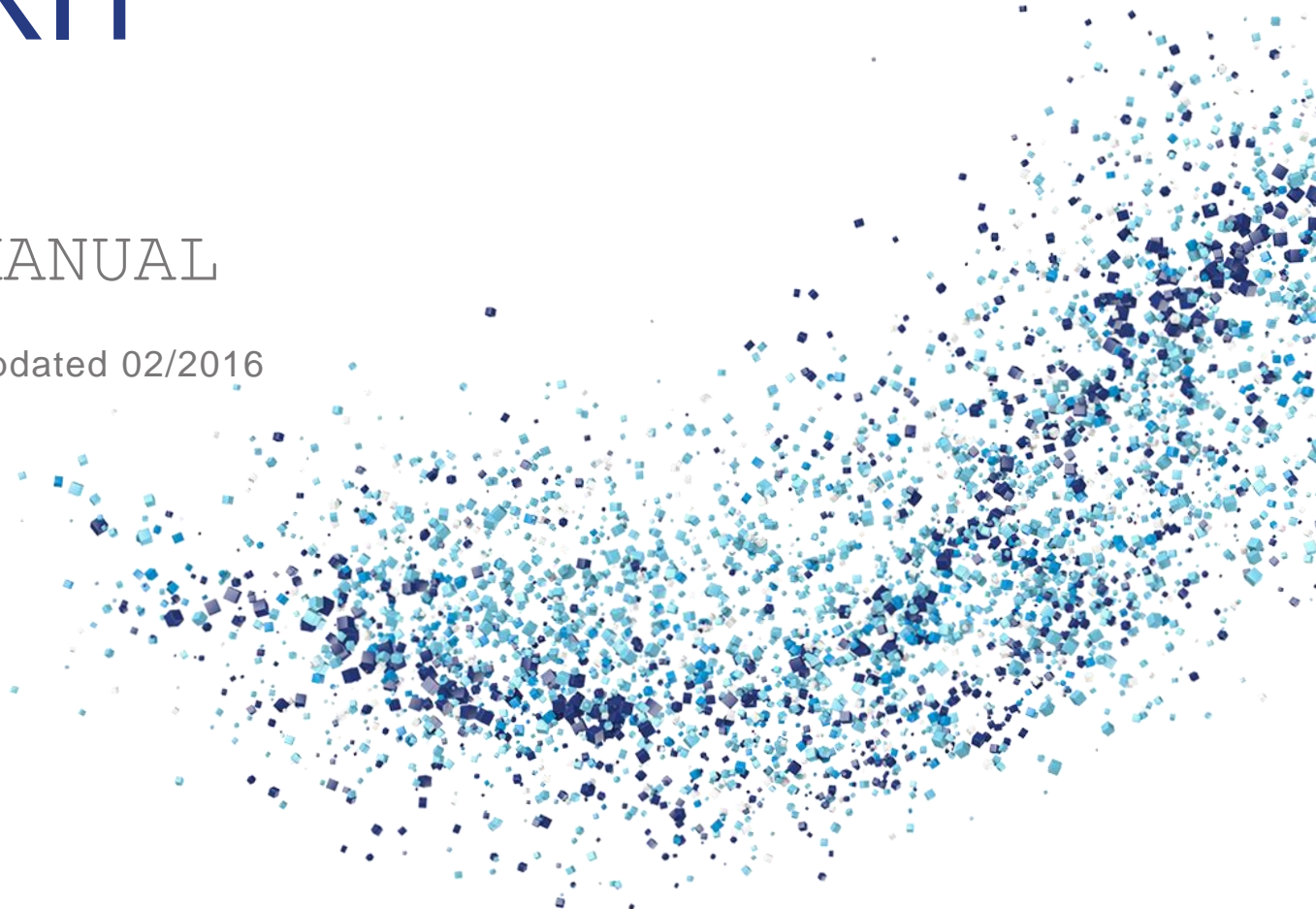


ERGONEERS
FROM SCIENCE TO INNOVATION

VEHICLE TESTING KIT

MANUAL

Updated 02/2016



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Dear Customer,

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

All kinds of studies can be carried out with the VTK. It allows you, for example, to carry out benchmark studies and even "real-world driving" studies in cars. These studies do not take an experimental approach, but rather investigate the natural behavior of road users under real conditions in road traffic. The road users, especially the motor vehicle driver, are observed as unobtrusively as possible over a long period.

The aim of these studies, for example, is to assess the impacts of driver assistance systems on driving behavior, the behavior-optimized design of operational interface or viewing behavior assessment in safety-critical situations. The list of possible uses for the Vehicle Testing Kit goes on and on.

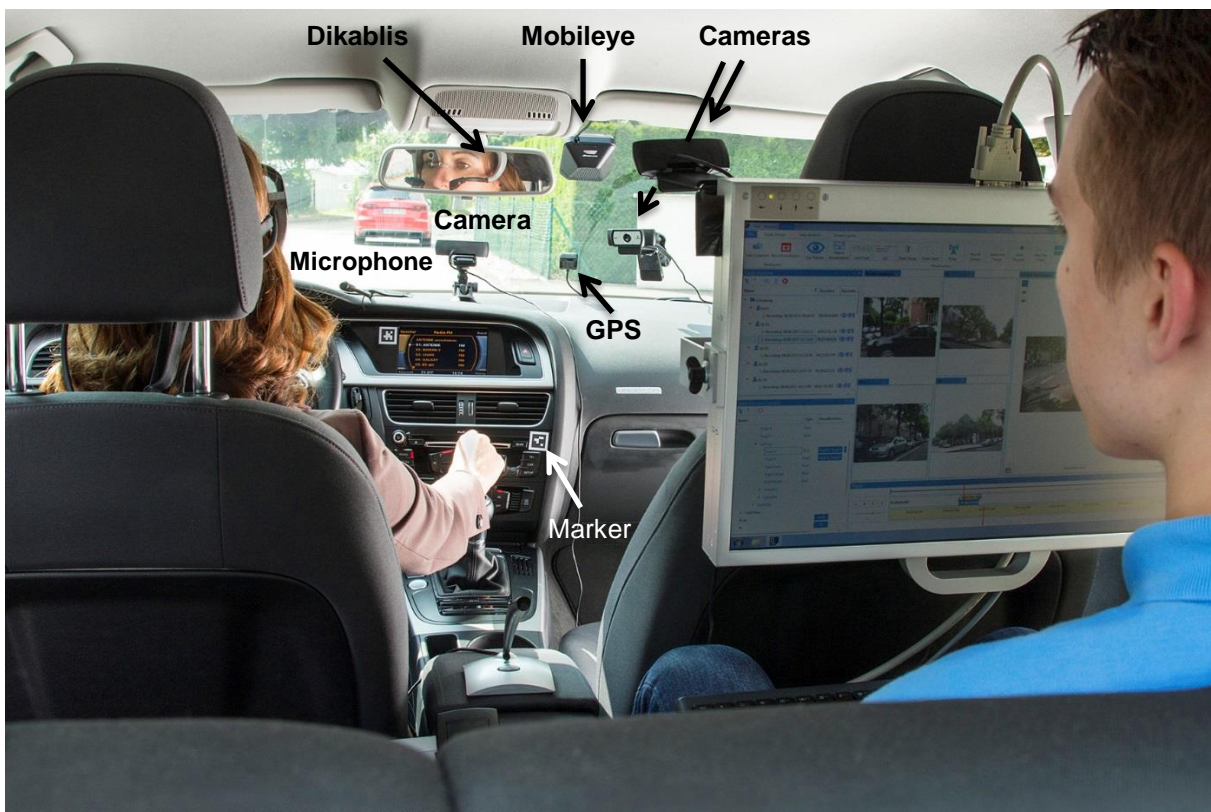


Figure 1 – VTK in operation in a "real-world driving" study

Various types of sensor are used, such as GPS, microphone and cameras that are connected to the VTK (see Figure 1). These are already included as standard with the Professional version.

Viewing data can also be recorded using the Dikablis eye tracking glasses and vehicle data can be captured both by the motor vehicle's CAN bus and by the Mobileye CAN bus. The Dikablis glasses and Mobileye are included as standard with the Enterprise version.

The VTK is optimized for use with D-Lab. D-Lab is the Ergoneers software with which the data from the connected sensors can be synchronously collected and then evaluated. The custom-combinable measurement and analysis modules mean that the software adapts flawlessly to the demands of the study or investigation and therefore supports the entire experiment process from planning and synchronous data capture to the analysis and visualization of results. The Professional and Enterprise versions come with corresponding D-Lab modules already included. These offer intuitive and straightforward processing of your experimental data.

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

To operate the D-Lab software, reference is made to the D-Lab manual, which discusses in detail all aspects of time-synchronized data recording and the evaluation of measured data. We are delighted that you have chosen a product from Ergoneers, and we very much hope you enjoy using the Vehicle Testing Kit.

Your Ergoneers Team

1. General information

1.1 Safety information

Read this manual 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. If the safety information and details of proper use in this manual are not followed correctly, we accept no liability for any resulting personal injury or material damage. The warranty / guarantee will also be rendered void in such cases.



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

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 VTK must never be connected simultaneously to the cigarette lighter and mains power. Doing so can damage the VTK.
3. Power packs and batteries must not be exposed to direct sunlight.
4. Remove the batteries if the VTK is not going to be used for some time.
5. The batteries must not come into contact with metallic objects. The batteries could short-circuit, discharge, heat up or leak and cause damage.
6. The batteries must not be exposed to fire, water or high temperatures. They can explode, leak, and cause damage.
7. The VTK must not be used if the batteries, cigarette lighter cable, cigarette lighter plug, mains cable, mains plug or other current-carrying cables or plugs are damaged.
8. Never operate the VTK unsupervised.
9. Plugs should not be connected with force. This applies to all plugs that are connected to the case or associated components such as the monitor, Dikablis glasses, chargers for batteries, etc.
10. Handle the VTK carefully. It should not be dropped or exposed to impacts. Heavy impacts, blows or falls from even a moderate height can damage it. If it is sent via the mail, it must be secure and well padded and packaged appropriately for its weight.
11. The VTK housing does not contain any parts that can be maintained by the user. Opening of the device casing and any accessory parts or their repair must only be carried out by an Ergoneers service engineer. Otherwise the guarantee will be rendered void.
12. Before the system is commissioned, ensure that the supply voltage specified on the type plates of the individual components matches that of the voltage available at the place of use. This applies to mains voltage as well as battery and vehicle voltage. An incorrect supply voltage can destroy the device.
13. The system must only be operated with original Ergoneers accessories or Ergoneers-approved accessories. No liability is accepted for damage caused by third-party accessories or non-approved accessories.
14. If any modification is made without the written consent of Ergoneers, the guarantee shall be rendered void.

15. Please also note the safety information and operating instructions for the other devices that are connected to the VTK.

If you are in any doubt about the way the VTK works, its safety or how it is connected, or if you have any other questions that are not answered in these operating instructions, please contact Ergoneers Support (support@ergoneers.com)

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 Liability disclaimer

Compliance with the instructions for use is essential for the safe operation of the VTK and for the fulfillment of the specified product characteristics and performance features.

You must therefore read the instructions for use before working with the system!

Ensure that all people who will be working with the system have access to the instructions for use.

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.

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

1.4 Disposal



Electrical and electronic equipment as well as spent batteries and accumulator batteries must not be disposed of in domestic waste. Their constituent parts must be taken for recycling or disposal because they contain toxic and hazardous elements which can harm the environment if disposed of incorrectly.

As a consumer, you are obliged to return electrical and electronic equipment to the manufacturer, retailer or public collecting points provided for this purpose free of charge at the end of the equipment's useful life. The individual terms and conditions for this are subject to state law. The symbol on the product, the instructions for use and/or the packaging indicates the applicable terms. With this type of material separation, recycling and disposal of equipment, you are making an important contribution towards protecting our environment.

1.5 Supplied package

1.5.1 Hardware



Figure 2 - Supplied package for VTK Professional

VTK Professional includes the following system components:

- VTK main unit (computing unit in case)
- LCD screen with bracket
- 4 USB cameras and 4 USB extension cables
- 4 camera brackets with suction cup for securing to the windshields
- 1 camera bracket for securing to the headrest
- 2 x 12 V batteries
- 1 charger for the batteries
- 1 keyboard with touchpad
- 2 clip-on microphones with USB sound card
- 1 trolley
- 2 ISOFIX belts for securing to the back seats
- 1 standard belt extender
- 1 Ergoneers accessories bag (messenger bag)
- 1 USB license dongle for the D-Lab measurement and analysis modules:
 - D-Lab Audio Professional

- D-Lab Video Essential
- D-Lab CAN Bus Essential

VTK Enterprise includes the following system components:



Figure 3 - Supplied package for VTK Enterprise

- All of the components from the Professional version
- GPS sensor
- Mobileye, a camera-based driver assistance system
- Dikablis Professional Cable eye tracking glasses
- The supplied license dongle also includes the following D-Lab measurement and analysis modules in addition to the modules in the Professional version
 - D-Lab CAN Bus Professional
 - D-Lab Data Stream Professional
 - D-Lab Eye Tracking Head Mounted Professional

1.5.2 Software

The D-Lab software is already pre-installed on the computer of the VTK main unit. The supplied package includes a USB license dongle which contains the measurement and analysis licenses listed in the previous section and which you will need to be able to use D-Lab. This dongle also contains installation files for D-Lab so that the software can also be restored or reinstalled if necessary at a later date. It is therefore also possible to install D-Lab on another computer in order to be able to analyze the data recorded. The computer specifications recommended for operation with D-Lab can be found in the FAQs database under the entry "Getting Started". (www.ergoneers.com/faq/).

To operate the D-Lab software, reference is made at this point to the D-Lab manual, which discusses in detail all aspects of time-synchronized data recording and the evaluation of measured data.

2. Description of the VTK hardware and its function

2.1 Main unit

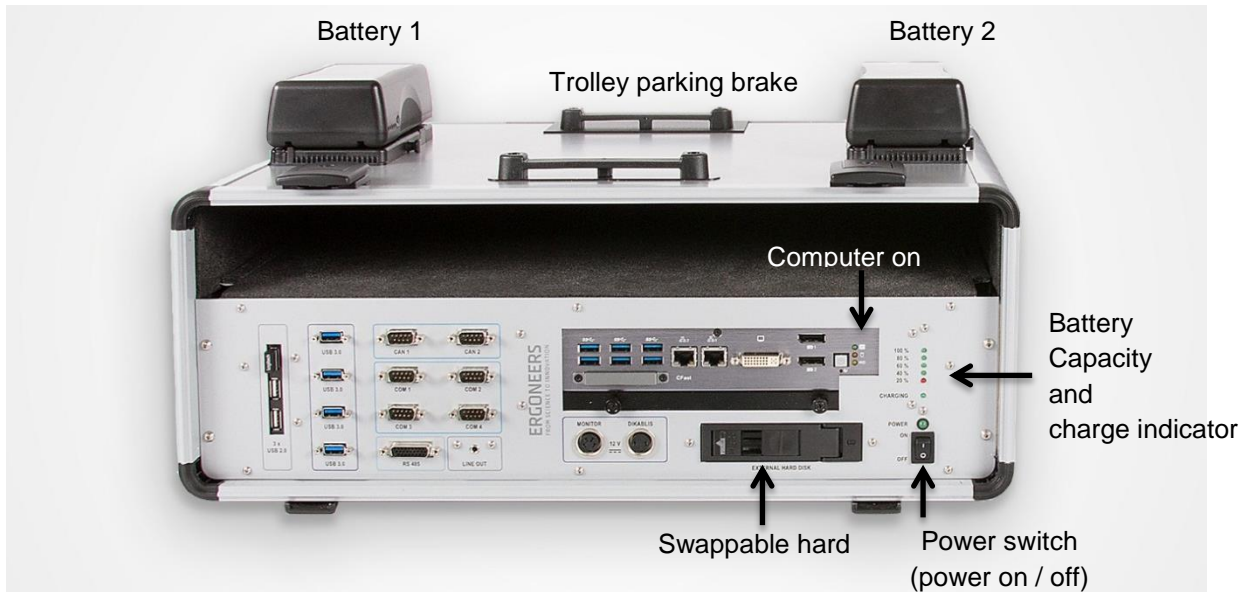


Figure 4 – VTK main unit with two batteries attached

The VTK main unit is the core of the Vehicle Testing Kit. It contains a computer unit with various interfaces for the sensors that can be used. These are described in more detail in the sections below.

2.1.1 Power supply

The VTK can be supplied with power in three different ways. Via a mains voltage of 100 - 230 V, using the cigarette lighter adapter with a motor vehicle voltage of 12 V and using the two supplied batteries, which are connected to the top of the case. The VTK is switched on using the operating switch at the bottom right. This is responsible for the entire voltage supply; if it is switched on and one of the three sources of voltage are connected, then the VTK computer can be started by pressing the corresponding actuator button (see Figure 4). The power switch therefore only switches the power sources on or off, not the actual computer! This has the advantage, for instance, that the batteries can be charged without the computer having to be operational at the same time.



Note: The power switch only switches the power on, not the computer! This is started by pressing the corresponding actuator button.



Note: Never remove or change the power supply while the device is in operation! This can damage the computer and also the data it contains, as well as any connected devices. The exception to this rule is the replacement of batteries, provided two are connected simultaneously - but only then!



Note: While the computer is running, the operating system must always be shut down first before switching off the power supply with the power switch. If the power switch is switched off while the computer is still running, this can cause data loss and damage to the application software or operating system!

2.1.1.1 Operation based on mains power

The VTK can be operated using the cold-device plug located on the right-hand side on a mains grid at a voltage of 100 - 230 V. If the batteries are connected at the same time, these are automatically charged (see also Section 2.1.1.3).



Note: In order to avoid overheating and prevent damage, the device must not be operated on 100 - 230 V mains voltage and 12 V motor vehicle voltage at the same time!

2.1.1.2 Motor vehicle battery operation (current from the motor vehicle battery)

With a supply voltage of 12 V, the VTK can be operated in a motor vehicle with the help of the 3m long cigarette lighter connecting cable supplied.



Note: When operated in the motor vehicle, the VTK should always be operated in tandem with at least one battery or both batteries! These act like an uninterruptible power supply, for example if there are fluctuations in the on-board voltage supply or if voltage peaks occur, and also if the ignition is switched off. Otherwise there is a danger that the current will be interrupted and the computer switched off without shutting it down properly first. Loss of data and damage to the application software or operating system may result!

Additional connected batteries are not normally charged since the capacity of the motor vehicle battery is not sufficient for the simultaneous operation of the VTK, all vehicle functions and charging of the batteries. If however the engine is switched off, key vehicle functions are stopped and the motor vehicle battery's energy is sufficient to charge the batteries. This depends greatly, however, on the motor vehicle used and the characteristics of the motor vehicle battery. So please therefore be aware:



Note: If the engine is not running and the VTK is being operated with the 12 V on-board voltage network, it is possible that the battery or batteries, if two are connected simultaneously, will discharge the motor vehicle battery. To ensure that the motor vehicle battery is not discharged to the point where the motor vehicle can no longer be started, the engine should be left running while using the VTK in the motor vehicle - but not in a garage or other closed environment; the exhaust gases emitted by the engine can be toxic!

2.1.1.3 Battery operation, battery charging procedure and displaying the remaining capacity

The VTK can also be operated with the two supplied batteries, which can be inserted into the two "V-Mount Power Plates" provided on the top of the case. When fully charged and depending on how many sensors the VTK needs to supply, the VTK can be operated for up to three hours independently of the mains supply and motor vehicle power supply. However either the 12 V motor vehicle voltage supply or the 100 - 230 V mains voltage can be added. If the batteries are connected to the VTK while it is also connected "to the power socket", i.e. the mains voltage supply, then the batteries will be charged. This situation is indicated by a green LED marked "Charging" above the power switch and the green operating LED (see Figure 4). All batteries are always charged evenly, regardless of whether only one or both batteries are connected at the same time.

Indicated directly above the operating LED is the residual battery capacity. Five LEDs - four green, one red - are used for this (see Figure 6). If the four green LEDs light up, the batteries are fully charged. If only three light up, then the batteries still have a capacity of 80% or less. If two LEDs are lit up, the capacity is 60% and if only one green LED lights up, then the maximum residual capacity is 40%. As soon as the last green LED goes out, the red LED lights up. This indicates that the capacity is only around 20% and the batteries will need to be replaced soon. Around 10 minutes before they discharge completely, a warning sound is emitted to indicate that the batteries now need to be replaced. Data should be backed up straight away, the computer shut down and then switched off.

If fully charged replacement batteries are available, it is also possible to replace the batteries while the VTK is still running. Care should simply be taken to ensure that the power supply to the VTK is not interrupted during the replacement procedure, i.e. at least one battery must always remain connected to the device while the other one is being replaced.



Note: The display of battery capacity on the VTK always relates to all of the connected batteries together. This means that a display of 100% relates to both together when two batteries are connected. As an example, if one of the batteries is empty and the other is full, only a residual capacity of around 50% would be displayed.

If it is ever not possible to charge the batteries on the VTK case itself because the case will remain in the motor vehicle, for example, or if replacement batteries are going to be used to continue using the VTK, the batteries can be removed and charged elsewhere using the supplied charger. The battery has a charging socket for this, to which the female plug of the charger is connected. The operating LED on the charger lights up red until the battery is fully charged. The charging process is complete once the LED lights up green (see Figure 5).



Figure 5 – Charging a battery with a charger

... During the charging process, the LED on the power pack is red

... The charging process is complete, the LED is green

The residual capacity of each battery can be displayed at any time by pressing the corresponding button on the battery (see Figure 6, left).



Figure 6 – Capacity indicator
... on the battery

... on the VTK with the battery connected

2.1.1.4 Operating the VTK outside a motor vehicle

The VTK can of course also be operated outside a car. The use and cabling of the individual devices remains the same as when operated in a car or in a driving simulator. It then acts virtually like a completely normal desktop computer that can be used on a desk. As described in the previous sections, the VTK can in this situation be operated with a mains voltage of 100 - 230 V and/or with the two batteries.

The advantages of this "desktop operation" are obvious:

- Both the recording and the analysis of data can take place on the VTK computer. As a result, it is not necessary to transfer the data to another computer either by copying it or by using the swappable hard disk.
- With the simultaneous use of mains voltage and batteries, the batteries are charged in parallel to the VTK's use.
- It is possible to connect the computer via one of the two Ethernet connections to a network in order to exchange data, for example, update software or drivers or install new software.

2.1.2 Interfaces and available USB bandwidth

In addition to the power connections for the monitor and Dikablis eye tracking glasses, the VTK also offers several permanent interfaces for connecting all kinds of sensors. In total, the VTK offers the following interfaces:

Display:	1 x DVI-I, 2 x display ports for monitors
USB:	10 x USB 3.0, 3 x USB 2.0, offering a wide variety of uses
COM:	4 x RS 232, 1 x RS 485, e.g. for physio sensors or specific HW control
CAN:	2 x CAN, e.g. for Mobileye or vehicle data
Network:	2 x Gigabit Ethernet, e.g. for use with D-Lab Data Stream
Audio:	1 x line out, e.g. for connecting a loudspeaker

One of the most frequently used interfaces is the USB. As a result, the VTK offers 12 permanent sockets when you remember that the thirteenth socket is always occupied by the keyboard's radio receiver. The number of sockets can be increased further by using a hub, for example.

However there is a limit on the number of USB devices that can be used simultaneously, and that limit is the availability of bandwidth. This is explained as follows: The VTK has a total of

three USB controllers. One USB 2.0 and two USB 3.0 controllers (see Figure 7). According to the specifications, USB 2.0 offers a data transfer rate of 480 Mbit/s, while USB 3.0 offers a gross rate of 5 GB/s. The data rates quoted are however theoretical values which are not achieved in practice, so with USB 2.0 a rate of around 320 Mbit/s (40 MByte/s) can be assumed in practical terms, while USB 3.0 can be expected to offer a usable data rate of around 2400 Mbit/s (300 MByte/s). These values in principle represent the maximum bandwidth for each controller.

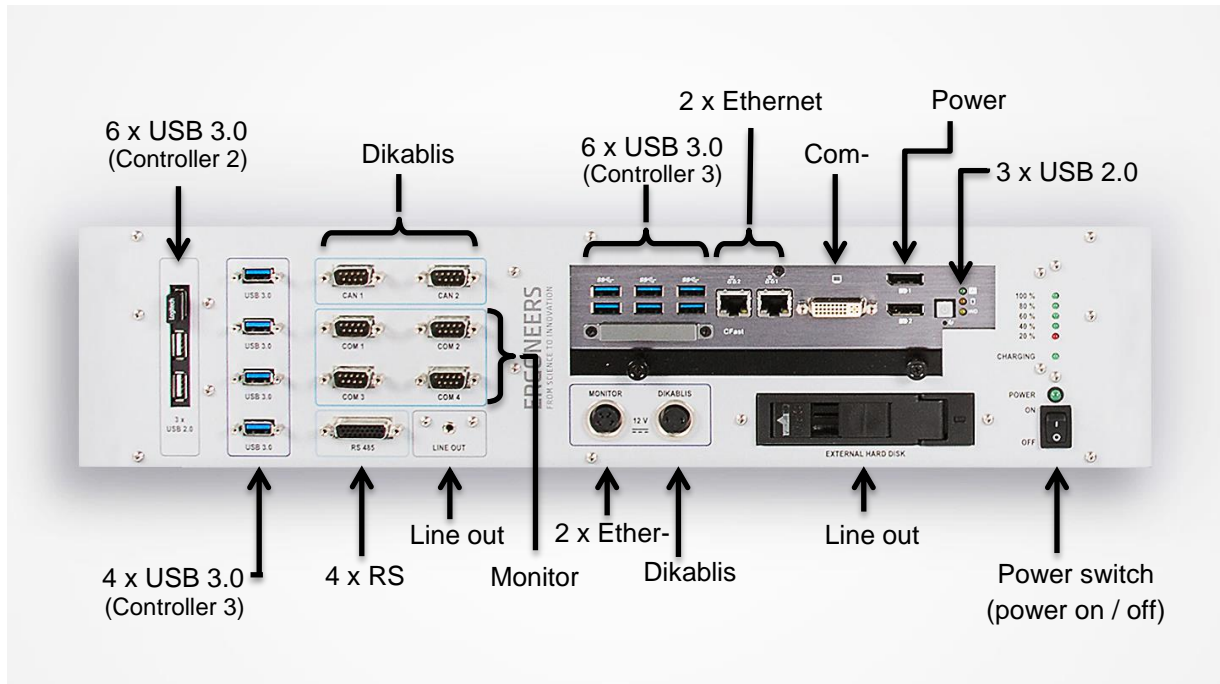


Figure 7 - Front plate of the VTK with all of the available connections

This means that all devices that are connected to one and the same controller must share this bandwidth or data transfer rate. If a controller's available bandwidth is exhausted, no further devices can be operated. A camera, for example, that transfers 30 images per second at a resolution of 1920 x 1080 pixels will generate $1920 \times 1080 \times 30 \times 3 \text{ byte / pixel} = 178 \text{ MByte/s}$. If the color is reduced to 2 byte / pixel, the bandwidth is still around 120 Mbyte/s. Please bear in mind that this is the value achieved with uncompressed data. Two cameras at a data rate such as this would therefore generate around 240 Mbyte/s and would work simultaneously on a single USB 3.0 controller (provided USB 3.0 devices are used; USB 2.0 devices would also at most have the USB 2.0 bandwidth available even connected to a USB 3.0 port). The full HD webcams supplied are USB 2.0 devices which compress data, allowing several cameras to be connected simultaneously to one controller, depending on the resolution chosen.

The calculation also makes it clear that the data rate falls as the resolution of the cameras decreases, allowing multiple cameras to be connected to a single controller; this has the disadvantage of lower resolution.

In light of these considerations, it is evident that many sensors connected simultaneously must be distributed evenly over the VTK's three controllers. Since it is not possible to quote an exact data rate for any device, only recommendations can be offered for the connection of multiple devices. For the sensors included in the package supplied with the VTK, experience has shown that they should be distributed over the 3 controllers as follows:

Controller 1 (USB 2.0): Keyboard radio receiver, D-Lab license dongle, 1 x full HD webcam

Controller 2 (USB 3.0): Dikablis eye tracking glasses, 1 x full HD webcam, 1 x microphone

Controller 3 (USB 3.0): 2 x full HD webcam, 1 x microphone, GPS sensor

For the cameras, we recommend initially choosing a low resolution (e.g. VGA at 640 x 480 pixels) and gradually increasing it if no errors or drop-outs occur.

2.1.3 Swappable hard disk

In studies involving lots of test subjects who spend a long time being investigated, the VTK's data memory can in some cases become full. To be able to record as much measurement data as necessary, the VTK has been equipped with a swappable hard disk which can be replaced at any time with an "empty" hard disk or SSD.

When shipped, the shaft of the swap frame contains a 1 TB SATA hard disk. Essentially, all 2.5" hard disks and SSDs with dimensions of 9.5 to 15mm can be used that are SATA I, SATA II or SATA III-compatible.



Figure 8 - Opening the drawer compartment and removing the swappable hard disk

The swappable hard disk is located on the front plate of the VTK below the computer unit (see Figure 8). To swap the disk, the computer must be shut down and the VTK switched off using the power switch. A locking mechanism on the frame prevents the slide-in compartment from being opened inadvertently. This lock must first be released by pushing it all the way to the right. This provides access to the lever on the left hand side.

Using one finger, reach in and pull the lever so that the doors to the hard disk compartment open. If the doors are opened fully, the hard disk is ejected automatically. This allows it to be removed from the housing (Figure 8). When removing the disk, note its position and insert the new hard disk in exactly the same position in the shaft. Without using force, push it into

the shaft until it stops. Do not continue pushing it further in. Instead, close the doors. The locking mechanism moves the hard disk to the correct position. To lock it in place, move the slider back to the left.



Note: The doors of the slide-in compartment must not be opened with force and the hard disk must not be pushed in forcibly by hand.



Note: In some circumstances, after a new hard disk / SSD is used for the first time, a setting needs to be made in the operating system so that it can be recognized. If it is not automatically detected in the system, please contact Ergoneers Support (support@ergoneers.com).

2.2 Screen with bracket



Figure 9 – Chief investigator station on the back seat. The VTK is behind the driver and the monitor is secured to the headrest on the passenger seat.

The screen is supplied with power from the VTK main unit and can be secured to the passenger seat headrest using the bracket supplied.

To ensure that the residual capacity of the battery is always in view, even when the VTK has been secured in the luggage compartment, for example, the monitor has the same charge level indicator as the one on the VTK itself (see Figure 10, left). Its function has already been described in detail in Section 2.1.1.3.

Just like the other conventional computer monitors available nowadays, the four buttons on the bottom right-hand side of the VTK monitor can be used to make various settings, such as the color, brightness and contrast. Pressing the "Menu" button causes the menu to appear with the various sub-menus. This menu structure is navigated using the "+" and "-" buttons. Pressing the "Menu" button again takes you back to the sub-menu previously selected. Pressing the "Enter" button takes you back again. The display values are also set using the "+" and "-" buttons and confirmed with the "Enter" button.

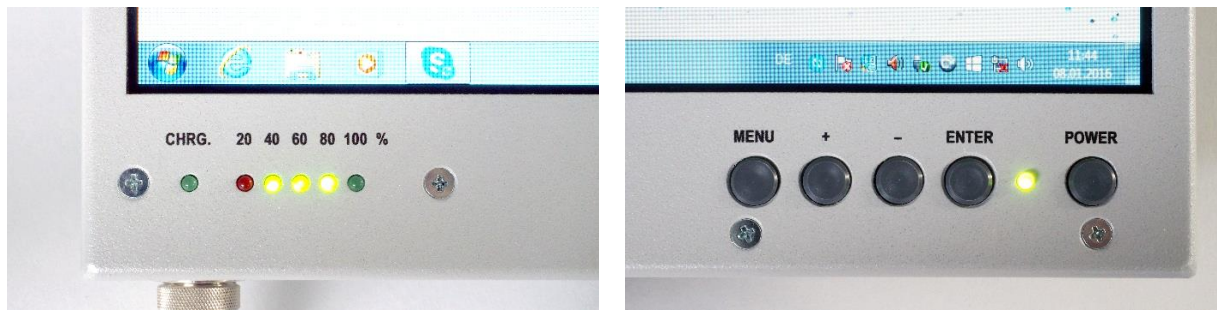


Figure 10 – Monitor operation:

.... Battery capacity and charge indicator

...Control elements

2.3 Accessories

2.3.1 Cameras and their securing options

Included in the package supplied with the Professional and Enterprise versions are four high-quality full HD web cameras, four suction cup brackets and a headrest bracket to allow various investigation situations to be recorded on video. The cameras can be secured at favorable points in the car and oriented towards objects being observed, locations and people in order to observe the driver, for example, the driving situation, the vehicle control elements, and the surroundings.



Figure 11 - Camera

... on a suction cup bracket



... on the headrest bracket

The cameras themselves do not have any elements that can be controlled; they are set and controlled exclusively via the software. The connection to the VTK is created via USB 2.0 and, thanks to the built-in microphone, records not only the images but also the sound. The sound recording can be suppressed in the D-Lab software, however, provided the sound does not need to be recorded as well. D-Lab can also be used to set the camera resolution. Each of the camera brackets comes equipped with a quick-change device, to which the camera can be simply clipped and secured using the knurled screw on the side. To release the camera from the quick-change device, the knurled screw must be undone and the pin pulled out (see Figure 12).

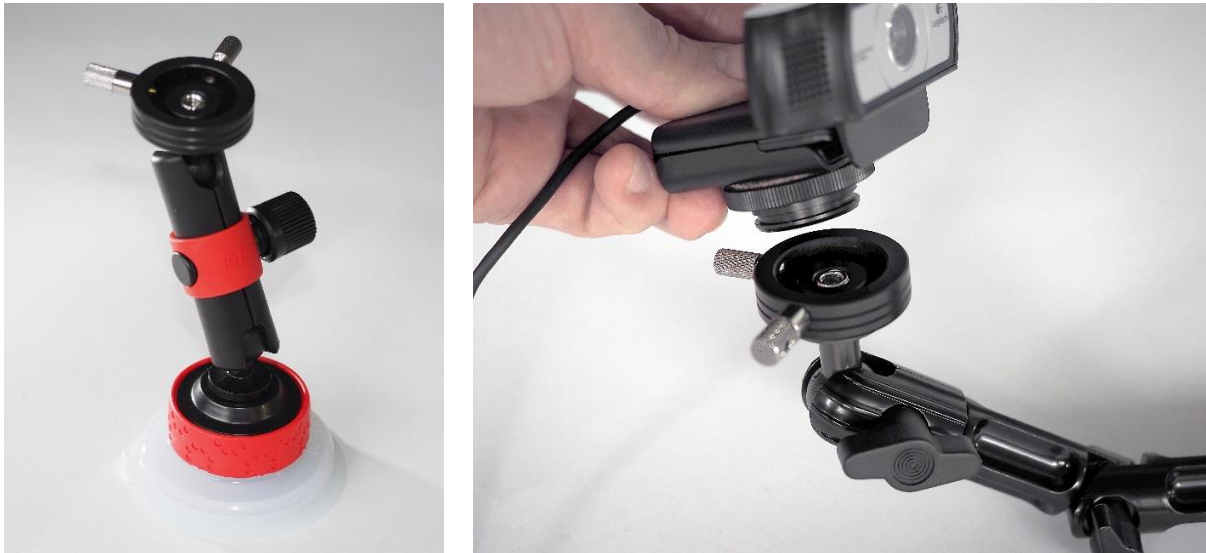


Figure 12 - Camera brackets with quick-change plate

.... Suction cup bracket

.... Headrest bracket

The headrest bracket is normally secured on the driver's side, since there is little space on the passenger headrest due to the monitor. It is made up of multiple members and is therefore very versatile in terms of its use. It can also be raised up slightly to capture the entire front area, including the dashboard and central console. Setup and securing are illustrated and explained in Section 3.3.1. To secure a camera to the windshield, allowing the way the car is driven to be filmed in the direction of travel, one of the supplied cameras has been equipped with two quick-change plates. This means that the camera can be secured optionally from above or below (see Figure 13). This is useful for cars that have steeply inclined windshields.



Figure 13 – Camera with two quick-change plates (L) and securing to the front windshield (R)

2.3.2 Microphone with USB sound card

In addition to the microphones built into the cameras, Lavalier microphones can be used. Two of these microphones (for the study leader and test subject) are included in the package supplied with the Professional and Enterprise version. These are very high-quality, sensitive clip-on microphones that can be secured with a clip on the back.



Figure 14 – Lavalier or clip-on microphone and USB sound card

Using a microphone of this type is useful if the cameras are positioned unfavorably for recording sound or the driver turns their head while they are saying something and none of the surrounding microphones is oriented towards him. Disruptive external sounds are therefore minimized, since often only what the test subject and study leader are saying is what needs to be recorded. Consequently, verbal instructions and comments from the study leader and all of the test subject's speech can be specifically analyzed during evaluation.

2.3.3 Eye tracking and Mobileye driver assistance system



Figure 15 - Dikablis Professional Eye tracking glasses (L), Mobileye driver assistance system (R)

The package supplied with the Enterprise version includes Dikablis eye tracking glasses and a Mobileye driver assistance system. This considerably increases the functional scope of the VTK and the resulting possibilities.

The real vehicle studies mentioned at the start consequently achieve a whole new standard of quality, since questions such as "Where did the driver look at a given moment?", "How fast was he driving at this moment?" and "What was the distance from the car in front?" can be answered.

With the Dikablis Professional glasses, the test subject's eye movements can be captured and the viewing position recorded. The Mobileye offers the ability to document all kinds of driving performance and behavior parameters, such as the speed of the vehicle, the distance

from the vehicle in front, collision warning, lane departure warning, and a range of other parameters.

For the purposes of a more detailed explanation, reference is made at this point to the Dikablis Manual or Mobileye instructions for use.

2.4 Transporting the VTK

To be able to transport the VTK conveniently and with as little physical effort as possible, there is the specially created trolley, which is included in the supplied package.



Figure 16 – VTK on the trolley with accessories bag on top.

To be able to transport the VTK together with all of its components as easily as possible, a messenger bag is provided along with the trolley, and this bag can store the cameras, brackets, microphones, GPS, and all cables. It can be pulled along using the extended trolley handle; this makes transporting the entire VTK equipment possible with just one hand (see Figure 16).



Note: Due to its weight and dimensions, the VTK case is not suitable as hand luggage on airplane flights.

3. Installing the VTK in a motor vehicle

Following the explanation in the previous chapter of how the individual hardware components work, the task now is to install them safely and trouble-free in a vehicle, wire them up and test their function. The procedure for doing this is, in principle, always the same. Only the number and type of sensors used varies and depends on the requirements of the study being carried out. The following sequence should be observed:

1. Installation, calibration and function check of the Mobileye, if it is being used.
2. Securing the VTK case onto the back seat or luggage compartment and power connection.
3. Fastening and connection of the monitor.
4. Fastening of the cameras in favorable positions and connection to the VTK.
5. Fastening and connection of the GPS sensor.
6. Connection of the microphones.
7. Connection of the Dikablis glasses, if they are being used.
8. Positioning of markers or infra-red markers, if they are being used.
9. Checking of the individual components.



Note: Below, 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. There are, among others, 2, 3 and 4-pin round plugs that look the same on the outside. 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.

3.1 Securing the VTK case



Figure 17 - Positioning the VTK on the back seat

Open the cover of the VTK case and remove it. Inside the cover itself is the keyboard, which you will need again later. Remove the monitor and first put it to one side. If the monitor bracket is still in the case, remove it too. Now place the case on the back seat behind the driver so that the battery connection points are seen to be pointing upwards and the front panel with the connections is aligned towards the front seat, as shown in Figure 17. Connect the two ISOFIX straps supplied into the brackets provided for them on the back seat (see Figure 18). The position of the ISOFIX straps may vary depending on your car brand.



Figure 18 – Securing the VTK on the back seat with ISOFIX straps

Guide the loose ends of the strap through the belt buckles on the sides of the case and secure them using the belt fastener (see Figure 18).



Note: Before every journey, ensure that the VTK is properly secured in the car. Otherwise the VTK can be damaged and people endangered, for example during braking maneuvers.

If your car does not have ISOFIX connections, the normal seat belts can be used in conjunction with the supplied belt extender. As previously, the case is placed on the back seat behind the driver. The belt extender is connected to the car seatbelt and the free end is guided through the metal loop on the right-hand side over the case, through the metal loop on the left-hand side of the VTK and connected to the car's belt buckle. Check the fastening is secure and ensure that the belt is taut (see Figure 19).



Figure 19 - Fastening the VTK on the back seat using a belt extender



Note: The package supplied with the VTK includes a standard belt extender. Unfortunately there are a great number of different types of belt connection, which can vary depending on the manufacturer. In some instances, the belt extender supplied therefore will not work. In such cases, contact the distributor or vehicle manufacturer direct to obtain a belt extender suitable for your vehicle.



Note: If your vehicle has neither ISOFIX or seat belts to secure the VTK, it must be secured in the luggage compartment or it must not be used in the vehicle at all!

If the VTK case is to be stowed in the luggage compartment, or if there is no other option available, then two important points must be observed. First, adequate fastening must be ensured so that the case is locked in position in the luggage compartment and cannot move around. Given its weight, there would otherwise be the danger that the VTK can be damaged or injure people, for example during braking maneuvers.

Since every car luggage compartment has a different design, a secure solution must be found for fastening the VTK in place. In newer vehicles, for example, there are also ISOFIX brackets in the luggage compartment. Loops or hooks are also available for belts or a floor mesh. If there is no adequate option available for securing the VTK in place, it must not be used in the luggage compartment.

It must also be possible to feed the connecting cables from the luggage compartment into the passenger compartment. Depending on the type of vehicle involved, half of the back seat may need to be folded down, or the cables may be guided over the seats, between the seats or through a flap in the center of the rear seat row. If there is no option for guiding the cables into the passenger compartment, the VTK cannot be used in the luggage compartment.

In the final stage - if the VTK case is positioned in the car and has been secured in place - it can be connected using the supplied power cable via the cigarette lighter to the car's 12 V on-board electrical network. To do this, the 3-pin round plug on the left-hand side of the VTK case is inserted and screwed into place. When the plug is being connected to the cigarette lighter, a little force may sometimes be needed to ensure a good fit between the plug and the socket, and to guarantee a good electrical connection.

3.2 Securing the monitor

The monitor can be secured using the supplied bracket to the passenger headrest. If the bracket is in individual pieces for transportation reasons, it must first be assembled. Assembly is easy and the individual parts are shown in Figure 20 on the left. The three "T-screws" simply need to be screwed through the longitudinal holes in the bracket into the rear clamping jaw and tightened, as shown in Figure 20 on the right.

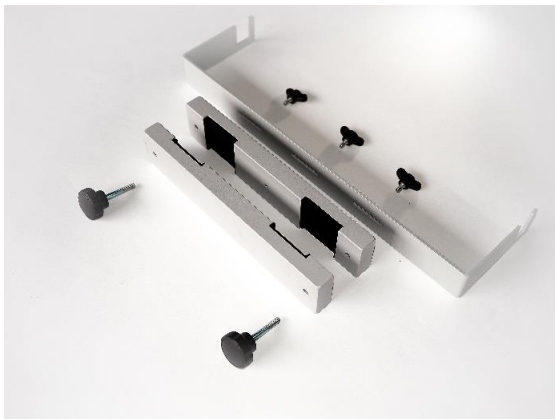


Figure 20 – Monitor bracket
... Individual parts



... Assembly

For fastening to the headrest, pull the headrest out of the seat slightly so that the retaining spars are visible. The two "clamping jaws" on the bracket are positioned in front of and behind the headrest spars and screwed together using the two T-screws (see Figure 21).



Figure 21 - Fastening the monitor bracket to the headrest

Then push the headrest together with the bracket as far back into the seat as possible or as necessary. Loosen the T-screws which are located on the side of the monitor and hang the monitor in the bracket on the headrest. Then screw it into place on the left and right using the T-screws (see Figure 22).



Figure 22 - Fastening the monitor to the mounted headrest bracket

Once the monitor has been secured and moved to a suitable position, route the DVI cable from the computer to the monitor, connect it and screw it both to the computer and the monitor. Then connect the monitor power cable (4-pin round plug) into the power outlet of the VTK main unit and then into the corresponding socket on the monitor and also screw them into position at both ends.

Ensure that the cables are routed safely without tangling and as close to the ground as possible so that they do not interfere with the footwell or impair visibility.

3.3 Installing and connecting the accessories

3.3.1 Securing and connecting the cameras

Up to four cameras can be secured simultaneously using the suction-cup brackets to the windows or three of them using a suction-cup bracket and one to the headrest bracket. To attach a camera to a window, the window pane in the area to be used for attachment must first be cleaned with a dust-free cloth; to ensure that the attachment is firm and reliable, the area must be clean and dry. In the next step, ensure that the red ring on the foot of the bracket is turned all the way to the left, i.e. anti-clockwise. Then, using a hand, push the silicon surface of the suction cup firmly against the window and turn the red ring in a clockwise direction. This suction the bracket firmly to the window (see Figure 23, left).



Figure 23 - Suction-cup bracket
.... Fastening to the window



.... Attachment of the camera

Connect the camera, as explained in Section 2.3.1, to the bracket and orient it towards the area being investigated or desired direction. To do this, release the knurled screw on the spar. This allows the bracket to be aligned in virtually any possible direction.

Once it has been moved or aligned in the desired direction, tighten the knurled nut again to fix the camera in the specified orientation (see Figure 24). The image section can be corrected later when the devices are checked during commissioning.



Figure 24 - Suction-cup bracket
.... Alignment



.... Fixing

To attach a camera to a headrest, the bracket must be mounted before being used for the first time. It comprises several similar metal components which are screwed together using a T-screw (see Figure 25). If the screw connection is released, then each individual component can be moved and re-secured in a different position, enabling the bracket to be attached in even angled positions. On the first and last component is a ball head socket which carries the fastening for the headrest at one end and the camera fastening at the other.



Figure 25 - Headrest bracket
... Individual parts and tool



... Screwing the components together

The ball head is secured to the headrest using 4 short Allen screws (see Figure 26). The Allen key needed to tighten the screws is included with the bracket. 4 longer screws are also supplied since the headrest spars do not have the same diameter with every manufacturer and the short screws may not be sufficient in some cases. Tighten the 4 screws evenly so that the ball head bracket is not strained. Then attach the socket and screw it into position using the T-screw (see Figure 27).

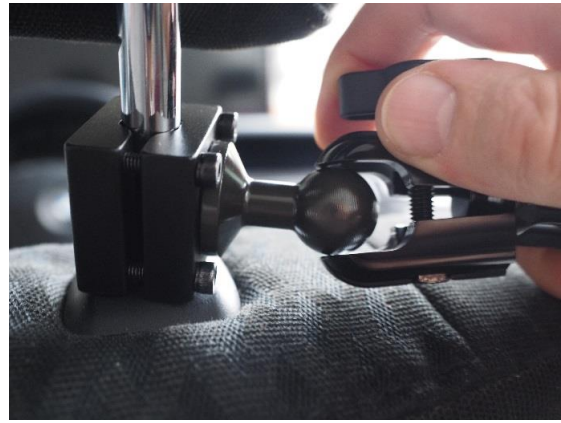
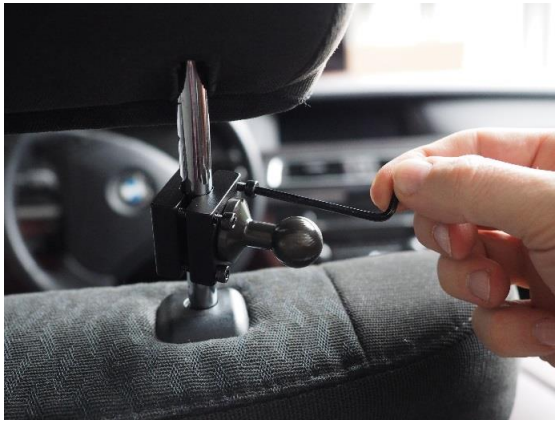


Figure 26 - Fastening the ball head bracket to the headrest spars

In sequence, align all of the components of the bracket for your purpose by loosening the T-screws, adjusting the components and tightening them back into place.

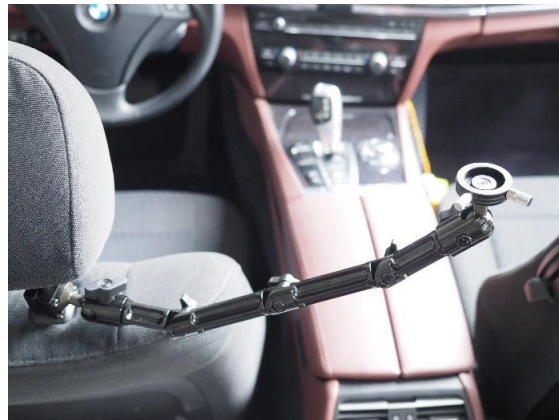


Figure 27 - Securing the components on the ball head and its alignment

Once the brackets and cameras have been secured in the car, route the cables and connect each camera with a USB port on the VTK. Ensure that the cables are guided cleanly in order to prevent them from getting tangled. If the USB camera cable does not reach from the fastening position to the connection to the VTK, a USB extension cable can be used.

3.3.2 Securing the clip-on microphones and sound adapter

The microphones are attached using their clamp on the back to the collar or lapel of the jacket or shirt that the test subject is wearing. They can however also be attached at other points in the vehicle where they are secured in place with clamps. Connect the jack plug of the free end into the microphone socket on the sound card and then plug this into a free USB port on the computer. Repeat this process for the second microphone, which is the chief investigator's. Using D-Lab, check the sound quality during commissioning by making a sound recording.



Figure 28 - Lavalier microphone
.... Fastening to the lapel



.... Connection to the VTK

3.3.3 GPS sensor

Metal shields the sensor from GPS signals transmitted from satellites, thereby impairing reception. For this reason, the GPS sensor must be positioned in the car in such a way that as clear a "line of sight" to the sky as possible is achieved. On the dashboard, ideally well under the windshield, is a good place for it. There, the sensor can be secured in place using double-sided adhesive tape, for example. The cable can be routed under the windshield to the left into the footwell and from there along the door sill to the VTK on the back seat.

If it does not work under the windshield, it can also be tested on the side or rear windshields. If reception does not however work as expected, first test the function outside the vehicle. If it functions there, then check whether the vehicle has thermal glazing. The metal-vaporized windows can limit reception. In such instances, contact Ergoneers Support.



Figure 29 - GPS sensor

3.3.4 Mobileye

The package supplied with the Enterprise version also includes a Mobileye driver assistance system (see Figure 15, right). A special cable is also supplied for installation in the vehicle. In the simplest scenario, it can be used to connect the OBD2 plug to the vehicle. This does not work in every case, since not all of the required signals will be present at the OBD2 plug, depending on the vehicle. Please ask the Ergoneers whether the Mobileye can be connected to your vehicle with the OBD2 plug. The Mobileye comes with installation instructions. If it however cannot be operated from the OBD2 connection on your car, we advise having the installation carried out by a specialist. If you require assistance with this, Ergoneers will be pleased to provide you with details of professional engineers who can carry out the installa-

tion for you. Once the Mobileye is installed, it is connected to the first of the two CAN sockets on the VTK (see Figure 30).

3.3.5 Vehicle CAN connection

The VTK offers two CAN sockets, either of which can be used. In addition to the Mobileye CAN bus already mentioned, any other vehicle CAN bus can also be connected to it. This allows the special vehicle signals mentioned at the beginning to be evaluated. Of course, any combination is possible, as shown in Figure 30,

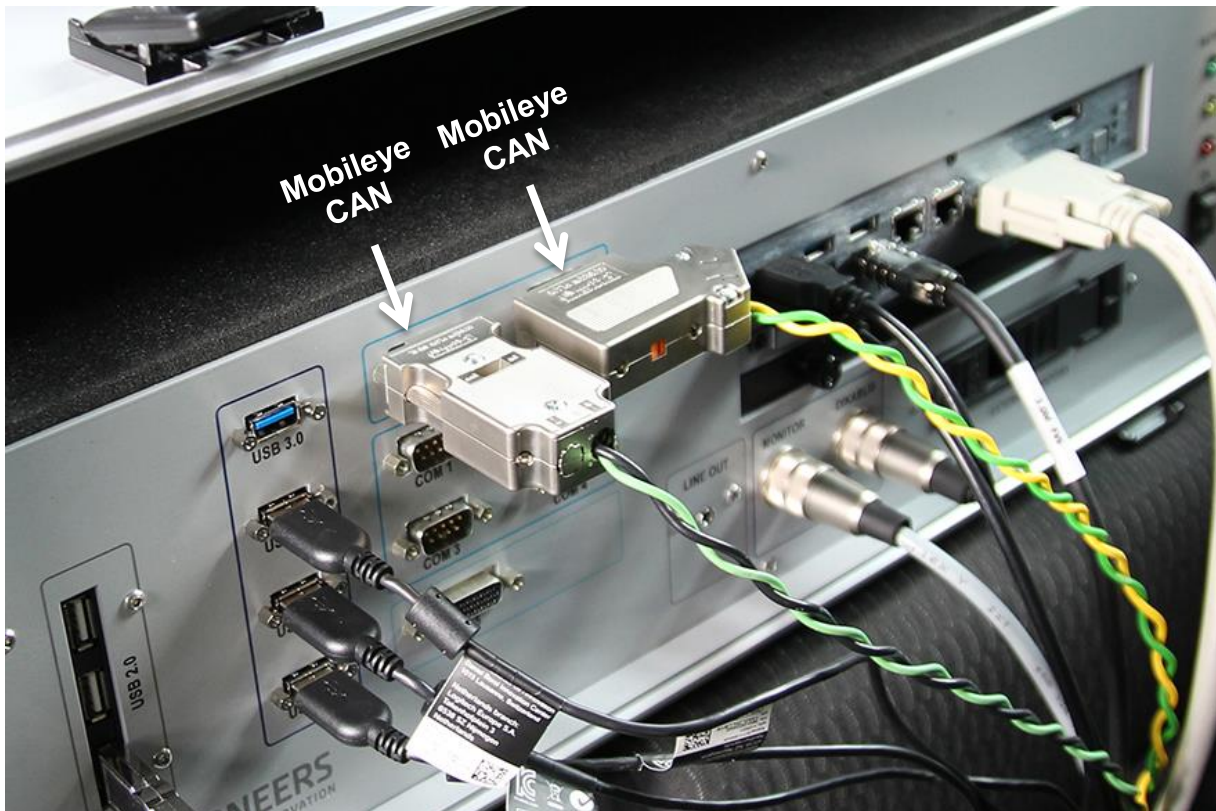


Figure 30 - Connection to VTK for Mobileye and a car CAN bus

To analyze the CAN bus with D-Lab, the description of the signals that are sent and analyzed via the CAN bus is required. In the simplest of cases, the manufacturer provides a dbc file with the description of signals that can be analyzed with a suitable dbc viewer. The signal data can then be entered in D-Lab. Reference is made at this point to the D-Lab manual.

3.3.6 Dikablis Professional eye tracking glasses

The package supplied with the Enterprise version also includes Dikablis Professional eye-tracking glasses (see Figure 15). For a detailed description and commissioning, see the Dikablis manual. This is where you will find all of the relevant information.

There is one difference, however. The glasses draw their power supply from the VTK. As a result, the VTK package includes a power adapter cable for connection to the Dikablis Connector Box. The power connection to the VTK is next to the monitor power connection, as shown in Figure 31.



Figure 31 - Dikablis power connection to the VTK

3.4 Commissioning

Before the power supply to the VTK is switched on first and then the computer, it must be ensured that the keyboard radio receiver is connected to a USB port and is switched on (the switch is at the top right of the keyboard, see Figure 32). The D-Lab license dongle should also be connected to another port so that D-Lab can be started.



Figure 32 – Keyboard and monitor of the VTK

For commissioning, first remove all the batteries from the VTK and connect it using the supplied power cable via the cigarette lighter to the 12 V on-board network in the car provided it is not already connected.

Now re-check all of the cable connections and ensure that all of the plugs on the VTK and monitor are connected securely. Then switch the power switch on. If the operating LED lights up and the fan starts running, the cigarette lighter is supplying power. If this is not the case, this may be due to the fact that the cigarette lighter only supplies current when the ignition is switched on. Check this by switching on the ignition.

If current is present, then at least one other battery should be connected to the VTK, as explained in Section 2.1.1.2, before the computer is switched on. If one or both have been connected, the computer and monitor can be switched on one after the other. To operate the computer, use the radio-operated keyboard with integrated touchpad, which is used like a computer mouse by swiping a finger over the touch surface.

Once the operating system has booted, start D-Lab by double-clicking on the corresponding icon on the desktop.

Now, using D-Lab, check the function of each individual device in sequence. The use of D-Lab is explained in the D-Lab manual. Should any of the devices not be functioning, check the following points in sequence:

- Are the device cables damaged (or crushed by a car door)?
- Are the plugs correctly seated and contacting, or are they correctly screwed in?
- Does the device have power; are the device's operating LEDs lighting up?
- Does the battery have sufficient capacity?
- Is there a USB bandwidth problem (see Section 2.1.2)?
 - The device operates in some situations on another USB port.
 - If the camera is involved, reduce the resolution.
- With GPS:
 - Is the GPS sensor attached so that it can receive the GPS signal?
 - Does it work outside the car?
 - Does the car have thermal glazing (the metal-vaporized windshields may be limiting reception)?

If not all of the devices can be switched on, and no faults can be identified, please contact Ergoneers Support (support@ergoneers.com).

This means that the system is ready for the first study.

4. Technical data

VTK MAIN UNIT (CASE)

Major dimensions	56cm x 42cm x 22cm (22,05 in x 16,54 in x 8,66 in)
Weight	14kg (30,86 lbs) (case without monitor and batteries)
Line voltage	100-230 V ~AC
Rechargeable battery	2 Li-ion battery (14.8 V / 6.6 Ah / 97.7 Wh)
Average battery runtime (2 external batteries combined)	Up to 3 hours while using D-Lab
Battery charger	External battery charger
Car battery power supply	12 V via cigarette lighter connector
DC out monitor	12 V power supply for the monitor
DC out Dikablis	12 V power supply for the Dikablis glasses
Keyboard / Touchpad	Logitech keyboard, including touchpad
Fixation	2 ISOFIX belts, belt extension (if no ISOFIX available)
Transport	Snap-In Trolley

AUTOMOTIVE COMPUTER

Operating system	Windows 7 Pro 64 Bit
Processor	Intel® Core™ i7-4700EQ processor (4th generation)
Processor clock rate	2.40 GHz (max Intel Turbo Boost 3.4 GHz)
Processor Count	4 / 8
RAM	8 GB DDR3L 1600 SODIMM7
Hard drive	512 GB SSD
Removable hard disk	1 TR S-ATA (5.400 rpm)
Graphic card	IntelHD Graphics 4400 Intel® Quick Sync

MONITOR

Type	TFT display with LED backlight
Size of Display	17.3 inches (43.94cm)
White luminance	300 cd/m ²
Screen resolution	1920 x 1080 px
Fixation	Attached to the head rest
LED display	Operating status / current charge state
Major dimensions	46 cm x 31 cm x 5.5cm (18,11 in x 12,20 in x 2,17in)
Weight	1.9kg (4,19 lbs)

IO CONNECTION

Display / monitor	1 x DVI-I, 2 x display ports
USB	10 x USB 3.0, 3 x USB 2.0
Serial (COM)	4 x RS 232, 1 x RS 485, 2 x CAN
Ethernet	2 x Gigabit Ethernet
Audio	1 x Line Out

ENVIRONMENT

Operating temperature	-20°C to 60°C (-4°F to 140°F)
Storage temperature	-40°C to 85°C (-40°F to 185°F)
Humidity	max. 95% (non-condensing)
ESD (electrostatic discharge)	Contact discharge ± 4 kV, air discharge ± 8

CAMERA

Type	Business grade HD video webcam
Connection	USB 2.0
Video Coding	MJPEG, "H. 264-ready" (Windows driver for H. 264 is in preparation)
Resolution	adjustable up to 1920 x 1080 pixels
Field of view	90° diagonal
Lens	ZEISS® glass lens
Color	black/silver
Dimensions	4.3 x 9.4 x 7.1cm (1,7 x 3,7 x 2,8 in)
Weight	163g

SOUND ADAPTER

Type	Sound card in USB stick format
Connection	USB 2.0
Signal-Noise-Ratio	90 dB, supports 16 bit / 48 kHz

MICROPHONE

Type	Electret microphone
Transmission range	50 – 18000Hz
Connection	to Sound Adaptor via 3.5mm cinch plug, 3-pole
Cable	1m (3,3 ft)
Fixation	Clamp, e. g. attaching it at the lapel
Dimensions	19 x 9 x 9mm (0,7 x 0,35 x 0,35 in)
Weight	18g (0,03 lbs)

MOBILEYE

Producer / model	Mobileye 560
Description	Retrofittable driver assistance system with the following properties: Camera-based Fixation at the windshield Cable Connection to VTK via the CAN bus
Scope of Delivery	Mobileye camera Cable set for integration of Mobileye into the vehicle VTK connecting cable (via CAN) Startup and Installation Guide Access to the Mobileye setup wizard (for calibration)
Detection Range	Vehicle Detection Day: 150m (492,1 ft) Vehicle Detection Night: 90m (295,3 ft) Pedestrian Detection (Day only): 40m (131,2 ft)
Recordable Driving Data and Behavior Data behavior data	Vehicle Data(velocity, Status of brake, Blinker, wipers and light)

	Traffic warnings (distance warning, lane keeping, speeding)
	Traffic signs (type and position)

SCOPE OF DELIVERY VEHICLE TESTING KIT PROFESSIONAL

VTK Main Unit (including Automotive Computer), 17.3" LCD monitor with monitor mounting, keyboard with touchpad, 4 cameras and 4 extension cables,

4 suction cup fasteners, 1 camera mount for the headrest, 2 Clip-on microphones with USB sound adapter, 2 12 V batteries including a battery charger

2 ISOFIX belts, belt extensions, trolley

Data acquisition and analysis software: D-Lab Audio Professional, D-Lab Video Essential, D-Lab CAN Bus Professional

SCOPE OF DELIVERY VEHICLE TESTING KIT ENTERPRISE

VTK Main Unit (including Automotive Computer), 17.3" LCD monitor with monitor mounting, keyboard with touchpad, 4 cameras and 4 extension cables,

4 suction cup fasteners, 1 camera mount for the headrest, 2 Clip-on microphones with USB sound adapter, 1 GPS sensor, 2 12 V batteries including a battery charger

2 ISOFIX belts, belt extensions, trolley

Mobileye Sensor

Eye tracking glasses: Dikablis Professional Cable

Data acquisition and analysis software: D-Lab Audio Professional, D-Lab Video Essential, D-Lab CAN Bus Professional

D-Lab CAN Bus Professional, D-Lab Data Stream Essential, D-Lab Data Stream Professional, D-Lab Eye Tracking Head Mounted Professional

5. Ergoneers warranty program

Ergoneers offers contractual partners a comprehensive and global warranty program (defect claims) under German law by explicit exclusion of the rules of the Convention on the International Sale of Goods (CISG). Ergoneers runs a quality assurance plan and all products are tested before they are shipped.

Entitled for warranty repair

The warranty program is provided for a period of 12 months after delivery of the product. The product; only in this period the product will be repaired or replaced free of charge if one or various facts pointed out below become true:

- DOA (Dead On Arrival)
- Product no longer functioning
- Electronic or electrical damage
- Mechanical malfunction
- Optical malfunction

Not included in Warranty

- Damaged due to over-voltage
- Damaged due to incorrect use
- Damaged due to using the product in improper environments
- Damaged due to dropping
- Wastage

RMA

Before returning a product to Ergoneers for a warranty or non-warranty repair, an RMA number needs to be requested from support@ergoneers.com.

Shipping rules

Warranty repairs are done in our office in Geretsried/Germany. Products need to be sent in all shipment costs and fees paid. Ergoneers will return the product free of charge if

- a) the product was sent in with a valid RMA number and
- b) the failure is caused by one of the reasons listed under “entitled for warranty repair”.

Repair times

We aim to return the repaired product as soon as possible back to the customer. Please note that repair times might depend on availability of spare parts and other resources. Customers can request the estimated shipment date by quoting the RMA Number and send an email to support@ergoneers.com.

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