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Electronic Instruments
for the Life Sciences

made to measure

OPERATING INSTRUCTIONS AND SYSTEM DESCRIPTION FOR THE

FiberOptoMeter III

Fiber Photometry System
with 470 nm light source

Version 1.1
npi 2020

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1. Safety Regulations

<u>VERY IMPORTANT</u>: Instruments and components supplied by npi electronic are NOT intended for clinical use or medical purposes (e.g. for diagnosis or treatment of humans), or for any other life-supporting system. npi electronic expressively disclaims any warranties for such purpose. Equipment supplied by npi electronic shall be operated only by selected, trained and adequately instructed personnel. For details please consult the GENERAL TERMS OF DELIVERY AND CONDITIONS OF BUSINESS of npi electronic, D-71732 Tamm, Germany.

1) GENERAL: This system is designed for use in scientific laboratories and should be operated by trained staff only. General safety regulations for operating electrical devices are to be considered.

2) AC MAINS CONNECTION: While working with the npi systems, always adhere to the appropriate safety measures for handling electronic devices. Before using any device please read manuals and instructions carefully.
   The device is to be operated only at 115/230 Volt 60/50 Hz AC. Please check for appropriate line voltage before connecting any system to mains.
   Always use a three-wire line cord and a mains power-plug with a protection contact connected to ground (protective earth).
   Before opening the cabinet disconnect mains power-plug.
   Disconnect mains power-plug when replacing the fuse or changing line voltage. Replace fuse only with an appropriate specified type.

3) STATIC ELECTRICITY: Electronic equipment is sensitive to static discharges. Some devices such as sensor inputs are equipped with very sensitive FET amplifiers, which can be damaged by electrostatic charge and must therefore be handled with care. This can be avoided by touching a grounded metal surface when changing or adjusting sensors. **Always turn power off when adding or removing modules, connecting or disconnecting sensors, headstages or other components from the instrument or 19” cabinet.**

4) TEMPERATURE DRIFT / WARM-UP TIME: All analog electronic systems are sensitive to temperature changes. Therefore, all electronic instruments containing analog circuits should be used only in a warmed-up condition (i.e. after internal temperature has reached steady-state values). In most cases a warm-up period of 20-30 minutes is sufficient.

5) HANDLING: Please protect the device from moisture, heat, radiation and aggressive chemicals.

6) **SPECIAL WARNING:** THIS INSTRUMENT HAS A HIGH POWER OPTICAL OUTPUT.

2. Special Safety Notice for Instruments with high optical irradiation

HIGH OPTICAL IRRADIATION!
RISK TO EYES AND SKIN!

Observe extreme caution when working with this instrument!

1) Always attach the provided plug to the fiber output, if the fiber is not connected.

2) Collimated light emitted from the unit does pose a potential risk to eyes and skin if viewed directly or skin is left exposed to the light.

3) Protect your eyes and skin from fiber output and collimator output.

4) Do not wear any reflective items like watches or rings when working with the instrument.

5) Servicing should be only done by qualified personnel aware of the hazards!

6) If in doubt, return to supplier for servicing!

3. System Description

3.1. General description

The FiberOptoMeter III (FOM III) is built into a desktop housing. It is equipped with an internal power supply.

This FiberOptoMeter III can be used for fiber coupled optical stimulation and fluorescent recordings through the same fiber. The fiber is connected with an SMA connector.

This device is intended to excite the specimen with blue light and record the emission in green. The light path is made up of the excitation light source, the beam splitter that directs the blue light from the excitation LED towards the optical fiber and transmits the emission from the fiber towards the detector. To narrow the excitation and emission, the light source and the detector are equipped with optical filters. A schema of the light path can be found in Chapter 6.

The blue excitation LED light source (470 nm) can be controlled either manually or by the inputs on the front panel, the output of the detector signal is also available as an analogue voltage output at the front panel.

The detector detects the incoming light filtered with abBandpass with wavelength range of 500-548nm, the blue excitation light source is filtered with 450-475nm and intended to excite fluorescence in the detector filter wavelength range.

The filters are exchangeable to customize the light path

3.2. Modes of operation

The FiberOptoMeter III illumination channel can be controlled in three different modes: CONT, TTL and ANALOG. Indicator LEDs next to the control element will light up, to show, which of the inputs and control is active:

- CONT: the LED of the respective channels is continuously on, the output power is set with the ANALOG 10-turn potentiometers
- TTL: the LED is controlled by the TTL inputs: a TTL HIGH signal switches the LED on. The output power is set with the ANALOG 10-turn potentiometers.
- ANALOG: the LED is controlled by an analog input voltage at the ANALOG IN BNC connector. Input range is 0 … 1 V.
- OFF: The LED is off, independent of any analog or TTL input signal or potentiometer setting.

The output of the internal photodetectors is provided at the OUTPUT BNC connector. Range is -5 … 5 V.

3.3. Front panel elements:

Figure 1: FOM III front panel view.

POWER ON LED

LED indicating that the FiberOptoMeter III is switched on.

CHANNEL LED

LED indicating that the channel is active i.e. the mode switch is either in CONT, TTL or ANALOG position. The LED will not light up in OFF.

DETECTOR LED

LED indicating that the detector is active and ready to record. Start-up can take up to 1 min. after power on

Note: the color of the LED does not exactly correspond to the actual color of the stimulation LED inside the FOM III housing.

10-turn potentiometer

Potentiometer for control of the LED output power. The red LED next to it indicates that the amplitude is controlled by the potentiometer (only in CONT and TTL mode, see chapter 3.2).

MODE rotary switch

Switch for selecting the mode of operation (see chapter 3.2).

ANALOG IN BNC connector

An analog input signal (0 … 1 V) can be used to control the LED output power. The red LED next to it indicates that this input is active (only in ANALOG mode).

TTL IN BNC connector

A TTL signal (0 … 5 V) can be used to control the LED on and off switching. The red LED next to it indicates that this input is active (only in TTL mode). The output power is controlled by the 10-turn potentiometer (see above).

OUTPUT BNC connector

The output signal from the detector is provided at this BNC connector as an analogue voltage (max 10V). The DETECTOR LED has to be active, this indicates that the detector is ready.

FIBER OUT SMA connector

The optical fiber is connected to this SMA port.

HIGH OPTICAL IRRADIATION!
RISK TO EYES AND SKIN!

3.4. Rear panel elements:

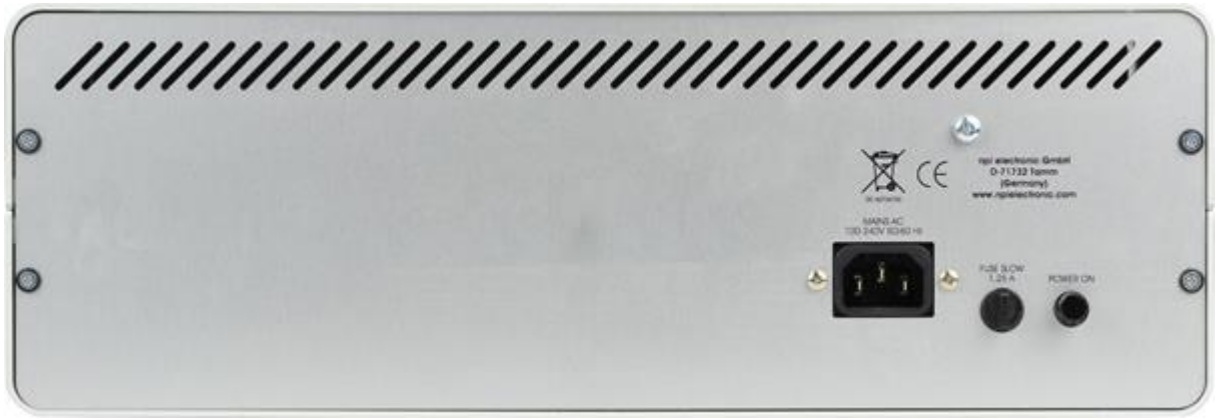


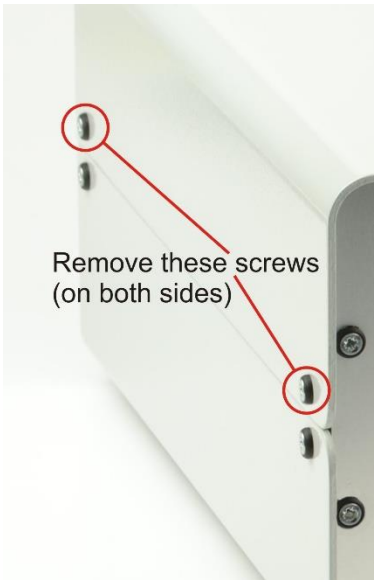
Figure 2: FOM III rear panel view.

On the rear panel of the FiberOptoMeter III housing there is the mains connection, a fuse box, and the power switch (see Figure 2).

4. Exchangeable Filters

Figure 3: Filter cube insert for FOM-02D.

This FiberOptoMeter-III is equipped with special filter cubes for easy exchange of filters and dichroic mirrors (see Figure 3). The filter cubes consist of an outer frame and a removable inner cube, which is held by magnets. These cubes are self-centering and can be removed and inserted by hand - no tools are required.



To access the cubes, disconnect the FiberOptoMeter-III from the mains power line, remove the four lid screws (see Figure 4 on the left) using a suitable screwdriver and remove the lid. Afterwards, reinstall the lid and fix it with the four screws.

Figure 4: Lid screws to be removed to open the FiberOptoMeter-III housing.

To exchange the filters and dichroics in the inner cubes, please follow the instructions provided by this video: https://www.youtube.com/watch?v=qWIfiwuL-gQ
You can find further information on these cubes via the Thorlabs website: search for DFM1/M, there is also the above mentioned video embedded.

Note: A tool kit is provided for exchange of the filters and dichroics. It consists of a hex key, a screw driver, a filter ring fastening tool and cotton gloves. It is highly recommended to wear these gloves while handling the filters to avoid scratches and contamination (e.g. finger prints).

Note: To prevent damaged filters during transportation, the FOM III is shipped with the filter cubes secured with tape. Remove the tape to exchange the cubes

5. References

Zhang Q, Yao J, Guang Y et al.: Locomotion-Related Population Cortical Ca2+ Transients in Freely Behaving Mice. **Front Neural Circuits**. 2017 Apr 7; 24(11). doi: 10.3389/fncir.2017.00024

Justus D, Dalügge D, Bothe S. et al.: Glutamatergic synaptic integration of locomotion speed via septoentorhinal projections. **Nat Neurosci.** 2016 Nov 28; 20(1):16-19. doi: 10.1038/nn.4447.

Fuhrmann F, Justus D, Sosulina L, Kaneko H, Beutel T, Friedrichs D, Schoch S, Schwarz MK, Fuhrmann M, Remy S.: Locomotion, Theta Oscillations, and the Speed-Correlated Firing of Hippocampal Neurons Are Controlled by a Medial Septal Glutamatergic Circuit. **Neuron**. 2015 Jun 3; 86(5):1253-64. doi: 10.1016/j.neuron.2015.05.001

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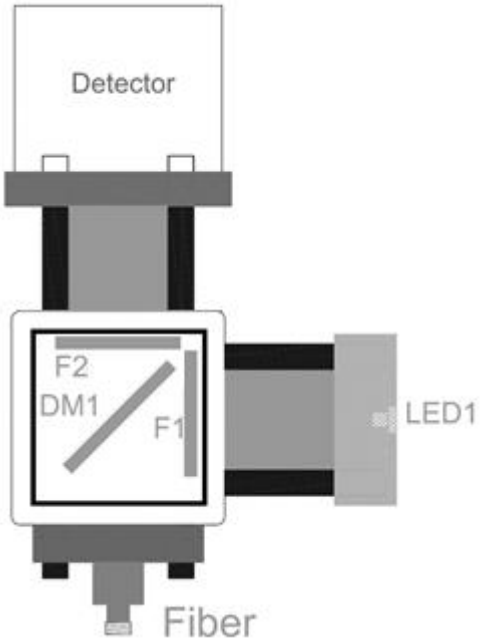
Adelsberger H, Grienberger C, Stroh A, Konnerth A.: In vivo calcium recordings and channelrhodopsin-2 activation through an optical fiber. **Cold Spring Harb Protoc.** 2014 Oct 1; 2014(10):pdb.prot084145. doi: 10.1101/pdb.prot084145.

6. Technical Data



For filter spectra, please refer to the corresponding article reference on www.ahf.de

F1:	470/40 Bandpass AHF article F49-470
F2:	525/50 Bandpass AHF article F47-525
DM1:	495 Beamsplitter T LPXR AHF article F48-495
LED1:	470 nm (please see datasheet attached to this manual)

Figure 5: Schematic drawing of optical components with description of filter and dichroic wavelengths. To improve the GCaMP measurement, the Filter F3 can be replaced by filter F4.

Signal Outputs:

OUTPUT A:	Filter F2
OUTPUT B:	not installed

Dimensions: (W x D x H) 365 mm x 260 mm x 130 mm