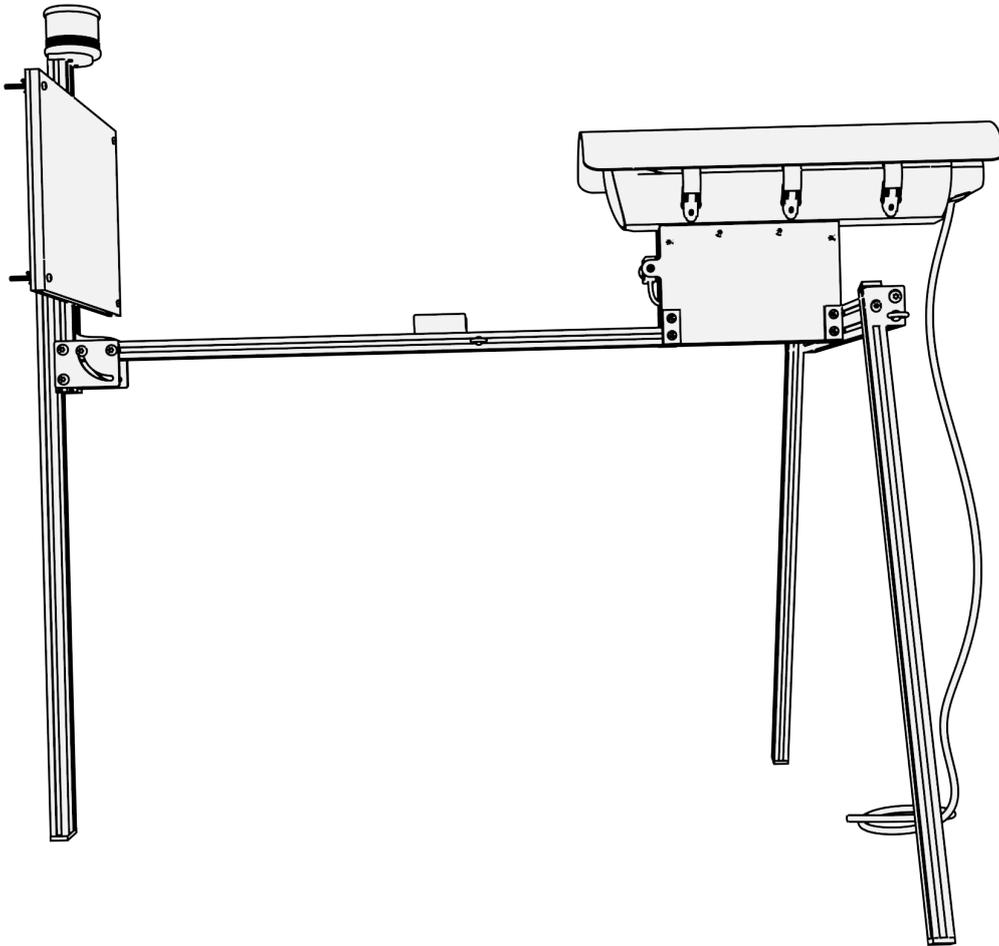


English



# Automated recorder of nocturnal insectes (ARNI) Set up guide





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Safety

Compo-  
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Setup

Power

Start

Menu  
hidden

Menu

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tics

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Output

LEPMON  
Code

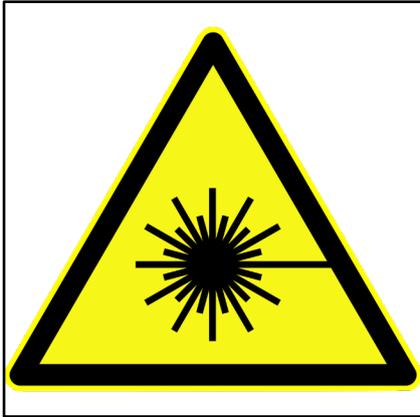
This manual describes firmware version 2.3.1 released 25.03.2026.

If your ARNI is running an older version, you can find the appropriate instructions for download at <https://lepmon.de/en/arni-manual/>.

Your ARNI must be updated to firmware version 2.3.0 or newer before the start of the 2026 field season. The [update process](#) is described in this document.



# 1 Safety instructions



## UV

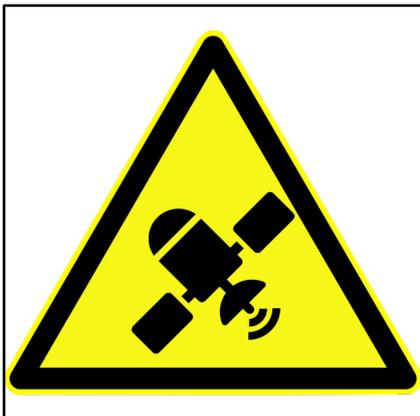
The Automated Recorder for Nocturnal Insects (ARNI) uses a UV lamp. When operating the lamp, always **maintain a distance of at least 50 cm**. Do not look directly into the UV lamp. No precautions are necessary as long as the device is not connected to the power supply.

Safety



## Rain

ARNI is fundamentally protected against splashing water. Once components are opened, e.g. during installation or maintenance, this protection is no longer guaranteed. If moisture enters the housing, the windscreen [heater](#) can be activated in the menu.



## GPS

ARNI has a hidden GPS module and transmits its location.

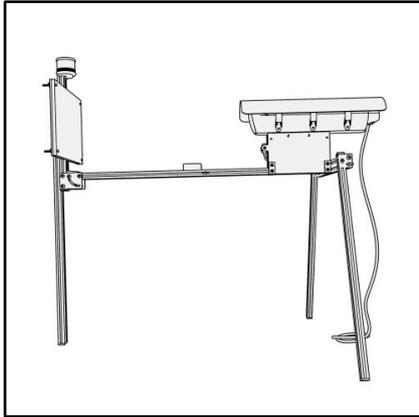


## camera surveillance

ARNI takes pictures of the white foam surface. The spotlight under the camera housing lights up with each picture.

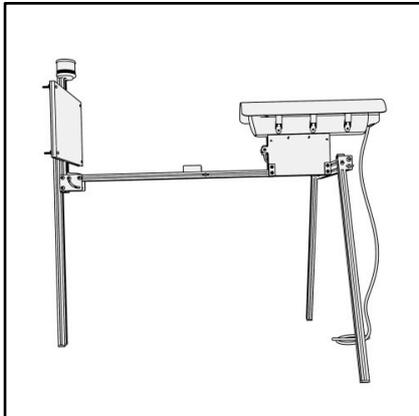


## 2 Generations



### Pro\_Gen\_1 und Pro\_Gen\_2

Prototype series of the ARNI, operated exclusively by the LEPMON project and in Jena.



### Pro\_Gen\_3 und Pro\_Gen\_4

Series variants of the ARNI Pro model. ARNI

ays the device generation in the [start sequence](#). Both generations are almost identical in design and differ mainly in their [control electronics](#). The most important difference is that Pro\_Gen\_4 has integrated [protection against deep discharge](#) to protect the [battery](#).

Pro\_Gen\_3 was awarded by the LEPMON project. From 2026 onwards, only Pro\_Gen\_4 will be distributed by K2W.

### CSS and CSL

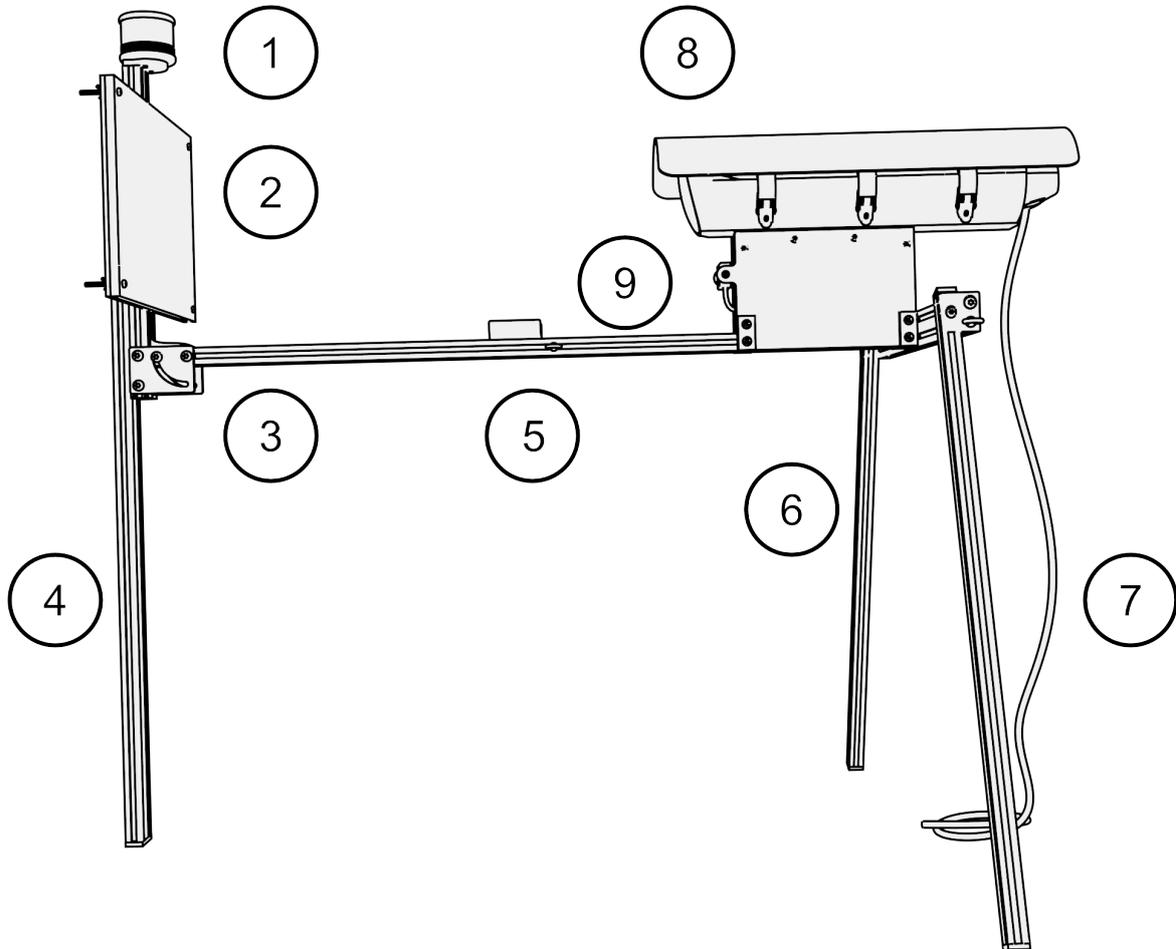
The citizen science variants of ARNI are expected to be available in the spring of 2026.

Compo-  
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## 3 Components

### 3.1 Rack

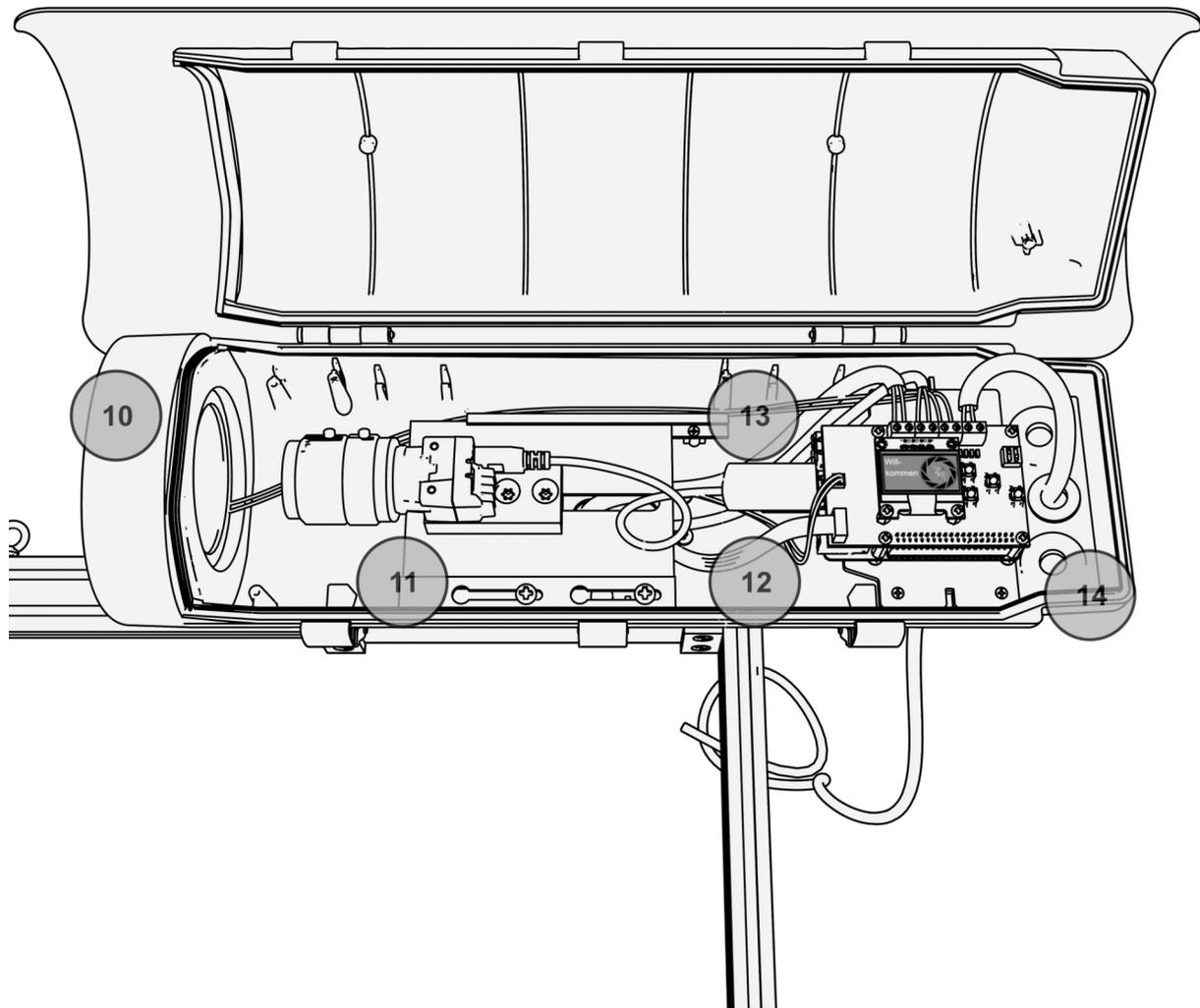


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- |   |                                   |   |                                    |
|---|-----------------------------------|---|------------------------------------|
| 1 | UV-Lamp                           | 6 | Rear pair of legs with cross strut |
| 2 | Canvas                            | 7 | Power cable                        |
| 3 | Hinge                             | 8 | Camera housing                     |
| 4 | Front leg                         | 9 | Spotlight                          |
| 5 | Longitudinal bar with lamp holder |   |                                    |



## 3.2 Camera housing

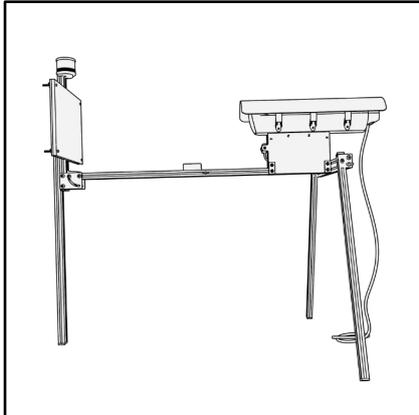


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- |    |  |    |                                 |
|----|--|----|---------------------------------|
| 10 | Glass pane with heating                      | 13 | USB stick                       |
| 11 | Camera and lens                              | 14 | electronics with User interface |
| 12 | <a href="#">USB Y-cable</a> and sensor cable |    |                                 |

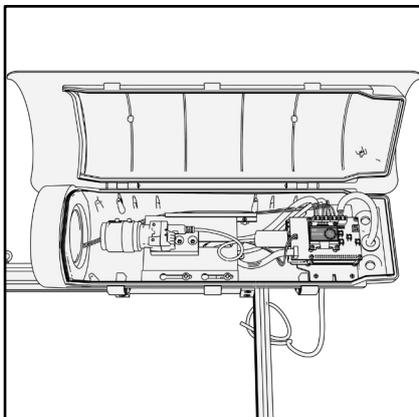


## 3.3 Details



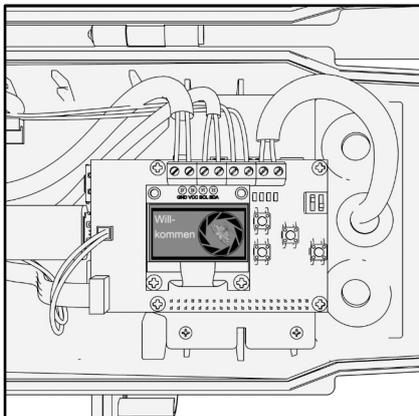
### Rack

The rack consists of a front leg (left) with UV lamp, screen and hinge. On the right-hand side is the camera housing with spotlight above the rear pair of legs.



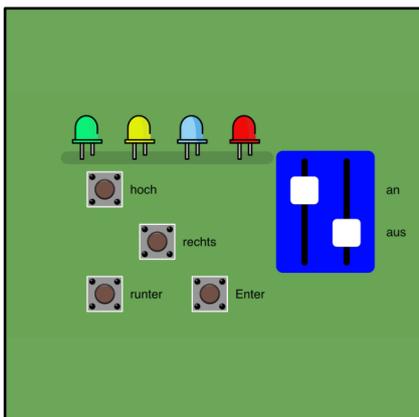
### Camera housing

The camera housing contains the camera assembly, including the lens and control electronics. When the camera housing is open, it is possible to interact with ARNI via the user interface and maintain the memory.



### User interface – display

The user interface provides a black-and-white OLED panel for interacting with ARNI.

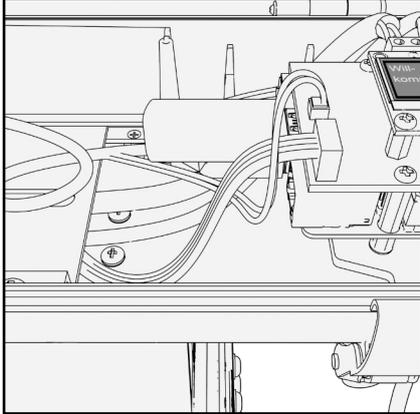


### User interface – buttons

There are 4 buttons to the right of the OLED panel:

#### Up, down, right, enter

The on/off switch has two channels.

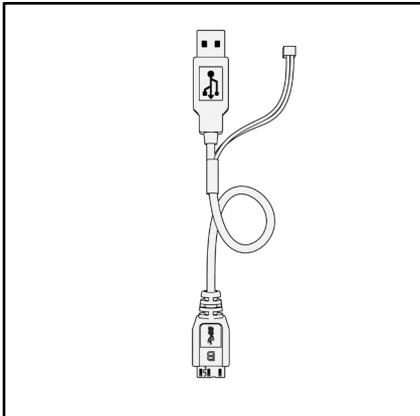


## Connections on the Raspberry Pi

A USB stick for data storage and the camera's [USB Y-cable](#) are connected to the Raspberry and the control board.

The sensor cable is also connected to the board with a broadband connector.

Compo-  
nents



## Modified USB Y-cable

All [Pro generations](#):

The USB cable has been modified: The power wires are separated from the data wires and connected to the board. The cable is shaped like a "Y".



## 4 Setting up the ARNI

### 4.1 Tools

- Torx 25 and Torx 30 screwdrivers
- Toothpick/small flat-head screwdriver
- UV glasses (not included)

Setup

### 4.2 Overview

To set up ARNI, a total of four steps must be performed:

- Screw on the pair of legs
- Attaching the support leg
- Raising the pair of legs
- Erect the support leg and unfold the screen holder

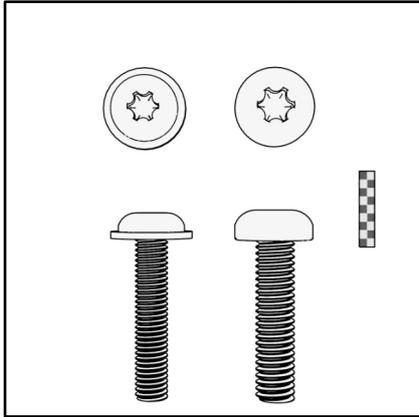
ARNI is shipped in two separate parts:

- Camera housing with folded screen and front leg attached
- Rear pair of legs, retracted

[A foam board is attached](#) to the screen. This part of the device must not be removed during installation.



## 4.3 Assembly

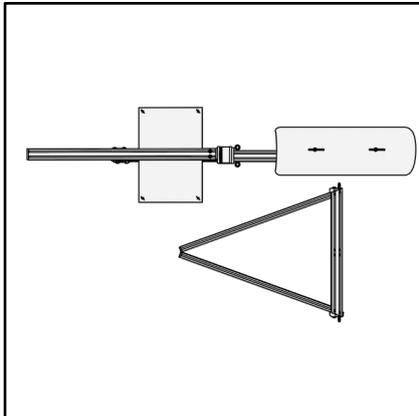


### Screws

ARNI is assembled using screws. Some screws are never completely unscrewed. Each step specifies whether the screw must be completely unscrewed or only partially unscrewed.

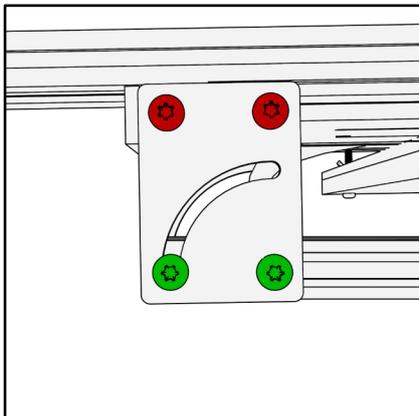
Two types of screws are used: Torx 25 screws (left) and Torx 30 screws (right).

Setup



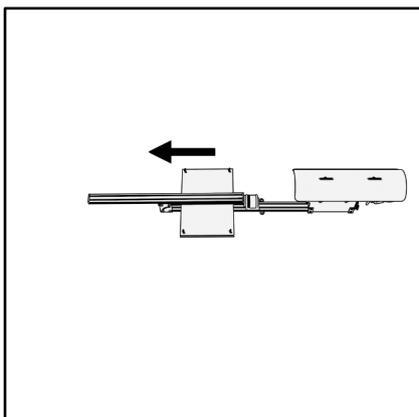
### Step 1

Place both components on the floor.



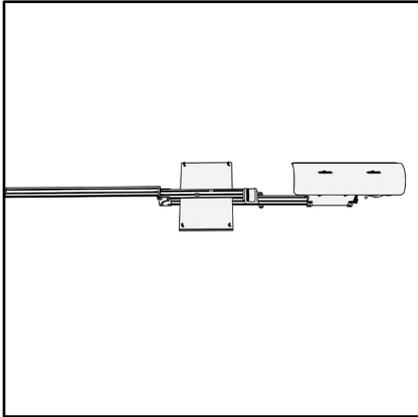
### Step 2

There are four screws on each side of the hinge under the UV lamp. All four screws must be tightened securely. It is essential to check that the Torx 25 screws (marked in green) are tight.



There is a movable aluminium profile above the UV lamp and shade. Move this carefully in the direction of the arrow. Make sure that the aluminium does not scratch the UV lamp.

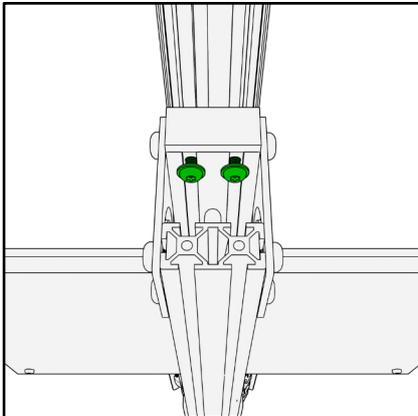
Not applicable to devices sold by K2W Lights.



#### Step 4

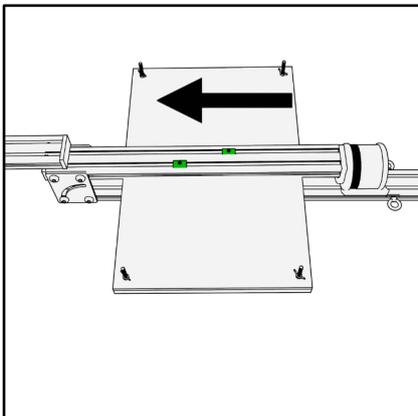
The movable aluminium profile is now fully extended.

Not applicable to devices sold by K2W Lights.



#### Tip

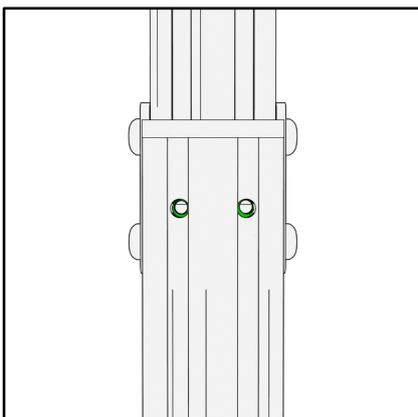
If the profile sticks slightly, the two Torx 25 screws (marked in green) on the underside inside the hinge can be loosened slightly. Never remove these screws completely. If these screws are tightened too much, the hinge can be loosened and folded down ([step 23](#) and [step 24](#)) to make these screws more accessible.



#### Step 5

Move the two slotted nuts (marked in green) in the direction of the arrow to the very end of the profile.

Not applicable to devices sold by K2W Lights.

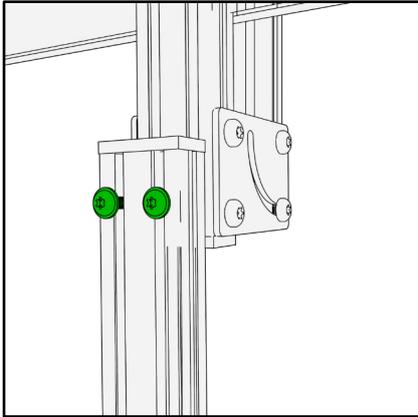


#### Step 6

Align the movable aluminium profile so that the two holes are exactly above the slotted nuts (marked in green).

Not applicable to devices sold by K2W Lights.

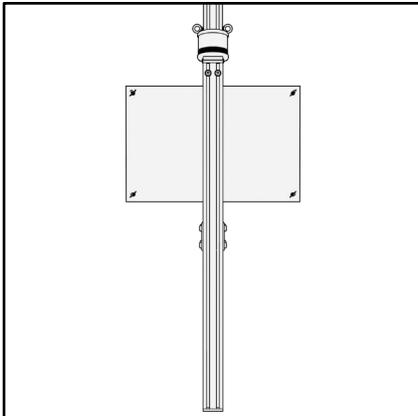
Setup



### Step 7

Insert the two separate Torx 25 screws (marked in green) into the holes and screw them loosely into the slot nuts underneath.

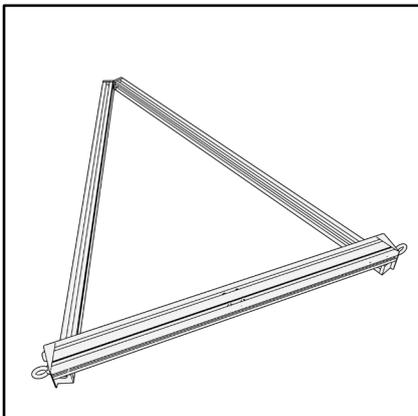
Not applicable to devices sold by K2W Lights.



### Step 8

Carefully slide the movable aluminium profile towards the UV lamp. Then tighten both screws securely.

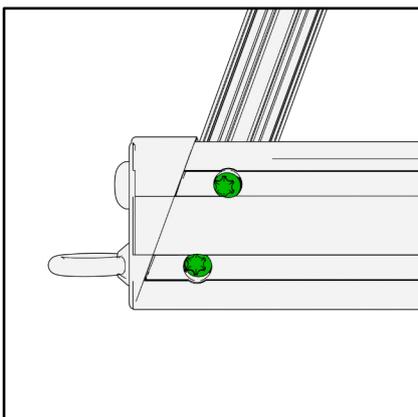
Not applicable to devices sold by K2W Lights.



### Step 9

Place the pair of legs on the floor so that the two aluminium profiles touch the floor and the middle profile is floating.

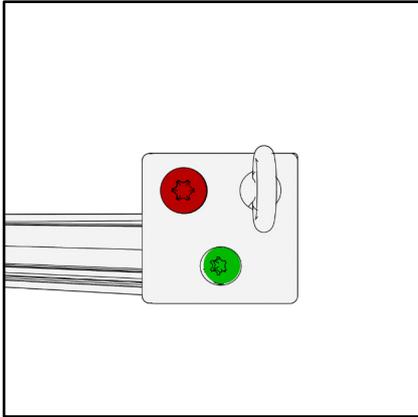
[Continue to step 15](#)



### Step 10

There are a total of four screws in the corners of the pair of legs. The screws (marked in green) can be seen from above. Loosen these Torx 30 screws. Never unscrew them completely!

Setup

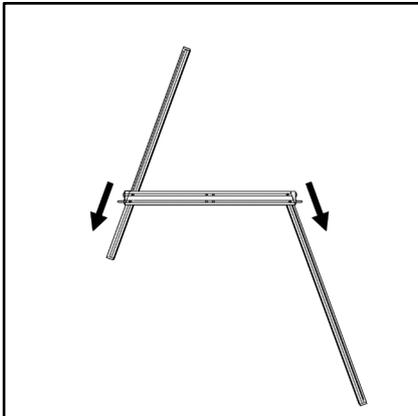


### Step 11

Two further screws are visible from the outside. Loosen the Torx 25 screw (marked in green) by approximately half a turn until the leg can be moved.

Never loosen the other screw (marked in red).

Perform steps 10 and 11 on both sides of the pair of legs.

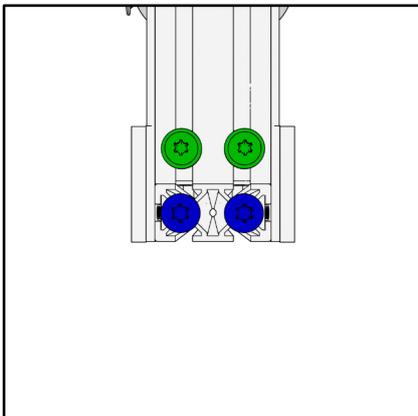


### Step 12

Pull the two aluminium profiles in the direction of the arrow. To align ARNI straight in the field, these profiles can be moved to the desired position.

Once the legs are extended, first tighten the screw (marked in green) from step 11 and then the two screws from step 10.

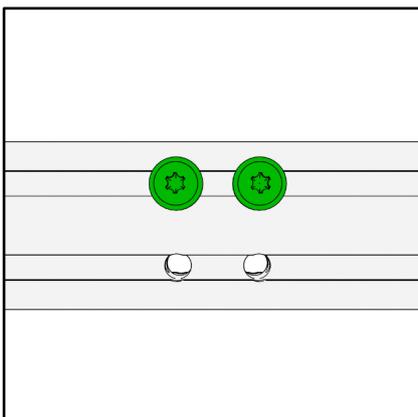
[Continue to step 28](#)



### Step 13

There are 2 x 2 Torx 25 (marked in green) and Torx 30 (marked in blue) screws under the camera housing. Unscrew all screws.

[Continue to step 21](#)



### Step 14

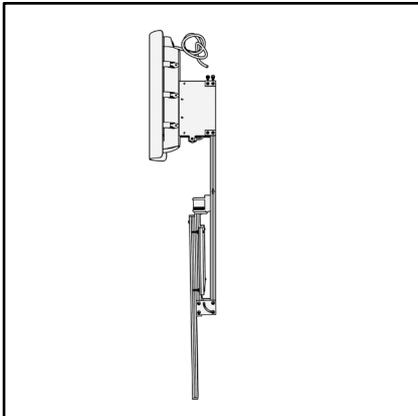
Insert the Torx 25 screws from step 13 into the upper holes of the cross strut.

Setup



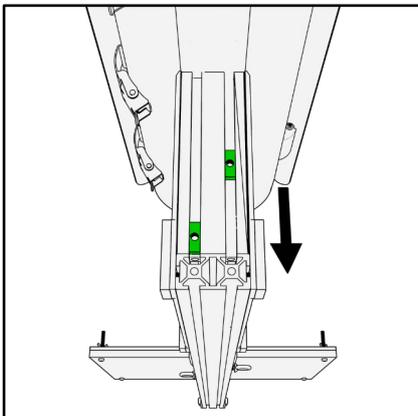
### Step 15

The pair of legs is positioned as in [step 9](#): the two extended aluminium profiles touch the floor and the middle bar is floating.



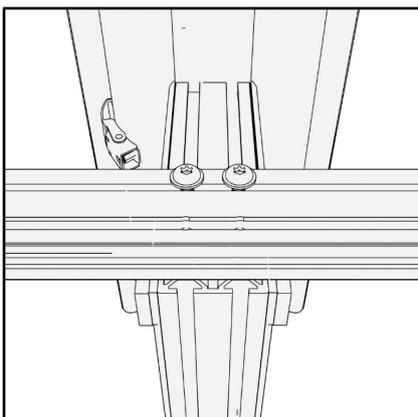
### Step 16

Set up the frame vertically so that the camera housing is at the top. Make sure that the frame does not fall over.



### Step 17

Pull the two slotted nuts (marked in green) in the direction of the arrow until they stop.

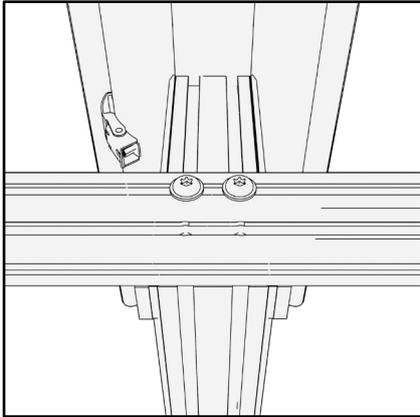


### Step 18

Place the cross strut of the pair of legs on the upper end of the longitudinal strut so that the screws are in the same position as the slotted nuts in the frame.

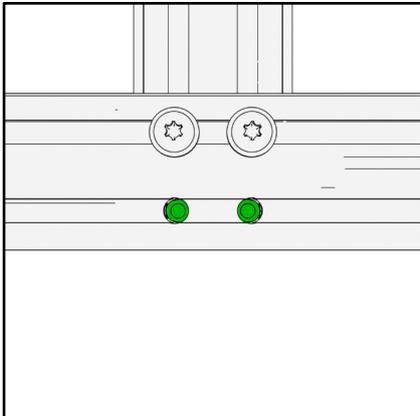
Tighten the screws slightly – the pair of legs must remain movable.

Setup



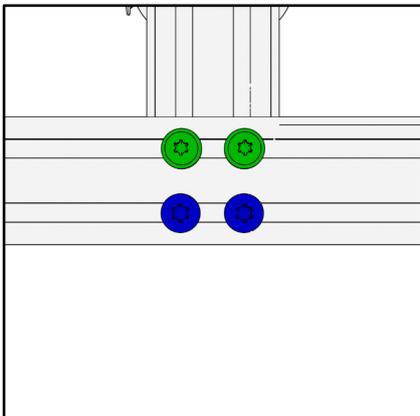
### Step 19

Now carefully slide the cross strut away from the camera housing until the aluminium profiles on the side without screws are flush with each other.



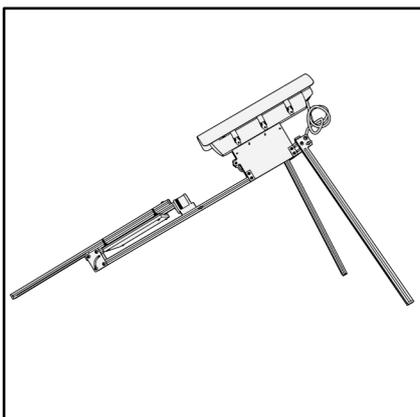
### Step 20

The two holes without screws are located exactly above the threads in the longitudinal strut (marked in green).



### Step 21

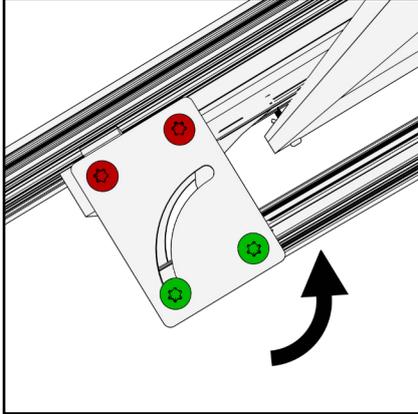
Now insert the two Torx 30 screws from [step 13](#) (marked in blue) through the holes. Tighten all screws securely.



### Step 22

Place ARNI back on the floor.

Setup

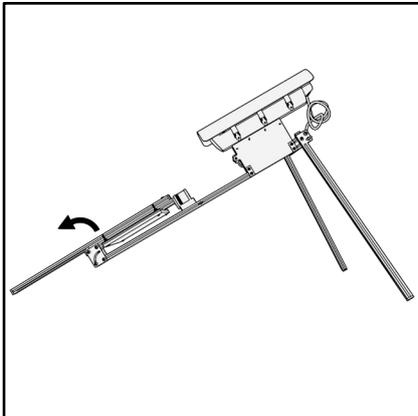


### Step 23

There are four screws on each side of the hinge under the UV lamp. The Torx 25 screws (marked in green) must be loosened by a quarter turn in the direction of the arrow. Never unscrew the screws completely. Do not turn the screws marked in red.

Both screws marked in green sit on springs. Therefore, the screws must never be turned too loosely to prevent the springs from being lost. In addition, the hinge can slip if the screws are too loose.

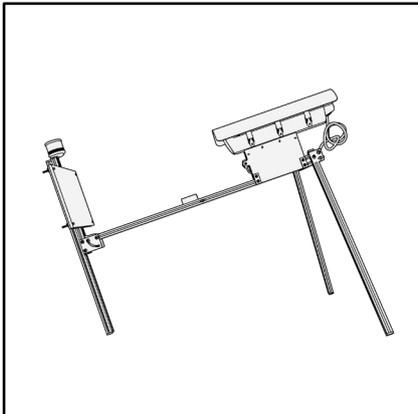
Setup



### Step 24

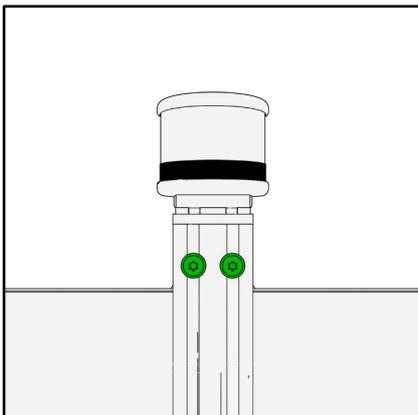
Open the hinge completely and raise ARNI in the direction of the arrow.

[Back to step 4](#)



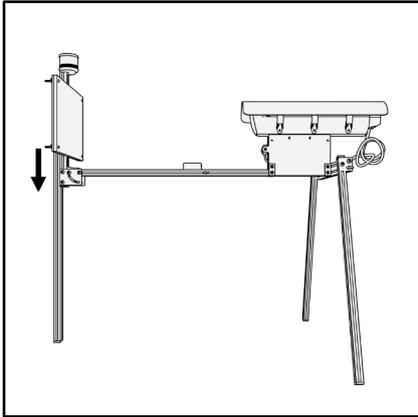
### Step 25

Tighten the two screws from step 23 on each side again with a quarter turn (in the other direction).



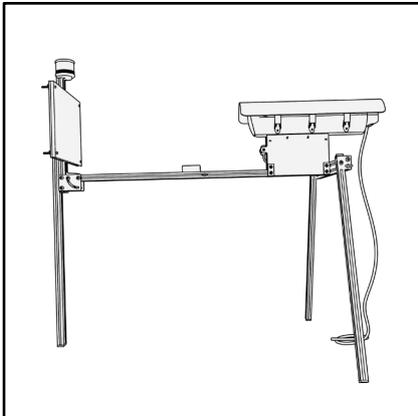
### Step 26

Loosen the two Torx 25 screws (marked in green) under the UV lamp. Do not unscrew them!



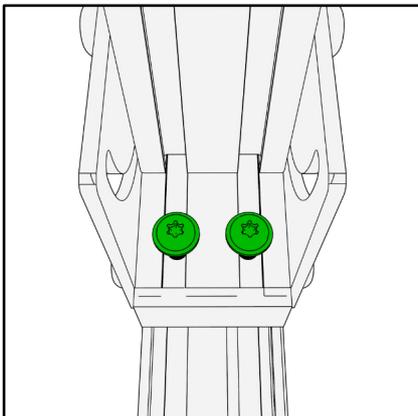
### Step 27

Extend the support leg to the desired height.



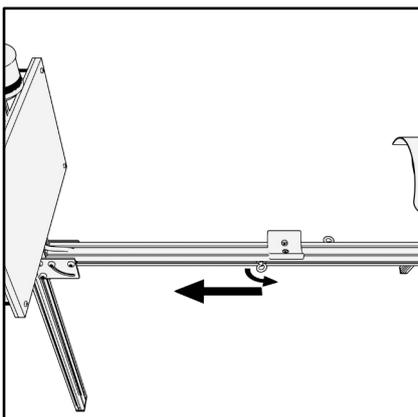
### Step 28

When setting up, ensure that ARNI has a slight downward slope towards the canopy. This means that the pair of legs should be positioned slightly higher than the support leg. This allows condensation and rainwater to run off. On uneven ground, adjust the pair of legs to the surface as described in [step 12](#). The crossbar under the camera housing should be horizontal.



### Step 29

There are two Torx 25 screws (marked in green) inside the hinge. Tighten these securely.



### Step 30

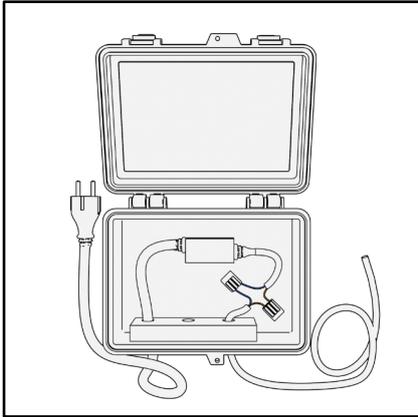
ARNI has eyelets at the front end of the longitudinal strut and on the cross strut. Ropes (as with a tent) can be attached here to make ARNI wind-stable. In addition, the eyelets on the longitudinal strut can be carefully rotated (curved arrow). This allows them to be moved to the left and right to the desired position.

Setup



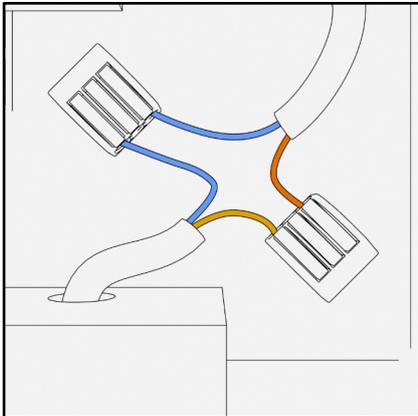
## 5 Power connection

### 5.1 Option A – Power grid



#### 12 V DC with 5 A

A 60 W power supply unit should be used for mains operation. The standard values are 12 V/5 A. It should also be protected against the weather with a splash-proof (IP54) cable box. The box provides storage space to protect the earthed plug of an extension cable against splashing water.



#### Cable cores

The connection to the power supply unit is made using WAGO terminals. Blue must be connected to blue (ground) and orange to brown (positive pole).

Power

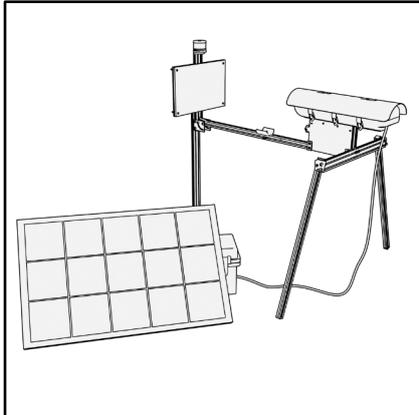
#### Note

This power supply combination is not included in the standard scope of delivery of ARNI. Devices loaned through the LEPMON project can be equipped with a power supply.

A power supply unit must be purchased for devices sold by K2W Lights. A suitable power supply unit including a box, as otherwise loaned by the LEPMON project, can be purchased from Insects & Lights Jena (contact:info@gunnarbrehm.de).



## 5.2 Option B – Solar panel and charge controller



### 12 V DC with 5 A

ARNI can be operated independently with a PV system. This unit is not included in the standard scope of delivery of ARNI. Devices loaned out by the LEPMON project can be shipped with a PV box. Important: This box includes a charge controller, protective box and connection cables.

Battery (50 Ah, 12.8 V) and solar panel are not included! If necessary, please inquire about suitable models and batteries at [info@gunnarbrehm.de](mailto:info@gunnarbrehm.de)



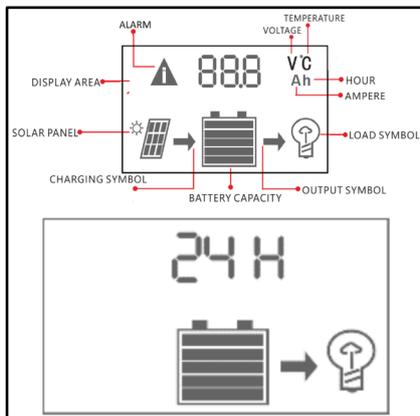
### Charge controller

The PV units are equipped with a controller from Victron Energy and a converter. Detailed instructions for the control unit can be downloaded from the Victron Energy website:

<https://www.victronenergy.com/upload/documents/Manual-BlueSolar-PWM-Charge-Controller-LCD&USB-12V-24V-5A-10A-20A-EN-NL-FR-DE-ES-SE-IT.pdf>

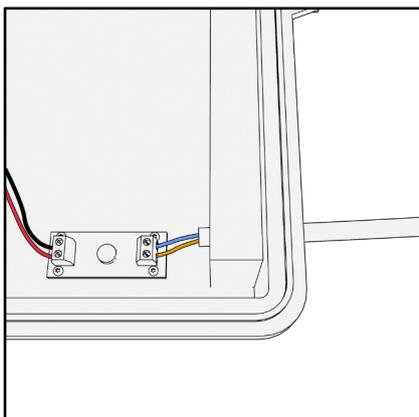


Power



### Power output

Set the operating mode to "24H" for commissioning/maintenance. Use "L" in recording mode. In this mode, the system only supplies power in the dark. Press the MENU button several times to display the controller information. If "24H" or "L" (or another load output) is shown on the display, press and hold MENU for a few seconds until the display/number flashes. You can now scroll through the outputs using the up and down buttons on the controller and select one.



### Connecting the wires

Depending on the model, the connection to the PV box is made either directly via Wago terminals or to a converter. To do this, the cable ends from ARNI must be tightened securely in the converter using a flat-head screwdriver. The brown wire of the cable from ARNI is screwed opposite the red wire (positive pole), and the blue wire opposite the black wire (ground).



## 5.3 Protection against deep discharge

[Pro Gen 4](#), [CSS Gen 1](#) and [CSL Gen 1](#) only:

ARNI has integrated protection against deep discharge to protect the [battery](#). This threshold is 9.7 V input voltage.

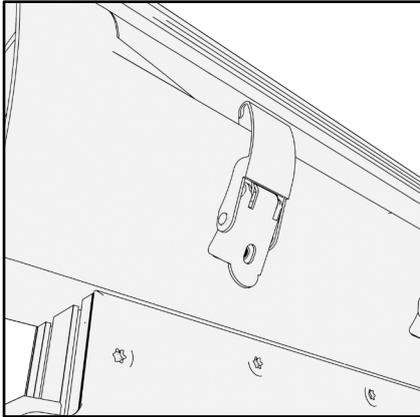
ARNI measures the current regularly. Nevertheless, it may switch off without prior warning.

If the battery charge level is too low (output voltage below 9.7 V), ARNI cannot be switched on. In this case, follow the instructions for the battery and charge it.

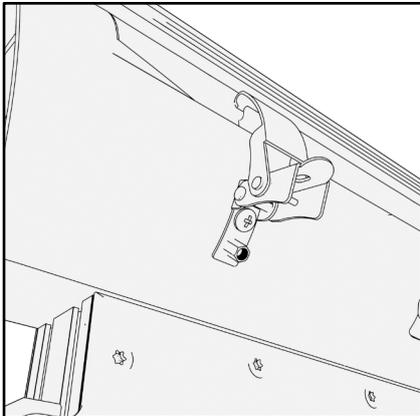
Power



## 6 Opening/closing the camera housing



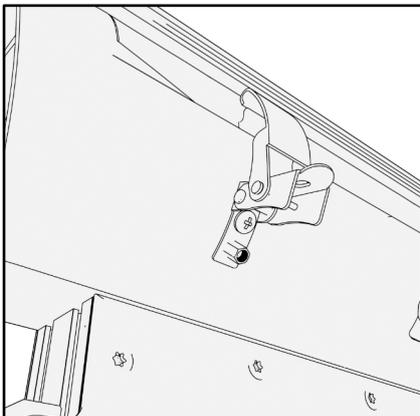
The camera housing has a hinge on the right-hand long edge (viewed from the camera) and three snap locks on the left-hand side. These snap locks are located under the sun visor.



### Opening

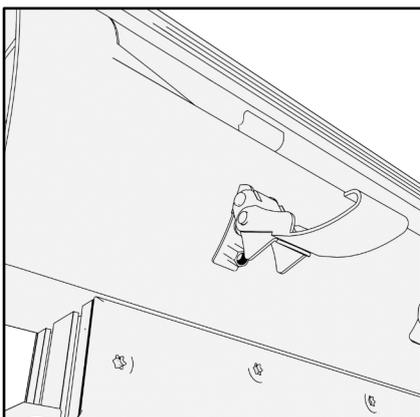
To release the snap locks, carefully press the handle upwards. This releases the barb from its counter bearing and allows it to be moved around it. Once all three locks have been released, the cover can be lifted upwards.

Start



### Closing

Carefully lower the lid. When the seals make contact, check that no cables are trapped. Carefully place the three hooks over the counter bearing. Then carefully press the three handles down one after the other.



### Caution

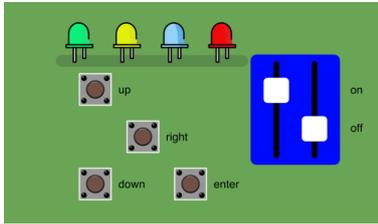
When opening the camera housing, check for insects under and between the snap locks.

Do not open the camera housing in the rain!

When closing the camera housing, it is essential to ensure that no cables are trapped.

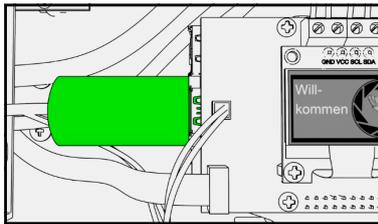


## 7 Switch on

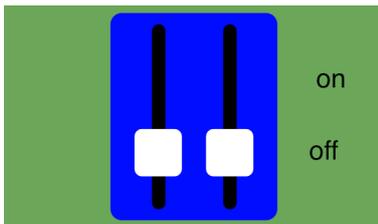


User interface with four buttons, four control LEDs, and the on/off switch (OLED panel not shown).

The buttons are small. Use a toothpick or small screwdriver (included) to move the controls. Never use a twig or tool that is too coarse to operate the buttons!

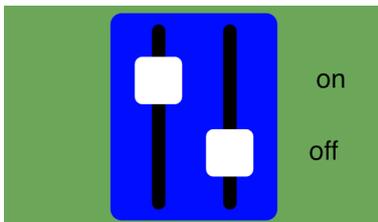


Insert an empty USB stick (green) with at least 256 GB storage capacity into the USB port via the [USB Y-cable](#).



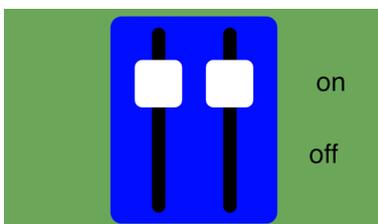
[All ARNI variants](#) are switched off when both switches are set to 'off'.

Start



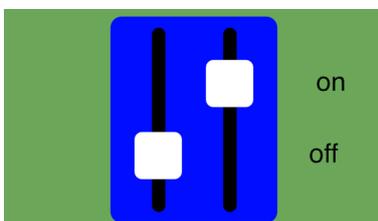
First, switch the left on/off switch to 'on' (up). The green control LED will start flashing and the LEDs on the Raspberry Pi (not the control LEDs next to the on/off switch) will light up.

ARNI is in continuous operation and also consumes power during the day.



[Pro Gen 4](#), [CSS Gen 1](#) or [CSL Gen 1](#) and for [solar powered](#) operation of these generations:

set the right switch to 'on'. This activates the ARNI's power-saving mode and it consumes only minimal power during the day.



When switched off on the left and on on the right, the ARNI cannot be operated.

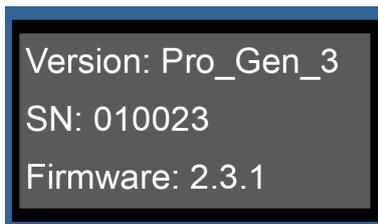


## 8 Start sequence



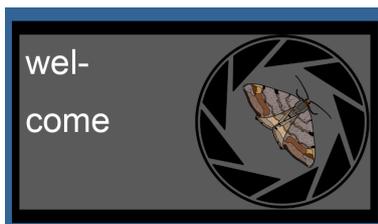
During the start-up sequence, ARNI first refers to the instructions (this document). The QR code displayed can be scanned with a mobile phone to download it from the project website:

<https://lepmon.de/en/arni-manual/>



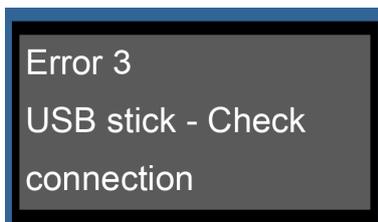
ARNI displays important device data:

- The device version and generation
- Unique identification/serial number (SN)
- The current firmware version

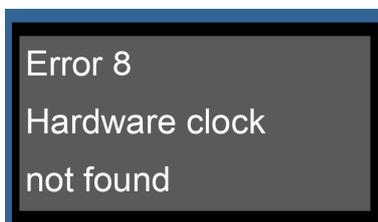


After a short time, ARNI displays the start sequence. The LEPMON logo appears. If ARNI does not display anything and the red control LED flashes repeatedly, there is a fault with the display. The display is plugged in and secured with a screw. Check this plug connection and restart manually.

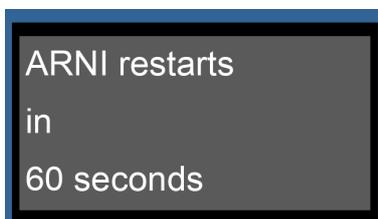
Start



If no USB stick has been inserted or if it is faulty, ARNI will display [error 3](#) as soon as it starts up. The stick can be reinserted. If this is successful, ARNI will continue with the start sequence. The red indicator LED will light up a total of up to ten times. Each time it lights up, ARNI will attempt to access the memory.



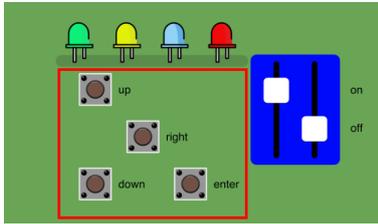
If there is a problem with the hardware clock, ARNI will indicate this (repeatedly) in the start sequence. The time can only be set in the menu on the Raspberry itself. However, this time quickly becomes inaccurate.



If one of these problems persists, ARNI will start a countdown to restart. Wait for this countdown to finish and let ARNI restart on its own. Reinsert the USB stick during the restart.

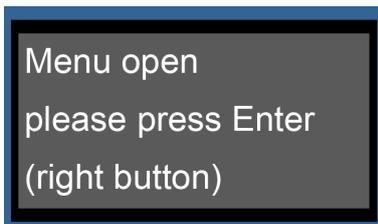


## 9 Input menu



User interface with four buttons, four control LEDs, and the on/off switch (OLED panel not shown).

The input menu is navigated using four buttons: **up**, **down**, **right**, and **Enter** (red box).



After the start sequence, you have the option of opening the input menu. To do so, press **Enter** within the next 10 seconds. If nothing is pressed during this time, ARNI will start recording mode and wait for the first recording.

If you miss the input menu, ARNI must be restarted.

If you accidentally enter the same setting twice within a menu item, you can easily correct this by either adjusting the setting using **up** or **down** or by repeatedly pressing **right** to select the desired position again. If you press **Enter** accidentally or too often, you can return to the previous menu item by pressing **right**.

Menu hidden

The input menu consists of three components: "hidden menu," "visible menu," and "diagnostics," and allows access to various settings:

Hidden menu: Language, Focus, Firmware update

Visible menu: Power supply, Delete USB stick, Windshield heating, Date and time, Latitude and longitude including LEPMON code

Diagnostics: Status messages for all electronic components

When it comes to the settings options, ARNI indicates when it is waiting for input from the user. The blue indicator LED lights up. When the blue indicator LED is not lit, ARNI displays information.

The coordinates only need to be entered the first time or when changing location. These can be determined using an external GPS device or a smartphone and a navigation app. ARNI uses the WGS-84 format.

In addition to the coordinates, ARNI uses an abbreviation (LEPMON code) to assign the recorded data to the location. This code consists of the state and county. It is essential that this is set correctly.

The date and time must be reset each time the device is started manually or the memory is changed. This is necessary because the device's internal clock may deviate from the actual time over time.



## 10 Hidden menu

### 10.1 Change language

Input menu  
opened

When the input menu is opened with **Enter**, ARNI displays a message. If you press **down** during this display, the language menu opens.

Language: English  
change?

▲ = yes ▼ = no

ARNI displays the language currently in use. In addition, either press **up** to select a new language or press **down** to exit the language menu.

Deutsch ▲  
English →  
Español ▼

When the **up** is pressed, ARNI displays the supported languages. By selecting:

**up** = German

**right** = English

**down** = Spanish

the new language is selected and displayed with an "x".

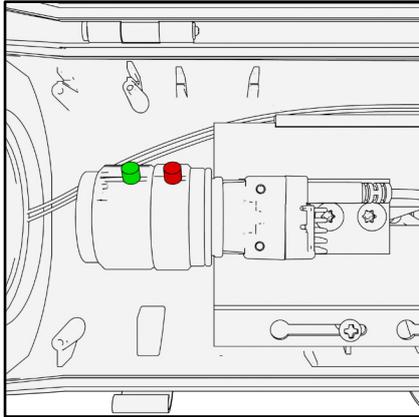
Menu  
hidden

Input menu  
opened

The language menu is closed, but can be reopened by pressing **down** again.



## 10.2 Focus



Not [CSS Gen 1](#):

ARNI has a fixed focus lens. The focus is close to 0.7 m. If the focus shifts and ARNI produces blurry images, it will issue a [warning in the log file](#). The focus can be readjusted without additional tools. To do this, loosen the small screw at the front end (marked in green) of the lens by hand.

Never unscrew the screw completely! Do not turn the rear red screw!

The screw marked in green is partially invisible, depending on the rotation of the lens. Hold the rear part firmly when rotating the front part of the lens between 0.5 m and 1 m.

Input menu  
opened

When the input menu is opened with **Enter**, ARNI displays a message. If you press **right** while this message is displayed, the focus menu opens.

Menu  
hidden

Cancel focusing:  
press Enter  
and hold

If the menu has opened accidentally, you can cancel it.

To do this, **press and hold the Enter**.

Determine exposure  
for focusing  
255; 100 ms; 10

ARNI runs through a series of exposures and attempts to find the optimal exposure. To do this, the illuminator is switched on. ARNI captures frames and calculates their average brightness (e.g., 150.7) and displays the current exposure time (140 ms) and sensor sensitivity (gain 4).

Exposure  
determined

Once a good exposure has been found, ARNI will notify you.

Note: If one of the following displays appears permanently and without change, ARNI is "frozen." It must be restarted and focusing must be restarted.



Focusing  
until sharpness  
maximum reached

ARNI starts recording frames again. ARNI calculates the Gaussian blur of each frame. During recording, the blue control LED is off and the lens must not be adjusted! The OLED panel also indicates when the lens (green screw area) can be focused/rotated.

turn focus  
ring (0.5 - 1 m)  
old:120 - new:100

When “now turn focus ring” is displayed, focus/turn the lens (area of the green screw). The focus of ARNI is between 0.5 and 1 m. The blue control LED lights up. First turn in one direction.

Taking test image  
do not turn  
old:120 - new:100

As soon as the display changes to “Record test image, do not turn”, do not rotate the lens. The blue indicator LED is off.

Menu  
hidden

Image is sharper  
turn further  
old:120 - new:134

After evaluating the frame, ARNI indicates whether the focus has improved or not. To do this, note the values for “old” and “new.”

If “turn further” is displayed, turn in the same direction the next time “now turn focus ring” is displayed.

Image is blurrier  
turn back  
old:120 - new:103

When “turn back” is displayed, turn in the opposite direction the next time “now turn focus ring” is displayed.

Image unchanged  
no change  
old:120 - new:120

If “no change” is displayed, turn the focus ring in the other direction the next time you hear “now turn focus ring.” If this display is reached continuously, the focus is set.



Focusing ended  
by user

The focus menu can be closed by the user. To do this, hold down the **Enter**.

Tighten the screw marked green on the lens again. Do not change the alignment of the camera under any circumstances.

Input menu  
opened

The focus menu is closed, but can be reopened by pressing **right**.

Camera - Check  
cable connection  
n/91

If an [error occurs in the communication between the camera](#) and the Raspberry, ARNI indicates that the cable connection must be checked. The Raspberry attempts to access the camera and displays the number of attempts (n).

Menu  
hidden

Camera overloaded  
focusing not  
finished

If the camera has been unable to create frames multiple times, it is overloaded.

continue focusing  
after restart

ARNI restarts and reopens the focus menu, as it can be assumed that the lens has not yet been fully focused.

Emergency stop  
Visible LED  
after 5 minutes

If the focus menu is open for too long and the spotlight stays on for too long, there is a risk that the spotlight's LED will burn out. ARNI therefore switches off the spotlight in an emergency.



Focusing loop  
starts

[CSS Gen 1](#) only:

ARNI starts the focus loop automatically.

Focusing ended  
Diopters old: 4.98  
Diopters new: 5.1

After completing this loop, it displays the newly found focus value in diopters.

Menu  
hidden



## 11 Visible menu

### 11.1 Power supply, storage deletion, heating

Input menu  
opened

When **Enter** is pressed, ARNI indicates that the input menu is open. If no button is pressed during this display, ARNI switches to the visible menu.

Power supply:  
▲ = Solar → = back  
▼ = Grid

ARNI can be operated with a solar panel with charge controller (in a splash-proof box) and battery or power supply. Depending on the operating mode, select **up** for solar panel and charge controller or **down** for a power supply. Use **right** to return to the hidden menu.

Power supply  
Solar

ARNI displays the selected power supply.

Erase USB data?  
▲ = yes → = back  
▼ = no

Images already uploaded to [LAUP](#) can be deleted from the USB stick. ARNI provides a function for this purpose: ARNI asks whether the USB stick should be deleted. This will permanently delete all folders, images, and files from previous recording sessions that are still stored on the USB stick.

Erasing USB data  
please wait  
n/x

If the question is confirmed with “yes” (pressing **up**), ARNI deletes all previous recording sessions. Depending on the size of the memory, this may take a moment. ARNI displays the progress with  $n$  = number of folders already deleted and  $x$  = number of folders to be deleted.

USB data deleted

Once all folders have been deleted, ARNI will display a success message.

Note: This action cannot be undone.

Menu



USB data  
not deleted

If the question is rejected with “no” (pressing the down button), ARNI continues without deleting.

Heat window?  
▲ = yes    → = back  
▼ = no

Only Pro\_Gen\_2; 3; 4:

ARNI has a heater around the glass pane. This can be switched on if there is moisture in the housing. Press **up** to activate. Press **down** to turn the heater off. Press **right** to navigate back to the USB stick delete function.

Heater on  
for 15 min

When the heater of the front glass is activated, ARNI displays the message “Heater activated for 15 min” and switches it on after diagnosis and/or at the start of the recording run.

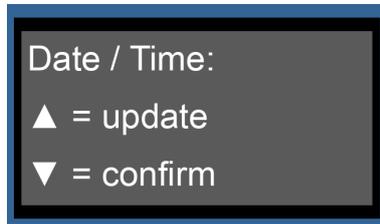
Heater remains  
off

Alternatively, the heating remains switched off.

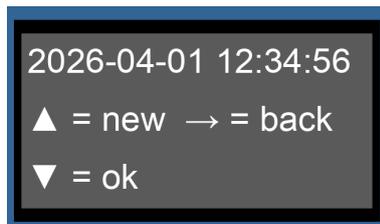
Menu



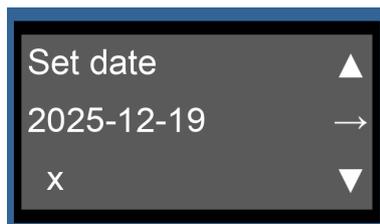
## 11.2 Setting the date and time



First, the time must be checked. To do this, ARNI indicates that the current time can be confirmed with **down** or corrected with **up**.



ARNI displays the current time and date. This continues until either this timestamp is corrected or confirmed. Alternatively, you can return to the windshield heating by pressing **right**.



When pressed, ARNI displays "Set date." The second line shows the date in the format YYYY-MM-DD. The third line shows the position currently being edited with an x. The arrows symbolize the function of the buttons: **right** moves the x one place to the right. **Up/down** increase/decrease the corresponding digit. If the date is correct, confirm with Enter.

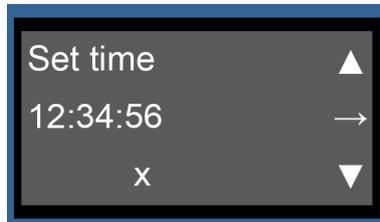
Menu

Each individual digit of the year, month, and day can be changed by pressing **up/down** to increase or decrease the value by 1. This is done from left to right:

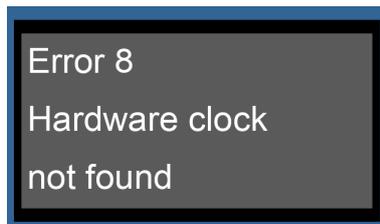
Once the first digit has been set correctly, it is saved by pressing **right**. Now you can change the second digit. In the third line, an "x" indicates the currently selected position. Press **right** again to save this and enter the third digit, etc. When you reach the last digit, you can save the displayed value for the date by pressing **Enter**.

If a correction is necessary, press **right** until the incorrect digit is reached. Pressing the **up/down** buttons again allows you to make the correction. Once all digits are correct, press **Enter** to save the displayed value.

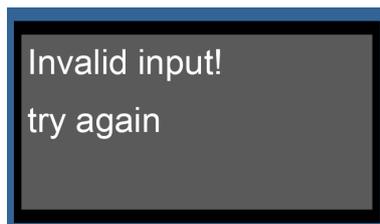
If ARNI already displays the correct date, it can be saved by pressing **Enter**.



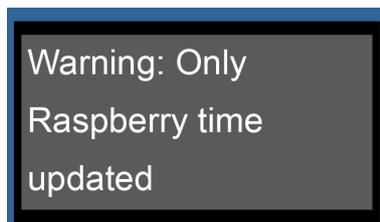
Entering the time follows the same pattern as for the date. ARNI displays “Set time” and below that the internal time in HH:MM:SS format at the beginning. In the third line, “x” marks the current position. The arrows indicate the key function: **right** moves the x one place to the right. **Up/down** increase or decrease the corresponding digit. When the time is correct, confirm with Enter.



If ARNI already displays [error 8](#) here, there is a problem with the hardware clock. Only the Raspberry's clock can be set, but it becomes inaccurate after a short time.



ARNI only allows the range 1-31 for the day and 1-12 for the month. The year can be left blank, but ARNI will display an “invalid entry” message if the year is not between 2025 and 2035. In this case, ARNI will automatically restart the time entry process.



Only the Raspberry's clock can be set, but it becomes inaccurate after a short time.

Menu

Tip:

Set the displayed time to the next full minute and press **Enter** when the current minute reaches :59.

Note:

ARNI uses the time zone determined from the [coordinates entered](#) to determine whether it needs to set the clock forward or backward. This always takes place [after the experiment](#) on the relevant night in spring and fall.



## 11.3 Enter GPS coordinates

Coordinates:

▲ = update

▼ = confirm

ARNI displays the currently set location coordinates and allows the user to reset them with **up** or confirm them with **down**. In addition, **right** can be used to navigate back to the date and time.

N-S: 11.23456789

E-W: -123.45678

▲ new ▼ ok →back

The display remains visible until the coordinates are confirmed or corrected.



ARNI uses WGS84 (World Geodetic System 1984) as its reference system. It uses decimal notation.

The coordinates can be determined using a map service provider in a smartphone app, for example.

Menu

Google Maps © is shown in the example. The red box shows the location coordinates in decimal format. Alternatively, the coordinates can also be determined in advance and set in ARNI.

Gesetzte Markierung

In der Nähe von Vor dem Neutor,  
07743 Jena

1 min

Route Start Speichern

In der Nähe von Vor dem Neutor,  
07743 Jena

(50.9241077, 11.5837992)

Entfernung messen

Please  
enter hemisphere

First, the hemispheres must be entered for north/south or east/west.



▲ = North

▼ = South

ARNI first queries the northern/southern hemisphere:

**Up** selects the northern hemisphere and **down** selects the southern hemisphere.

Germany: "North"

▲ = East

▼ = West

Next, the east/west hemisphere is queried:

**Up** selects the eastern hemisphere and **down** selects the western hemisphere.

Germany: "East"

Latitude (N-S):

51.3456789

x



First, ARNI displays "Latitude (N-S)" and the currently set latitude. ARNI remembers the hemispheres from the previous step and displays a minus sign for "South." If all positions are correct, the latitude can be saved by pressing **Enter**.

Longitude (E-W):

-123.45678

x



Now enter the longitude (E-W). Here too, ARNI remembers the hemisphere and displays a "minus" for west. As soon as the longitude is confirmed with **Enter**, ARNI saves the current position. The next time it is started, it displays the latitude and longitude values again. If ARNI's position is unchanged, you can press **Enter** directly under "Coordinates."

Coordinates

saved

ARNI indicates that the save was successful.

Invalid longitude!

Please choose  
a valid value

If a longitude greater than 180 or less than -180, or a latitude greater than 90 or less than -90 is entered, ARNI will indicate that this value is invalid.

Menu



Checking country/  
province of entered  
coordinates

ARNI has a function that checks the country and province/state of the coordinates entered. This serves as a safety measure for the user. It has no influence on the LEPMON code. In addition, inaccuracies in the determination may occur in the border area between two provinces.

Country: Germany  
Province: Thuringia  
▲ = new ▼ = ok

ARNI displays the country and province. Confirm with **down** and continue, or correct the coordinates entered with **up**. If the province cannot be determined, ARNI displays [error 16](#).

Menu

When entering latitude and longitude, each individual digit can be changed by pressing the **up/down** to move up or down one position. This is done from left to right:

Once the first digit has been set correctly, it is saved by pressing **right**. Now the second digit can be changed. In the third line, an "x" indicates the currently selected position. Pressing **right** again saves this and allows you to enter the third digit, etc. When you reach the last digit, you can save the displayed value for latitude or longitude (press **Enter**).

If a correction is necessary, press **right** until the incorrect digit is reached. Pressing **up/down** again allows you to make the correction. Once all digits are correct, press **Enter** to save the displayed value.

If ARNI is already displaying the correct coordinates, they can be saved by pressing **Enter**.



## 11.4 Enter LEPMON code

LEPMON-Code:

▲ = update

▼ = confirm

Once the coordinates have been entered, the LEPMON code can be set. The code is a location stamp consisting of the country, province, and city. The city follows the region's license plate code.

If ARNI is set up in a different region, this menu must be accessed (press up).

Province: TH

District: J

▲ = new ▼ = ok

ARNI displays the currently set LEPMON code. This code can be confirmed by pressing **up** or reset by pressing **down**. A list of [available codes](#) is provided at the end of this document.

When **down** is pressed, ARNI prompts for the state, province, and city codes.

Select country:

Germany

right = confirm

ARNI prompts you to enter the country. Use **up/down** to scroll through the list of countries until the destination country is displayed. Then confirm with **right**.

Select province:

TH

right = confirm

ARNI prompts you to enter the province/state. Use **up/down** to scroll through the list of provinces/states until the target province is displayed. Then confirm with **right**.

Select district: J

1. right = confirm

2. Enter = finish

ARNI prompts you to enter the district. Select the abbreviation for the region's license plate here. Use **up/down** to scroll through the list of license plates until the desired district is displayed. A list of available license plates can be found at the end of this document.

Then confirm with **right** and finish with **Enter**.

Selection

finished

The selection is now complete...

Menu



```
Germany
TH
J
```

...and ARNI displays the new LEPMON code.

(here, TH = Thüringen and J = Jena)

```
Code unchanged
continue
```

If the code is unchanged, ARNI continues normally.

```
Code changed
ARNI adopts
changes
```

When a new LEPMON code has been entered, ARNI applies it to the data already written for this run and logs this change. The input menu can be continued.

Menu



# 12 Diagnostics

## 12.1 Sensors

▲ = Start test run

→ = back

After the visible menu has ended, a test run can be started immediately with **up** or you can navigate back to the coordinates menu with **right**. ARNI will start the test run automatically after 2 minutes at the latest. ARNI tests all essential components and displays their status:

Light\_Sensor

Status: OK

Wert: 171 Lux

- Brightness (ambient light)

Inner\_Sensor

Status: OK

Wert: 22.8 °C

- Internal temperature (inside the camera housing)

Power\_Sensor

Status: OK

Wert: 12.12 V

- Current meter (supply from ARNI)

Environment\_Sensor

Status: OK

Wert: 22.8 °C

- Air pressure and humidity (ambient air)

Power\_Sensor

Status: Fehler

Wert: ---

If a sensor cannot be found, its status is displayed as an error. ARNI initiates a series of accesses to the sensors so that, for example, the sensor cable can be checked.

Diagnostics



```
test sensors  
again  
waiting...
```

During the loop, ARNI displays the corresponding [error codes](#). In addition, the control LEDs light up during sensor access.

```
All sensors  
present
```

If all problems have been resolved, ARNI displays a success message and shows all current sensor values.

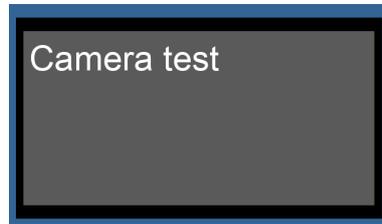
```
Sensor still  
missing  
continue anyways
```

If access to one or more sensors fails, ARNI will inform you of this, but will continue with the diagnosis in the input menu.

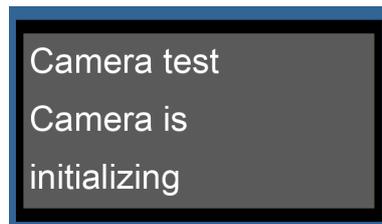
Diagnos-  
tics



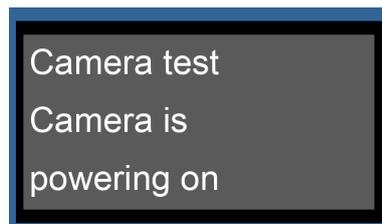
## 12.2 Camera



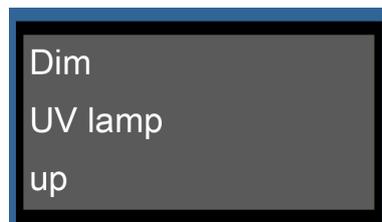
ARNI is now testing the camera.



To do this, it is initialized...



... and switched on.



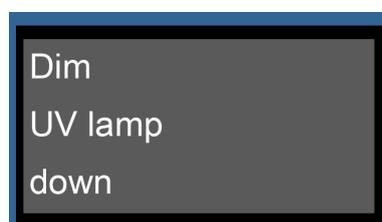
Both lamps dim up.

Diagnosis



Never look directly into the UV lamp! Danger to eyes!

The radiation is largely invisible and only a faint violet color is visible. Maintain a distance of at least 50 cm from the UV lamp during operation!



After a test image has been captured, the lamps immediately dim.



Image  
saved

When the camera has been activated and the image has been successfully saved, ARNI will confirm this.

Camera test  
successful  
finished

The camera test has been successfully completed.

Camera - Check  
cable connection  
n/91

If an [error occurs in the communication between the camera](#) and the Raspberry, ARNI indicates that the [USB Y-cable](#) connection must be checked. The controller attempts to access the camera and displays the number of attempts (n).

Camera test  
Access  
failed

If 91 attempts were unsuccessful, access has failed. ARNI initializes the camera again.

Diagnosis

Camera test  
camera not  
available - restart

If the camera cannot be accessed even after multiple initializations, ARNI will restart. After restarting, open the input menu again.



## 12.3 USB and twilight times

```
USB storage
total: 255.9 GB
available: 255.8 GB
```

The memory device that was inserted into the USB slot before switching on is then queried. The values are displayed in gigabytes (GB). The capacity and the amount of free storage space available are determined.

```
USB storage
OK
```

If the memory is OK, ARNI displays "OK."

```
USB storage
not detected
check connection
```

If the memory is not recognized, ARNI displays a warning.

```
USB storage
almost full
delete
```

If the USB stick has less than 16 GB capacity or the USB stick is not readable, ARNI will indicate that the stick has not been recognized.

ARNI will restart after 5 seconds. This allows another stick to be inserted for a new diagnosis.

Diagnosis

```
Sunset: HH:MM:SS
Sunrise: HH:MM:SS
```

Finally, ARNI displays the sunrise and sunset times for the location in HH:MM:SS format.

The sunrise time should always be earlier than the sunset time. Check the coordinates if necessary.

```
Test run finished
close
lid
```

The diagnosis is complete. ARNI reminds you to close the lid.

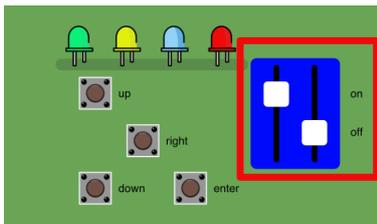


Test run finished  
adopting new  
LEPMON-Code

If a new LEPMON code has been entered, ARNI now applies the changes and logs [them](#).

Starting in  
HH:MM:SS

After the menu has ended or if the menu has not been opened, ARNI waits until the first recording if the night has not yet begun. The remaining time is displayed as a countdown for 2 minutes. "Start in: HH:MM:SS." After that, the display goes blank and ARNI is in "sleep mode."



[Pro Gen 3](#) only: leave the power switches in the "Adjustment" position. This means that the left switch on the left channel is up and the right switch is down.

UV



At the beginning of the night, ARNI switches on the UV lamp.

**Never look directly into the UV lamp! Danger to your eyes!**

**The radiation is largely invisible and only a faint violet color is visible. Keep a distance of at least 50 cm from the UV lamp during operation!**

Diagnosis

ARNI restarts  
in  
60 seconds

At the end of each night, ARNI displays the last minute of activity before it stops monitoring and restarts.



## 13 Maintenance

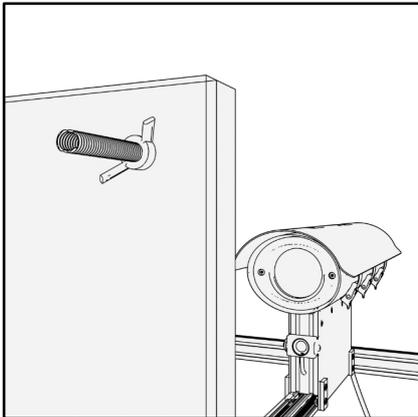
### 13.1 During the season

ARNI must be visited approximately every 14 days to change the storage medium (always) and update the time (always). Other parameters (geographical coordinates and LEPMON code) only need to be adjusted if the location is moved to another site (only in consultation with the LEPMON team).

Steps:

1. Switch off ARNI using the on/off switch. The system is switched off when none of the lights on the Raspberry next to the on/off switch are lit.
2. Remove the USB stick.
3. Insert the second, empty USB stick provided for this purpose.
4. Restart ARNI by pushing the on/off switch again.
5. Repeat the steps described above starting in [chapter 7](#). The location of ARNI is almost never changed. Therefore, press **Enter** directly after setting the latitude and longitude and always [reset the time](#).
6. Upload ARNI's images to LAUP: <https://lepmon.de/annot8/login> Detailed step-by-step instructions are available on the project website: <https://lepmon.de/annot-8-das-lepmon-annotierungstool/>

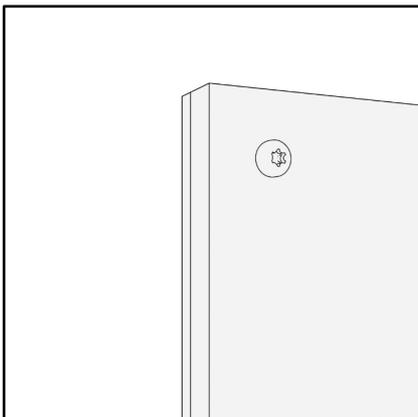
### 13.2 After the season



#### Change canvas

The white foam should be cleaned during the season occasionally with a damp microfiber cloth to remove any dirt.

After one year/at the start of a new season, the foam might be dirty and needs to be turned around or replaced. The foam is secured at the four corners with screws and wing nuts.



Loosen the wing nuts and remove the screws. Turn the foam so that the side that was previously facing the camera is now directly against the mount. Then reinsert the screws and tighten them by hand with the wing nuts. The foam should be secure but not squashed.

Service



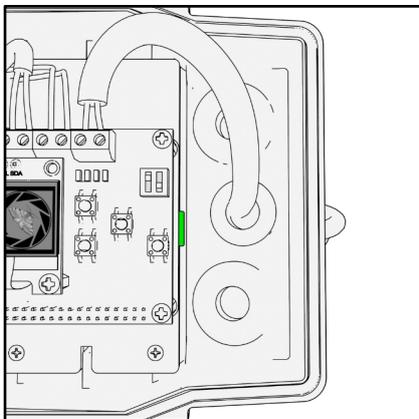
## 14 Firmware-Update

Updates version 2.3.0 and above differ significantly from the previous procedure. With these updates, the entire micro SD card of the Raspberry Pi, which is installed in the ARNI, must be rewritten. We provide all the necessary files.

### Preparation

Please download the following file:

<https://lepmon.de/en/arni-firmware-2/>



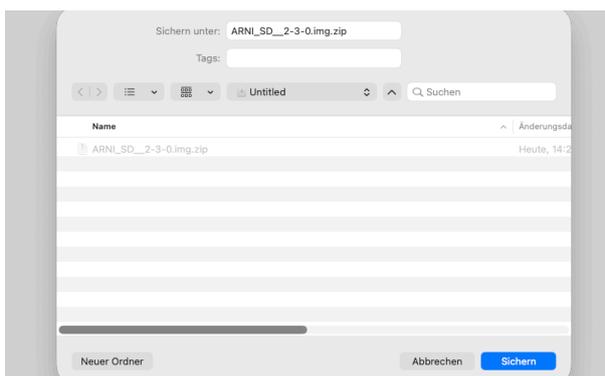
Diese Datei muss auf die Micro-SD Karte des Raspberry Pi installiert werden. Die Karte ist im Kamera-Gehäuse ganz rechts eingesteckt. Zuerst ARNI ausschalten. Danach vorsichtig die Karte (grün markiert) aus der Steuerelektronik herausziehen. Wir empfehlen, eine Pinzette zu verwenden.

To install the file onto the SD card, you will need the "Raspberry Pi Imager". If this is not yet installed on your computer, you can download it for free here:

<https://www.raspberrypi.com/software/>

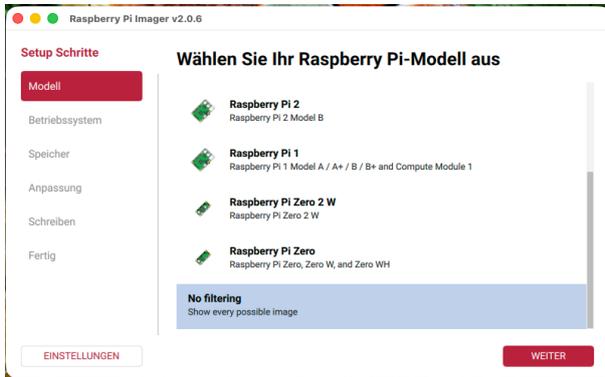
Connect the micro SD card to your computer. You can use the SD card adapter that we included with your delivery. Your computer should recognise this card as 'bootfs' with a size of 512 MB (Windows and Mac). The remaining steps are carried out in the Raspberry Pi Imager.

Service



### Image Download

The download link takes you directly to the Raspberry Pi image file. Download this file. It is approximately 2 GB in size.



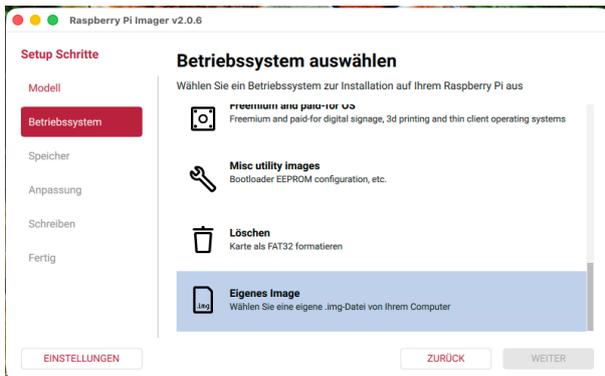
## Raspberry Imager

As soon as the Raspberry Pi Imager is opened, it guides you through the installation process. The items in the left-hand menu are taken through one by one.



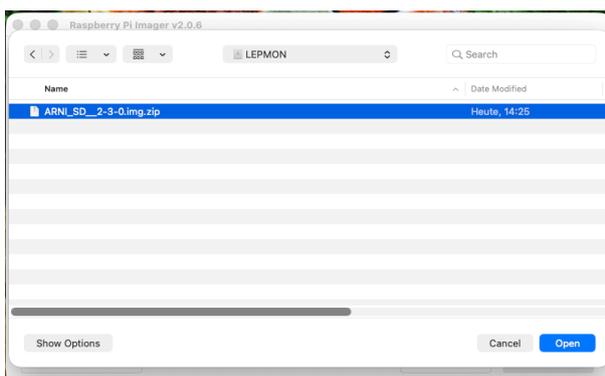
## Device

Scroll right to the bottom and select: **No filtering**



## Select operating system

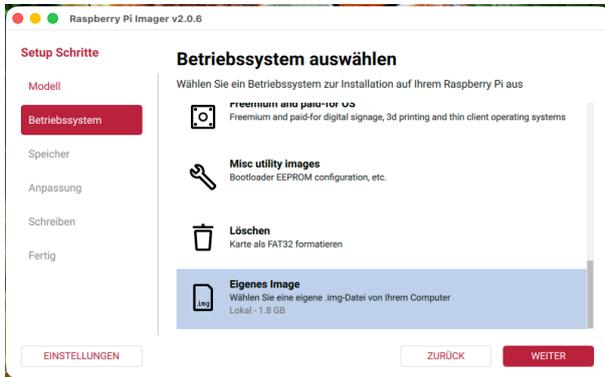
At the very bottom, select 'Custom image'



## Select image file

A file browser will open. Navigate to the downloaded file and select it.

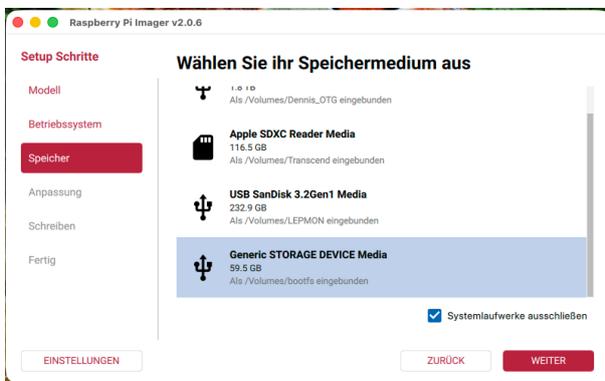
Service



### Select image file

The file has now been selected.

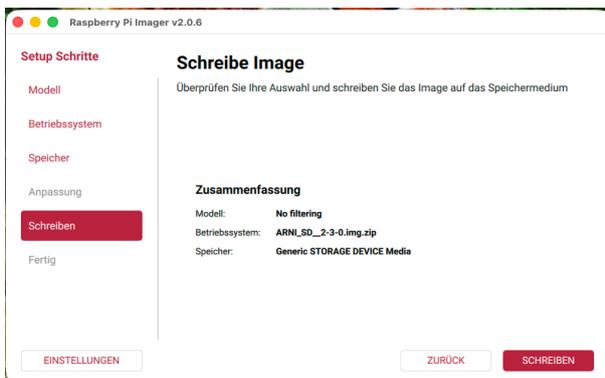
Press Continue



### Storage medium

Select the SD card. **Please ensure that no other storage medium is selected, as this will be completely and irrevocably deleted later.**

Start writing. (Delete and write)

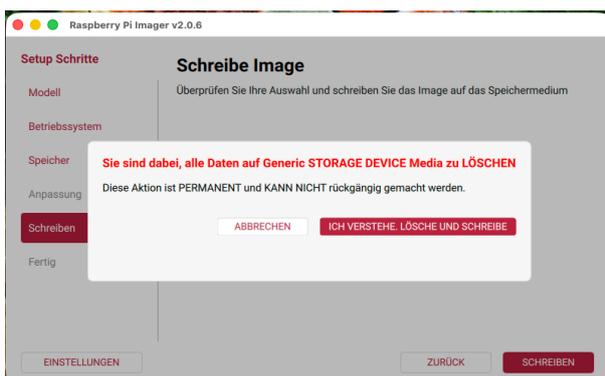


### Write image

Once everything is set up correctly, press Write

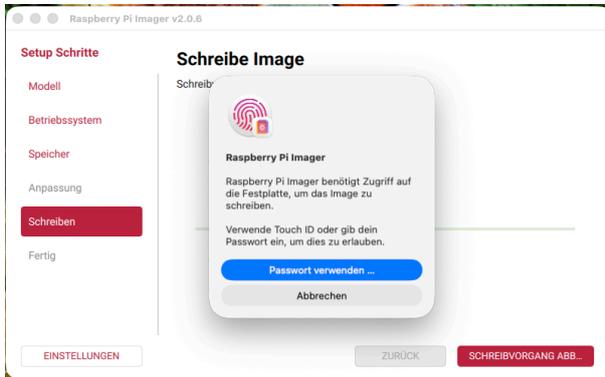
When the process starts, the imager will ask for access to the SD card (this may look different depending on the computer)

Service



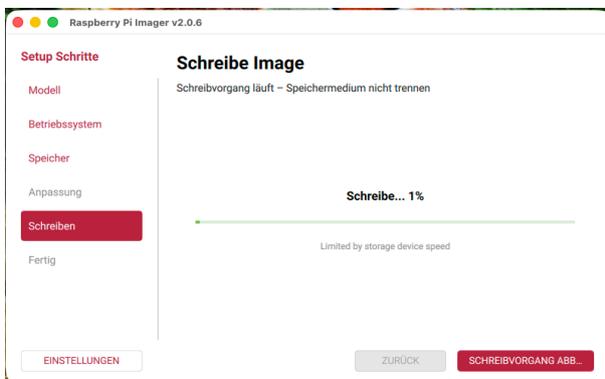
### Confirm

The imager will warn you that all data on the selected storage medium will be deleted. If this is the ARNI's SD card, confirm.



### Access

Enable access to the storage medium.



### Writing process

The progress bar fills up slowly as data is being written to the SD card. The progress bar may go beyond 100%.

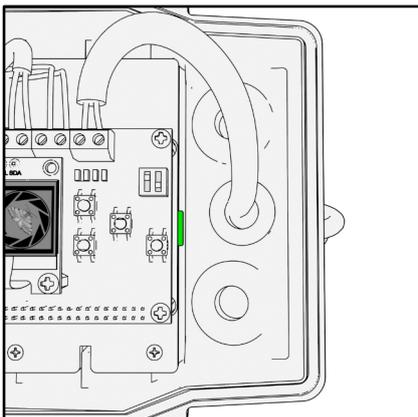
Keep an eye out for any error messages.



### Verify

The card is being checked. It will then be ejected. Please remove the card from the computer.

Service



### Restart

Reinsert the card into the Raspberry Pi and switch on ARNI



## 15 errors

ARNI can display various errors. There are two types of errors:

### Deficiency:

Malfunctions of individual or multiple components that impair the operation of the ARNI and prevent the completeness of the data. However, operation is still possible. Errors occur, for example, in the communication between the sensors and the control unit.

### Critical errors:

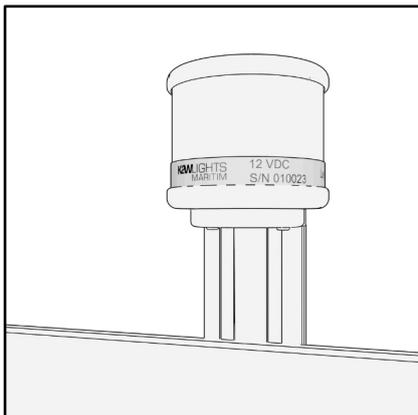
Failure of one or more components that makes it impossible for the ARNI to operate (or impairs its operation). Critical errors occur, for example, in communication between the control unit and the camera or the USB stick.

ARNI restarts  
in  
60 seconds

ARNI itself displays errors at various points in the program and diagnosis and provides instructions to the user on how to rectify the error, e.g., by checking a cable connection. If an error causes the program to terminate, ARNI displays the error code and a brief description.

The program is designed to attempt to correct critical errors by restarting if no interaction is performed by the user.

Errors



If your ARNI displays one or more errors, please read the following table carefully. Please also contact the LEPMON team, even if you have already been able to resolve the error. Have the serial number (SN xxx label on the UV lamp) of your ARNI and the location and name of the supervisor ready.



1

Error 1  
Camera - Check  
cable connection

### error handling

### Critical error

Error in communication between the camera and the Raspberry Pi. ARNI was unable to capture images.

Turn off ARNI. The camera is connected to the Raspberry Pi using a [USB Y-cable](#). Carefully check that all three plugs are properly connected and turn your ARNI back on. Also check that a USB stick is inserted correctly.

### Camera

Camera - Check  
cable connection  
n/91

### error handling

### Critical error

Error in communication between the camera and the Raspberry Pi. The Raspberry Pi is attempting to access the camera and displays the number of attempts (n). No image has been captured yet.

The camera is connected to the Raspberry Pi using a [USB Y-cable](#). Carefully check that all 3 plugs are correctly connected and switch your ARNI back on. Also check that a USB stick is inserted correctly.

2

Error 2  
Camera busy  
not initialized

### error handling

### Critical error

This error may occur during focusing. ARNI was unable to capture a new image to determine the focus value several times in succession.

Restart ARNI and call up the focus menu again. Note: ARNI detects this error itself and calls up this menu again automatically.

Errors

3

Error 3  
USB stick - Check  
connection

### error handling

### Critical error

ARNI was unable to access the (connected) USB stick.

If the red indicator LED flashes up to 10 times and the error persists: Switch off ARNI and check that the USB stick is inserted correctly and pushed in as far as it will go. Switch ARNI back on again. If the error occurs repeatedly, replace the USB stick.



4

Error 4  
Light sensor - Check  
sensor cable

**error handling**

deficiency

The integrated light sensor does not communicate with the Raspberry. To ensure data collection, a threshold value for ambient light is assumed (90 lux) and ARNI generates data between 15 minutes before dusk and 60 minutes before dawn.

During the input menu, note the [accesses](#) and check the cable connections on the circuit board.

5

Error 5  
Outdoor sensor -  
Check sensor cable

**error handling**

deficiency

The integrated environmental sensor does not communicate with the Raspberry. ARNI does not record outside temperature, air pressure, or humidity.

During the input menu, note the [accesses](#) and check the cable connections on the circuit board.

6

Error 6  
Inner sensor  
board error

**error handling**

deficiency

The integrated indoor sensor does not communicate with the Raspberry. ARNI does not record indoor temperature.

Pay attention to [accesses](#) during the input menu. If the error persists, contact the LEPMON team immediately.

Errors

7

Error 7  
Current sensor  
board error

**error handling**

deficiency

The integrated current sensor does not communicate with the Raspberry. ARNI does not measure power consumption or the status of the spotlight. When operating on solar power, the battery is not monitored.

Open the menu. If the error persists, contact the LEPMON team immediately.



8

Error 8  
Hardware clock  
not found

**error handling**

deficiency

Error in communication with the external clock. This error may occur if an invalid format was entered when setting the time or if the external clock is not accessible.

If the error occurs during the input menu, switch ARNI off and on again. In the input menu, check whether a valid time stamp has been entered. If the error occurs repeatedly, contact the LEPMON team immediately and check the button cell battery as instructed.

9

Error 9  
FRam  
board error

**error handling**

deficiency

Error in communication between Raspberry and Fram module.

Check if a firmware update is available and contact the LEPMON team.

10

Error 10  
Logging  
Check USB

**error handling**

deficiency

ARNI was unable to create the [log file](#) or write an entry to it.

Turn off ARNI and check whether the stick is inserted in the correct orientation and pushed in as far as it will go. Turn ARNI back on. If the error occurs repeatedly, check whether a firmware update is available.

Errors

11

Error 11  
Checksum not  
calculated

**error handling**

deficiency

ARNI creates a so-called checksum for each file. This is determined after the file has been saved. If the file is not available because it has not been created, error 11 is logged.

Check the [log file](#) on the USB stick.



12

Error 12  
Visible LED  
darkened

**error handling**

deficiency

The illumination LED is dimmed and the screen is not fully illuminated during image capture.

Check the connection of the power supply or solar system, including the battery. Also check the images from the relevant time and inform the LEPMON team.

13

Error 13  
Metadata table  
Software/ USB error

**error handling**

deficiency

Current data such as measured values, image name, or timestamp could not be written to the [metadata table](#).

Turn ARNI off and then on again

14

Error 14  
Sanity Check  
Photo incomplete

**error handling**

deficiency

The current image has not passed the completeness check and will be re-recorded.

Turn off ARNI. The camera is connected to the Raspberry Pi using a [USB Y-cable](#). Carefully check that all three plugs are properly connected and turn your ARNI back on. Also check that a USB stick is inserted correctly. Check the [log file](#) on the USB stick.

Errors

15

Error 15  
Package installation  
failed

**Fehlerbehandlung**

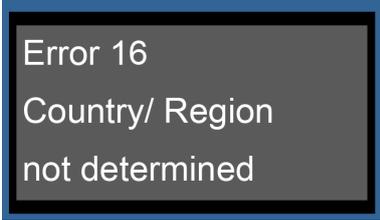
Critical error

An error occurred while installing additional Python packages. This may cause parts of the firmware to no longer function or to exhibit unexpected behavior.

Inform the LEPMON team immediately and install any available firmware updates right away. Further steps must be taken in consultation with the LEPMON team.

**16**

deficiency



Error 16  
Country/ Region  
not determined

The country/region of the entered coordinates could not be determined. The [LEPMON code](#) is not affected by this.

**error handling**

Check the coordinates you entered manually and very carefully. To do this, return to the GPS menu using the right arrow key before running the diagnostic test.

## 16 Promotion

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Errors



# 17 Output

## 17.1 Sample log file

### Hinweis:

ARNI schreibt die Log-Datei immer auf Deutsch, unabhängig von der [eingestellten Sprache](#).

```

20:41:00; Logfile erstellt: /media/Ento/INTENSO/Lepmon#SN010023_TH_J_2026-05-14_T_2041/
Lepmon#SN010023_TH_J_2026-05-14_T_2041.log
20:41:00; =====
20:41:00; Run Informationen
20:41:00; -----
20:41:00; Letzter Durchlauf | ordnungsgemäß beendet. Fahre mit dem neuem Ordner fort:
20:41:00; Alter Ordner:      | /media/Ento/stick/Lepmon#SN010023_TH_J_2026-05-13_T_2039/
20:41:00; Neuer Ordner:      | /media/Ento/stick/Lepmon#SN010023_TH_J_2026-05-14_T_2041/
20:41:00; =====
20:41:00; Gerätedaten
20:41:00; -----
20:41:00; ARNI SN Nummer:    | SN010023
20:41:00; ARNI Generation: | Pro_Gen_3
20:41:01; verbaute Kamera: | AV__Alvium_1800_U-2050
20:41:01; verbauter Sensor: | imx183
20:41:01; Auflösung (LxB): | 5496 x 3672
20:41:01; Red Balance     | 2.169922
20:41:01; Blue Balance    | 2.049805
20:41:02; ARNI run:       | SN010023_0016
20:41:02; Firmware:       | 2.3.1 vom 2026-03-25
20:41:00; =====
20:41:00; Experiment Zeiten
20:41:00; -----
20:41:10; Beginn Experiment: | 2026-05-14
20:41:17; Attiny on:      | 20:23:04
20:41:17; Start Aufnahme: | 20:38:04
20:41:17; Sonnenuntergang: | 20:53:04
20:41:17; Verzögerung Start: | 10 Minuten
20:41:00; -----
20:41:17; Ende Experiment: | 2026-05-15
20:41:17; Ende Aufnahme:  | 04:27:51
20:41:17; Attiny off:    | 04:32:51
20:41:17; Sonnenaufgang: | 05:27:51
20:41:00; =====

Bei Pakete Installation:
20:41:37; Starte Installation von Python Paketen...
20:41:37; erwarte installation für pycountry, h3, opencv-python, numpy
20:41:37; pycountry ist bereits installiert und wird deinstalliert
20:41:41; pycountry wurde deinstalliert
20:41:48; opencv-python ist bereits installiert und wird deinstalliert
20:41:50; opencv-python wurde deinstalliert
20:41:50; numpy ist bereits installiert und wird deinstalliert
20:41:53; numpy wurde deinstalliert
20:41:53; Installiere fehlende Pakete: pycountry, opencv-python, numpy
20:41:53; Versuche Installation von opencv_python-4.8.1.78-cp37-abi3-manylinux_2_17_aarch64.
manylinux2014_aarch64.whl ...
20:42:02; opencv_python-4.8.1.78-cp37-abi3-manylinux_2_17_aarch64.manylinux2014_aarch64.whl
installiert
20:42:11; Versuche Installation von numpy-1.26.4-cp311-cp311-manylinux_2_17_aarch64.
manylinux2014_aarch64.whl ...
20:42:33; numpy-1.26.4-cp311-cp311-manylinux_2_17_aarch64.manylinux2014_aarch64.whl
installiert
20:42:33; Versuche Installation von pycountry-24.6.1-py3-none-any.whl ...
20:42:43; pycountry-24.6.1-py3-none-any.whl installiert
20:42:43; Alle Pakete erfolgreich installiert!
20:42:45; Installation von Python Paketen beendet
20:42:45; -----

```

Output



### Bei aufgerufenem [Eingabe Menü](#):

20:42:50; Lokales User Interface von ARNI wurde geöffnet. Es wurde zum 0026 mal geöffnet  
20:42:51; -----

20:42:53; Menü zum [Updaten](#) geöffnet  
20:42:58; Update-Stick ist gültig und Update erlaubt  
20:43:03; altes Programm im Ordner LepmonOS\_2\_1\_1-2026-04-02 hinterlegt  
20:43:03; alter Programmordner gelöscht  
20:43:12; neue LepmonOS Version geladen  
20:43:18; Update-Ordner LepmonOS\_update vom USB Stick gelöscht  
20:43:19; neue Firmwareversion:2.2.1

### Bei nicht gefundenem Update Paket auf dem USB Stick:

20:42:57; Update nicht erlaubt oder kein gültiger Update-Stick gefunden.  
20:42:57; Firmwareversion bereits aktuell  
20:42:57; kein Update gefunden  
20:42:57; fahre fort  
20:43:02; -----  
20:43:02; lokale Fokussierhilfe geöffnet  
20:43:37; Fokus gefunden mit Schärfewert: 61.0  
20:43:37; Fokussieren beendet  
20:43:37; -----  
20:43:37; [Sprachmenü](#) geöffnet  
20:43:39; gespeicherte Sprache: de  
20:43:39; Sprachmenü geschossen  
20:43:52; -----  
20:43:52; [Stromversorgung](#) auf Netz gesetzt  
20:43:56; -----  
20:43:56; Menü zum [Löschen des USB Sticks](#) geöffnet  
20:43:58; Ordner gelöscht: /media/Ento/INTENSO/Lepmon#SN010023\_Manueller\_TestRun\_2026-05-14\_T\_2100  
20:43:59; Ordner gelöscht: /media/Ento/INTENSO/Lepmon#SN010023\_Manueller\_TestRun\_2026-05-14\_T\_2101  
20:44:00; Ordner gelöscht: /media/Ento/INTENSO/Lepmon#SN010023\_Manueller\_TestRun\_2026-05-14\_T\_2104  
20:44:00; Datei gelöscht: /media/Ento/INTENSO/Lepmon#SN010023\_TH\_J\_2026-05-14\_T\_2120.Key  
20:44:00; Menü zum Löschen des USB Sticks geschlossen  
20:44:04; -----  
20:44:04; [Scheibenheizung](#) wird aktiviert  
20:44:04; -----  
20:44:04; Menü zum aktualisieren der Uhrzeit geöffnet  
20:44:14; Hardware [Uhrzeit](#) gesetzt auf: 2026-05-14 20:44:14  
20:44:14; Menü zum aktualisieren der Uhrzeit geschlossen  
20:44:14; -----  
20:44:14; Menü zum aktualisieren der [Koordinaten](#) geöffnet  
20:44:18; alte Koordinaten: Breite 50.9241073, Länge 11.5837985  
20:44:31; Länge unverändert  
20:44:31; neue Koordinaten: Breite 50.9241072, Länge 11.5837985  
20:44:31; neue Koordinaten wurden gespeichert  
20:44:34; Eingegebene Koordinaten befinden sich in Land: Germany, Region: Thüringen  
20:44:39; Nutzender hat bestätigt, dass die eingegebenen Koordinaten in der Zielregion liegen  
20:44:39; Menü zum aktualisieren der Koordinaten geschlossen  
20:44:44; -----  
20:44:44; Menü zum Ändern der Provinz und Kreiskürzel geöffnet. Erwarte neuen [LEPMON-Code](#)  
20:45:10; Land unverändert: Germany  
20:45:11; Provinz unverändert: Thüringen  
20:45:11; Kreis unverändert: J  
20:45:11; Menü zum Ändern der Provinz und Kreiskürzel beendet. Es wurden keine Änderungen eingegeben. Fahre fort  
20:45:11; LEPMONCODE in Konfigurationsdatei geschrieben: TH, J  
20:45:11; Eingaben beendet  
20:45:14; Starte Systemcheck

Output



### Bei einem Fehler in der Verbindung zu den Sensoren:

20:45:17; [Fehler 4](#): Fehler in der Verbindung zum Lichtsensor. Wert des Umgebungslichtes auf Schwellenwert gesetzt: 90: No I2C device at address: 0x23  
 20:45:21; [Fehler 5](#): Fehler in der Verbindung zum Umweltsensor: cannot access local variable 'bme280' where it is not associated with a value  
 20:45:23; [Sensor](#): Light\_Sensor, Status: Fehler, Wert: --- Lux  
 20:45:25; Sensor: Inner\_Sensor, Status: OK, Wert: 36.38 °C  
 20:45:27; Sensor: Power\_Sensor, Status: OK, Wert: 11.91 V  
 20:45:28; Sensor: Environment\_Sensor, Status: Fehler, Wert: --- °C  
 20:45:32; Alle Sensoren nach erneutem Auslesen OK  
 20:45:37; Sensor: Light\_Sensor, Status: OK, Wert: 8.33 Lux  
 20:45:38; Sensor: Inner\_Sensor, Status: OK, Wert: 35.88 °C  
 20:45:40; Sensor: Power\_Sensor, Status: OK, Wert: 11.91 V  
 20:45:42; Sensor: Environment\_Sensor, Status: OK, Wert: 21.82 °C  
 20:45:43; [Kamera](#) Zugriff erfolgreich  
 20:45:43; Kamera Test erfolgreich beendet

### Bei nicht oder falsch angeschlossener Kamera:

20:46:56; Kamera Test fehlgeschlagen, Kamera nicht verfügbar

20:45:46; [USB](#) Speicher: gesamt: 468.72 GB; frei: 468.71 GB  
 20:45:46; USB Speicher OK

### Bei vollem USB Stick:

20:45:46; USB Speicher fast voll bitte leeren

20:45:46; Sonnenuntergang: 20:53:04  
 20:45:46; Sonnenaufgang: 05:27:51  
 20:45:46; Beende Systemcheck  
 20:45:46; -----  
 20:45:50; Breite: 50.9241072  
 20:45:50; Länge: 11.5837985  
 20:45:50; Stromversorgung: Netz  
 20:45:50; warte bis Nachtbeginn: 0:02:10  
 20:48:11; Schalte USB Ports des Raspberry aus  
 20:48:11; USB Ports des Raspberry eingeschaltet  
 20:48:16; #####  
 20:48:16; #####

### Beginn Aufnahmeschleife:

20:48:16; Beginne Daten und Bildaufnahme  
 20:48:16; Aufgenommene frames werden mit Gamma Wert 1.5 aufgehellt  
 20:48:16; USB Speicher gesamt: 468.72 GB  
 20:48:16; USB Speicher belegt: 0.01 GB 0.0 %  
 20:48:16; USB Speicher frei: 468.71 GB 100.0 %  
 20:48:24; erwartete Bilder: 467  
 20:48:24; Scheibenheizung zu Beginn der Aufnahme Schleife eingeschaltet  
 20:48:24; LepiLED eingeschaltet  
 20:48:24; -----  
 20:48:40; Exposure erhöht von 135 auf 140  
 20:48:52; Bild gespeichert: /media/Ento/INTENSO/Lepmon#SN010023\_TH\_J\_2026-05-14\_T\_2041/Lepmon#SN010023\_TH\_J\_2026-05-14\_T\_2048.jpg  
 20:49:01; Warten bis zur nächsten Aufnahme: 120 Sekunden. Aktulle Kamerafehlerserie: 0  
 20:50:20; Gain verringert von 5 auf 4.5  
 20:50:28; Bild gespeichert: /media/Ento/INTENSO/Lepmon#SN010023\_TH\_J\_2026-05-14\_T\_2041/Lepmon#SN010023\_TH\_J\_2026-05-14\_T\_2050.jpg  
 20:52:30; Warten bis zur nächsten Aufnahme: 90.0 Sekunden. Aktulle Kamerafehlerserie: 0  
 20:54:16; Sowohl Exposure als auch Gain haben das Maximum erreicht. Keine weitere Erhöhung möglich.  
 20:54:24; Bild gespeichert: /media/Ento/INTENSO/Lepmon#SN010023\_TH\_J\_2026-05-14\_T\_2041/Lepmon#SN010023\_TH\_J\_2026-05-54\_T\_2045.jpg  
 20:54:33; Warten bis zur nächsten Aufnahme: 87.0 Sekunden. Aktulle Kamerafehlerserie: 0  
 21:00:38; Bilder der AV\_\_Alvium\_1800\_U-2050 sind scharf: Schwellenwert: 100, gemessene Fokusvarianz: 100,21

Output



### Weißabgleich

21:00:48; Trigger für Weißabgleich aktiviert und Zeit für WB Anpassung erreicht. Starte Weißabgleichsanpassung...  
 21:01:18; Starte Weißabgleichsberechnung für Bild: /media/Ento/INTENSO/Lepmon#SN010023\_TH\_J\_2026-05-14\_T\_2041/Lepmon#SN010023\_TH\_J\_2026-05-54\_T\_2045.jpg  
 21:01:18; Maske erstellt mit Threshold: 205.0  
 21:01:18; Berechne RGB-Mittelwerte für 2237184 Hintergrundpixel...  
 21:01:18; Berechnete WB-Verhältnisse -> Rot: 0.919, Blau: 1.083  
 21:01:18; #####  
 21:01:18; #####  
 21:01:18; verwendete Maske:  
 21:01:18; Matrix\_BW\_Beginn  
 21:01:18; Hinweis: diese Maske ist durch 0/1 codiert



21:01:20; Matrix\_BW\_Ende  
 21:01:20; #####  
 21:01:20; #####  
 21:01:20; Übernehme Weißabgleich:  
 21:01:20; Red Balance old | 2.169922  
 21:01:20; Blue Balance old | 2.049805  
 21:01:20; Red Balance new | 1.995035  
 21:01:20; Blue Balance new | 2.219208  
 21:01:20; Weißabgleichsanpassung abgeschlossen und Trigger zurückgesetzt.  
 21:01:22; Warten bis zur nächsten Aufnahme: 62.0 Sekunden. Aktuelle Kamerafehlerserie: 0

### Bei fehlerhaft gespeicherten Bildern

21:00:38; unvollständiges Foto media/Ento/INTENSO/Lepmon#SN010023\_TH\_J\_2026-05-14\_T\_2041/Lepmon#SN010023\_TH\_J\_2026-05-54\_T\_2045.jpg erkannt. ARNI nimmt neu auf.  
 Fehlerdetails: Path does not exist"  
 21:01:00; Kein Frame zum Speichern vorhanden  
 21:01:03; Fehler bei der Bildprüfung: Fehlerdetails  
 21:01:05; Foto hat Sanity Check nach 4 Versuchen endgültig nicht bestanden.

### Bei Kamera Fehler 1 und 3 - Mögliche Details:

21:00:38; Fehler beim Laden der Kameraeinstellungen: File not found  
 21:00:38; Fehler beim Setzen der Belichtungszeit: out of range  
 21:00:38; Fehler beim Setzen des Gains: out of range  
 21:00:38; Fehler beim Setzen von Gamma: out of range  
 21:00:38; unbekanntes Pixelformat: Camera does not support RGB8  
 21:00:38; Fehler bei der Frame Aufnahme: tuple index out of range  
 21:00:38; Fehler beim Abrufen des Frames: Camera does not support RGB8  
 21:00:38; Fehler beim Kopieren der Kameraeinstellungen: File not found error  
 21:00:38; Fehler beim Speichern des Bildes: Path not found

Output



### Bei unscharfen Bildern von allen Pro Generationen und CSL\_Gen\_1

21:00:38; WARNUNG: Bilder der AV\_\_Alvium\_1800\_U-2050 sind verschwommen: Schwellenwert: 100, gemessene Fokusvarianz: 89,39

### Bei unscharfen Bildern CSS\_Gen\_1

21:00:38; WARNUNG: Bilder der RPI\_Module\_3 sind verschwommen: Schwellenwert: 100, gemessene Fokusvarianz: 56,32  
 21:00:38, Unschärfe Bilder erkannt. Starte Fokussierung ...  
 21:00:55; Fokus RPI Module 3 geändert von 5.3 auf 5.2

21:00:59; Schalte USB Ports des Raspberry aus  
 21:01:08; USB Ports des Raspberry eingeschaltet

.  
 .  
 .

05:26:25; Bild gespeichert: /media/Ento/INTENSO/Lepmon#SN010023\_TH\_J\_2026-05-14\_T\_2041/  
 Lepmon#SN010023\_TH\_J\_2026-05-15\_T\_0526.jpg  
 05:26:25; Warten bis zur nächsten Aufnahme: 30.0 Sekunden  
 05:26:25; #####  
 05:26:25; #####  
 05:26:25; in dieser Nacht wurden 1.2 GB an Daten generiert  
 05:26:25; erwartete Bilder: 467, aufgenommene Bilder: 467  
 05:26:25; dimme LepiLED herunter  
 05:26:25; Beende Aufnahme Schleife. Leite zum Ausschalten über  
 05:26:25; Fahre ARNI in 1 Minute herunter und starte neu  
 05:26:25; #####  
 05:26:25; ### SELBSTINDUZIERTER SHUTDOWN ###  
 05:26:25; #####

### Bei Zeitumstellung im Frühjahr und Herbst während der Nacht:

08:06:13; Stelle UhrZeit um  
 08:06:15; neue Zeit: 07:06:135 wird um -1 Stunde(n) geändert

### Bei Zeitumstellung + Zwischenzeitlichem Stromausfall

08:08:17; Zeitumstellung bereits an diesem Tag durchgeführt

### Bei Neustart während der Nacht:

21:14:25; #####  
 21:14:25; ### Letzter Durchlauf nicht ordnungsgemäß beendet. Fahre mit altem Ordner fort #####  
 21:14:25; #####  
 20:42:51; -----  
 20:41:20; ARNI nicht mit lokalem User Interface parametrisiert  
 20:41:20; -----  
 20:41:20; Breite: 50.9241072  
 20:41:20; Länge: 11.5837985  
 20:41:21; Aktuelle Zeit liegt nach geplantem Nachtbeginn. Starte Schleife

Output





## 17.3 images



Example from Jena, Thuringia, Germany on July 3, 2025, at 3:34 a.m.



Output

Moth sample from 2025



## 18 Available LEPMON-Codes

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|  Albania .....       | 66 |
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**Albania**

Berat

BR  
KV  
SK

Dibër

DI  
BZ  
MT

Durrës

DR  
KR

Elbasan

EL  
GR  
LB  
PE

Fier

FR  
LU  
MK

Gjirokastrë

GJ  
PR  
TP

Korçë

KO  
DV  
ER  
PG

Kukës

KU  
HS  
BC

Lezhë

LE  
LA  
MR

Shkodër

SH

PU

MA

Tiranë

TR  
KJ

Vlorë

VL  
DL  
SR

**Austria**

Burgenland

B  
GD  
HN  
JU  
OW  
WE

Kärnten

K  
DO  
FR  
KL  
SP  
SV

Niederösterreich

N  
GM  
HO  
KR  
LA  
ME  
MD  
MI  
NE  
PO  
SK  
SW  
TU  
WN

Oberösterreich

OO

EF

FR

GR

KI

LL

PE

RO

SD

UR

Salzburg

S  
JO  
LI  
SL

Steiermark

ST  
DL  
FB  
GU  
HF  
JO  
LB  
MU  
RA  
VO

Tirol

T  
KU  
LA  
RE

Vorarlberg

V  
DO  
FR  
HO  
MO

Wien

W

**LEPMON  
Code**


 **Belgium**
Antwerpen

VAN

Brussels-Capital

BRU

Limburg

VLI

Oost-Vlaanderen

VOV

Vlaams-Brabant

VBR

West-Vlaanderen

VWV

Hainaut

WHT

Liège

WLG

Luxembourg

WLX

Namur

WNA

Brabant Wallon

WBR

 **Croatia**
Zagrebačka

ZG

DU

IV

KR

SB

VT

VZ

Krapinsko-zagorska

KZ

KZ

Sisačko-moslavačka

SM

KT

SI

Karlovačka

KA

SL

Varaždinska

VZ

Koprivničko-križevačka

KK

KZ

Bjelovarsko-bilogorska

BB

DA

GR

KZ

Primorsko-goranska

PG

CR

DE

DL

GS

KR

PU

Ličko-senjska

LS

OG

SM

Virovitičko-podravska

VP

SL

Požeško-slavonska

PS

SL

Brodsko-posavska

BP

NG

Zadarska

ZD

PA

Osječko-baranjska

OB

DJ

NA

VS

Šibensko-kninska

SK

DR

KN

Vukovarsko-srijemska

VS

VU

ZU

Splitsko-dalmatinska

SD

IM

MA

OM

SG

SU

VK

Istarska

IS

LB

PA

RO

UM

Dubrovačko-neretvanska

DN

PL

ST

Međimurska

ME

Grad Zagreb

GZ

LEPMON  
Code


 **Czech Republic**

Hlavní město Praha

PHA

Středočeský kraj

STC

Jihočeský kraj

JHC

Plzeňský kraj

PLK

Karlovarský kraj

KAR

Ústecký kraj

UST

Liberecký kraj

LIB

Královéhradecký kraj

HRA

Pardubický kraj

PAR

Vysočina

VYS

Jihomoravský kraj

JHM

Olomoucký kraj

OLM

Zlínský kraj

ZLN

Moravskoslezský kraj

MSK

 **Denmark**

Hovedstaden

HS

K

T

V

Midtjylland

ML

R

V

Nordjylland

NL

B

Sjælland

SL

L

N

Syddanmark

SM

F

M

 **Ecuador**

Azuay

A

Bolívar

B

Cañar

U

Carchi

C

Chimborazo

H

Cotopaxi

X

El Oro

O

Esmeraldas

E

Galápagos

W

Guayas

G

Imbabura

I

Loja

L

Los Ríos

R

Manabí

M

Morona Santiago

S

Napo

N

Orellana

Q

Pastaza

Y

Pichincha

P

Santa Elena

SE

Santo Domingo de los Tsáchilas

J

Sucumbíos

K

Tungurahua

T

Zamora Chinchipe

Z

 **Madagascar**

Morondava

MD

Tulear

MD

 **Netherlands**

Drenthe

DR

Flevoland

FL

Friesland

FR

Gelderland

GE

Groningen

LEPMON  
Code



GR  
Limburg  
 LI  
Noord-Brabant  
 NB  
Noord-Holland  
 NH  
Overijssel  
 OV  
Utrecht  
 UT  
Zeeland  
 ZE  
Zuid-Holland  
 ZH

 **Germany**

Baden-Württemberg

BW  
 BAD  
 BB  
 BC  
 BCH  
 BH  
 BK  
 BL  
 BUS  
 CR  
 CW  
 EM  
 ES  
 FDS  
 FN  
 FR  
 GD  
 GP  
 HCH  
 HD  
 HDH  
 HN  
 HOR

KA  
 KEL  
 KN  
 KUN  
 LB  
 LEO  
 LO  
 LR  
 MA  
 MGH  
 MOS  
 MUL  
 NEU  
 NT  
 OG  
 OHR  
 PF  
 RA  
 RT  
 RV  
 RW  
 S  
 SAK  
 SHA  
 SIG  
 SLG  
 STO  
 TBB  
 TT  
 TU  
 TUT  
 UB  
 UL  
 VAI  
 VS  
 WG  
 WN  
 WOL  
 WT

Bayern

BY  
 AB  
 AIB  
 AIC  
 ALZ  
 AM  
 AN  
 AO  
 AS  
 BA  
 BGD  
 BGL  
 BOG  
 BRK  
 BT  
 BUL  
 CHA  
 CO  
 DAH  
 DEG  
 DGF  
 DKB  
 DLG  
 DON  
 EBE  
 EBN  
 EBS  
 ED  
 EG  
 EI  
 ER  
 ERH  
 ESB  
 FDB  
 FEU  
 FFB  
 FO  
 FRG  
 FS  
 FU

**LEPMON**  
Code



|     |     |                    |
|-----|-----|--------------------|
| FUS | MM  | SEF                |
| GAP | MN  | SEL                |
| GEO | MOD | SMU                |
| GRA | MSP | SOB                |
| GRI | MU  | SOG                |
| GUN | MUB | SR                 |
| GZ  | N   | STA                |
| HAB | NAB | STE                |
| HAS | NAI | SUL                |
| HEB | ND  | SW                 |
| HIP | NEA | TIR                |
| HO  | NEC | TOL                |
| HOH | NEN | TS                 |
| HOS | NES | UFF                |
| ILL | NEW | VIB                |
| IN  | NM  | VIT                |
| KC  | NO  | VOH                |
| KE  | NU  | WEN                |
| KEH | OA  | WER                |
| KEM | OAL | WM                 |
| KF  | OBB | WOR                |
| KG  | OCH | WOS                |
| KON | OVI | WS                 |
| KOZ | PA  | WU                 |
| KRU | PAF | WUG                |
| KT  | PAN | WUM                |
| KU  | PAR | WUN                |
| LA  | PEG | <u>Berlin</u>      |
| LAN | R   | BE                 |
| LAU | REG | <u>Brandenburg</u> |
| LF  | REH | BB                 |
| LI  | REI | BAR                |
| LIF | RH  | BER                |
| LL  | RID | BRB                |
| M   | RO  | BSK                |
| MAI | ROD | CA                 |
| MAK | ROL | CB                 |
| MAL | ROT | EE                 |
| MB  | SAD | EH                 |
| MET | SAN | EW                 |
| MIL | SC  | FF                 |



|                |     |                     |
|----------------|-----|---------------------|
| FI             | DA  | <u>Mecklenburg-</u> |
| FOR            | DI  | <u>Vorpommern</u>   |
| FRW            | DIL | MV                  |
| FW             | ERB | AT                  |
| GUB            | ESW | BUZ                 |
| HVL            | F   | DBR                 |
| KW             | FB  | DM                  |
| KY             | FD  | GDB                 |
| LC             | FKB | GMN                 |
| LDS            | FZ  | GU                  |
| LIB            | GG  | GVM                 |
| LN             | GI  | GW                  |
| LOS            | GN  | HGN                 |
| MOL            | HEF | HGW                 |
| NAU            | HG  | HRO                 |
| NP             | HOG | HST                 |
| OHV            | HP  | HWI                 |
| OPR            | HR  | LBZ                 |
| OSL            | HU  | LRO                 |
| P              | KB  | LUP                 |
| PM             | KS  | LWL                 |
| PR             | LDK | MC                  |
| PZ             | LM  | MSE                 |
| RN             | MEG | MST                 |
| SDT            | MKK | MUR                 |
| SEE            | MR  | NB                  |
| SFB            | MTK | NVP                 |
| SPB            | OF  | NWM                 |
| SPN            | ROF | NZ                  |
| SRB            | RUD | OVP                 |
| TF             | SLU | PCH                 |
| TP             | SWA | PW                  |
| UM             | USI | RDG                 |
| WK             | VB  | RM                  |
| <u>Bremen</u>  | WA  | ROS                 |
| HB             | WEL | RUG                 |
| <u>Hamburg</u> | WI  | SBG                 |
| HH             | WIZ | SN                  |
| <u>Hessen</u>  | WOH | STB                 |
| HE             | WZ  | TET                 |
| BUD            |     | UEM                 |



|                      |                            |     |
|----------------------|----------------------------|-----|
| UER                  | NOH                        | DIN |
| VG                   | NOM                        | DN  |
| VR                   | NOR                        | DO  |
| WIS                  | OHA                        | DU  |
| WLG                  | OHZ                        | E   |
| WRN                  | OL                         | EN  |
| <u>Niedersachsen</u> | OS                         | ERK |
| NI                   | PE                         | EU  |
| AUR                  | RI                         | GE  |
| BRA                  | ROW                        | GEL |
| BRL                  | SHG                        | GK  |
| BRV                  | STD                        | GL  |
| BS                   | SY                         | GLA |
| BSB                  | SZ                         | GM  |
| CE                   | UE                         | GT  |
| CLP                  | VEC                        | GV  |
| CLZ                  | VER                        | HA  |
| CUX                  | WF                         | HAM |
| DAN                  | WHV                        | HER |
| DEL                  | WL                         | HF  |
| DH                   | WOB                        | HS  |
| DUD                  | WST                        | HSK |
| EIN                  | WTL                        | HX  |
| EL                   | WTM                        | JUL |
| EMD                  | <u>Nordrhein-Westfalen</u> | K   |
| FRI                  | NW                         | KK  |
| GAN                  | AH                         | KLE |
| GF                   | BE                         | KR  |
| GO                   | BF                         | LEV |
| GS                   | BI                         | LH  |
| H                    | BLB                        | LIP |
| HE                   | BM                         | LP  |
| HI                   | BN                         | LUN |
| HK                   | BO                         | ME  |
| HM                   | BOH                        | MG  |
| HMU                  | BOR                        | MH  |
| HOL                  | BOT                        | MI  |
| LER                  | BUR                        | MK  |
| LG                   | CAS                        | MO  |
| MEL                  | COE                        | MON |
| NI                   | D                          | MS  |



|                        |                 |     |
|------------------------|-----------------|-----|
| NE                     | KIB             | BNA |
| OB                     | KL              | BZ  |
| OE                     | KO              | C   |
| OP                     | KUS             | DD  |
| PB                     | LD              | DL  |
| RE                     | LU              | DW  |
| RS                     | MY              | DZ  |
| SG                     | MYK             | EB  |
| SI                     | MZ              | ERZ |
| SLE                    | NR              | FG  |
| SO                     | NW              | FLO |
| ST                     | PRU             | FTL |
| SU                     | PS              | GC  |
| TE                     | ROK             | GHA |
| UN                     | RP              | GR  |
| VIE                    | SAB             | GRH |
| W                      | SIM             | GRM |
| WAF                    | SP              | HC  |
| WAN                    | SUW             | HOT |
| WAR                    | TR              | HY  |
| WAT                    | WIL             | KM  |
| WES                    | WO              | L   |
| WIT                    | WW              | LOB |
| <u>Rheinland-Pfalz</u> | ZEL             | MAB |
| RP                     | <u>Saarland</u> | MEI |
| AW                     | SL              | MEK |
| AZ                     | IGB             | MTL |
| BIN                    | MZG             | MW  |
| BIR                    | NK              | NOL |
| BIT                    | OTW             | NY  |
| BKS                    | SB              | OVL |
| COC                    | SLS             | OZ  |
| DAU                    | VK              | PIR |
| DIZ                    | WND             | PL  |
| DUW                    | <u>Sachsen</u>  | RC  |
| EMS                    | SN              | RG  |
| FT                     | ANA             | RIE |
| GER                    | ASZ             | RL  |
| GOA                    | AU              | SEB |
| GOH                    | BED             | STL |
| KH                     | BIW             | SZB |



|                       |                           |     |
|-----------------------|---------------------------|-----|
| TDO                   | NMB                       | ARN |
| TG                    | OBG                       | ART |
| TO                    | OC                        | EA  |
| V                     | OK                        | EF  |
| WDA                   | QFT                       | EIC |
| WSW                   | QLB                       | EIS |
| WUR                   | RSL                       | G   |
| Z                     | SAW                       | GRZ |
| ZI                    | SBK                       | GTH |
| <u>Sachsen-Anhalt</u> | SDL                       | HBN |
| ST                    | SFT                       | HIG |
| ASL                   | SGH                       | IK  |
| AZE                   | SK                        | IL  |
| BBG                   | SLK                       | J   |
| BK                    | WB                        | KYF |
| BLK                   | WMS                       | LBS |
| BO                    | WR                        | LSZ |
| BRG                   | WSF                       | MGN |
| BTF                   | WZL                       | MHL |
| DE                    | ZE                        | NDH |
| EIL                   | <u>Schleswig-Holstein</u> | NH  |
| GA                    | SH                        | PN  |
| GHC                   | HEI                       | RU  |
| GNT                   | HL                        | SCZ |
| HAL                   | IZ                        | SDH |
| HBS                   | KI                        | SHK |
| HDL                   | MED                       | SHL |
| HET                   | NF                        | SLF |
| HHM                   | NMS                       | SLN |
| HV                    | OD                        | SLZ |
| HZ                    | OH                        | SM  |
| JE                    | PI                        | SOK |
| JL                    | PLO                       | SOM |
| KLZ                   | RD                        | SON |
| KOT                   | RZ                        | SRO |
| MD                    | SE                        | UH  |
| MER                   | SL                        | WAK |
| ML                    | <u>Thüringen</u>          | WBS |
| MQ                    | TH                        | WE  |
| MSH                   | AP                        |     |
| NEB                   | APD                       |     |


 **Italy**
Abruzzo

ABR  
CH  
PE  
TE

Basilicata

BAS  
PZ

Calabria

CAL  
CS  
KR  
RC  
VV

Campania

CAM  
BN  
CE  
NA  
SA

Emilia-Romagna

EMR  
FE  
FC  
MO  
PC  
PR  
RA  
RE  
RN

Friuli Venezia Giulia

FVG  
PN  
TS  
UD

Lazio

LAZ  
LT  
RI

RM

VT

Liguria

LIG  
IM  
SP  
SV

Lombardia

LOM  
BS  
CO  
CR  
LC  
LO  
MB  
MI  
MN  
PV  
SO  
VA

Marche

MAR  
AP  
FM  
MC  
PU

Molise

MOL  
IS

Piemonte

PIE  
AT  
BI  
CN  
NO  
TO  
VB  
VC

Puglia

PUG  
BR

BT

FG

LE

TA

Sardegna

SAR  
CI  
NU  
OG  
OR  
OT  
SS  
VS

Sicilia

SIC  
CL  
CT  
EN  
ME  
PA  
RG  
SR  
TP

Toscana

TOS  
FI  
GR  
LI  
LU  
MS  
PI  
PO  
PT  
SI

Trentino-Alto Adige

TAA  
TN

Umbria

UMB  
TR

**LEPMON**  
Code



Valle d'Aosta

VDA

Veneto

VEN

PD

RO

TV

VE

VR

VI