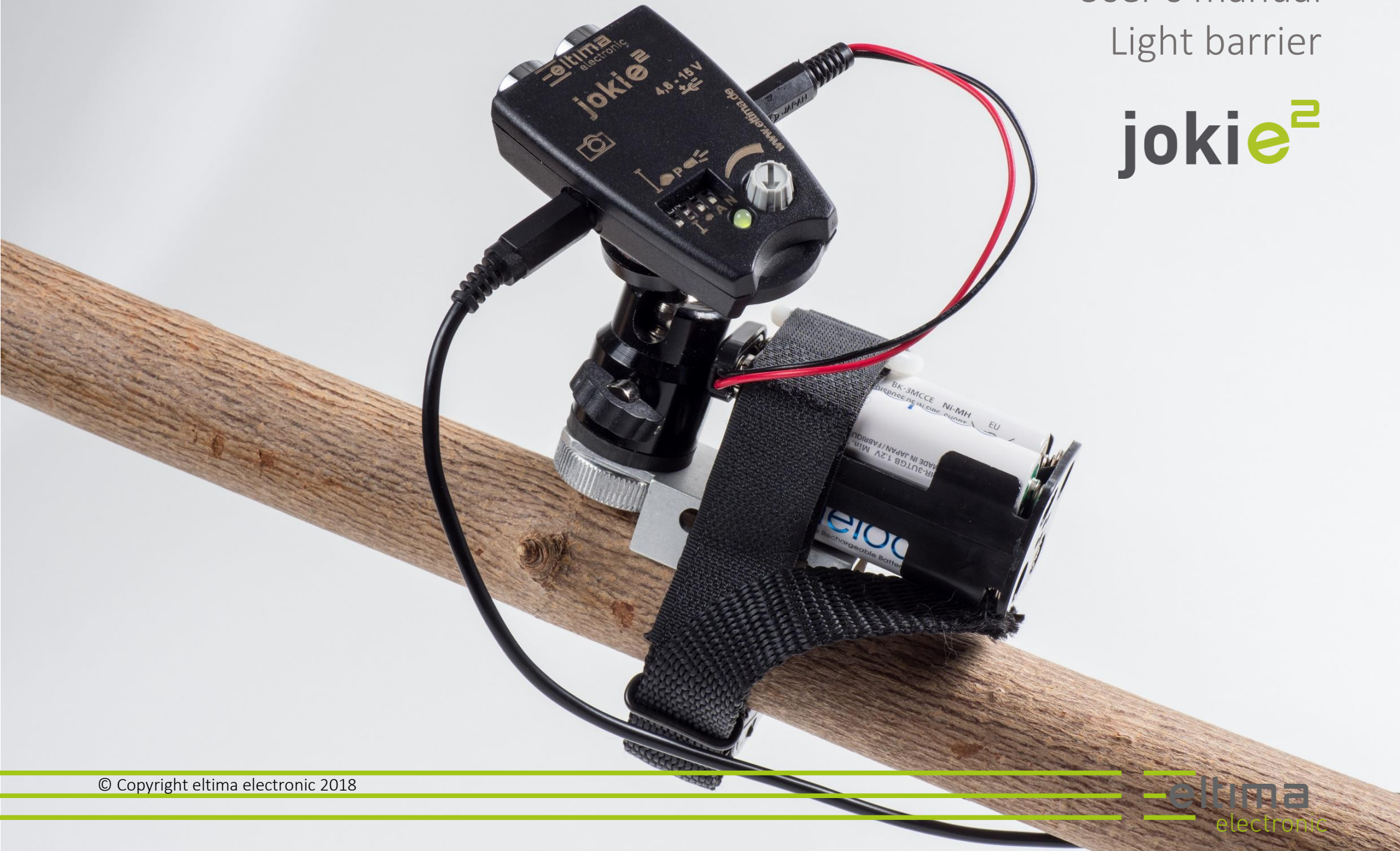
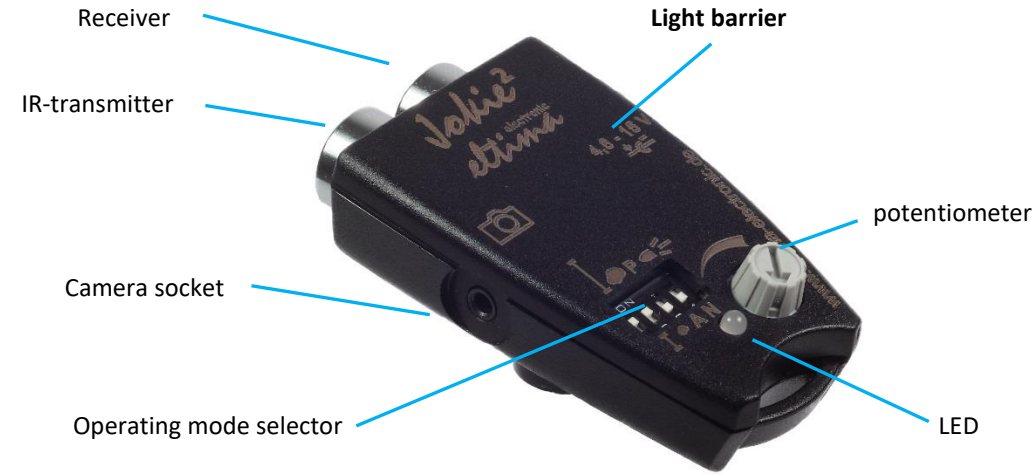
User’s manual
Light barrier

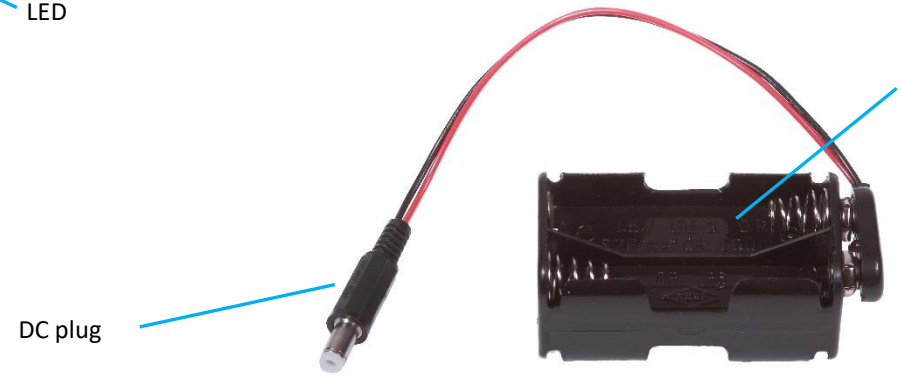
jokie²



eltima electronic

Part Description





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Introduction

Dear Customer,

thank you for purchasing the light barrier **jokie²**. It shall give you a handy, easy to operate and reliable tool.

If you have wishes and suggestions for improvement, please do not hesitate to share them with us. So this product may grow and meet your needs.

Please read the instruction manual carefully before you use the light barrier. It will familiarize you with the operation and functioning of this system. Thus you can fully use the advantages offered by this device.

Purpose of use

The light barrier is designed exclusively for the triggering of photographic cameras, speedlights and film equipment. Only use it for this purpose!

Symbols

Symbol for tips on handling of the device.

Important note on the function of the device.

Important note to avoid damage to the device or the devices connected to it.

Maintenance and storage

- The light barrier is not waterproof and is not suitable for use in the rain or under water. If the device gets wet, contact the manufacturer. Water drips can be wiped with a dry cloth.
- Never drop the device or expose it to shocks.
- This device is a precision electronic system. Do not attempt to make changes by yourself.
- If you plan not to use this device for a longer period of time, remove the batteries from the battery holder to avoid leakage.
- From time to time clean the lenses of the light barrier with a soft cloth.

First Steps

- Insert four batteries or rechargeable batteries into the battery case.

Pay attention to the correct polarity. It is shown at the bottom of each battery compartment.

Figure 1: Battery case

Figure 2: Polarity markings

- Turn the operating mode switch 2 ON and all others OFF.
- Turn the potentiometer to the left limit.
- Install the light barrier and the 40 mm reflector on a tripod.
- Insert the DC plug of the battery holder into the DC socket of the light barrier. The LED now turns ON having a green colour.

Figure 3: operating mode switch

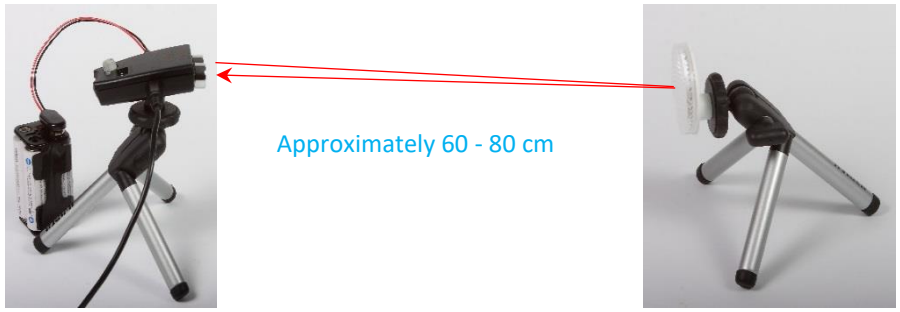


Figure 4: Quick start setup

- Plug the 2.5 mm jack plug of the camera adapter set into the camera socket.
- Place the light barrier and reflector opposite to each other at a distance of about 60 - 80 cm.

Note: This distance is arbitrary and is neither the smallest nor the greatest distance between light barrier and reflector.

- Align the IR beam of the light barrier to the reflector until the LED turns OFF. The light barrier is now ready for operation.
- Plug the other end of the camera adapter set into the remote control socket of your camera.
- Switch the auto focus of your camera to "Manual".
- Move your hand or another object through the beam. The camera will trigger.

Reflex light barrier

The light barrier **jokie²** is built on the principle of a reflex light barrier. Transmitter and receiver are in the same housing.

Figure 5: Reflex light barrier

The transmitter emits fast successive infrared light pulses, which are reflected by a reflector and sent back to the receiver.

If at least one pulse is missing, or is received very weak, e.g. because an object is in the path of the beam, a solid state switch is closed and the connected device is triggered.

Figure 6: Light beam is interrupted

This principle offers several advantages. On one hand, only one device, the light barrier itself, needs a power source, the other side, the reflector, is passive.

The reflector is also very robust and easy to handle, to fix and to camouflage. On the other hand, any object can be used as a reflector, as for example the subject itself.

Within certain limits, the light barrier can thus also be operated without a retro-reflector.

The light beam

As described, the light barrier **jokie²** emmits fast successive invisible infrared light pulses, which are sent back by a reflector to the receiver. The receiver needs to receive back a minimum quantity of the emitted light of each impulse.

During normal operation of the light barrier with a reflector the quantity of light received will be above a fixed threshold and the LED is OFF. If the received quantity of light falls below the threshold or at least one pulse is missing, because an object is the beam, the LED will turn ON and the connected device will be triggered.

Due to the transmission and reception characteristics of the optical components, combined with the reflective properties of the retro reflectors, the working distance, the distance between the light barrier and reflector, can roughly be divided into three sections.

Figure 7: Sections of the IR beam

The green, middle section is the "normal" working section of the light barrier. Depending on the reflector and the selected working distance a "beam diameter" of 3 - 5 mm can be assumed. The objects must cross this beam in order to trigger the light barrier. The small diameter leads to a very precise and reproducible operating point of the light barrier. In the green section the sensitivity of the system is the highest.

In the orange section, close to the reflector, the sensitivity decreases and small objects will no longer be reliably detected.

In the blue section near the light barrier, objects can act as reflectors. It may well be that a bright, well reflecting object reflects the light better than a distant reflector. This will lead to the situation that the received quantity of light will not fall below above-mentioned threshold and the light barrier will not trigger, although an object is in the light beam. Hence the light barrier should be installed in such a way that objects do not pass through the blue section.

In the blue section the light barrier can be operated without a reflector, which in some cases this is a great benefit. The range of the light barrier then depends essentially on the size and the reflection characteristics of the object, see section *Photographing without reflector*.

Reflectors

In the delivery scope of the light barrier **jokie²** there are two retro-reflectors. They consist of a circular plate with many honeycomb corner reflectors.

Corner reflectors have the property to reflect light back to its source with a minimum of offset. *Figure 8* shows the operating principle of a corner reflector.

Due to this property a retro reflector, in comparison to a plane mirror, must not be aligned exactly towards the light barrier. It is sufficient to be aligned roughly towards the light barrier. Only for reaching the maximum working distance the reflector should be aligned exactly.

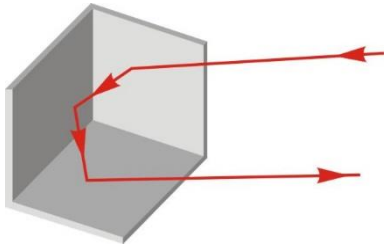


Figure 8: Corner reflector

Sensitivity

The sensitivity indicates how big an object must be at least, in order to be detected by the light barrier. Working with high sensitivity very small objects can be detected. At low sensitivity only bigger objects are detected, smaller objects are ignored.

The sensitivity of the light barrier cannot be adjusted. However, it can be controlled by the choice of the reflector used, the working distance and the power of the IR transmitter.

The smaller the reflector, the less light is reflected and thus less received by the receiver, see section *Reflectors*. The less light reaches the receiver in normal operation, the closer the quantity of light received gets to the threshold. In this case already a small object crossing the beam is sufficient to weaken it so far, that the light quantity fall below the threshold.

The larger the working distance, the more the light loses its intensity before it arrives at the receiver and the closer the received quantity of light will be to the threshold. Here, too, already a small object in the beam is enough to attenuate the light to fall under the threshold.

The less light is emitted by the IR transmitter, the less will be received by the receiver and the smaller the objects can lead to a trigger.

Conclusion: The **smaller** the reflector, the **larger** the working distance, or the **smaller** the power of the IR transmitter the **higher** the sensitivity.

The other way round, the **larger** the reflector, the **smaller** the working distance, or the greater the power of the IR transmitter the **less sensitive** the light barrier will be.

Range and sensitivity

The two characteristics range and sensitivity are closely related to each other.

For a high range, because of the light losses, the IR transmitter must emit a high quantity of light.

For a high sensitivity, the IR transmitter must emit a small quantity of light.

In order to meet both requirements, the power of the IR transmitter can be set in four stages by the mode selector switch, resulting in four possible range areas.

The *Table 1* gives a picture of the correlation.

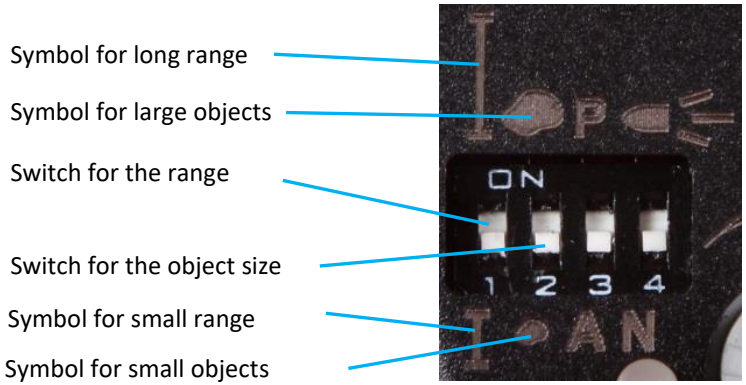


Figure 9: Switch symbols

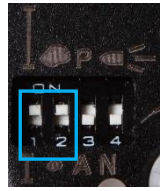
Switch positions				
	small, small	small, large	long, small	long, large
Range	minimum	small	big	maximum
Minimum object size	very small	small	medium	large
Sensitivity	maximum	high	low	minimum
Power of the IR transmitter	minimum	low	high	maximum
Colour of the LED	green	green	red	red

Table 1: Effect of the switch positions

The mode selector can be switched by using a pen, ball pen or tweezers.

Don't worry, the switch will **not** break when using it!

Operating modes

The table below shows the maximum ranges when using reflectors offered by eltima electronic.

The 20 mm reflector listed in the tables below is not included in the delivery scope of the light barrier, but can be purchased in our store!

Reflector size [mm]	Switch position		Max. Range [m]
	Range	Object	
20	small	small	0.3
	small	large	0.45
	long	small	2.8
	long	large	5
40	small	small	0.45
	small	large	1
	long	small	6.5
	long	large	9
80	small	small	1.3
	small	large	8
	long	small	12
	long	large	16

Table 2: Maximum ranges for different reflector sizes

The following tables show the dependence of the sensitivity, i.e. the smallest detectable object in mm, from the reflector size and the working distance (distance between the light barrier and reflector), relative to the four possible range areas.

Switch position: Small range, small object

Working distance [m]	Reflector size [mm]		
	20	40	80
0.1	5	---	---
0.2	5	5	---
0.3	0.5	3	---
0.4	---	0.5	26
0.6	---	0.5	20
0.8	---	---	12
1	---	---	10
1.3	---	---	1

Table 3: Sensitivity in mm, using switch position small, small

Switch position: Small range, large object

Working distance [m]	Reflector size [mm]		
	20	40	80
0.2	7	---	---
0.3	5	---	---
0.4	0.5	12	---
0.6	---	8	---
0.8	---	4	---
1	---	1	26
2	---	---	23
3	---	---	15
5	---	---	5
8	---	---	1

Table 4: Sensitivity in mm, using switch position small, large

Switch position: Long range, small object

Working distance [m]	Reflector size [mm]		
	20	40	80
1	5	20	50
2	4	18	40
3	0.5	15	36
4	---	12	36
5	---	5	30
6	---	0.5	30
8	---	---	30

Table 5: Sensitivity in mm, using switch position long, small

Switch position: Long range, small object

Working distance [m]	Reflector size [mm]		
	20	**40**	**80**
2	7	20	---
3	7	18	---
4	5	18	---
5	3	18	50
6	---	18	45
8	---	12	36
10	---	---	30
12	---	---	23
14	---	---	12
16	---	---	8

Table 6: Sensitivity in mm, using switch position long, large

Trigger delay

If needed, a trigger delay can be set using the potentiometer. It will delay the triggering of the camera by the amount of time, referred to the time point of the interruption of the beam.

The trigger delay can be set from the smallest delay of the light barrier (i.e. 20 µs) on the left side stop to 10 seconds at the right side stop.

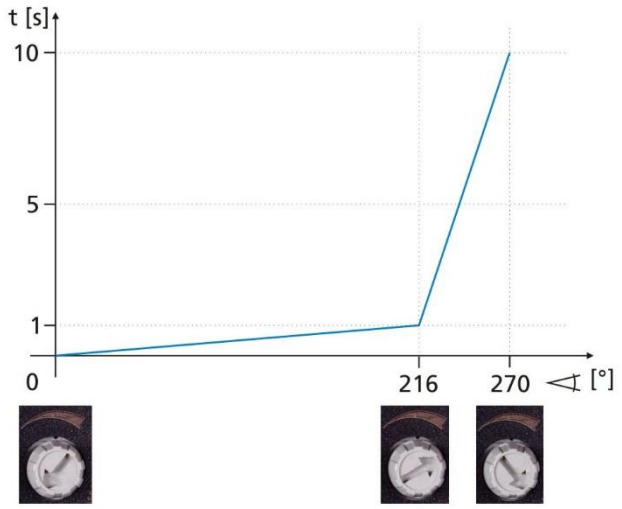


Figure 10: Trigger delay characteristic

A knee-shaped characteristic allows very precise delay time settings up to one second, then a coarse adjustment until 10 s.

The trigger delay is effective in all modes except the passive mode, see *Thunderstorm photography*.

Thunderstorm photography

The light barrier **jokie²** can be switched to the passive mode with switch 3. In this case, the operation of the IR diode is stopped and the light barrier only responds to very rapid changes in light, as they happen in thunderstorm lightning.

In this mode the potentiometer is used to set the sensitivity.

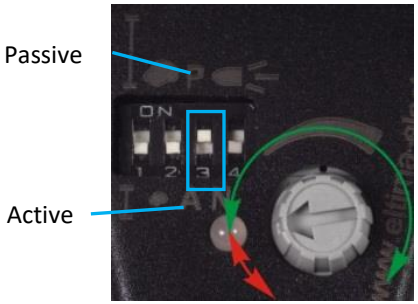


Figure 11:
Passive mode

Use only the green range for the sensitivity setting starting from the LED, and not the red marked range!

The sensitivity is the highest at the left end of the green range.

To photograph in passive mode, the light barrier is mounted on a tripod and directed with the receiver to the thunderstorm.

The mode selector can be switched by using a pen, ball pen or tweezers.

Ballistics mode

For the reliable detection of objects with speeds that exceed 200 m/s or 720 km/h, like bullets from firearms, the light barrier **jokie²** must be switched to the ballistics mode using switch 4.

The range is reduced to approximately 8 m with an 80 mm reflector. In this mode, the switch 1 has no effect. With the switch 2, the range and sensitivity for the ballistics mode can be set.

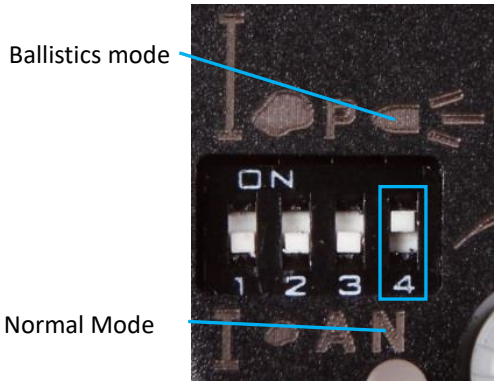


Figure 12:
Ballistics mode

For all objects that move slower than the speed mentioned above, the normal mode should be used.

In the ballistics mode the range for the trigger delay changes. This can be now set from 0.02 ms to 10 ms.

Wake-up

Most of the cameras and speedlightes turn off after a certain time and fall into a power saving mode. For some, this power saving mode cannot be switched off by the camera settings.

To keep such devices "awake" the light barrier activates the camera in an interval of 10 minutes. Therefore the light barrier acts as if the shutter button of the camera is pressed halfway for a short time.

The wake-up function is always active. It cannot be switched off.

Reducing the cameras shutter lag

All cameras have a technically related delay that varies depending on the camera type.

The shutter lag is a limiting factor in the high-speed photography because the picture is taken quite a lot later from the moment the light barrier has been interrupted. It can have values from approximately 60 ms to 300 ms, depending on the camera type.

In addition to the delay itself, there is also a variation of the shutter lag from one release to another aggravating the situation. The variation of the shutter lag also depends on the type of camera. For some cameras, it is only a few milliseconds, while others show variations of tens of milliseconds.

Using this special mode of the light barrier **jokie²**, the shutter lag of many camera types can be reduced significantly. It also reduces the variation of the shutter lag for many camera types.

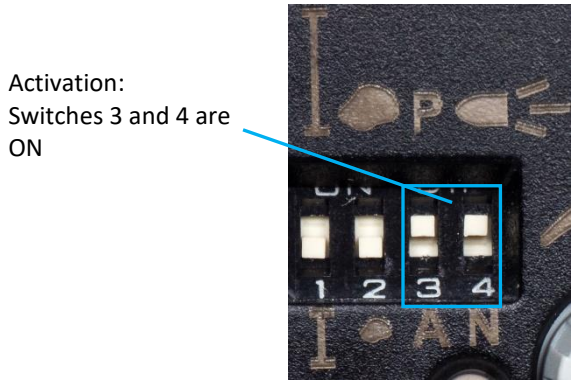


Figure 13: Reducing the shutter lag

To activate this mode, the switches 3 and 4 must be turned on, see *Figure* 13.

This mode behaves as if you press and hold the shutter button halfway. Thus, the picture review does not work in this mode, neither do live view modes. To view the images either the mode must be turned off or the connection to the camera must be cut.

Taking pictures with jokie²

Setup and alignment of the light barrier

In nature photography, light barriers are usually set up in places where it is known exactly where and in which direction the animals are moving. Examples of such places could be feeding places, nests, caves, trails, etc... In the experimental photography, on the other hand, the light beam crosses the trajectory of the object to be detected.

Setup

Light barrier and reflector are mounted on tripods or clamps. The more stable the setup is, the less unwanted releases will occur.

Install the reflector at a location outside of the image frame and align it so that it points approximately towards the light barrier. An exact alignment is only required if the highest range is to be achieved.

Then install the light barrier and connect the power supply.

Alignment of the light barrier

Point the beam intentionally above the reflector and move the light beam towards the reflector in a meandering movement, see *Figure 14*. The distance a between the horizontal travels should be smaller than the diameter d of the reflector, see *Figure 14*, otherwise the beam could drive around" the reflector, see *Figure 15*.

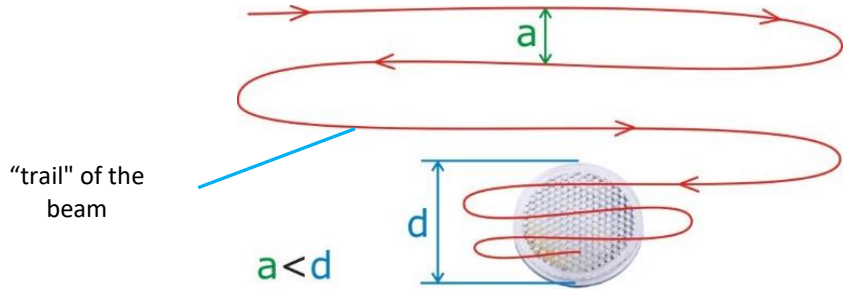


Figure 14: Finding the centre of the reflector

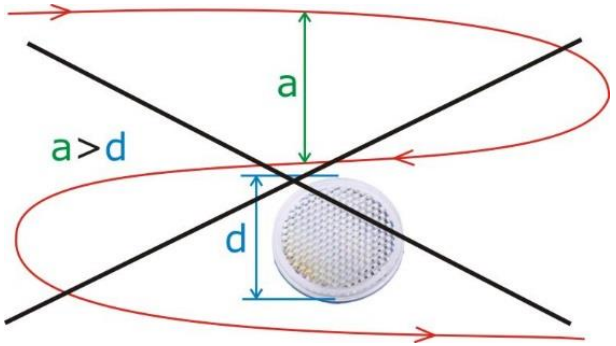


Figure 15: Missing the reflector

While doing this, observe the LED of the light barrier. Without reflection it will light. As soon as the beam hits the reflector, the LED turns off.

Finding the centre of the reflector

To find the horizontal centre of the reflector pan the light barrier slowly to the right until the LED goes on and remember this point. Then pan the light barrier to the left until the beam leaves the reflector and the LED goes on, and remember this point too. The centre between these two points is the horizontal centre of the reflector.

Now align the light barrier to the vertical centre. To do so proceed as described above, but in the vertical direction.

Connecting the Camera

After the alignment of the light barrier, the camera can be connected. The system is now ready for operation and the camera will trigger as soon as the light beam is interrupted.

Important settings on the camera

Autofocus

When taking pictures with light barriers, it **is mandatory to** switch the **autofocus** of the camera to manual, i.e. the autofocus is turned off. If you do not, the camera will most likely not trigger! This principle applies to all operating modes of the light barrier.

Reason: The autofocus is too slow in the very most of the cases, despite the fact that nowadays systems are considered to be very fast. Until the AF finds a target, it is already gone.

The light barrier replaces the autofocus of the camera.

Focus the lens to a point at which you expect your subject, when the image is taken. Hereby take in account the movement direction and speed of the subject as well as the cameras shutter lag.

Depending on the speed of the subject and the shutter lag of the camera, the image is created at some distance from the beam of the light barrier. The optimum focus setting is determined by trying it out.

Strategies for positioning of the light barrier

Wherever possible, the focal plane of the camera should be parallel to the beam or to the flight path of the subject. These setups will increase the success rate, particularly during the first experience in dealing with light barriers.

Plane of focus is parallel to the IR-beam

If the camera´s focal plane is parallel to the light beam, the subject can be depicted sharply from the left to the right edge of the image, no matter where it breaks the light beam, see *Figure 16*.

Figure 16: Plane of focus is parallel to the IR-beam

In this context it is irrelevant whether the light beam itself is installed horizontally or vertically.

If the plane of focus and the light beam intersect at an angle, the subject is only sharply imaged when it interrupts the light beam at the point of intersection of the focal plane and the light beam, see *Figure 17*.

Figure 17: The plane of focus intersects the light beam

Plane of focus is parallel to the flight path

For moving subjects at high speeds, if possible, the flight path should be parallel to the plane of focus. Using the example of bird photography, the advantages of this arrangement become clear.

Due to the shutter lag of the camera and the birds speed, it will be imaged in the situation as in *Figure 18* more or less far away from the light barrier.

Since the flight path is in the plane of focus, the bird is shown in focus regardless of its speed.

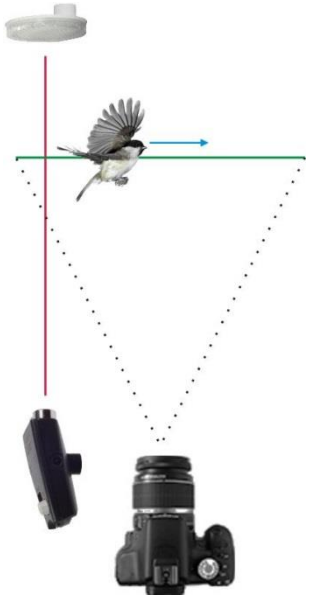


Figure 18: The plane of focus is parallel to the flight path

In this context a possible motion blur due to too long exposure times are not taken into account!

Taking advantage of the geometry of the subject

The hit rate is at its highest when the light beam is oriented so that it crosses the broadest side of the subject profile. This becomes clear in the following example.

A bird in flight with spread wings, seen from the front is much wider than it is high (truism).

If the light barrier is positioned vertically, then with only **one** beam an area, here marked blue, can be covered which is almost twice as wide as the wingspan of the bird, and as high as the working distance, see *Figure 19.*

With a horizontal beam, the area is very limited because the bird can easily fly over or below the beam, see *Figure 20*.

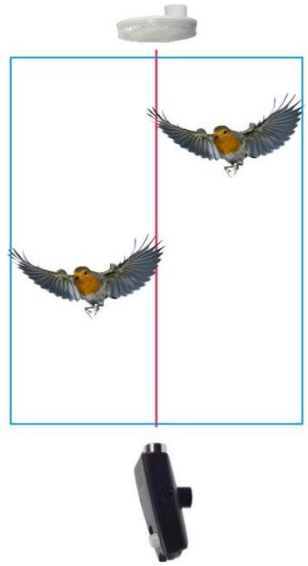


Figure 19: Bird photography with vertical light beam

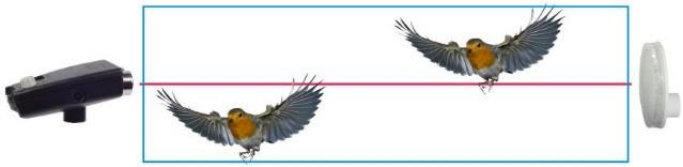


Figure 20: Bird photography with horizontal beam

How to handle the sensitivity of the light barrier

As described in the section *Sensitivity*, the sensitivity of the light barrier depends on the power of the IR transmitter, the working distance and the size of the reflector, like it is shown in the *Table 1* up to *Table 6*.

Photographing small objects

For photographing small and smallest objects like water drops, small insects take a small reflector and set the power of the IR transmitter to the minimum, see *Table 1*. For a high sensitivity place the reflector as far as possible away from the light barrier, however the LED must be off and should not flicker.

If it is not possible to place the reflector far enough away from the light barrier, you can also reach the desired sensitivity by pivoting the reflector to one side, as shown in the figure *Figure 21*.

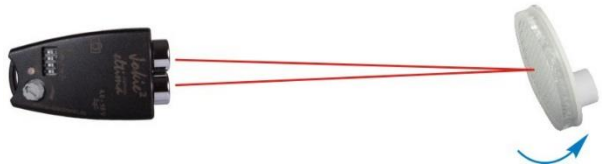


Figure 21: Increasing the sensitivity

Blanking out of small objects

When photographing larger subjects, like mammals, it is desirable to avoid false triggers, caused for example by buzzing small insects or falling snow flakes.

To do this, take the large reflector, switch the power of the IR transmitter to higher power stages or to maximum, see *Table 1*, and position the reflector as close as possible to the light barrier.

Photographing without reflector

In the section *The light beam* the blue marked section next to the light barrier has been described, in which objects can act as a reflector.

In situations where installing the reflector is difficult or even impossible and at the same time the distance between the light barrier and subject may be small, a reflector is not really needed.

The range of the light barrier in this case depends very much on the reflecting properties of the subject.

Also the precision of the system in this mode is not as high as when operating with reflector, since it cannot be predicted, which parts of the subject reflects good or bad.

Nevertheless, this mode may be very attractive.

The *Table 7* shows the possible ranges when using the palm of the hand as a reflector.

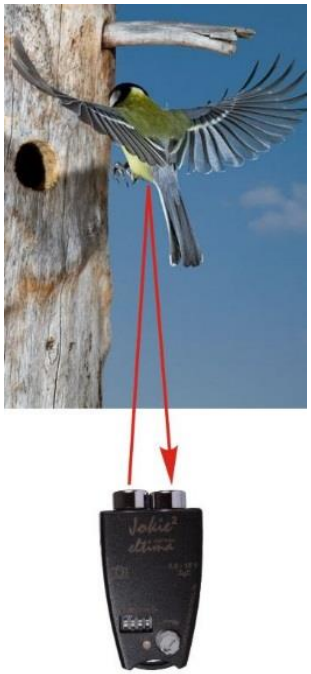


Figure 22: Operation without reflector

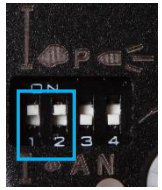
Switch positions				
	small, small	small, large	long, small	long, large
Range approx. [cm]	5 - 6	15	50	70

Table 7: Range without reflector

Electrical connections

Camera Connection

The camera is connected via a 2.5 mm stereo jack plug. When the camera is triggered the switches for measure and release are closed at the same time for 300 ms. The switches used are a transistors in open-collector circuit with a current carrying capacity of 200 mA per transistor.

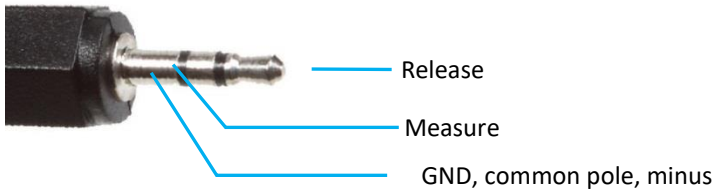


Figure 23: Pinning camera connector

Power supply

The power supply is reverse polarity protected and connected via a DC plug with 4.75 mm outer and 1.7 mm inner diameter.

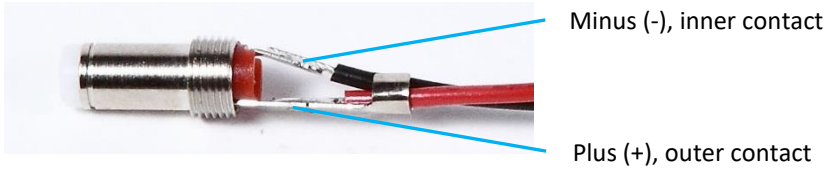


Figure 24: Pinning DC plug

Specifications

Type and design

Infrared reflex light barrier
Wavelength IR light: 850 nm

Dimensions:

L x B x H [mm]: 64 x 36 x 29

Weight

40 g (without battery case and reflectors)
Total weight: 86 g

Power supply

4 AA batteries or rechargeable batteries type AA, LR6, etc..
External power supply: Output: U = 4.5 V - 15 V; I > 100 mA

Power consumption

Max. 240 mW

Operating time with one set of batteries

Switch position:
- Long range, large objects: > 4 days
- Other switch positions: > 7 days
(tested with average alkaline batteries)

Range

80 mm reflector

Switch position:
small distance, small objects: 1.3 m
small distance, large objects: 8 m
long distance, small objects: 12 m
long distance, large objects: 16 m

Response time

Operating mode:
- Normal: min. 100 µs
- Ballistics mode: min. 20 µs

Scope of delivery

Light barrier jokie²
Battery case with cable
Reflector 80 mm
Reflector 40mm
Velcro tape

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