

# Optrode



Manual

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# **Optrode**

## **Manual**

Technische Dokumentation  
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# 1 Introduction

## 1.1 Description

The Optrode is used as a photometric sensor for various titration methods that require the use of indicators. Its enclosed glass shaft enables it to be safely used in nonaqueous or corrosive media. It does not require any time-consuming care or conditioning.

Equipped with eight LED light sources with different wavelength ranges (see Table 1, page 10), it can be used with a large variety of indicators. The sensor does not have a mechanical switch.

The LED light source can be selected either via the control software **tiamo** (version 2.5 and higher) or without the need for contact using the provided stirring bar.

A USB connection ensures the power supply to the Optrode's light sources and electronic components. Metrohm titrators are equipped with USB ports for this purpose. In addition, a USB power adapter is available to power the Optrode independently.

The Optrode provides an analog measuring signal and can be connected reliably to any Metrohm titrator at the **Ind.** connector. This allows the Optrode to be used for titration like other sensors.

## 1.2 Intended use

The Optrode is designed for use with a titrator in analytical laboratories. It is intended solely as an optical sensor for photometric titrations.

This sensor can be used in chemicals and flammable solvents. Usage of the Optrode therefore requires the user to have basic knowledge and experience in handling toxic and caustic substances. Knowledge with respect to the application of the fire prevention measures prescribed for laboratories or production plants is also mandatory.



## 1.3 Symbols and conventions

The following symbols and formatting may appear in this documentation:

(5-12)	<b>Cross-reference to figure legend</b>
	The first number refers to the figure number, the second to the instrument part in the figure.
<b>1</b>	<b>Instruction step</b>
	Carry out these steps in the sequence shown.
<b>Method</b>	<b>Dialog text, parameter</b> in the software
<b>File ▶ New</b>	Menu or menu item
<b>[Next]</b>	<b>Button</b> or <b>key</b>
	<b>WARNING</b>
	This symbol draws attention to a possible life-threatening hazard or risk of injury.
	<b>WARNING</b>
	This symbol draws attention to a possible hazard due to electrical current.
	<b>WARNING</b>
	This symbol draws attention to a possible hazard due to heat or hot instrument parts.
	<b>WARNING</b>
	This symbol draws attention to a possible biological hazard.
	<b>CAUTION</b>
	This symbol draws attention to possible damage to instruments or instrument parts.
	<b>NOTE</b>
	This symbol highlights additional information and tips.

## 1.4 Recycling and disposal



This product is covered by European Directive 2002/96/EC, WEEE – Waste from Electrical and Electronic Equipment.

The correct disposal of your old equipment will help to prevent negative effects on the environment and public health.

More details about the disposal of your old equipment can be obtained from your local authorities, from waste disposal companies or from your local dealer.



### 3 Installation

The Optrode's USB cable is used to supply power to the electronics and the sensor's light source. The actual sensor cable (measuring signal) has a conventional F plug for connecting to the indicator measuring input (**Ind.**) on a titrator.

#### 3.1 Connecting to a Titrand

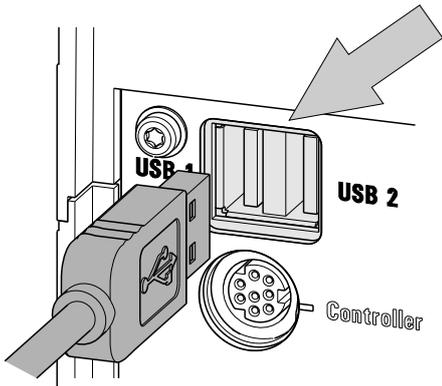


Figure 2 Power supply at the USB connector of a Titrand

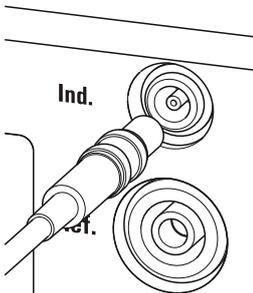


Figure 3 Connecting the Optrode to a Titrand



### 3.2 Connecting to a Ti-Touch

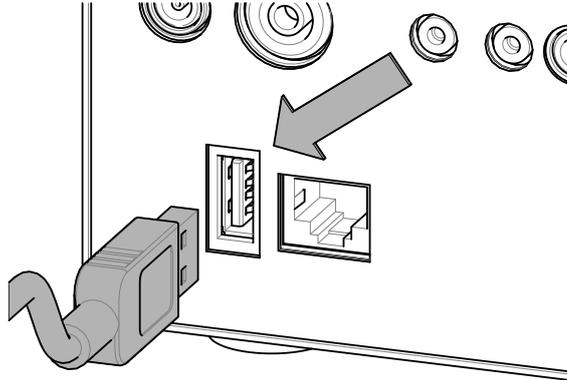


Figure 4 Power supply at the USB connector of a Ti-Touch

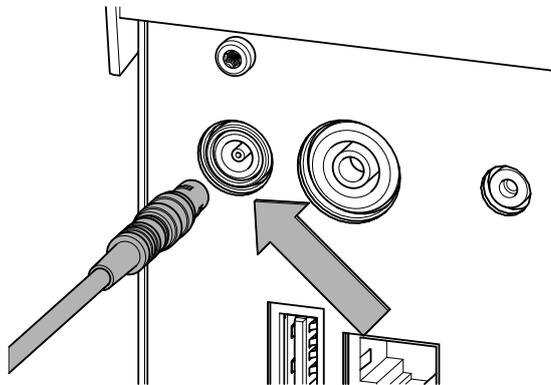


Figure 5 Connecting the Optrode to a Ti-Touch

### 3.3 Connecting to a Titrino plus

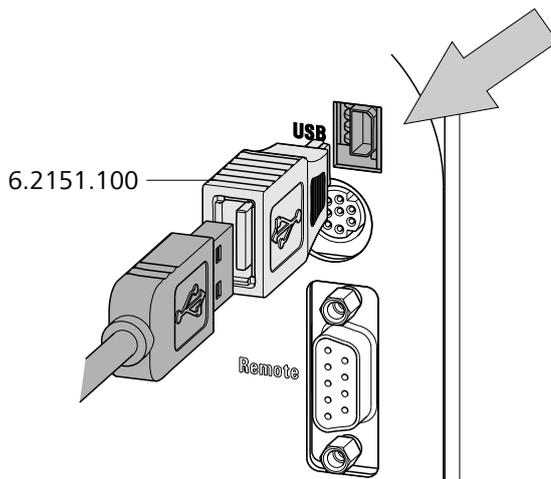


Figure 6 Power supply at the USB connector of a Titrino plus

In order to connect the Optrode's USB cable to a Titrino plus, a USB Mini (OTG) - USB A (6.2151.100) adapter is required (see figure).

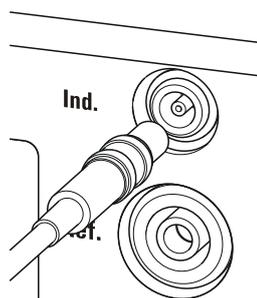


Figure 7 Connecting the Optrode to a Titrino plus

### 3.4 Power supply with USB power supply unit

A 6.2166.000 USB power supply unit is available if power to the Optrode cannot be supplied via a titrator's USB port. This USB power supply unit can be connected to a socket directly. The cable for supplying the Optrode with power can be connected to the USB port on the USB power supply unit.

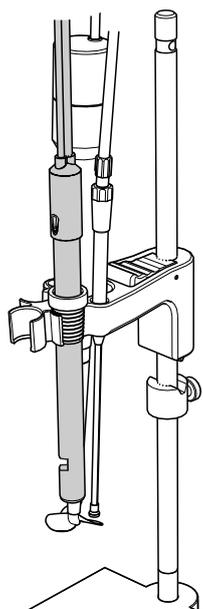
### 3.5 Installing the Optrode



#### NOTE

Ensure that the sensor is not exposed to direct sunlight and avoid disruptive light reflections.

Install the Optrode as shown in the figure below.



The sensor must be firmly installed on the titration head. Particularly when automation is used, you have to account for the cable movement.

During the titration, it is important that the solution is well mixed. The stirring rate should be high enough to form a small vortex. If the stirring rate is too high, then air bubbles will be aspirated. This results in incorrect measured values. If the stirring rate is too low, then the solution at the sensor will not be mixed correctly.

In order for the measurement to be taken in a well-mixed solution after the addition of the titrant, the titration tip should be positioned where turbulence is high. Furthermore, the distance between the addition of the titrant and the electrode should be as large as possible. Therefore, take into account the stirring direction (counterclockwise or clockwise) when positioning the electrode and titration tip.

The sensor's optical window is to be positioned facing the flow direction. This removes small air bubbles from the measuring gap.





## 4 Operation and maintenance

### 4.1 Setting the wavelength

The Optrode has eight LEDs (LED = light-emitting diode) on its optical circuit board that serve as light sources. Each LED emits light in a different wavelength range. The LEDs are labeled with their primary wavelength on the optical circuit board. It is easy to recognize which LED is active and which wavelength is set by the fact that the label is lit in the corresponding color.

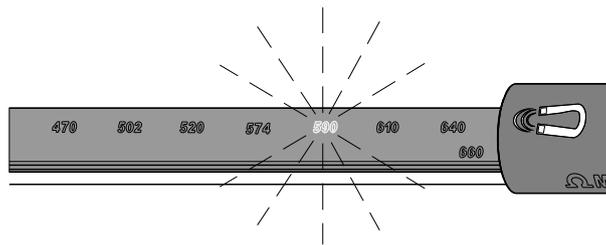


Figure 9 Wavelength display of the Optrode

Table 1 Wavelength ranges

LED	Color	Usable wavelength range / nm
470	blue	460 - 480
502	blue-green	485 - 520
520	green	505 - 535
574	yellow-green	560 - 585
590	yellow-orange	575 - 605
610	orange	595 - 625
640	light red	620 - 655
660	red	650 - 670

The magnetic switch in the sensor head is used to switch between LEDs or it is done automatically via **tiamo** (version 2.5 and higher).

#### Switching between LEDs with magnet

The wavelength is changed manually as follows:

- 1 Hold a magnet, e.g. a stirring bar, against the magnet symbol.

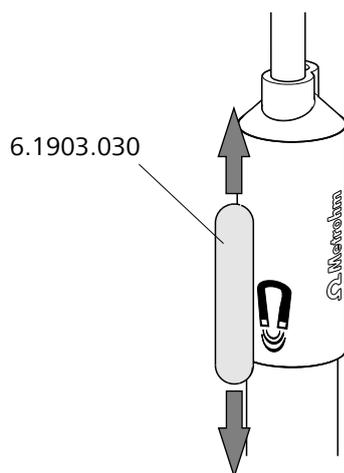


Figure 10 Switching the LED

- 2 Briefly move the magnet up and down again.  
Moving the magnet switches to the next LED.
- 3 Move the magnet again until the desired wavelength is set.

### Switching between LEDs via *tiamo*

The Optrode is recognized automatically by the control software *tiamo* (version 2.5 and higher). However, this only works if the Optrode is connected directly to the titrator or control instrument via USB.

The wavelength is changed as follows in *tiamo*:

- 1 Double-click on the command in the method run.
- 2 Open the **General/Hardware** tab.
- 3 Under **Sensor**, select the option **Optrode**.
- 4 Under **Wavelength**, select the desired wavelength.  
(A wavelength of 610 nm is suggested by default, no matter what wavelength the Optrode is currently set to.)  
The selected wavelength can later be used in the formula editor as variable (**.WVL**).

**NOTE**

- The LED only switches to the selected wavelength once the determination starts.
- The wavelength cannot be changed while a determination is running (neither with a magnet nor via **tiamo**).
- The Optrode can additionally be used for measurements (measured quantity U) with selectable wavelength in the **Manual control**.

**CAUTION**

The light intensity of the LED must have stabilized sufficiently before use. Each time you switch on and each time you change the wavelength, wait at least five minutes before starting the first determination.

**NOTE**

The wavelength remains set even if the Optrode is switched off or the power supply is interrupted (USB connection).

## 4.2 Sensor care

The Optrode does not require any special care. Store the sensor dry in the storage vessel provided.

If it becomes dirty, the Optrode's glass shaft can be cleaned with warm water and a small amount of detergent or ethanol. Use a soft cloth for this.

## 5 Troubleshooting

Problem	Cause	Remedy
<b>Signal jumps. No endpoint. Several endpoints. Erratic signal changes of the measuring curve.</b>	<i>Air bubbles enter the measuring gap.</i>	<ul style="list-style-type: none"> <li>▪ Decrease the stirring rate.</li> <li>▪ Make sure you are using degassed (CO<sub>2</sub>-free) water.</li> <li>▪ Glass vessels facilitate visual checking.</li> <li>▪ Position the sensor in the sample vessel as described in <i>Chapter 3.5, page 7</i>.</li> </ul>
	<i>Stirring is inadequate.</i>	<ul style="list-style-type: none"> <li>▪ Adjust the stirring rate (take the beaker size into account!).</li> <li>▪ Position the sensor facing the stirrer stream as described in <i>Chapter 3.5, page 7</i>.</li> </ul>
	<i>The sample is not completely dissolved.</i>	Make sure that salts are completely dissolved before adding indicator.
	<i>The sensor is not stable in the titration head.</i>	Avoid strain on the sensor cable (automation!).
	<i>The stirring rate is too high or too low.</i>	Adjust the stirring rate to the beaker size.
	<i>The indicator solution is too old.</i>	Check the stability (usable just for one day, in some cases). Prepare fresh solution, if necessary.
<b>No light. None of the LEDs are lit up.</b>	<i>Addition of the indicator solution.</i>	<ul style="list-style-type: none"> <li>▪ Do not add indicator before the sample has completely dissolved.</li> <li>▪ After the addition of indicator, start with the titration right away.</li> <li>▪ Adjust the amount of indicator to the sample amount / fill volume.</li> </ul>
	<i>There is no power supply to the Optrode.</i>	<ul style="list-style-type: none"> <li>▪ Connect the Optrode to a USB port on a titrator or a USB power supply unit.</li> <li>▪ Check the USB cable.</li> </ul>
	<i>The Optrode is defective.</i>	Replace the Optrode.



<b>Problem</b>	<b>Cause</b>	<b>Remedy</b>
<b>No signal. The measured value is constant at approximately 0 mV.</b>	<i>The solution is too dark.</i>	<ul style="list-style-type: none"> <li>▪ Use less indicator.</li> <li>▪ Dilute the solution.</li> </ul>
	<i>The Optrode is dirty.</i>	Clean the sensor, particularly the smooth surfaces in the measuring gap (see Chapter 4.2, page 12).
<b>Signal is too high. Constant measured value at approximately 900 mV.</b>	<i>The solution is too bright.</i>	Use more indicator.
	<i>Too much ambient light present (e.g. direct sunlight).</i>	Protect the measuring equipment from light.
<b>Optrode is not recognized automatically in tiamo (version 2.5 and higher).</b>	<i>The Optrode firmware is outdated.</i>	Have the firmware updated by a service engineer.

## 6 Technical specifications

### 6.1 Optrode

#### 6.1.1 Measuring mode

*Measured quantity* Absorption  
(For titration only)

#### 6.1.2 Resolution

*Potential* 0.1 mV

#### 6.1.3 Measuring interval

*Measuring cycle* 3 ms

#### 6.1.4 Ambient conditions

*Operating temperature* 0 - 40 °C

*pH range* 0 - 14

#### 6.1.5 Power supply

*Voltage* 4.75 - 5.25 V DC

*Power consumption* max. 85 mA

#### 6.1.6 Reference conditions

*Ambient temperature* +25 °C ( $\pm 3$  °C)

*Instrument status* At operating temperature, sensor operating for at least 5 minutes

#### 6.1.7 Light sources (LEDs)

*Typical wavelengths* 470 nm  
502 nm  
520 nm  
574 nm  
590 nm  
610 nm  
640 nm  
660 nm



### 6.1.8 Safety specifications

This instrument fulfills the following electrical safety requirements:



CE marking in accordance with the EU directives:

- 2004/108/EC (EMC Directive, EMC)

*Design and testing*

According to EN/IEC/UL61010-1, protection class III.

*Safety instructions*

This document contains safety instructions which have to be followed by the user in order to ensure safe operation of the instrument.

### 6.1.9 Electromagnetic compatibility (EMC)

*Emission*

Standards fulfilled:

- EN/IEC 61326-1
- EN/IEC 61000-6-3
- EN 55011 / CISPR 11

*Immunity*

Standards fulfilled:

- EN/IEC 61326-1
- EN/IEC 61000-6-2
- EN/IEC 61000-4-2
- EN/IEC 61000-4-3

### 6.1.10 Dimensions

<i>Shaft diameter</i>	12 mm
<i>Sleeve diameter</i>	14.2 mm
<i>Height</i>	177 mm
<i>Installation length</i>	135 mm
<i>Cable length</i>	1.2 m fixed cable (plug F and USB)
<i>Material</i>	
<i>Sleeve</i>	PBT
<i>Glass tube</i>	Borosilicate glass

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