



**TechnoTeam**  
Bildverarbeitung GmbH

# Operating Manual

## Goniophotometer

### RiGO801 - LED



Version: V.01  
Last update: 17 June 2020

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# 1 General notes / Basic information

Dear customer,

Please read through the following operating manual carefully. It contains important information on the proper and intended use of the device. If you should have any questions or problems which you cannot solve even by means of this documentation, please contact the TechnoTeam Bildverarbeitung GmbH company. The address as well as the telephone number can be found in Chapter 6.

## 1.1 Intended use

In the following, a difference is made between the technical terms „goniometer“ and „goniophotometer“. „Goniometer“ only refers to the mechanical motion unit, whereas „goniophotometer“ means the overall measuring system including the photometric sensors.

The goniophotometer as an overall system serves for the photometric measurement of light sources (LEDs, OLEDs, modules). It consists of two rotation axes moved by a motor. One moving arm (the Theta axis) carries a camera, a photometer, and – optionally – additional measuring instruments. The second upstanding rotation axis carries the sample to be measured (DUT). In this way, all directions around the DUT can be measured by the sensors.

## 1.2 Liability disclaimer

The TechnoTeam Bildverarbeitung GmbH company shall not be liable for any damages resulting from improper use. The appropriate use also implies the knowledge of the present operating manual. You are therefore requested to follow the instructions given in this documentation as well as in the documentations concerning single station components. We shall not assume liability for errors resulting from non-observance of the technical documentations.

## 1.3 Shipment and handling

The RiGO801 – LED goniophotometer and belonging components are packed in a wooden transport box. For storage, the ambient temperature range shall be within 10°C to 30°C with less than 70% relative humidity. The box is designed for handling with fork lifts.



Figure 1: Transport box (closed)



Figure 2: Transport box (opened)

The box is designed for reuse and can be disassembled by opening the brackets. For packing, ensure that the device is protected against shocks by using thick foam material. The transport

of the goniometer unit must be upstanding with the sensor arm at the top. Remove the test socket from the upstanding telescope axis and shift the axis to the lowest position. For handling of the goniometer please refer to chapter 4.1 *Placing and alignment*.

## 1.4 Scope of delivery

The scope of delivery includes:

- Complete and ready-to-use measuring device
- Technical documentation

## 1.5 Notes on how to handle the Operating Manual

Guidelines contained in this document:

- Table of contents
- List of figures
- List of tables
- Column title in the header

### 1.5.1 Table of contents

The table of contents contains an overview of the single chapters of the Operating Manual as well as an indication of the main and subordinate points including the respective page numbers.

### 1.5.2 List of figures

The list of figures contains an overview of all figures shown in the operating manual including the figure number and title as well as the page number. The figures are numbered consecutively.

### 1.5.3 List of tables

The list of tables contains an overview all tables presented in the operating manual including the table number and title as well as the page number. The tables are numbered consecutively.

### 1.5.4 Symbols used

The warning and information signs used are explained below:







Sign	Explanation
	Indicates a general hazard
	Indicates hazard of life due to electric shock caused by a high operating voltage.
	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
	Indicates a potentially hazardous situation, if not avoided, could result in death or serious injury.
	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
	Indicates potentially property damage hazardous situation.

Table 1: Symbols legend

## 1.6 Improper application



Improper application entails dangers to the machine, the operator and third parties. Refer to the use of the machine contrary to its intended use.

TechnoTeam Bildverarbeitung GmbH company shall not be liable for any damages resulting from improper application. The appropriate use also implies the knowledge of the present Operating Manual. You are therefore requested to carefully follow the instructions given in this Operating Manual. We shall not assume liability for errors resulting from non-observance of the instructions laid down in the Operating Manual.

## 2 Technical documentation

### 2.1 System layout

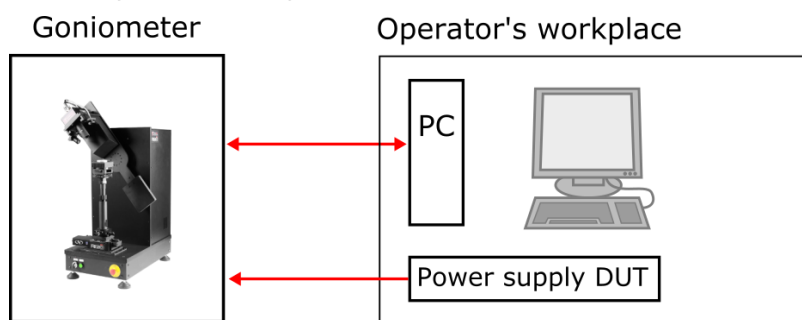


Figure 3: System layout

### 2.2 Installation diagram

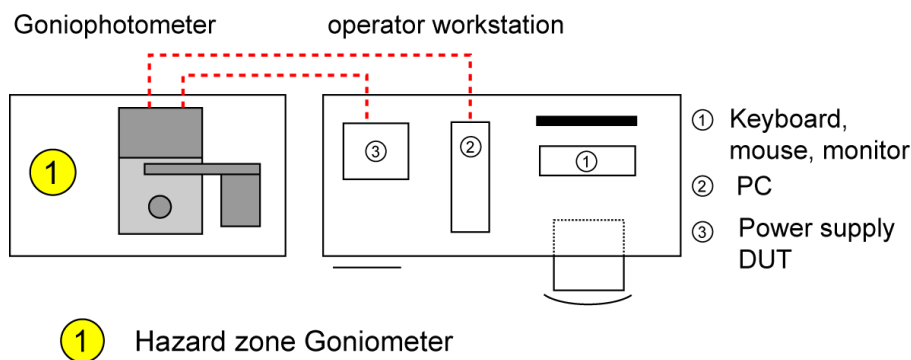


Figure 4: Installation diagram

The hazard zone 1 *Goniometer* is defined by the operating area of the goniometer. This is a rectangular volume (width x height x depth = 0.8m x 1m x 0.3m) defined by the moving arm.

### 2.3 Placing of the goniometer and operator workstation

The goniometer should be placed on a separate table / platform for preventing vibrations and shocks caused by the work of the operator. This table must be sufficient stable and mechanically stiff for absorbing the low vibrations coming from the device while moving. There shall be no obstacles within the moving range.

The cable length between goniophotometer device and PC is 3m so that the operators place needs to be nearby. There shall be enough space in front of the device so that the operator can easily reach all parts that are necessary to setup measurements.

Optionally the goniometer can be placed inside a black chamber for excluding the ambient light influence.

## 2.4 Laboratory requirements

### 2.4.1 Ambient conditions

Room	Laboratory environment, low dust
Temperature range	20°C to 26°C, +/- 1°C
Relative humidity	< 50%
Air movement	< 0.2 m/s (IES LM-79-19)

### 2.4.2 Darkening

Unless the goniophotometer device is not placed inside a black chamber, all room elements should be painted black with special low reflectivity paint. A black carpet with low reflectivity is recommended for the floor. Subdivisions, if they are necessary, can be realized with black curtains (e.g. Molton).

### 2.4.3 Lighting

Sufficient room lighting is required for handling the parts at the center of the goniometer as well as in order to align them.

### 2.4.4 External Vibrations

External Vibrations (e.g. created by production machinery or forklifts etc.) can be harmful to the measurements. The influence on the DUT support axis must be below 10 microns. The usage of a shock damped optical table might be advantageous.

### 2.4.5 Space required

The goniometer device needs at least a volume of 1m height, 0.8m width and 0.8m depth. Please also refer to chapter 2.3.

## 2.5 Wiring



Only authorized personnel shall be allowed to carry out work inside the goniophotometer device.

### 2.5.1 Mains connection – Goniometer

The goniometer is powered by a power cord in accordance with IEC 60320 - C13.

Electrical characteristics	
1-phase + earth	50/60 Hz
Main line voltage	110/ 230 V +/- 10%
Full load power	80 W
Fault current	< 30 mA
Enclosure Rating	IP20

Table 2: Electrical characteristics

### 2.5.2 Mains connection – PC

Use a IEC 60320 - C13 power cord for mains supply of the PC. When available, connect to to a separate power circuit for IT equipment.

### 2.5.3 Device connections

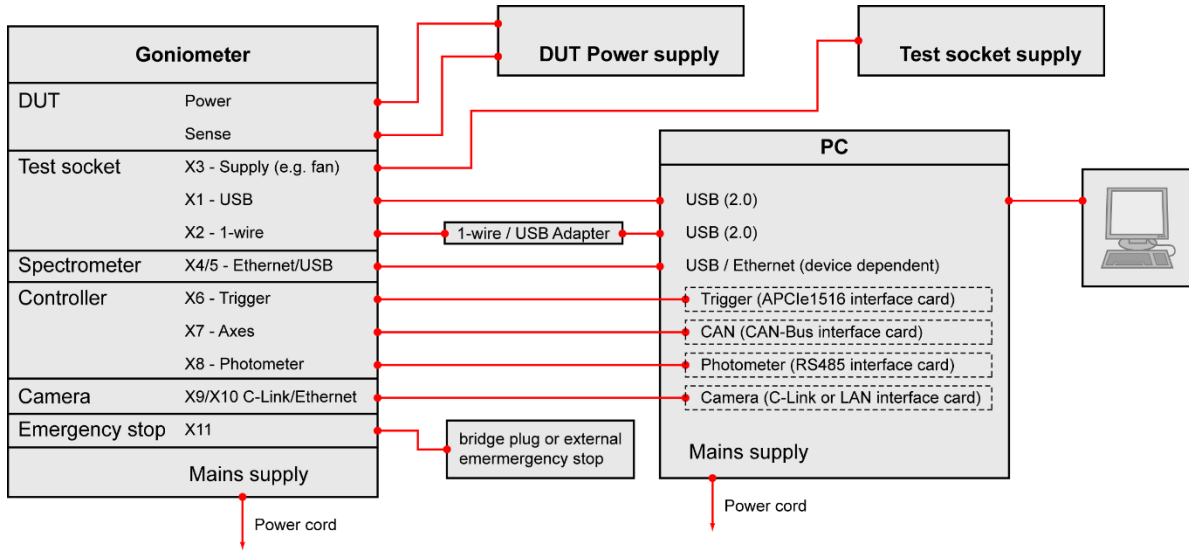


Figure 5: Interconnection diagram

The goniometer unit is a ready-to-connect device with all sensors and drivers embedded. Refer to Figure 5 for an overview of all connections. All connections are made to the back connecting plate of the goniometer.



Figure 6: Connecting plate

The plate is separated into groups of functions.

#### DUT and Test socket

Direct connections to the test socket plug interface. For details refer to chapter **Fehler! Verweisquelle konnte nicht gefunden werden. Fehler! Verweisquelle konnte nicht gefunden werden.** for details.

#### Spectrometer

Depending on the type of spectrometer there's a USB (X5) or Ethernet interface (X4).

#### Controller

This group includes the CAN Bus interface connection to the servo amplifier (X7), the triggering interface for real time data acquisition (X6) and the photometer RS485 interface (X8).

#### Camera

Depending on the type of camera there's a C-Link (X9) or Ethernet interface (X10, GigE!).



## Emergency stop

The emergency stop loop is routed to the outside via this plug. Normally there's no need of an external emergency switch so that a bridged plug is inserted.

X11 – Emergency stop (Plug Lemo FGA.0B.304.CLAD52), emergency stop circuit loop between pins 1 and 2.

## 2.5.4 PC connections

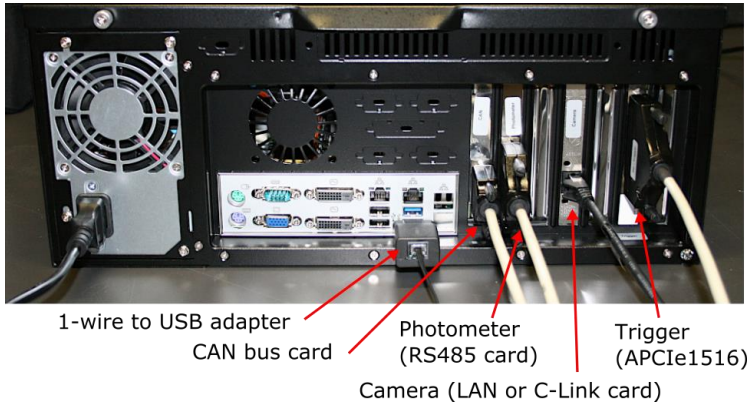


Figure 7: PC – goniophotometer connections

## 2.6 Phi axis components

The Phi axis of the goniophotometer is defined by the rotation stage. If necessary, everything on-top can be replaced by customer specific elements.

The standard configuration is a x/y stage mounted to the rotation stage. On top of the stage a telescopic tube is mounted. The tube ends in a mechanical and electrical plug interface where different kinds of DUT supports can be attached to. The plug interface and the standard DUT mount are described below.

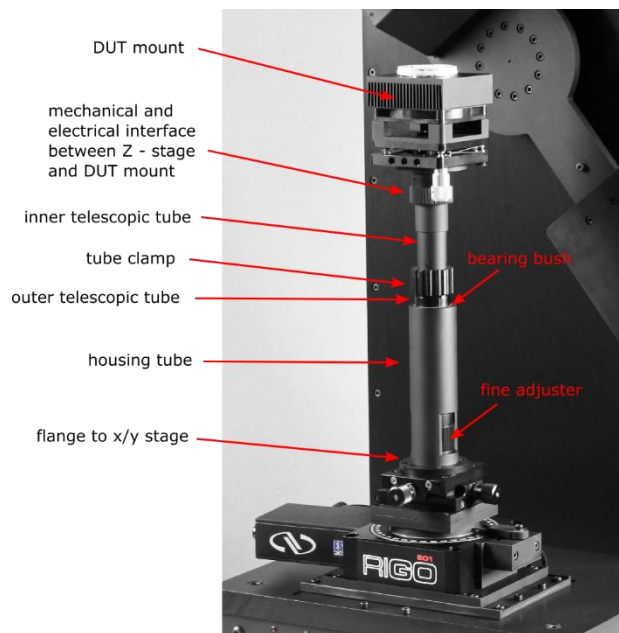


Figure 8: Components of Phi axis

## 2.6.1 Plug interface



Socket (Goniometer):

Lemo

EGG.4B.312.CLL

Plug:

Lemo

FAG.4B.312.CLA

Figure 9: Plug interface

Pin assignment:

Pin	Function	
1	Power +	Max. 60V / 12A
2	Power -	
3	Sense +	
4	Sense -	
5	Power DUT mount (+)	
6	Power DUT mount (-)	
7	1-wire Data	1-wire
8	1-wire GND	
9	USB VCC	USB
10	USB Data +	
11	USB Data -	
12	USB GND	
Earthing at plug housing		

## 2.7 Standard DUT mount

The standard DUT mount consists of a fan cooled heat sink, a leveling element and a fixable plug connection. The heat sink has a grid of threads for the fixing of the DUT, e.g. a LED-board. A 1-wire temperature sensor is situated in the center of the heat sink. The plug provides contacts for the DUT power, the sense lines, the fan supply, the 1-wire signal and USB interface for future purpose. All signals can be contacted at the back panel of the goniophotometer.

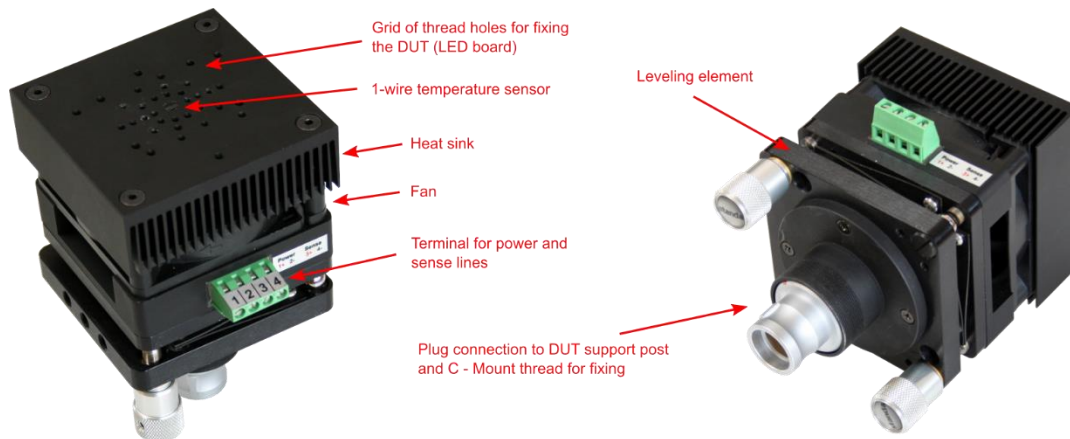


Figure 10: Standard DUT mount



Figure 11: Back panel connections to DUT mount plug interface

### 2.7.1 Heat sink and fan

Dimension	75 x 75 x 25 mm
Fan	ebm-papst 712F, 12V DC, air flow 44 m³/h
Temperature max.	60 °C

### 2.7.2 Thread grid

The inner thread pattern (M2 and M2.5 threads) has been designed to fit for all common LED boards. They are arranged as opposing pairs so that at least two screws can be used for fixing the board. Please refer to Figure 12 for details of the thread positions.

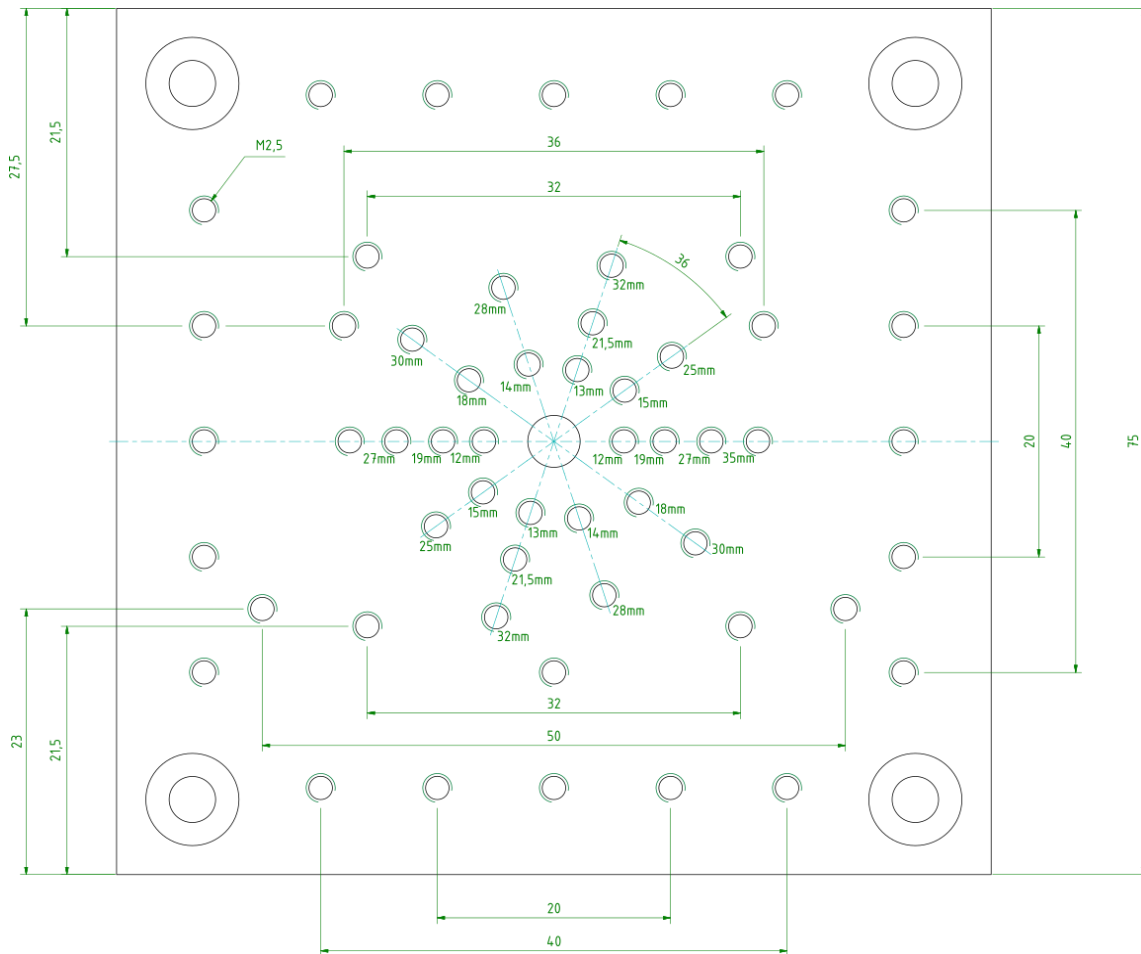


Figure 12: Grid of thread holes for fixing the DUT

### 2.7.3 Temperature sensor

<b>Article description</b>	18B20 (Dallas Semiconductor)	
<b>Description</b>	Digital thermometer sensor in TO92 housing, communication via 1-wire Bus	
<b>Temperature range:</b>	-55°C to +125°C	
<b>Resolution:</b>	9 to 12 Bit	
<b>Accuracy:</b>	+/- 0,5°C (-10°C to 85°C)	

### 2.7.4 Plug

<b>Type</b>	12 pins, Lemo FAG.4B.312.CLA
<b>Power lines</b>	Maximum 60 V AC/DC / 12 A

### 2.7.5 1-wire USB adapter

Manufacturer: Eclo (<http://www.eclo.pt>)

Type: PN10000500011

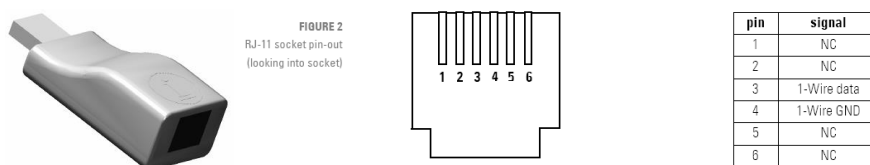




Figure 13: 1-wire USB adapter

## 2.8 Safety

### 2.8.1 Safety signs applied on the installation

Sign	Explanation
	EMERGENCY-STOP button at the front panel.
	Located on the back side of the housing.

### 2.8.2 Emergency-Stop circuit

Enabling of the servo motor controller is only possible with a closed emergency stop circuit. This circuit is connected to the emergency stop button at the front panel and the external emergency circuit connector X11 at the back panel (refer to 2.5.3 *Device connections*).

In case the Emergency-Stop circuit is disconnected/opened, the power supply of the motor output stage is disconnected immediately and the axes become de-energized. Unless the circuit is not closed again, enabling of the controller by pressing the green button is not possible.



Figure 14: Emergency-stop switch at front panel



Figure 15: Emergency-stop circuit connector at the back panel

### 2.8.3 Technical condition

The installation has been designed in consideration of the protective measures for avoiding industrial accidents in compliance with the provisions in force.

The set-up, operation and maintenance may only be carried out by qualified staff.

Any willful reconstruction or modifications are forbidden.

Attention is to be paid to the following:

- In order to avoid potential hazards and to guarantee optimum performance, no reconstruction or modifications of the installation are allowed.
- The operator is obliged to operate the installation only in a perfect and safe operational condition. The technical condition must comply with the statutory requirements and provisions at any time.
- Prior to using the installation, it must be checked for damage and its proper condition.
- Any occurring modifications of the installation which affect safety must be notified immediately by the operating personnel to the operator.
- The system components may be connected exclusively to the supply lines designed and provided for that purpose.

- All safety devices and locking mechanisms must be easily accessible and regularly checked to ensure proper functioning.

#### **2.8.4 Operating personnel**

Before starting any work, all operating personnel must be familiarised with the potential hazards involved in the installation.

The installation can present an increased risk of accident and injury in the case that it is operated by unauthorized or untrained staff.

The operator of the installation is responsible for instructing all operating staff in the operation and valid occupational health and safety regulations on a regular basis. The instructions must be certified by signature.

Any personnel to be trained, taught or instructed or still in vocational training may work on the installation only under the supervision of an experienced person.

The Operating Manual must be attached to the installation. Each person who is charged with the commissioning of the installation, its operation or maintenance must have read and understood the complete operating manual.

The ultimate responsibility for an accident-free operation of the installation lies with the operator or also the operating personnel authorized by him.

Only instructed, sufficiently qualified, trained personnel charged with the operation of the installation is allowed to operate the machine.

Attention has to be paid to the following:

- It is to be ensured that only operating staff charged with the operation of the installation execute work on it or stay in the vicinity of it or in the hazard area.
- According to the operational procedures, the operating staff must pay attention to the measures cited below in order to guarantee industrial safety:
- Observance of the information contained in the Operating Manual and all supplier documentations.

#### **2.8.5 Safety instructions regarding operation**

The goniometer has been designed in compliance with the provisions in force concerning protective measures for preventing occupational accidents.




The operator of the entire installation is responsible for the overall safety-related equipment of the complete goniometer with protection facilities and sufficient protective measures during operation (cf. paragraph 2.8.2 *Emergency-Stop circuit*).

The operator of the installation is responsible for the proper instruction on health and safety of all operating staff.

The single protective measures and safety instructions are explained in the present Operating Manual. However, some further focal points shall be mentioned below for extending and summarizing purposes.

- Only qualified personnel is allowed to work on the goniometer and to operate it.
- Before commissioning, all necessary safety tests must be carried out by the operator.
- There are unprotected components inside the housing that carry up to 230V voltage. Opening the housing and performing any work inside may only be carried out by qualified staff.
- All staff working on the installation must be instructed in accordance with this operating manual!


## 2.8.6 Safety instructions regarding transport and installation

	<p><b>Warning</b> Risk of injury and damaging components</p> <p>The transport and installation of the goniophotometer may be effected exclusively by qualified personnel. The device may only be lifted by the handles. At least 2 people are required for this (device weighs approx. 60 kg).<sup>^</sup></p> 
	<p><b>Warning</b> Risk of accidents!</p> <p>Watch out for obstacles when carrying.</p>

## 2.9 Safety instructions regarding electrical systems

Only qualified personnel having specialist knowledge of and experience with electrical systems may be charged with any work on high voltage electrical equipment.

Unauthorized assembly and installation work is prohibited.

	<p><b>Danger</b> Danger of accidents and injury owing to electric current!</p> <p>There are unprotected components inside the housing that carry up to 230V voltage. Opening the housing and performing any work inside may only be carried out by qualified staff.</p>
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## 2.10 Behaviour in the case of emergency

In dangerous situations or in the case of accidents, the installation must be switched off immediately by pressing the EMERGENCY-STOP keys.

As in a hazardous situation quick reactions can be life-saving, the following must be guaranteed:

- All EMERGENCY-STOP keys must be easily accessible for the operating and monitoring personnel.
- The operating personnel must know where safety equipment, accident and hazard alarms as well as First-aid and rescue facilities are located, and how to handle them safely.
- The operator is responsible for the appropriate training of the operating personnel.
- All First-aid facilities (First-aid kit, stretcher, etc.) as well as firefighting means (fire extinguishers) must be located within reach and easily accessible. All equipment must be in faultless condition. Their good functioning must be regularly checked.
- In the case of an emergency, the competent operator must be informed immediately, and all necessary rescue operations carried out.
- All provided escape routes must be unobstructed and useable.
- Parts and components of the installation must be properly disposed of.

## 3 Risk assessment

Please read the sections 2 *Technical documentation* and 4 *Operation* carefully to understand the details of the system layout and intended use.

### 3.1 Limits

#### 3.1.1 Phases of the whole life cycle of the machinery

- Transport  
The system comes packed in a wooden transport box (cf. 1.3 *Shipment and handling*). Unpacking shall be done by qualified / instructed personnel.
- Assembly, installation and commissioning  
All this tasks shall be done by qualified personnel.
- Operation  
Operation of the Goniophotometer system by operators.
- Maintenance  
Maintenance shall be done by trained personnel.
- Decommissioning, dismantling  
Decommissioning and dismantling by technical personnel skilled for handling electrical and mechanical parts.

#### 3.1.2 Use limits

##### Intended use

The goniophotometer as an overall system serves for the photometric measurement of light sources (LEDs, OLEDs, modules). It consists of two rotation axes moved by a motor. One moving arm (the Theta axis) carries a camera, a photometer, and – optionally – additional measuring instruments. The second upstanding rotation axis carries the sample to be measured (DUT). In this way, all directions around the DUT can be measured by the sensors.

Only trained operators shall be allowed to operate the system.

##### Reasonably foreseeable misuse

- Damaging of machinery and optical sensing parts (lenses, filters, optical measuring heads)
- Collision of moving machinery parts with DUT or other obstacles within the moving area.
- use of the system by untrained operators
- feed and placement of components whose types differ from those intended for the machine
- operation of the machine beyond its application limits
- modifying the control program of the machine without prior consultation of the manufacturer
- operation of the machine contrary to the instructions in the Operating Manual
- modifying of safety and protection devices
- operation of the machine in the case of obvious malfunctions
- carrying out any repair, cleaning or maintenance work while the machine is running

#### 3.1.3 Space limits

The required space of the goniometer mechanic and the place of the control cabinet are handled in section 2 *Technical documentation*.



### 3.1.4 Time limits

The intended life time is at least 15 years or 20000 operational hours.

The recommended service interval is every 2 years.

The laboratory room shall be cleaned regularly. Cleaning of the goniometer parts shall be done only by Operators (cf. **Fehler! Verweisquelle konnte nicht gefunden werden. Fehler! Verweisquelle konnte nicht gefunden werden.**). Cleaning personnel shall be advised to clean only the room.

### 3.1.5 Other limits

#### Pollution

Pollution of the goniometer parts by dust or dirt shall be avoided. Dust pollution increases the reflectivity of the paint which may affect the measuring uncertainty.

#### Environment

Please refer to 2.4 *Laboratory requirements*.

## 3.2 Hazard identification

### 3.2.1 Extent of the system analyzed

The hazard identification is limited to the operation phase.

### 3.2.2 Tasks to be performed

During the operation of the system, the following tasks are to be performed:

- General work within the moving area of the goniometer
- Transport of the Goniometer

### 3.2.3 Relevant hazard and accident scenarios

The hazard zones are defined in Figure 4. For the hazard identification please refer to Table 4.

Hazard identification									
<b>Device</b>	Goniophotometer RiGO801 - LED			<b>Analyst</b>	Knut Bredemeier				
<b>Sources</b>	Operating manual RiGO801-LED			<b>Current version</b>	1				
<b>Extent</b>	Transport, operation phase			<b>Date</b>	2020-06-17				
<b>Method</b>	Checklists: ISO 12100:2010, Anhang B								
Ref. no.	Life cycle	Task	Hazard zone	Hazard	Hazardous situation	Accident scenario	Hazardous event	Ref. no.	
1	<b>Transport</b>	Lift and carry the device	Goniometer	impact, crushing, muscle strain	Wrong positioning while lifting the load, not using the intended handles, stumble over obstacles.		For transporting or moving the device it's necessary to lift it. The weight of 30kg makes it necessary to have two persons using the handles provided. An unfavorable standing position and uneven lifting can lead to muscle strains. If you stumble over obstacles, there is a risk of falling and resulting impact injuries.	1	
2	<b>Operation</b>	General work within the moving area of the goniometer	Goniometer	squeezing, impact	Coming close to moving parts		Although the moving speeds of the goniometer axes are relatively slow a contact with moving parts is possible. Furthermore black parts within a black environment are poorly visible. At some places there's little space between moving and non moving parts so that there's a risk of an impact and/or squeezing even though the axes power is very weak.	2	

Table 3: Hazard identification

### 3.3 Risk estimation, risk evaluation and risk reduction

See Table 4 for Risk estimation, risk evaluation and risk reduction.

Risk assessment (risk estimation and evaluation) and risk reduction										
Device		Goniophotometer RiGO801 - LED			Analyst		Knut Bredemeier			
Sources		Operating manual RiGO801-LED			Current version		1			
Extent		Transport, operation phase			Date		2020-06-17			
Method		DIN EN ISO 13849-1			Page		1			
Ref. no.	Risk estimation (initial risk)			Risk estimation (after risk reduction)			Further risk reduction required	Ref. no.		
	S	F	P	S	F	P				
1	1	2	1	1	1	1	a	no	1	
2	1	2	1	1	1	1	a	no	2	
		<b>Risk reduction</b> <b>Protective/risk reduction measures</b> <b>Remarks</b>								
		Lifting of device only by at least two persons using the provided handles. Watch for obstacles on the transport way. Ensure good standing position and even lifting. Carry suitable shoes (Safety shoes preferable)								
		Prevent to operate within the area of moving parts.								




Table 4: Risk estimation, risk evaluation and risk reduction

## 4 Operation

In the following paragraph, only the basic operation of the installation is explained. Further information can be found in Measuring Manual.

## 4.1 Placing and alignment

Place the Goniophotometer device to its designated place. Refer to chapter 2.3 *Placing of the goniometer and operator workstation* and following for details.

	<p><b>Warning</b> Risk of injury and damaging components</p> <p>The transport and installation of the goniophotometer may be effected exclusively by qualified personnel. The device may only be lifted by the handles. At least 2 people are required for this (device weighs approx. 60 kg).<sup>^</sup></p> 
	<p><b>Warning</b> Risk of accidents!</p> <p>Watch out for obstacles when carrying.</p>

The Goniometer must be leveled. This is done by adjusting the 4 mounting feet. Ensure that all 4 feet are touching the base plate with approximately the same pressure (turn manually). Now place a spirit level as shown in Figure 16.

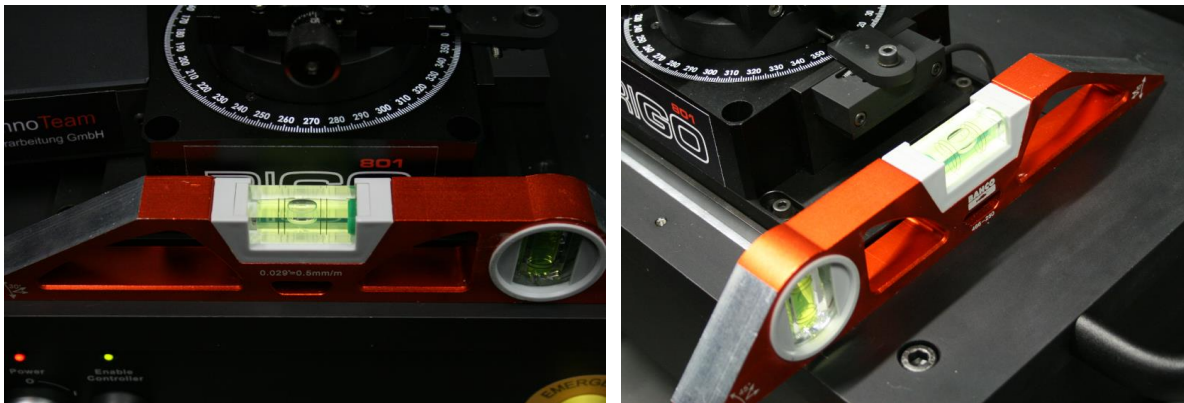


Figure 16: Levelling of Goniometer

Use an open-end wrench of size 14 for turning the mounting feet.




Figure 17: open-end wrench for turning the mounting feet

## 4.2 Wiring

Refer to chapter 2.5.

### 4.3 Switching on of the installation

	<p><b>Warning</b> Make sure that all directives explained in chapter 2.8 Safety are satisfied.</p>
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Turn the power switch to position I. The red LED must light on. If not, check the mains connection. Now press the green button (Enable controller) and the green LED must light on. If not, check the emergency stop switch and the connection to X11 (bridge plug or external emergency stop switch).



Figure 18: Front panel


Now the Device is ready for operation. Please refer to the Software manual for further details.

## 5 Maintenance and servicing notes

	<p><b>Attention</b> Damage of the installation! Any maintenance work may be carried out only by trained qualified personnel.</p>
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### 5.1 Servicing

### 5.2 General

	<p><b>Warning</b> Damage of the installation! Any maintenance work shall be carried out only by trained qualified personnel.</p>
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The mechanical parts of the Goniophotometer are maintenance free. When observing unusual effects (e.g. sound of drives or gears, vibrations, oil leakage) TechnoTeam Bildverarbeitung GmbH company shall be contacted for advice.

### 5.3 Cleaning and protection of photometric sensors and optical components

All photometric measuring equipment and optical components (the lenses, the camera window glass and neutral density filters) should be kept as clean as possible.

**NOTICE**

The following guidelines should be followed:

- Use only cleaning material and fluid that is suitable for optical surfaces.

- Never wipe over an optical surface until you have blown it off with pure compressed air. Otherwise dust particles may cause scratches.
- Always try first to clean with pure compressed air before using a dry optical cleaning cloth.
- Using cleaning fluid can cause streaks. Avoid to clean the camera window with fluid.
- Use a headlamp directed from different orientations towards the optical surfaces for detecting dust or other dirt.
- Use the protection cover caps for the lens, illuminance meter head and the spectrometer head. Keep the lens mounted at the camera to prevent dust on the camera window.

### NOTICE

Particular attention must be paid to the areas near the image sensor (camera window glass and back side of the optical lens). Even small dust particles or finger prints can cause strong influence on the measuring results.

## 5.4 Cleaning of the goniometer mechanic

The goniometer shall be kept clean. Use clean compressed air and/or a vacuum cleaner for cleaning. The black anodized surface is somewhat rough so that cleaning with cloth must be performed carefully. The application of harder foam blocks is also useful to get particles from the surface.

## 5.5 Cleaning of the room

Except the cleaning of goniometer parts the cleaning of the room may be done by cleaning worker. They must be instructed not to clean nor touch goniometer parts.

## 5.6 Daily maintenance

In order to guarantee faultless and safe operation, the following activities are to be carried out once a day:

- Inspection of cleanliness

## 5.7 Medium-term maintenance

Checking, cleaning and maintenance work are to be carried out at intervals of approximately four weeks:

- Checking of all sensors for damage
- Checking of the functioning of all safety equipment (EMERGENCY-STOP).

## 5.8 Long-term maintenance



### Warning

Damage of the installation! Long-term maintenance shall be carried out only by qualified personnel.

## 6 Technical data / Hotline

### 6.1 Technical data

Electrical characteristics	
1-phase + earth	50/60 Hz
Main line voltage	110/ 230 V +/- 10%
Full load power	80 W
Fault current	< 30 mA
Enclosure Rating	IP20

Table 5: Electrical characteristics

### 6.2 Hotline

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