



# **NIRSport APD/LED Module**

## ***User Guide***

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## Table of Contents

1	General Information.....	4
1.1	Intended Use .....	5
1.2	Correct Use .....	5
1.3	Electric Safety .....	6
1.4	Intended Readership .....	6
1.5	Related Documents .....	6
1.6	Problem Reporting Instructions.....	7
2	Handling and Maintenance .....	7
2.1	Transport and Storage .....	7
2.2	Safe Performance .....	7
2.3	Cleaning, Sterilization, and Disinfection .....	7
2.4	Routine Maintenance .....	8
2.5	Waste Products and Disposal .....	8
2.6	Operating Environment .....	8
2.7	Use of Device .....	8
3	The NIRSport APD/LED Coupler Module.....	9
3.1	Mainframe .....	9
3.2	NIRSport Cradle .....	9
3.3	Source Coupler .....	10
3.4	Detector Coupler .....	11
4	Operation .....	11
	NIRSport APD/LED Coupler Module Technical Specifications.....	13



## 1 General Information

	Attention, consult accompanying documents.
	Type BF equipment.
	Warning, high voltage.
	Protective earth (ground).
	Do not dispose off in household garbage. Contact Manufacturer for proper disposal information.
	Mains disconnect OFF.
	Mains disconnect ON.

## 1.1 Intended Use

The NIRSport NIRS measurement system and its accessories and extensions (in the following also referred to as, 'the device') are not medical devices and may be used in the context of non-medical applications in order to carry out fundamental research on the basis of neurophysiological methodology and data.

The devices are intended to be used for the Quantification of relative concentration changes of oxy- and deoxy-hemoglobin in tissue blood based on superficial diffuse near-infrared spectroscopic measurements.



Use of the device for diagnosis, therapy, monitoring of vital life functions (such as cardiovascular functions etc.) or other medical purposes is expressly forbidden.

The user is solely liable for any risks to test subjects (patients) associated with the investigation if the device is not used in accordance with the correct use described.

## 1.2 Correct Use

### Application environment

- The device is permitted to be used in hospitals, clinics, other medical environments, research institutes and other environments, provided that all the other stipulations regarding correct use (e.g. with respect to the user) are met and that the device is used in accordance with its intended use.
- The device is not permitted to be used in the vicinity of explosive gases as may be the case in operating theaters, for example.

### Target group

The device is permitted to be used on healthy and sick adults, children and animals.

### Users

- The device is permitted to be used by physicians and medical experts.
- The device is not permitted to be used by unqualified persons.
- The device is not to be used by people who personally cannot read or understand the User Manual (e.g. due to insufficient language knowledge, due to blindness).

### 1.3 Electric Safety

Properly ground the instrument.



This instrument is grounded through the power cord. It is a Class 1 device. Use only the power cord specified for your instrument (see section “Specifications”). Use only a power cord that is in good condition.



**WARNING:** To avoid the risk of electric shock, this equipment must only be connected to a supply mains with protective earth.

Do not operate without covers and panels installed



To avoid personal injury and equipment damage, the user needs to turn off the mains disconnect before removing covers, panels, or grounding connections. Reinstall covers, panels, or grounding connections before turning the mains disconnect back on.



**WARNING!** Modification of the equipment is not permitted.

### 1.4 Intended Readership

This document is required reading for operators of the NIRx NIRSport APD/LED Coupler Module in order to avoid instrument misuse potentially leading to hardware malfunctions or data corruption.

We furthermore recommend this document to any user concerned with the experimental planning or data analysis of measurements obtained with the NIRx NIRSport APD/LED Coupler Module.



Important notes and warnings are indicated with this symbol throughout the document.

### 1.5 Related Documents

The following user manuals and documents may contain additional information pertinent to the topic matter of this user manual:

- NIRx NIRSport User Manual

- NIRx API Design Document for the real-time data streaming Software Development Kit (SDK)
- NIRx NIRStar Software User Manual
- NIRx DOTS (Dynamic Optical tissue Simulator) User Manual
- NIRx nirsLAB User Manual
- Headgear and optode placement Manuals

## 1.6 Problem Reporting Instructions

You may use the following ways of contacting NIRx for additional support and bug reports:

E-mail: [support@nirx.net](mailto:support@nirx.net)

Web: [www.nirx.net/contact](http://www.nirx.net/contact)

## 2 Handling and Maintenance

### 2.1 Transport and Storage

NIRSport devices are mobile instruments and may be moved by the user between different investigation sites (i.e., labs, exam rooms, etc.) within the institution of the original installation. When storing the instrument, it should be covered to protect it from dust. NIRx recommends its dedicated hardcase containers for prolonged storage and transport.



The equipment must not be exposed to fluids or condensation humidity conditions.



During storage or transport, the equipment should be kept at a temperature between  $-15^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$  and at a relative humidity of 20% to 80% (non-condensing). Ambient pressure should be within 700 hPa and 1060 hPa.

### 2.2 Safe Performance

The equipment should only be handled and operated by trained personnel. Operators must familiarize themselves with the latest revision of the user's manual before using the device.

The NIRSport instruments are intended for continuous operation.

### 2.3 Cleaning, Sterilization, and Disinfection

The outside of the instrument may be cleaned with a damp cloth. A mild soap or a window cleaner may be used to aid cleaning; do not use solvents. Allow the instrument to thoroughly dry before use.

The fiber optic probe ends that come in contact with the skin can be cleaned and disinfected by wiping them after use with isopropyl alcohol 70%.



DO NOT USE ETHANOL OR METHANOL OR ACETONE FOR CLEANING OF THE FIBER-OPTIC SURFACES. THE FIBERS MUST NOT BE STERILIZED IN AN AUTOCLAVE.

## 2.4 Routine Maintenance

The fiber optic probes are delicate optical devices. Any strain, kinking, pinching, and tight bending (bending radius < 2 cm) should be avoided since this can damage the fibers. Before each measurement, the fibers should be visually inspected for signs of physical damage. In the case of suspected fiber damage, please contact the manufacturer.

No regular service, calibration, or inspection of the instrument by the user, vendor, manufacturer, is required for proper operation of the instrument. In order to maintain adequate signal quality, the user is advised to regularly perform the system check procedures such as a Dark Noise Check (see, NIRStar Software User Manual) and a static phantom stability measurement.

## 2.5 Waste Products and Disposal

There are no waste products from the equipment

Please contact the manufacturer for help with the disposal of the instrument or its components at the end of its useful life.

## 2.6 Operating Environment



NIRSport Instruments are for indoor use and may be used outdoors if precautions are taken against undue temperature and humidity exposure.

NIRSport instruments are not safe for the use in presence of inflammable anesthetics. NIRSport instruments are not to be used in an operating room.



The equipment should be operated at a temperature of -10°C to +40°C and at a relative humidity of 20% to 80% (non-condensing). Ambient pressure should be within 700 hPa and 1060 hPa.

## 2.7 Use of Device

The NIRx NIRSport Near Infrared Spectroscopy (NIRS) imaging system is intended for non-invasive transcranial Near-Infrared Spectroscopy (NIRS) of blood perfusion dynamics in the human head. NIRScout is a research instrument. The instrument and all accessories are to be used for research purposes only.





NIRx products are NOT “medical devices” intended to be used for the purpose of diagnosis of disease or other conditions, or in the cure, mitigation, treatment, or prevention of disease, or used as a life support device. Use of NIRx products are solely for research purposes.

### 3 The NIRSport APD/LED Coupler Module

The NIRSport APD/LED coupler module provides an integrated solution to adding optical fiber-based illumination and detection to NIRSport devices. The module consists of a mainframe (enclosure) with integrated power supply, a cradle for the NIRSport, illumination unit, and detection unit (Figure 1).



Figure 1: NIRSport APD/LED coupler module and main components: (1) Main frame; (2) NIRSport cradle; (3) illumination unit; (4) detection unit; (5) NIRSport.

#### 3.1 Mainframe

The Mainframe provides a sturdy, compact, and protected environment for integrating the NIRSport into fiber-based NIRS setups. It contains a power supply to provide electrical power to the NIRSport and the detection electronics.

#### 3.2 NIRSport Cradle

The cradle serves to hold the NIRSport firmly in the module, and to connect it to the internal power supply. Insertion of the NIRSport into the cradle and its installation inside the enclosure is shown in Figure 2.



**Figure 2: Installation of the NIRSport with the cradle in the coupler module (For details, see text).**

The installation procedure is as follows:

1. From the top, carefully slide the NIRSport into the cradle. Please note the orientation: The 'Detector' connector must be on the top, and the 'Source' connector on the bottom (Figure 2, 1,2).
2. Carefully slide the cradle with the NIRSport into the plastic rails of the enclosure. The cradle may meet a resistance from a power connector inside the enclosure, which mates with the power input in the NIRSport rear panel. If resistance is met, carefully execute slight sideways and up/down motions of the cradle while exerting moderate pressure to facilitate mating of the power connector.
3. Once fully seated (front panel of cradle is flush with the detector and source units), tighten the four jack screws in the corners of the cradle front panel.
4. Connect the detector and source ports of the NIRSport with the neighboring connector on the detector and source units using the short ribbon cables.

To remove the NIRSport from the module, follow these steps in reverse order.

While installed in the mainframe, and while the mainframe power is turned on the NIRSport will receive its electrical power through the APD/LED coupler module, and its internal battery will be automatically charged.

### 3.3 Source Coupler

The source coupler unit contains LED light sources to convert the electrical energy provided by NIRSport into NIR light at two wavelengths (760 nm/860 nm standard), which is launched into fiber optic cables. For each source channel, separate fiber connectors are provided for each wavelength to maximize the coupling efficiency. Bifurcated fiber optics combine the two wavelengths into a single fiber-optic illumination point for each source channel (Figure 3, left).

To connect the fiber optics, carefully insert the ferrule into the threaded connector and finger-tighten the knurled locking nut. For each source channel connect the two fiber-optic branches with the same channel number label. It is recommended to start at the bottom (channel no. 8) and proceed toward the top in descending channel number order as this provides the best physical access to the locking nuts.



**Figure 3: Fiber optic connections on the source coupler unit (left) and detector unit (right).**

### 3.4 Detector Coupler

The detector coupling unit contains eight fiber-coupled photoelectric sensors. High-sensitivity avalanche photo diode (APD) type sensors are used to compensate for optical losses that may occur especially in long (> 5m) fiber optic transmission lines. Connecting the detection fibers to the detector ports is performed in the same way as described above for the sources (Figure 3, right).

## 4 Operation

To operate the NIRSport with the APD/LED coupler module make sure the system is prepared according to the description in Section 3 and connected to a wall outlet, then proceed as follows:

1. Provide a USB connection between the host PC and the NIRSport front panel USB connector. The USB status light will blink. Connect a trigger cable to the NIRSport front panel trigger connector if desired.
2. Turn on the APD/LED module (switch is located in the back of the unit).
3. Proceed with the cap setup and other experimental preparation as usual.
4. Use the NIRStar software to operate the NIRSport as usual.
5. After use, turn off the mainframe.



Remember to switch on the APD/LED coupler before using the device and to turn it off after use.



## NIRSport APD/LED Coupler Module Technical Specifications

### Optical Illumination

No. of illumination Sources .....	16 light emitting diodes (LED)
No. of illumination channels.....	8 at 2 wavelengths
Wavelengths .....	760 nm, 850 nm standard, others on request
Power .....	10 mW / Wavelength max.
Connectors.....	SMA 905 fiber optic connector
Multiplexing Rate .....	62.5 Hz ÷ (No. of Sources)

### Optical Detection

No. of Channels .....	8
Sensitivity .....	better 0.1pW NEP
Dynamic Range .....	50dB <sub>opt</sub>
Sensor Type .....	Avalanche Si Photodiode

### Physical

Size (W × L × H) .....	257 mm × 326 mm × 165 mm
Weight .....	3 Kg

### Electrical

Supply Voltage .....	90-260 VAC (50-60Hz)
Power consumption.....	60 W max
Phases .....	1

### Environmental

Temperature range .....	10°C to 40°C (operating) -15°C to +70°C (storage and transport)
Humidity.....	20 to 80% relative humidity non-condensing
Ambient pressure.....	700 hPa to 1060 hPa