

ERGONEERS
FROM SCIENCE TO INNOVATION

DIKABLIS EYE TRACKING GLASSES PROFESSIONAL

MANUAL

Updated 5/2016



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Dear Customer,

By choosing the Dikablis eye tracking system from Ergoneers, you have opted for innovation, quality, performance and reliability. Dikablis will provide you with maximum support on all of your eye tracking experimentation projects and guarantees to offer you the utmost in efficiency and benefits. Ergoneers are providing you with a complete and consistent hardware and software system for scientific eye tracking. Compatibility problems between hardware components or limitations in terms of internal data flow are therefore a thing of the past.

Dikablis is used to capture and analyze the direction of your test subject's gazes, as well as the movements of their eyes and heads, in experimental situations. The integration of the key system components into the head unit means that the system offers unrestricted freedom of movement. The live view integrated into the recording software means that the viewing behavior of test subjects who are able to move around the room freely can be recorded and monitored simultaneously on the screen.

The list of potential uses for Dikablis is endless, ranging from the assessment of design and structural objects to the behavior-optimized design of user interfaces or for eye behavior assessment in safety-critical situations. The degree of experience in the field of eye tracking is irrelevant for the user, since beginners as well as experts are able to harness the system's potential with equal effectiveness.

The supplied package includes D-Lab Essential, the basic version of the measurement and analysis software, which allows the results of your experiments to be processed intuitively and in a straightforward manner. This standard software allows you to edit your empirical data manually. Ergoneers also offer the option of multiple expansion modules for D-Lab, such as modules for automatic analysis and preparation of the data obtained. With D-Lab, the manual processing of data becomes redundant and you have the option of high-quality graphics and informatively-presented representations of the measured eye behavior. Our product portfolio currently comprises the two versions Dikablis Eye Tracking Glasses Professional Cable and Dikablis Eye Tracking Glasses Professional Wireless . Which of these two versions you choose depends greatly on where your applications will be used.

This manual provides a detailed description of your system's hardware. The fundamental steps of assembly are explained and illustrated with graphics.

We are delighted that you have chosen a product from Ergoneers, and we very much hope you enjoy using the Dikablis eye tracking system.

Your Ergoneers team

1 GENERAL INFORMATION

1.1 Safety information

Read these instructions for use carefully before connecting and commissioning the system! As with all technical systems, flawless function and operating safety can only be guaranteed if the usual safety precautions are taken during operation and the specific safety information contained in this manual is complied with.



Note

The following information must be noted in order to reduce the risk of fire or electric shock. Failure to do so can result in death or serious injury.

1. The mains plug must not be connected or disconnected from a socket with wet hands. Do not use the power packs in damp environments (e.g. bathroom).
2. The power packs must not be exposed to direct sunlight.
3. Dikablis must not be used if the mains cable or power pack are damaged.
4. The plugs on the power pack must never be connected with force.
5. To avoid damaging them, the system components must be handled with care and must not be dropped.
6. The housings do not contain any parts that can be maintained by the user. The device housing must only be opened and repairs carried out by an Ergoneers employee.
7. Before commissioning the system, ensure that the mains voltage specified on the type plate of the individual components matches the mains voltage being supplied. An incorrect mains voltage can destroy the device.
8. The system must only be operating with original Ergoneers accessories or Ergoneers-approved accessories. No liability is accepted for damage caused by the use of unapproved accessories or third-party components.
9. If modifications are made without the written consent of Ergoneers, the warranty and EU declaration of conformity issued shall be rendered null and void.

Explanation of the symbols used in this manual:



General caution



Caution, hazardous electrical voltage: Danger of electric shock!



Caution, hot surface!



Information: Read the information carefully



Note: Failure to observe this information can damage or destroy your device or impair its performance

1.2 FAQs

Detailed documentation of all of the questions that have arisen so far and their associated answers can be found online at www.ergoneers.com/faq.

If you have any questions for which you cannot find an answer, please send an e-mail to Support (support@ergoneers.com).

1.3 Supplied package

1.3.1 Dikablis Cable



Figure 1 - Cable supplied package

The following parts are included in your Dikablis Cable eye tracking system:

- Head unit
- Connector box incl. power pack
- USB 3.0 cable (3 meters)
- Licensing dongle incl. software
- Two attachable lenses for the scene camera

1.3.2 Dikablis Wireless



Figure 2 - Wireless supplied package

The Dikablis Wireless eye tracking system contains all of the components of the Cable system and also the following parts:

- Rechargeable batteries (at least one; optionally a second one)
- Backpack for transporting the transmitter unit
- Router
- Microsoft Surface Pro Tablet with pre-installed D-Lab Mini
- Associated power packs

1.3.3 Optional upgrades

It is possible to upgrade from Dikablis Cable to Dikablis Wireless at any time. To do this, simply acquire the digital radio path (comprising a router and tablet).

Dikablis Wireless, just like Dikablis Cable, can be used with cables by linking the Dikablis system directly to the recording computer, i.e. without a tablet or router.

1.3.4 Software


The supplied package includes a USB licensing dongle on which the installation files for D-Lab Essential are located. The installation and commissioning of the software are described in point 3.1.3. If you have purchased a notebook from Ergoneers along with the eye tracking system, the D-Lab software is already pre-installed on it.

2 DIKABLIS HARDWARE

This section explains the eye tracking system's hardware components. First, the version-neutral system parts such as the head unit and recording computer are described. This is then followed by a version-specific description of the components for Dikablis Cable and Dikablis Wireless.

When establishing plug connections, please always check the compatibility of the plugs being used. The connections involved represent complex plug connections that can be damaged by the use of external force. If you feel strong resistance while trying to establish or release a plug connection, please check that the plugs and connecting elements are a match for each other.

Each plug has a different number of pins and therefore only fits into one specific jack. Red markings on the power plug and the associated jack make connecting these easier. Ensure that the markings overlap, as shown in Figure 3. **Please ensure that the plug and jack match before connecting the plug!**

	<p>If the plug is connected incorrectly, damage to the jack and/or plug can result.</p> <ul style="list-style-type: none">• Before connecting a plug, check that the number of pins on the plug matches the pattern of the jack.• When connecting the USB 3.0 plug, ensure that you only screw in the plug once it has been properly inserted.• To release the plug, grasp it by the fluted section and pull it out. Never pull the plug out by the cable!• The connector box is permanently attached to the head unit. Any attempt to remove the cable can damage the eyewear!
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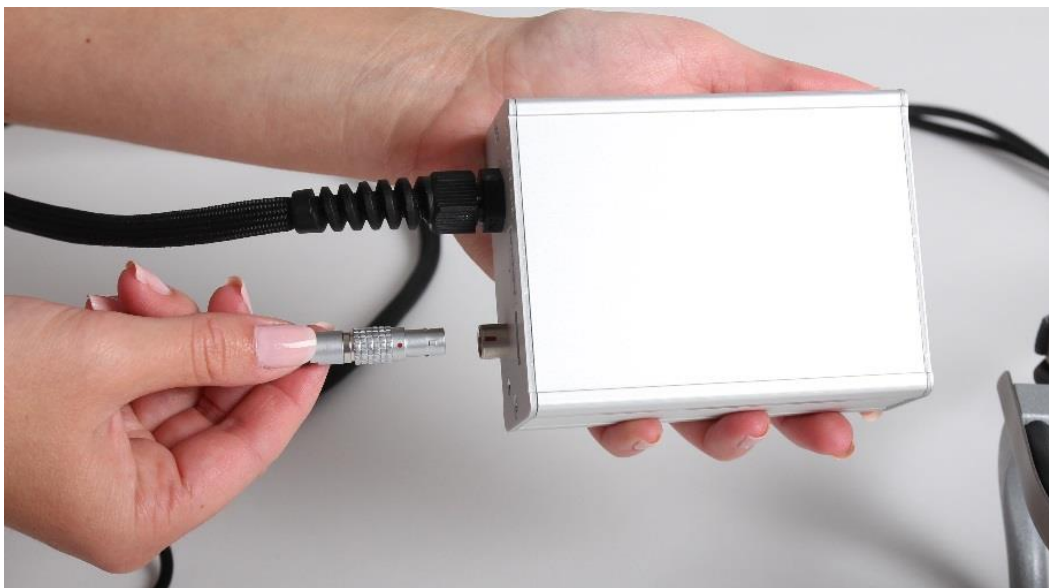


Figure 3 - Overlap of the markings

2.1 Head unit

One system-neutral component of your Dikablis system is the head unit, which is shown in Figure 4. It has an identical structure for all system versions, however the connection to the recording computer varies: either a direct cable connection is used or a wireless one is established via the Microsoft Surface tablet and the router. The head unit itself is made from resilient titanium.




Figure 4 - Head unit

The functions of the individual parts of the head unit, as shown in Figure 4, are explained below:

- The eye cameras are linked to the frame of the head unit via a mobile swan neck and are aligned with the wearer's eyes. The camera records a black/white video of the eye with a resolution of 640 x 480 pixels and up to 60 frames per second.
- The field camera records a high-resolution, color video of the surroundings that are observed in the test subject's field of vision during the recording. The resolution in this case is 1920 x 1080 pixels at 30 frames per second. To adjust the image of the field camera to the test subject's field of vision, the field camera can be realigned vertically. Magnetic clip-on lenses can also be used to adjust the field of vision between 40° and 90°.
- The nose piece, the brow rest, the side arms and the elastic strap ensures a secure and comfortable position for the head unit on the test subject's head.
- The connecting cable to the cable box or transmitter provides the power supply to the electrical components of the head unit and ensures the flow of data to the relevant system components.


- The infrared LED allows adequate illumination of the eye area.

	<p>If someone wearing the head unit (test subject) impacts with another object (e.g. car airbag, fall), they may sustain injuries.</p> <ul style="list-style-type: none"> • Avoid dangerous situations • Notify the test subject of this potential danger and ask him or her to pay particular attention to safety issues. Ensure that the test subject has understood this and agrees.
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2.2 Recording computer

One important element of the eye tracking system is the recording computer. Whatever the design of your Dikablis system, the recording computer represents the central entity for recording and processing the eye tracking data. The software required to capture the data is supplied on the licensing dongle. If the recording laptop was purchased from Ergoneers, the software is already pre-installed.

Please note that no other additional programs or data may be installed on the recording laptop. The laptop is designed for real-time eye tracking. The installation of additional software may mean that this function can no longer operate correctly.

	<p>The recording computer must satisfy the performance requirements specified for the operation of Dikablis and D-Lab. Ergoneers recommend using a Dell Precision M4800 or equivalent computer. Minimum recommendations:</p> <ul style="list-style-type: none"> • CPU: Intel™ Core i7 • RAM: 8GB 1600MHz DDR3 • Graphics: Nvidia Quadro K2100M 2GB GDDR3 • Hard drive: 2.5 inch SATA 750 GB @ 7200 RPM • OS: Windows 7 Professional 64 Bit <p>Only the Dell Precision M4800 has been tested by Ergoneers and approved for operation with D-Lab. As a result, we are only able to guarantee smooth operation of the software with this computer. It can be ordered as an option with the Dikablis system from Ergoneers.</p>
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2.3 Dikablis Cable

2.3.1 Connector box

The connector box contains some of the electronics required for Dikablis Cable and is shown along with the power pack which supplies current in Figure 5. Figure 6 then shows a detailed frontal view of the connector box. The connections are labeled according to their function and explained below.



Figure 5 - Connector box with power pack

- Status LED
- USB 3.0 port
- Power connection



Figure 6 - Connector box

When establishing plug connections, please always check the compatibility of the plugs being used. The connections involved represent complex plug connections that can easily be damaged by the use of external force. If you feel strong resistance while trying to establish or

release a plug connection, please recheck that the plugs and connecting elements are a match for each other. All plugs are designed so that there is only one jack into which they fit. The red markings on the plug and jack make connecting them easier; ensure that the markings overlap.

2.4 Dikablis Wireless

In addition to the head unit and the connector box described in 2.3, the Wireless system also includes a number of other components.

2.4.1 Router

The WLAN router included in the supplied package is used to transfer the live image captured by Dikablis to a remote recording or monitoring computer. Optionally, it can also act as an access point if it is equipped with a LAN cable. The router can establish a fast 5 GHz network and a normal network for older computers.

2.4.2 Tablet

The data from the Dikablis eyewear is recorded by a Microsoft Surface Pro 3 tablet and the live image is transferred simultaneously via WLAN to the remote computer. Once the eye tracking study is complete, the highly accurate data stored on the tablet can be transferred via WLAN to the analysis computer.

2.4.3 Rechargeable Battery

To operate the tablet and connector box independently of a fixed power source, the Dikablis Wireless system comes with a rechargeable battery that allows Dikablis to be used on the move. The battery supplied is intended for the operation of the Dikablis eyewear. An optional further battery can be purchased from Ergoneers to prolong the tablet's internal battery. One battery charge with Dikablis allows uninterrupted use of the system for around 2 hours.

2.4.4 Backpack

The backpack included has been created to directly address the needs of Dikablis Wireless users. The inlay is designed so that all equipment is held securely in place inside the backpack. The inlay also features a cable management system that ensures the secure position of plug connections.

3 FIRST STEPS

3.1 Commissioning

3.1.1 Dikablis Cable

The complete setup of Dikablis Eye Tracking Glasses Professional Cable with all of the components included in the supplied package can be seen in Figure 7. The system is cable-linked and can therefore only be used within a radius of 3 m from the recording computer. Ergoneers also offer a 5 m cable which can be purchased as an optional alternative. Dikablis Cable is particularly appealing for applications in which the separate handling of the head unit and recording computer is of secondary importance, such as in a fixed-location driving simulator or for use in a usability laboratory.

To commission your Dikablis Cable eye tracking system, proceed as follows:

- Set up the parts of the eye tracking system as shown in Figure 7.
- Start the recording computer and connect the licensing dongle to a USB port. Wait around 1 minute until the hardware components on the recording computer have initialized.
- Start the recording software via the D-Lab icon, which can be found on the desktop of the recording computer.
- The D-Lab interface opens. Configure the eye camera as described in the D-Lab instructions.

The eye tracking system is now ready for use. To record eye data, follow the instructions in the D-Lab manual.

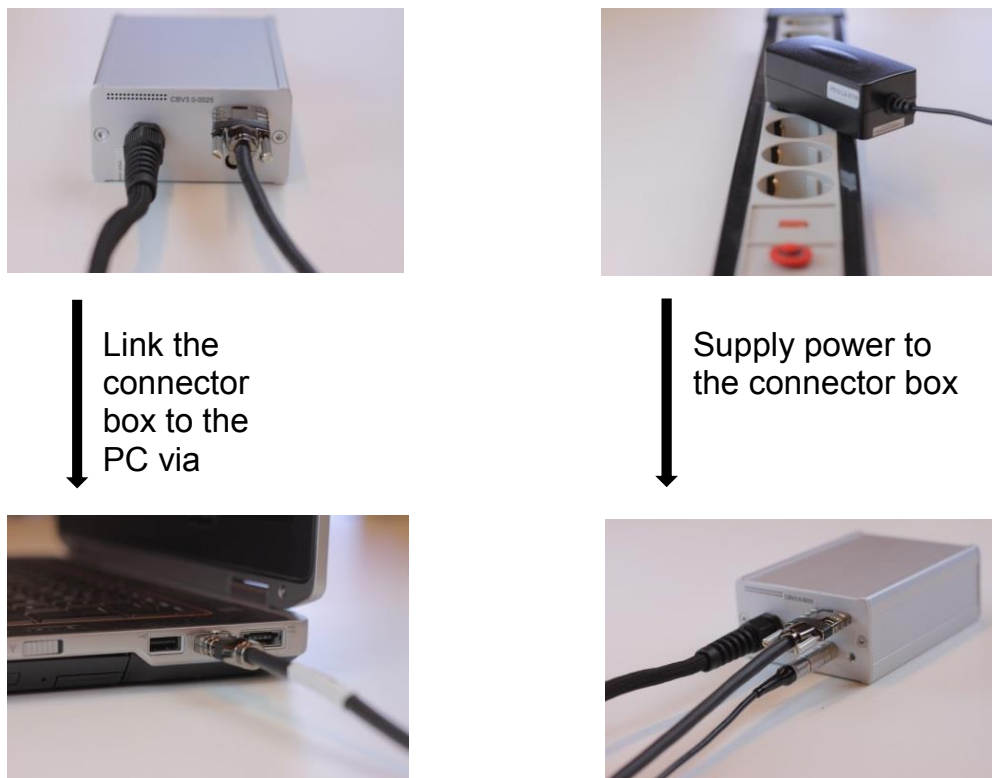


Figure 7 - Flowchart for Cable

3.1.2 Dikablis Wireless

The structure of the Dikablis Wireless system is shown in Figure 8. A special inlay has been provided to secure components in place in the backpack. The use of this inlay is described in the Dikablis Wireless Quickstart Guide. To use the Wireless system, however, other settings must be made to the software and hardware. Once these settings have been made, the Wireless system has a range of around 50 meters in open spaces, making it ideal for motion and outdoor studies.

To set up the system, proceed as follows:

- Connect the router to the power supply and switch it on. Now wait a few seconds until the router is ready for operation. This is indicated by the Power LED lighting up green.
- Now open the network settings of your Surface tablet and connect to the router's WLAN network (Dikablis-Wireless-XXXX-5GHz). Authentication is performed by pressing the WPS button on the reverse of the router or manually by entering the password which can also be found on the reverse.
- Repeat these steps on your recording computer and connect to the network. If you are using an older computer which does not support 5 GHz networks, use the other network available (Dikablis-Wireless-XXXX) on both devices (laptop and Surface).
- Now launch the D-Lab Mini App on your tablet. Once it starts, the program displays the status message "Awaiting connection".
- Now launch D-Lab on your recording computer. D-Lab detects the Surface tablet and the status message on the tablet changes to "Connected".

You can now use the Dikablis Wireless system. To be able to process analysis data after recording it on the recording computer, right-click on the session and download the data. You will find more information in the D-Lab manual.

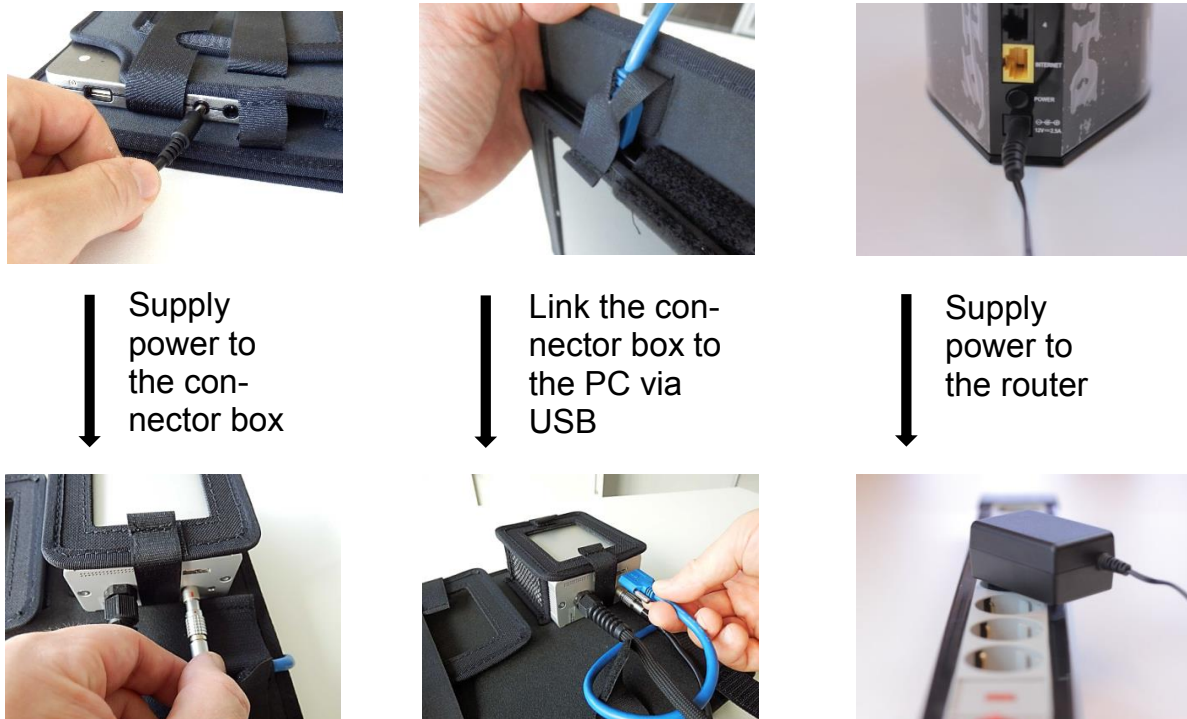


Figure 8 - Flowchart for Wireless

For more information about the backpack inlay, see the Dikablis Wireless Quickstart Guide.

3.1.3 Software installation

Please note that you will need local administrator rights on the computer on which you plan to install the software. To install one or more of the three Dikablis applications, proceed as follows:

- Connect the licensing dongle to a free USB port on your computer.
- Launch Setup, which can be found on the licensing dongle or which can be obtained from an Ergoneers employee.
- Press "Install" to start the installation process. Confirm the prompts. D-Lab is installed and shortcuts to it are created on the desktop. An Ergoneers →Dikablis directory with shortcuts to the installed applications is added to the computer's Start menu.

Please note that the applications must be installed for each user who wishes to work with them.

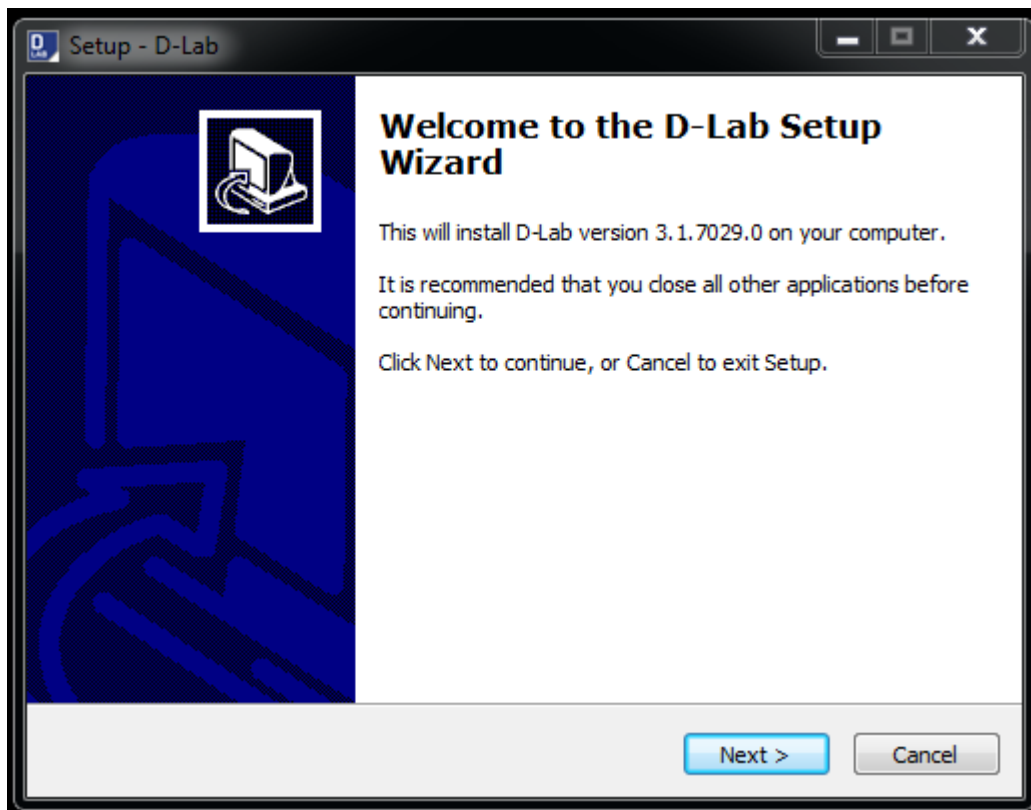


Figure 9 - D-Lab installation

3.1.4 Eyewear positioning and calibration

To ensure that your experiments work as well as possible, it is important to secure the head unit properly to the test subject's head and to set the cameras' recording range correctly. To adjust the cameras, however, the recording computer must be switched on and D-Lab must be running.

To ensure the best possible fit of the head unit on the test subject's head, be aware of the following:

1. To attach the head unit correctly, hold the elastic head strap with one hand and the brow rest with the other. Position the nose rest like a normal spectacle frame on the top of the test subject's nose and pull the elastic head strap over the head so that the forehead rest lies on the forehead. The figure below shows an example of a correctly fitted head unit.
2. Secure the head strap, adjusting the elastic head strap to the required length by pushing and moving the push button. The equipment must not be uncomfortably tight or pinch at any point. The ergonomic design of the head unit improves comfort for the wearer and ensures that experiments can be carried out without hindrance and with greater comfort.



Figure 10



Figure 11

Comment: Dikablis can also be used by spectacle and contact lens wearers. Spectacle wearers should place the head unit over their spectacles, as shown in Figure 11.

Open D-Lab and create a new study. Now open a new visualization and drag the eye tracker to the visualization window as described in the D-Lab manual. The eye camera must be adjusted so that the eye is in the middle of the image, as horizontal as possible and in focus.

The eye camera is attached to a flexible swan neck cable. This type of fastening allows easy adjustment of the camera in front of the eye. The position of the eye camera can be adjusted horizontally and vertically and its orientation changes (cf. figure below).

The text below describes the steps required to achieve the best possible settings of the eye camera. Starting from a completely incorrect setting, the example will show how this can be changed in stages until the result shown in Figure10 is achieved.



Figure 12 - Positioning in front of the eye

Starting out

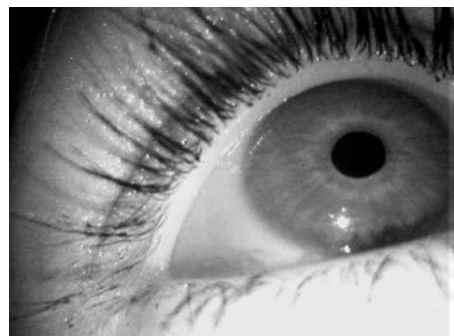
The starting position is shown in the figure below. The settings contain the following errors:

- Camera too close to the eye
- Eye skewed in the image
- Camera too far to the side
- Eye too far up



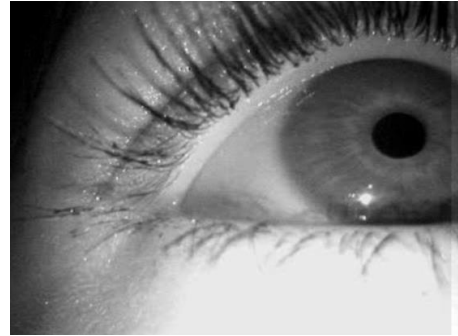
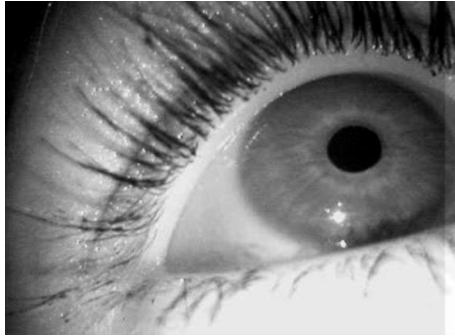
Setting the distance between the eye camera and the eye

You can set the distance between the eye and the eye camera by moving the eye camera towards or away from the eye. You will know when you have reached the correct distance by the fact that the eye camera image comes into focus, as shown.

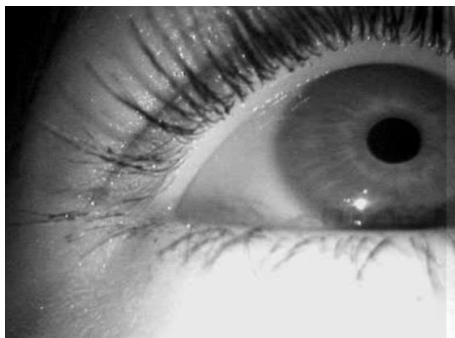


Setting the angle of the eye within the eye camera image

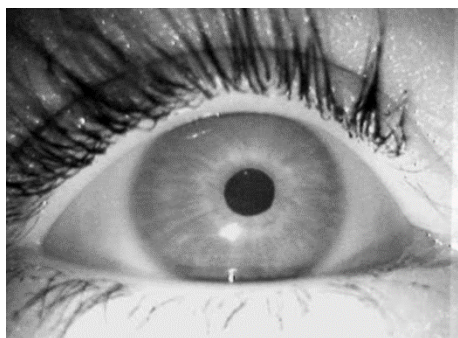
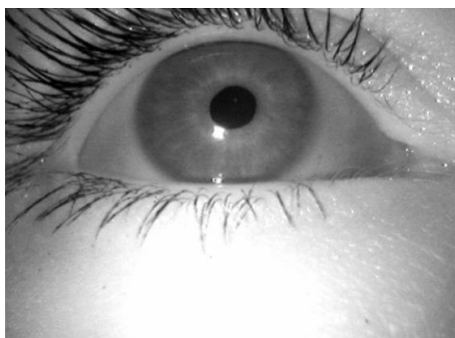
As show on the left, the eye is skewed in the eye camera image. This can be rectified by rotating the eye camera to the correct position. The figure on the right shows the correct setting in which the eye lies horizontally in the image.

**Setting the horizontal position of the eye within the eye camera image**

As can be seen on the left, the eye is pushed very much to the right in the eye camera image and therefore the camera is unable to permanently record it. Move the camera to the right or left in front of the eye to adjust the horizontal position of the eye in the eye camera image. The figure on the right shows the horizontal position after successful adjustment.

**Setting the vertical position of the eye within the eye camera image**

The final step of the adjustment process is the correct vertical setting of the eye in the eye camera image. To do this, move the camera upwards or downwards in front of the eye. As the figure on the left shows, the eye is positioned too far up in the eye camera image. Tilting the eye camera downwards slightly allows the correct vertical setting to be achieved, as shown on the right.



Position of the eye camera in front of the eye

The swan neck allows the vertical position of the eye camera in front of the eye to be changed across a suitably large area. The following illustration shows a correctly aligned camera.

If the test subject has long eyelashes which partially cover the pupil when the eye is being filmed directly from the front, it is recommended that the eye be filmed more from below, since the camera can then film underneath and past the eyelashes. To reduce the effect of the eyelashes on pupil detection, the masking options in the pupil detection settings can also be used.



Figure 13 - Correctly aligned eyewear

The scene camera looks forward and "sees" what the test subject sees. Open D-Lab and drag the eye tracker into a visualization window. Now examine the represented area of the scene camera in the preview window. If the surroundings being investigated are not shown as desired, you will need to adjust the field camera accordingly. To do this, apply gentle pressure to the scene camera and align it either upwards or downwards. Ensure that the test subject assumes the same position that he would for the experiment.

4 TECHNICAL DATA

The following tables show the technical data for the various components in the Dikablis system

4.1 Head unit

Structure material	Titanium
Field camera adjustment range	Horizontal setting corresponds to 0° + 15° (upwards) - 45° (downwards)
Eye-Cam adjustment range	Freely adjustable via the "swan neck"
Head size adjustment range	The test subject's head size can be freely set via a drawstring stopper.
Voltage supply	12 V DC
Current consumption	Max. 650 mA


4.2 Field camera

Active image area	4614 µm x 3444 µm
Array size	8MP / 3296 x 2460 pixels
Pixel size	1.4 µm x 1.4 µm
S/N ratio	35.7 dB
Lens size	1/3.2" optical format
Resolution	1920 x 1080 @ 30 fps
Operating temperature	-10° to 40°

4.3 Eye camera

Sensor	1/4" CCIQIII B/W camera
Effective image area	3.8(H) x 2.9(V) x 4.86(D)
Effective pixels	640 x 240 (NTSC)
Pixel size	6µm x 6µm
Lens	3.9 mm / F2.8
Operating temperature	- 10° to 40°

4.4 Infrared LED

	<p>The Dikablis eye tracking system uses an infra-red light source to illuminate one or - in binocular applications - both eyes. To ensure eye safety and to exclude any risk to the eyes, the IR-LED built into the device has been tested extensively by an independent laboratory in accordance with DIN EN 62471 ("Photobiological Safety of Lamps and Lamp Systems") for the application scenario of eye tracking documented here and classified as completely harmless in the standard's "risk-free group".</p> <p>All of the resulting measurement values from the IR-LED test are several times below the threshold value set by the above standard for risk. These critical threshold values are never reached at any point, which means that the exposure time does not need to be limited either. As a consequence, Dikablis is also suitable for long-term studies.</p> <p>Ergoneers GmbH does everything possible to ensure the safety of Dikablis users. And although the IR-LED used - as described above - is classed as safe and harmless, everyone is different and perceives influences differently. If you should feel unexpectedly unwell, experience headaches or other symptoms while using Dikablis, we advise stopping its use and waiting 1 hour before using it again.</p> <p>If the symptoms recur when you start using Dikablis again, please contact Ergoneers GmbH without delay in order to check whether the problem is due to a technical defect or a general incompatibility with the system.</p>
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Size	Flat top 2 x 2 mm
Opening angle	110°
IR emitter	875 nm TS AlGaAs, 17 mW/sr, 40 ns
IR detector	PIN Photodiode High Sensitivity Speed 7.5 ns
Current consumption	500 µA to 500 mA

4.5 Connector box

Video processing	2 channels + 2 monitoring channels
Video input	2 x CVBS 1Vpp 75 PAL (only via Ergoneers head unit)
Video output	2 x CVBS 1Vpp 75 PAL
Video monitoring output	2 x CVBS 1Vpp 75 PAL, optional

Primary	100 – 240 V AC
Secondary	12 V 2.0 A DC

4.6 Microsoft Surface Pro 3

	<p>Avoid direct sunlight on the tablet. Overheating can cause irreparable damage to the device.</p> <p>If the device has switched itself off due to exposure to excessive outdoor temperatures or intense sunlight, place it in a cool, dark place until it cools down.</p>
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Screen size	12.3 inches
CPU	Intel™ Core i5-6300U, Dual Core
RAM	8 GB
Hard drive	256 GB
Voltage supply	12 V

4.7 D-Link router

Device interfaces	802.11 a/b/g/n/ac WLAN 4 Gigabit LAN connections USB connection
Operating temperature	0° to 40°
Voltage supply	12V
Current consumption	2.5A

4.8 Rechargeable Battery

Battery technology	Lithium-polymer with 74 Wh
Voltage, Volt [V]	Variable: 12 V, 16 V, 19 V
Capacity [mAh]	20000 mAh
Charging voltage [V]	16-20V max. 1.3 A
Complete charging duration [h]	Approx. 3-4 hours at 20 V (from 0 to 100%)
Weight	561 g

5 WARRANTY AND LIABILITY CLAIMS

5.1 Claims for defects

Compliance with the instructions for use is essential for fault-free operation and the validity of any claims for defects. **You must therefore read the instructions for use before working with the Dikablis system!**

Ensure that the instructions for use are available in a legible condition to all people who work under their own responsibility with the Dikablis system.

5.2 Guarantee and customer service

Before shipping, our systems are subjected to rigorous quality checks. If damage occurs despite all our care during production or transport, please return the device to your dealer. In addition to statutory warranty claims, the purchaser shall also be entitled to claim based on the following guarantee:

We offer a one-year guarantee for the Dikablis system, starting from the date of purchase. During this period, we will make good any defects that are demonstrated to be due to material or production problems either through repair or replacement.

Defects caused by incorrect handling of the device and malfunctions caused by interventions and repairs by third parties or the installation of third-party components are not covered by this guarantee.

5.3 Liability disclaimer

Compliance with the instructions for use is essential for the safe operation of the Dikablis Cable and Dikablis Wireless eye tracking systems and for the fulfillment of the specified product characteristics and performance features. Ergoneers GmbH accepts no liability for any physical, material or immaterial damage resulting from non-compliance with the instructions for use. Liability for material defects is excluded in such cases.

6 GLOSSARY

Eye camera

Camera attached to the head unit that films the test subject's eye. The camera can be positioned manually via a flexible cable.

Recording computer (recording PC)

Computer supplied with the eye tracking system with pre-installed hardware and software

Recording software (D-Lab)

Application for recording and analyzing eye data.

Blending mode

A display option for the view film, via which a semi-transparent image of the eye camera is overlaid on the field camera video.

Eye tracking experiment (experiment, subject)

Eye tracking data for a participant of a view study.

Connector box

Device which receives signals from the head unit, processes them and then forwards them via the USB cable to the recording computer.

Scene camera / surroundings camera

Camera attached to center of the head unit that records the surroundings. The lens is interchangeable. The focus range can be defined either manually in the software or controlled automatically.

Head unit

Eyewear-like construction worn by the participants of the eye tracking experiment. Two cameras are attached to the head unit which film the test subject's eyes and the surroundings.

Licensing dongle

Allows the execution of applications and contains licensing data. For D-Lab to start, the dongle must be connected to a USB port on the recording computer.

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