The technology empowers researchers by providing greater flexibility for study design, including working within complex lab environments, and operating in non-traditional lab locations for field studies.

*f*NIRS systems are suitable for a wide range of applications.

- Human Performance Assessment
- Brain Computer Interface
- Neurorehabilitation
- Pain Assessment
- Autism
- Virtual Reality
- Depth of Anesthesia Monitoring
- Credibility Assessment (lie detection)

*f*NIR Systems for continuous *f*NIR spectroscopy (NIRS) include COBI control unit software and fNIRSOFT analysis software to view the data in real time and save it to perform post acquisition analysis.

The *f*NIRS device can produce digital TTL output signal through the BNC output port to synchronize any external device with data acquisition events. (2000M Output Sync port is JST PH-series instead of BNC.)

The *f*NIRS data combines with other physiological variables such as ECG, respiration, cardiac output, blood pressure, electrodermal activity, and stimulus response markers. Acq*Knowledge* software provides automated analysis tools for event related potentials and ensemble averaging. Combining the *f*NIRS data with the other physiological signals provides researchers with a detailed subject assessment.

FNIRS SYSTEMS *Functional brain imaging systems for continuous fNIR spectroscopy (NIRS)*

C Systems (with 3000C Imager)

fNIR104C Functional Near Infrared Brain Imaging System

Stand-alone imaging system—includes a 3000C Imager[1], *f*NIRSoft Standard/*f*NIRSoft Educational/COBI, and one 6-channel sensor pad with one sensor cable.

fNIR154C Functional Near Infrared Brain Imaging System

Stand-alone imaging system—includes a 3000C Imager, *f*NIRSoft Standard/COBI software, one 18-channel sensor pads with two sensor cables.

fNIR204C Functional Near Infrared Brain Imaging System

Stand-alone imaging system—includes a 3000C Imager, *f*NIRSoft Standard/COBI, and three 18-channel sensor pads with two sensor cables.

fNIR304C Functional Near Infrared Brain Imaging System

Stand-alone imaging system—includes a 3000C Imager, *f*NIRSoft Pro/COBI, three 18-channel sensor pads with two sensor cables, plus a tablet-style computer with caddy.

[1]The 3000C Imager can support a maximum of 18 channels.

S Systems (with 2000S Imager)

fNIR103S Functional Near Infrared High-Density Brain Imaging System

Stand-alone high-density imaging system—includes a 2000S Imager[2], *f*NIRSoft Pro/COBI, and three 18-channel sensor pads with two sensor cables.

fNIR203S Functional Near Infrared High-Density Brain Imaging System

Stand-alone high density imaging system—includes a 2000S Imager, *f*NIRSoft Pro/COBI, laptop computer with caddy, and three 18-channel sensor pads with two sensor cables.

fNIR303S Functional Near Infrared High-Density Brain Imaging System

Stand-alone high density imaging system—includes a 2000S Imager, *f*NIRSoft Pro/COBI, laptop computer, all-in-one computer with pole cart/shelf, three 18-channel sensor pads with two sensor cables, plus four additional sensors.

[2]The 2000S Imager can support a maximum of 54 channels. For full 54 channel support, three sensor pads and six sensor cables are required.

M Systems (with 2000M Imager)

fNIR103M Functional Near Infrared Mobile Imaging System

Stand-alone high-performance mobile imaging system—includes a 2000M Imager[3], *f*NIRSoft Pro/COBI, three 18-channel sensor pads with two sensor cables, US/EU power supply/adapter.

fNIR203M Functional Near Infrared Mobile Imaging System

All *f*NIR103M components PLUS one Notebook/Tablet Style computer.

fNIR303M Functional Near Infrared Mobile Brain Imaging System

All *f*NIR203M components PLUS additional sensors: two 5-Optode sensor pads; two 6-Optode sensor pads.

[3]2000M Imager supports a maximum of 18 channels.

E System (with 2000E Imager)

fNIR103E Functional Near Infrared Mobile Imaging Education System

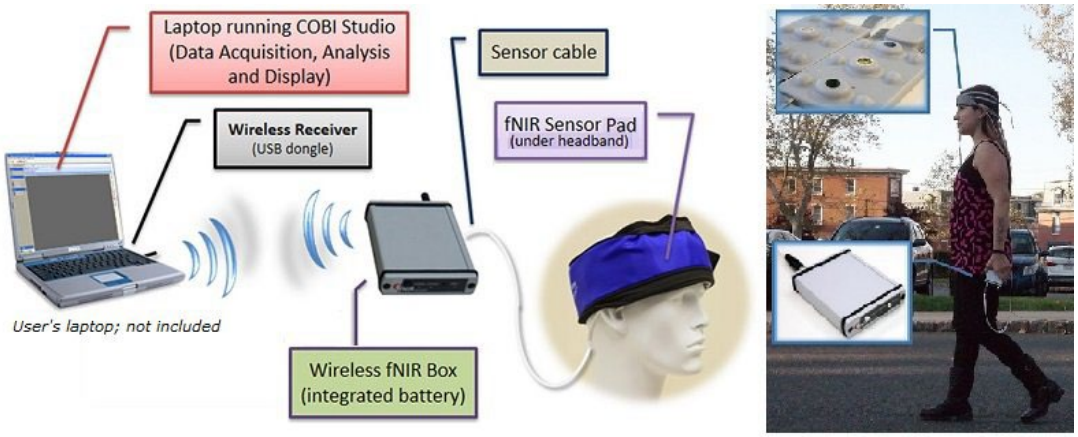
Easy to Use—Short Prep and Learning Curve, fNIRS Experiments included with Education System!

fS Education is a stand-alone software package designed to run *f*NIRS Experiments for with the 2000E Imager for Education Systems. Use fS viewer and data management tools to process, analyze, and visualize functional near infrared (*f*NIR) spectroscopy signals. View data in real time and perform post-acquisition analysis.

COBI Studio "Cognitive Optical Brain Imaging" software is designed for performing serial experiments and makes it easy to start recording, and to save all experimental data (*f*NIRS, synchronization markers from external presentation stimuli, etc.) in a standardized way.

- **Imager** 2000E control unit (6-optodes max)
- **Sensor** and **Cable**
  - *f*NIR2000E includes one 6-channel sensor and one 1.63 m (64-inch) sensor cable (RXfNIR-CBL-2000L)
- **fNIR Soft Educational Software** for real-time data viewing and post-acquisition analysis
  - Lesson Experiments included: Cognitive Activity Monitoring; Systemic Signal Extraction; *f*NIRS Noise Analysis; Blood Flow Occlusion Test

For more details about the included Lesson Experiments, see the fNIRE Education System Web Page.



fNIRS Sensor Transducers

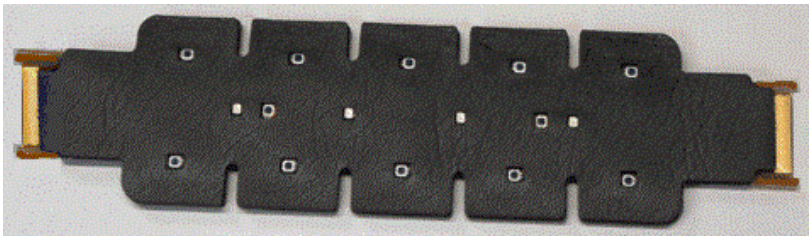
- Silicon photodiode with integrated trans-impedance preamp
- 730 nm/850 nm dual wave-length LED
- Comfortable to wear for prolonged periods
- Silicone rubber over-molded
- Compatible with wired (fNIR 2000) Imager

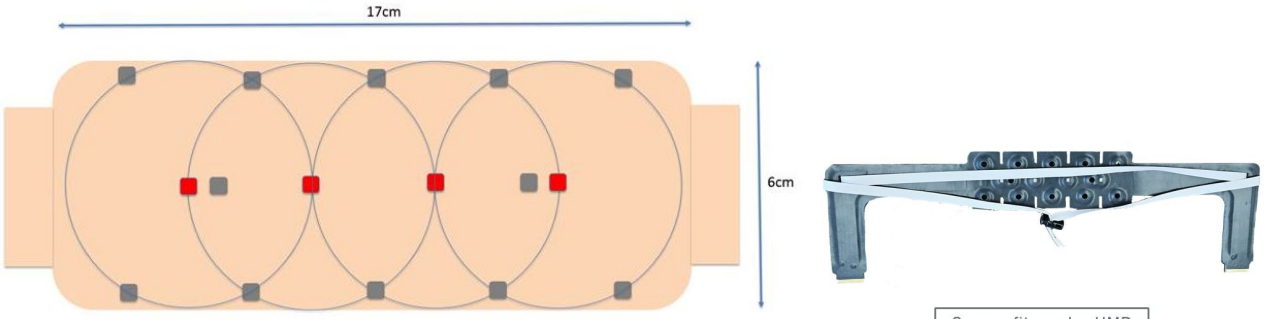
RXfNIR-3000-18S (Shielded)

Adult 18 optode, 4 emitter, 10 detector, full-head forehead sensor pad. 25 mm inter-optode distance.

- Requires 2 sensor cables
- Shielded: grounded layers of copper protect the signal lines from being corrupted by environmental Electro Magnetic waves
- Compatible with Imager 2000S/M or 1200; ships with systems
- To record 54 channels, use three (3) 18-optode sensors with required cables

info@biopac.com
support@biopac.com
www.biopac.com





RXfNIR2000-18S optode sensor layout

RXfNIR-3000-18U (Under-helmet, shielded)

Adult under-helmet shielded 18 optode, 4 emitter, 10 detector, full-head forehead sensor pad for use with head-mounted displays (HMD) and similar devices. 25 mm inter-optode distance.

- Thinner design to wear comfortably under HMDs
- Shielded: grounded layers of copper prevent signal noise from electromagnetic interference (EMI)
- To record 54 channels, use three (3) 18-optode sensors with required cables
- Requires two (2) cables

RXfNIR-3000-18

Adult 18 optode, 4 emitter, 10 detector, full-head forehead sensor pad. 25 mm inter-optode distance.

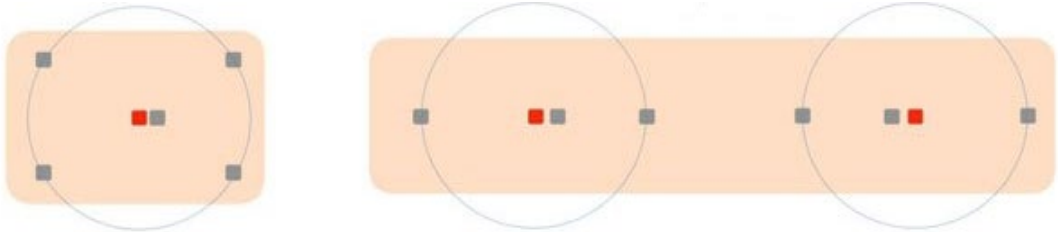
- Requires 1 sensor cables
- Compatible with Imager 3000C/E; ships with systems

Six Optodes—RXfNIR-3000-6 and RXfNIR-2000-6

Adult 6 optode, 6 emitter, 2 detector forehead sensor pad. 25 mm inter-optode distance.

Five Optodes—RXfNIR-3000-5 and RXfNIR-2000-5

Adult 5 optode, 5 detector, 1 emitter full-head forehead sensor pad. 25 mm inter-optode distance.



Five-optode and six-optode sensor layout

All Sensors requires RXfNIR-CBL3000 or RXfNIR-CBL-2000L/R interface cable.

RXfNIR-CBL-3000

This single cable (no left or right) can accommodate up to two sources and six detectors at up to 20 fps. RXfNIR-CBL-3000 sensor cables are compatible with 3000 and 2000 series devices.

RXfNIR-CBL-2000L or RXfNIR-CBL-2000R Sensor Transmission Cable

This 1.63 m (64-inch) sensor cable set connects NIRS prefrontal cortex sensor pads to an *f*NIR Imager 2000 unit to provide real-time oxy-Hb, deoxy-Hb, and raw data values for each channel measurement area. Newer *f*NIR Systems include one Left-Right cable set and additional cables can be added for increased channels. *f*NIR 103C systems ship with one RXfNIR-CBL-2000L only.

When ordering, specify Left (RXfNIR-CBL-2000L) or Right (RXfNIR-CBL-2000R).

Accessories

FNIR-HEADBAND

This self-adhering strap covers the fNIRS Sensor to block ambient light when recording with an fNIR Devices Imager System.

fNIR Software

NOTE: fNIRSOFT Standard and fNIRSOFT PRO software includes a maintenance agreement covering all upgrades and bug fixes for a period of one year. Beyond this period, extended maintenance can be optionally purchased to cover upgrades and bug fixes for an additional one year, two years, or five years.

fNIRSOFT-STD – fNIR Software Standard Edition

fNIRSOFT (fS) is a stand-alone software package designed to process, analyze and visualize functional near infrared (*f*NIR) spectroscopy signals through a graphical user interface and/or scripting (for automation).

*f*NIR Software **Standard Edition** offers the following functionality:

- Temporal visualization of *f*NIRS Data
- Customizable display graphs by data type (voxel/channel/wavelength), sensor geometry, time period and multiple color palettes
- FilterDesigner tool: High pass filter design and application
- User interface for time series data analysis
- Lithograph and Oxygraph OptodeView: Ability to navigate with keyboard buttons
- Inspect and manage optodes/channels/time periods visually
- Automated and user-selectable co-registration of all event marker information
- Event related and epoch analysis with customizable block definitions through easy to use GUI
- Customizable hemodynamic response calculation applying Modified Beer Lambert Law (MBLL) for oxy-Hb, deoxy-Hb, oxy and total Hb
- Spatial visualization of fNIRS Data
- Basic Noise reduction, pre-processing (Finite Impulse Response Filter Design and application) through GUI
- Through a wizard style tool, select and export time-series data in various formats
- Save/Send data in native binary format
- Through a wizard style tool, esaily customizible template, import various types of text data
- Load/share data in native binary format
- fS Scripting Language (functional and data-oriented)
- Editor with syntax highlighting and quick access tools for command list and run toolbar
- History of commands and log operations in command pane (can save for future reference)
- Store procedures in script files (re-apply procedures to previously saved data blocks)

fNIRSOFT-STD-4

fNIRSOFT-STD-4 is a site license that adds four additional users to fNIRSOFT Standard Edition.

fNIRSOFT-STD-9

fNIRSOFT-STD-9 is a site license that adds nine additional users to fNIRSOFT Standard Edition.

fNIRSOFT-PRO – fNIR Software Professional Edition

fNIRSOFT (fS) Professional Edition analysis software includes all of the Standard Edition analysis tools plus extended functionality. Included in fNIR103S, 203S, 303S, 103M, 203M, 303M, and 304C or add fNIRSOFT-PRO-U to upgrade Standard:

- Automated signal quality inspection for elimination of saturated and problematic channels through GUI
- Advanced signal processing algorithms for feature extraction
- Motion artifact removal algorithms
- Left/right/dorsal view with thresholding, animation (temporal changes) or group/subject/condition average
- Export visualization (time-based for animation, or threshold based for evaluation)
- Spatial visualization of *f*NIRS Data
- Apply Temporal and Spatial Processing actions (Averaging/Feature Extraction/Signal Conditioning) through GUI
- Apply Cell-by-cell Processing actions (Averaging/Signal Conditioning) through GUI
- Apply common statistical comparison and correlation through GUI
- Apply advanced Modified Beer Lambert Law (MBLL) oxygenation calculation through GUI

Click for more feature information about fNIRSOFT PRO 4.10.

fNIRSOFT-PRO-4

fNIRSOFT-PRO-4 is a site license that adds four additional users to fNIRSOFT PRO Edition.

fNIRSOFT-PRO-9

fNIRSOFT-PRO-9 is a site license that adds nine additional users to fNIRSOFT PRO Edition.

fNIR optical imaging technology measures hemodynamic response and neural activity in the prefrontal cortex

fNIR System	Type	Max CH†	Included Sensor	Software (*pre-loaded)	Computer/Stand	TTL	Isolation
fNIR154C	Wireless and Tethered Imager 3000C	18	1 x RXFNIR-3000-18 + 2 x RXFNIR-CBL-3000	fNIRSoft Standard and COBI	n/a	1 TTL	n/a
fNIR104C	Wireless and Tethered Imager 3000C	18	1 x RXFNIR-2000-6 + 1 x RXFNIR-CBL-3000	fNIRSoft Standard and COBI	n/a	1 TTL	n/a
fNIR204C	Wireless and Tethered Imager 3000C	18	3 x RXFNIR-3000-18 + 1 x RXFNIR-CBL-3000	fNIRSoft Standard and COBI	n/a	1 TTL	n/a
fNIR304C	Wireless and Tethered Imager 3000C	18	3 x RXFNIR-3000-18 + 1 x RXFNIR-CBL-3000	fNIRSoft Pro and COBI	Tablet Style Computer + Caddy	1 TTL	n/a
fNIR103S	Tethered Imager 2000S	54†	3 x RXFNIR-2000-18S + 1 x RXFNIR-CBL-2000L + 1 x RXFNIR-CBL-2000R	fNIRSoft Pro and COBI	--	3 TTL, 1 Serial, 1 Parallel	n/a
fNIR203S	Tethered Imager 2000S	54†	3 x RX-2000-18S + 1 x RXFNIR-CBL-2000L + 1 x RXFNIR-CBL-2000R	fNIRSoft Pro and COBI	Laptop + Caddy	3 TTL, 1 Serial, 1 Parallel	n/a
fNIR303S	Tethered Imager 2000S	54†	3 x RX-2000-18S + 1 x RXFNIR-CBL-2000L + 1 x RXFNIR CBL-2000R 2 X RX-2000-5 + 2 X RX-2000-6	fNIRSoft Pro and COBI	Laptop + All-in-one Computer + Pole Cart with Shelf	3 TTL, 1 Serial, 1 Parallel	n/a
fNIR103M	Wireless Imager 2000M	18	3 x RX-2000-18S + 1 x RXFNIR-CBL-2000L + 1 x RXFNIR CBL-2000R + US/EU Power Adapter	fNIRSoft Pro and COBI	--	1 TTL	n/a
fNIR203M	Wireless Imager 2000M	18	3 x RX-2000-18S + 1 x RXFNIR-CBL-2000L + 1 x RXFNIR CBL-2000R + US/EU Power Adapter	fNIRSoft Pro and COBI	Notebook/Tablet Style Computer	1 TTL	n/a
fNIR303M	Wireless Imager 2000M	18	3 x RX-2000-18S + 1 x RXFNIR-CBL-2000L + 1 x RXFNIR CBL-2000R 2 X RX-2000-5 + 2 X RX-2000-6 + US/EU Power Adapter	fNIRSoft Pro and COBI	Notebook/Tablet Style Computer	1 TTL	n/a
fNIR103E	Tethered Imager 2000E	6	1 x RXFNIR-2000-6 + 1 x RXFNIR-CBL-2000L	fNIRSoft Education and COBI	--		n/a

Cleaning fNIRS Imagers and Sensors

All generations and models: Use an alcohol-based antiseptic to gently wipe the surface of the fNIRS Imager unit or sensor; never use peroxide-based antiseptics.

Forehead Sensor *(prefrontal cortex)*:	†Real-time oxy-Hb, deoxy-Hb, and raw data values for each channel measurement area					
	Fit	Channels	Detectors	Emitters	Inter-optode distance	Compatible
RXFNIR-3000-18	Adult	18	10	4	25 mm	tethered and wireless
RXFNIR-2000-18S	Adult	18	10	4	25 mm	tethered and wireless
RXFNIR-2000-18U	Adult	18	10	4	25 mm	tethered and wireless
RXFNIR-3000-6/ RXFNIR-2000-6	Adult	6	6	2	25 mm	tethered and wireless
RXFNIR3000-5/ RXFNIR2000-5	Adult	5	5	1	25 mm	tethered and wireless
Photo-detectors:	Silicon photodiode with integrated trans-impedance preamp					
Photo-emitters:	730 nm/850 nm dual wave-length LED					
Material:	Silicone rubber over-molded					
Time resolution of measurements:	Imager S = 100 ms, Imager C = 200 ms					
Trigger in/out (wired Imager only):	TTL level positive-going pulse at start of the device, baseline, and data collection.					
PC connection:	USB 2.0 cable				fNIR103P: wireless (IEEE 802.15.4 radio link)	
Ext. Extension Cable(s):	2 x RJ45 1.5 m				fNIR103P: 1 x 1.5 m 14-conductor	
Operating environment:	0 to 50º C, 10% to 90% R.H. non-condensing					
Imager Dimensions :	S Imagers: 234 mm (W) x 89 mm (H) x 286 mm (D) C and E Imagers: 106 mm (W) x 32 mm (H) x 160 mm (D) M Imagers: 96 mm (W) x 85 mm (H) x 32 mm (D)					
Max Sampling Rates:	S Imagers: 10 hz C and E Imagers: 20 hz M Imagers: 5 hz					
Battery (Imager M only) :	Record for ≈1 hour after a full charge; allow ≈3 hours to fully charge from empty					
Power requirements:	90-264 VAC, 50/60 Hz, 250 mA				fNIR103P: 90-264 VAC, 50/60 Hz, 10 W	
Manuals (digital):	*fNIRSoft User Manual - step-by-step guide for using fS Standard and Pro* *fNIRSoft Scripting Manual - automation programming and command line options*					
Warranties:	Imager: 12-month				Sensor: 3-month limited	
fNIR Computer Requirements	CPU (processor): I5 or better, quad-core recommended Memory (system RAM): 1 GB minimum, 2 GB or more recommended Operating Systems: fNIRSoft — Windows 10/8/x7/Vista COBI Modern — Windows 10 only* *Note: Users will require both fNIRSoft and Cobi Modern to complete all lessons. Neither is compatible with Mac OS. fNIR Imager interface: USB 2.0 ports Network interface: Wireless or LAN Network adapter					
†To record 54 channels, use three (3) 18 optode sensors.						

➲ Click to view the *f*NIRS Wired System Diagram Click to view the *f*NIRS Wireless System Diagram