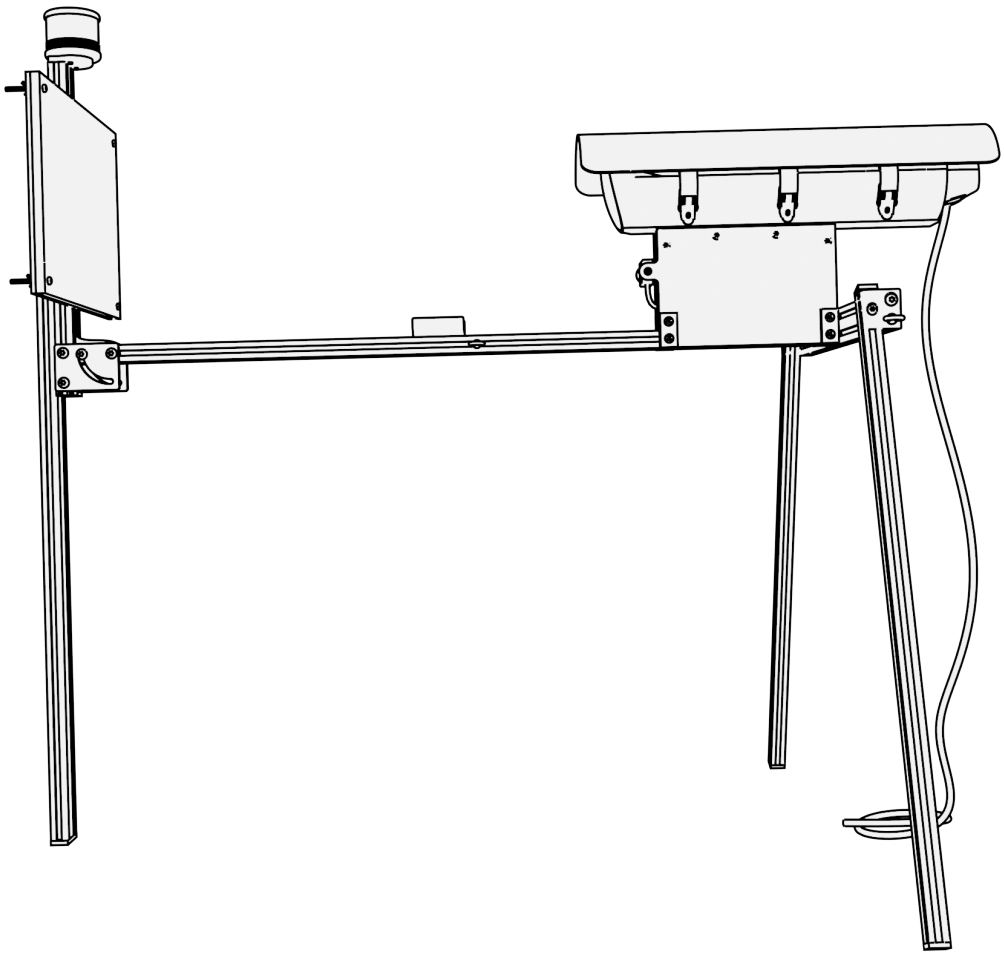
English

Automated recorder of nocturnal insectes (ARNI) Set up guide



K2W LIGHTS MARITIM

FEdA BMBF Research Initiative for the Conservation of Biodiversity

Federal Ministry of Research, Technology and Space

02.03.2026

Dennis Böttger and Gunnar Brehm

LepmonOS 2.2.0

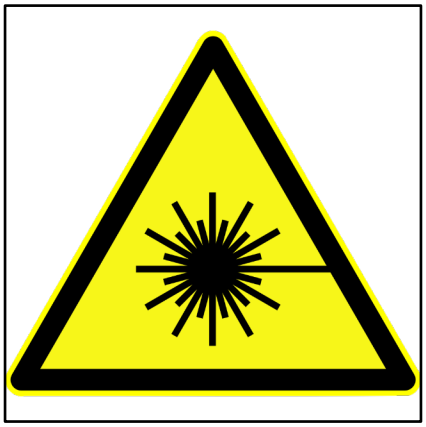
Table of Content

Theis manual describes firmware version 2.2.0 released 02.03.2026.

If your ARNI is running an older version, you can find the appropriate instructions for download at https://lepmon.de/en/software-and-documentation/

Your ARNI must be updated to firmware version 2.2.0 or newer before the start of the 2026 field season. You can use this document for the update process.

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.

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.

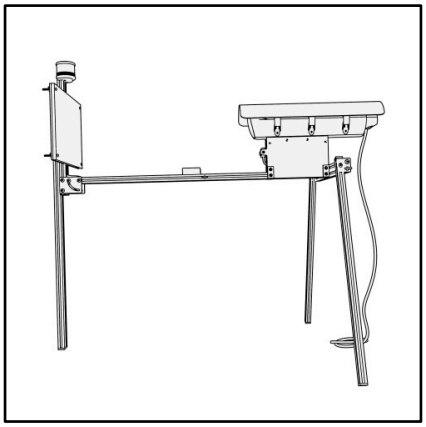
GPS

ARNI has a hidden GPS module and transmits its location.

camera surveillance

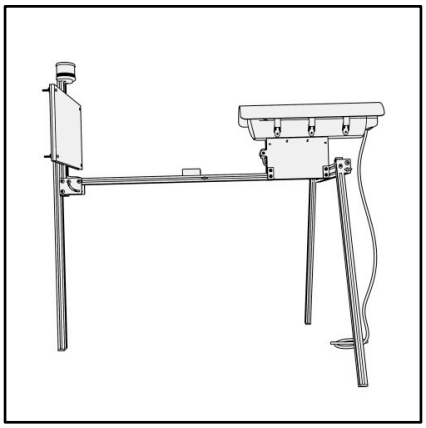
ARNI takes pictures of the white foam surface. The spotlight under the camera housing lights up with each picture.

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.

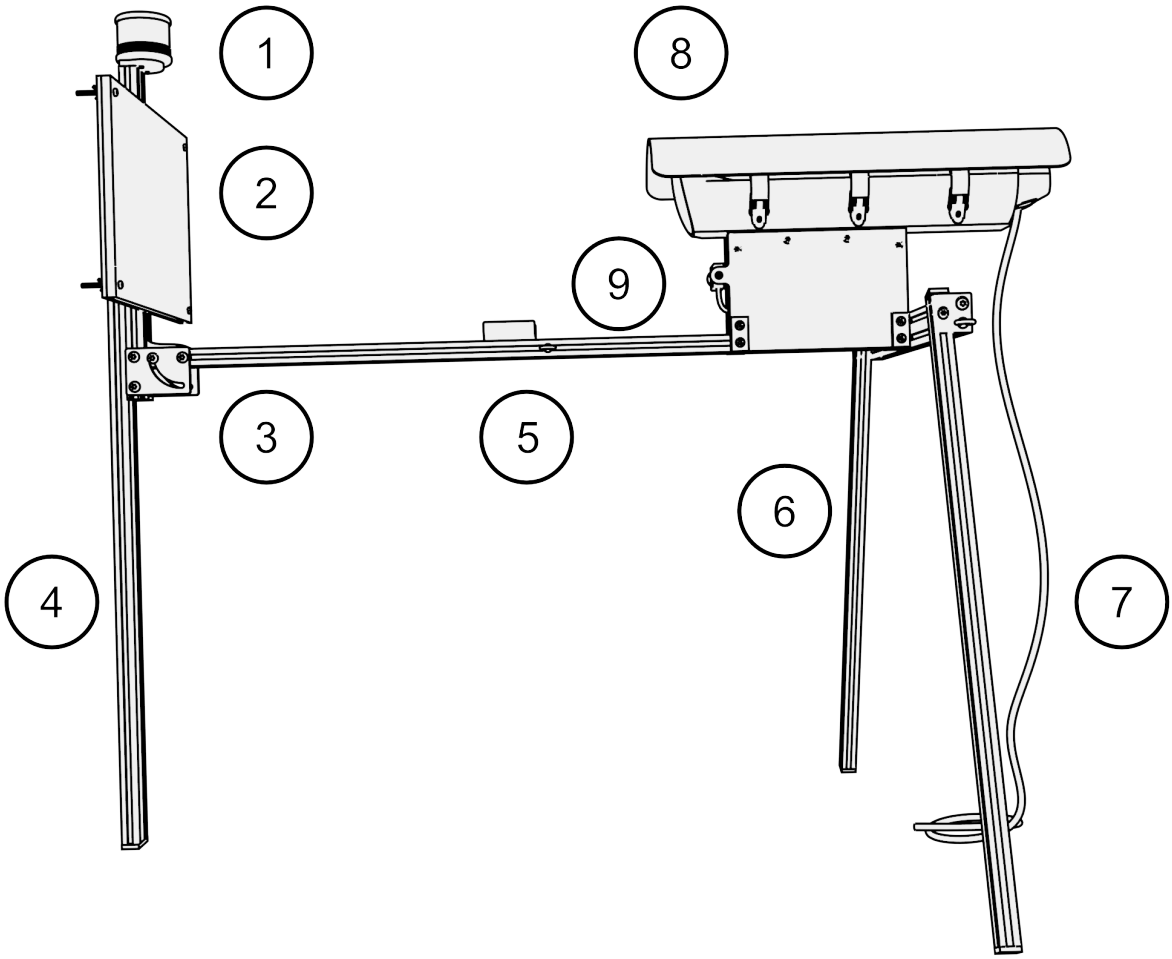
Pro_Gen_3 was awarded by the LEPMON project. From 2026 onwards, only Pro_Gen_4 will be distributed by K2W.

CSS and CSL

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

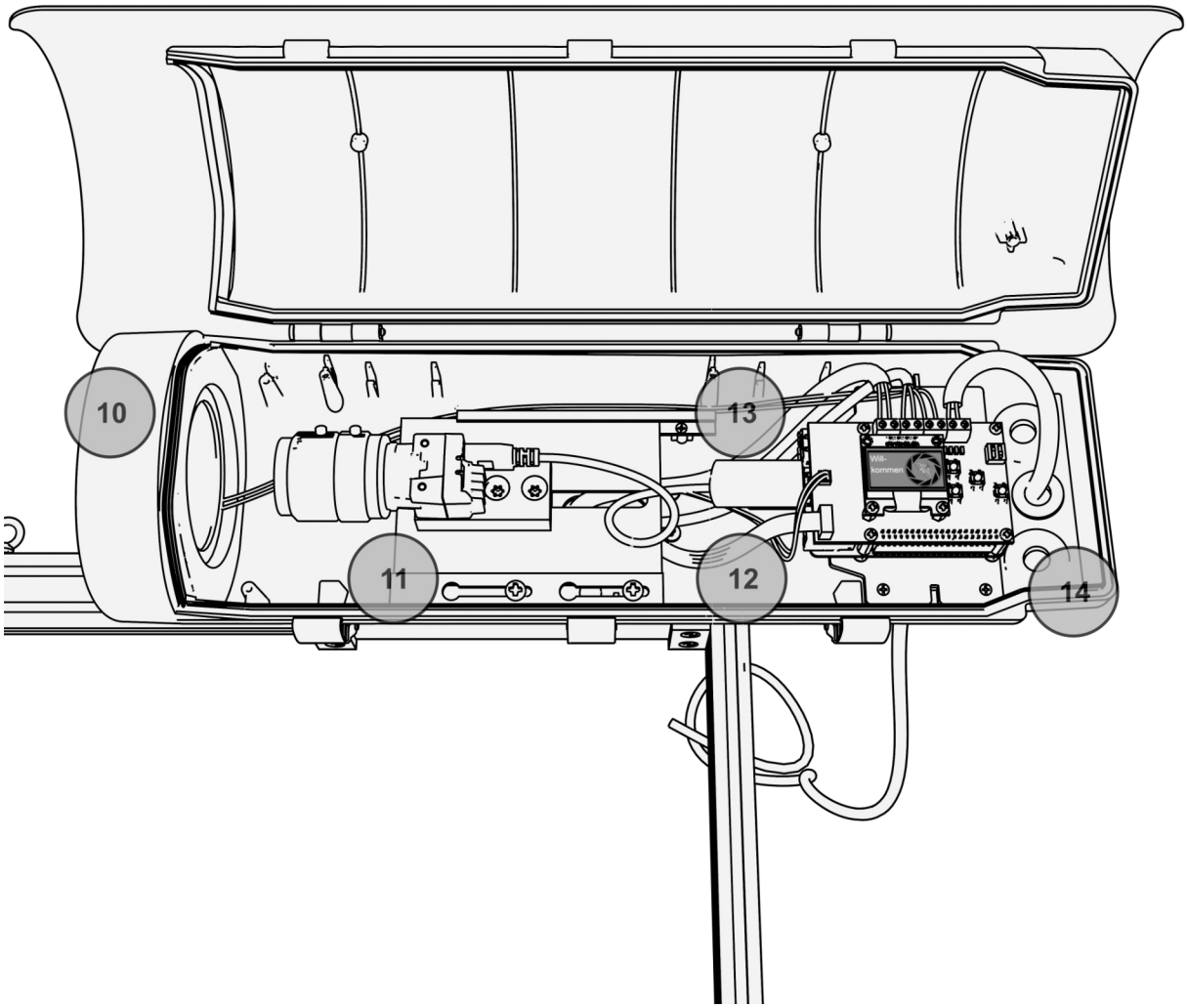
3 Components

3.1 Rack



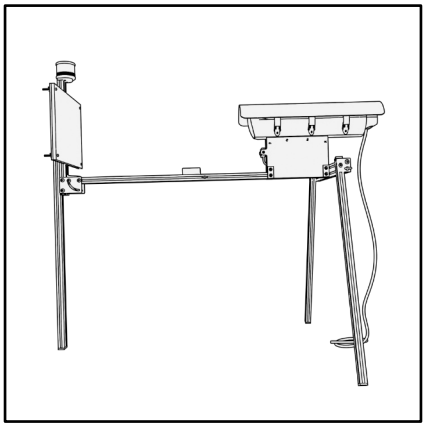
1	UV-Lamp	6	Rear pair of legs with cross strut
2	Canvas	7	Power cable
3	Hinge	8	Camera housing
4	Front leg	9	Spotlight
5	Longitudinal bar with lamp holder		

3.2 Camera housing



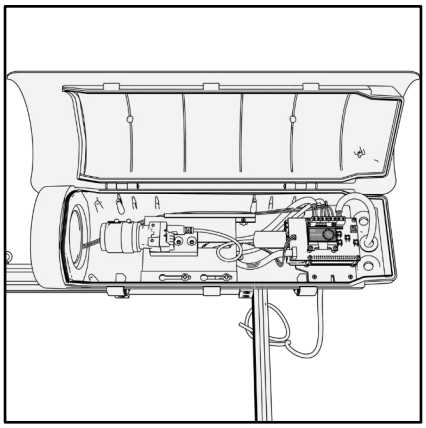
10	Glass pane with heating	13	USB stick
11	Camera and lens	14	electronics with User interface
12	USB Y-cable and sensor cable		

3.3 Details



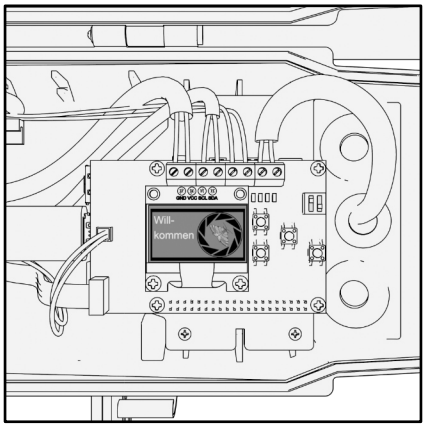
Rack

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.



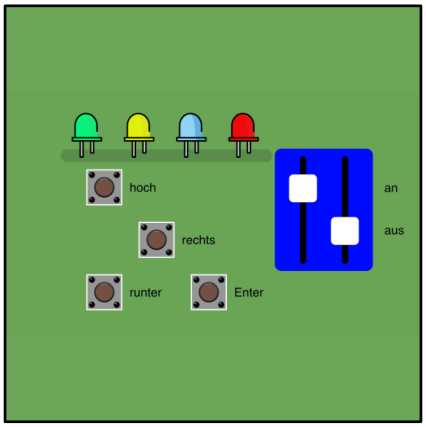
Camera housing

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.

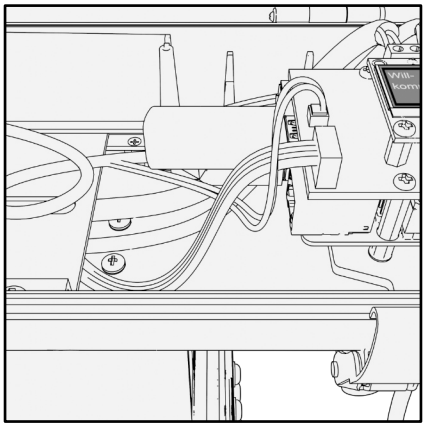


User interface – buttons

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

Up, **down**, **right**, **enter**

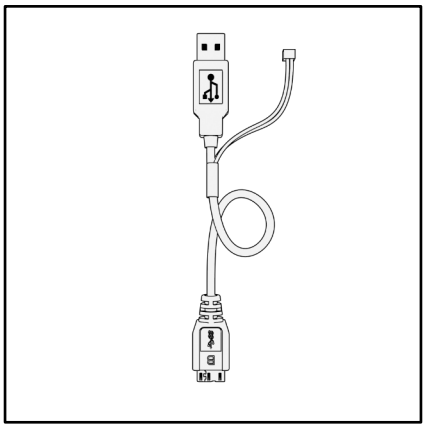
The on/off switch has two channels.



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.



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)

4.2 Overview

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

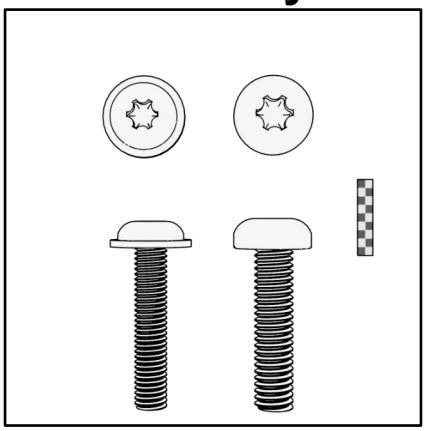
- Screw on the pair of legs
- Attaching the support leg
- Raising the pair of legs
- Erect the support leg and unfold the screen holder

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.

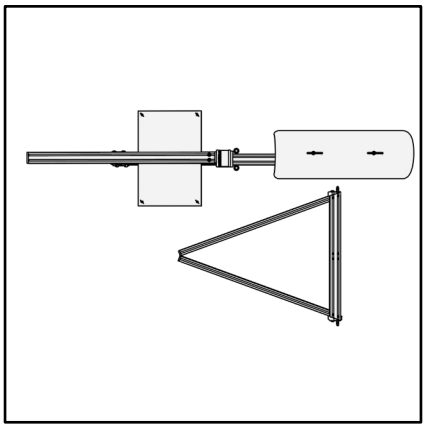
4.3 Assembly



Screws

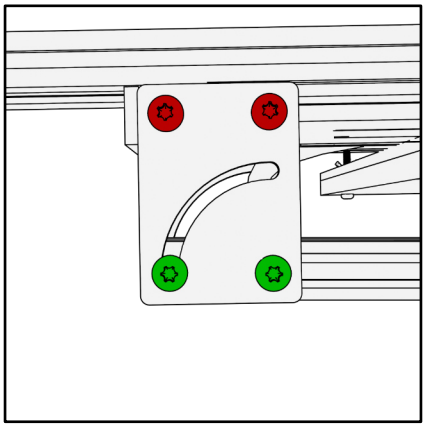
ARNI is assembled using screws. Some screws are never completely unscrewed. Each step specifies whether the screw must be completely unscrewed or only partially unscrewed.

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



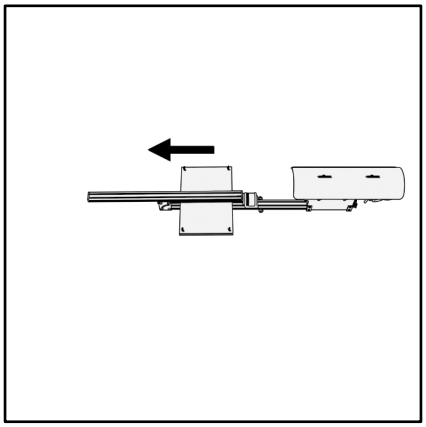
Step 1

Place both components on the floor.



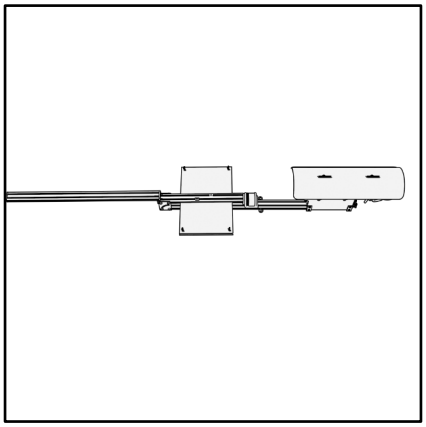
Step 2

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.

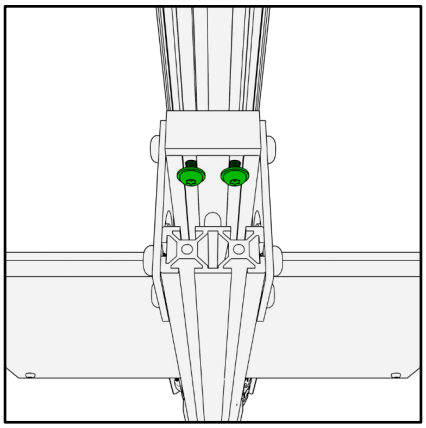
Not applicable to devices sold by K2W Lights.



Step 4

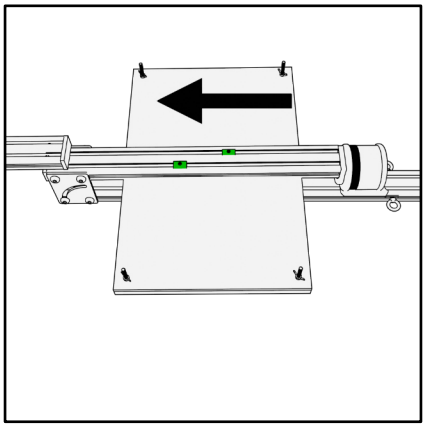
The movable aluminium profile is now fully extended.

Not applicable to devices sold by K2W Lights.



Tip

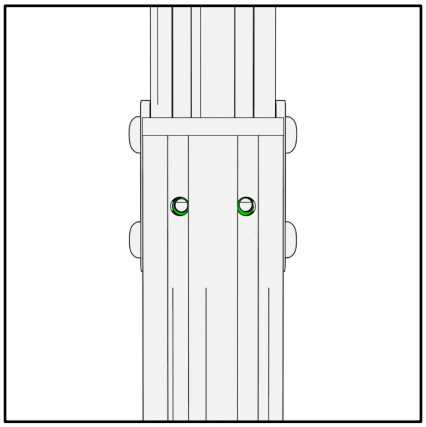
If the profile sticks slightly, the two Torx 25 screws (marked in green) on the underside inside the hinge can be loosened slightly. Never remove these screws completely. If these screws are tightened too much, the hinge can be loosened and folded down (step 23 and step 24) to make these screws more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



Step 5

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

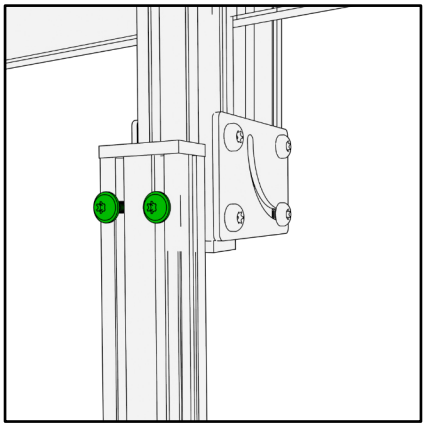
Not applicable to devices sold by K2W Lights.



Step 6

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

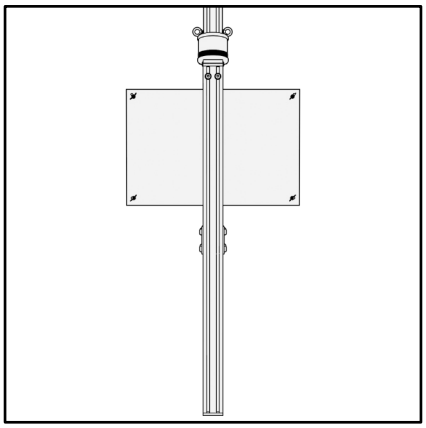
Not applicable to devices sold by K2W Lights.



Step 7

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

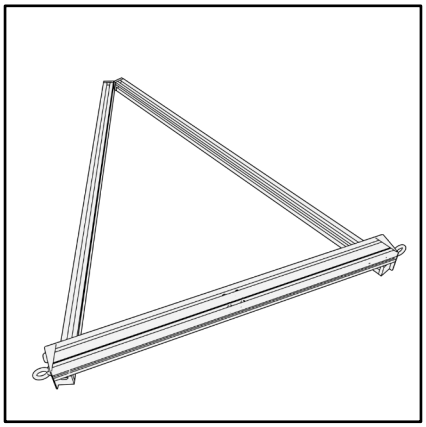
Not applicable to devices sold by K2W Lights.



Step 8

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

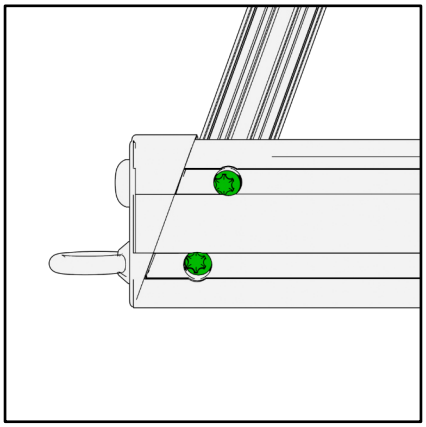
Not applicable to devices sold by K2W Lights.



Step 9

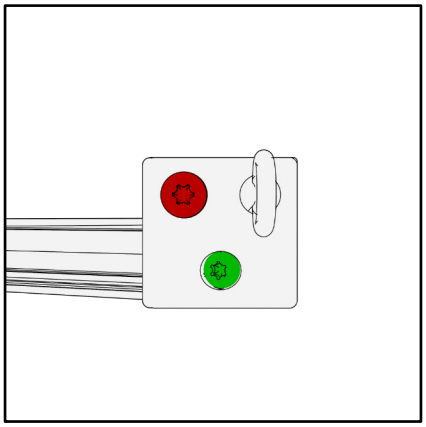
Place the pair of legs on the floor so that the two aluminium profiles touch the floor and the middle profile is floating.

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!

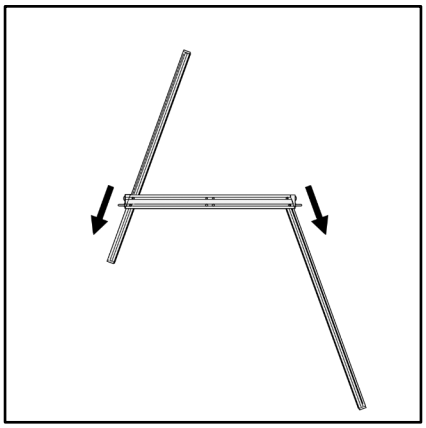


Step 11

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.

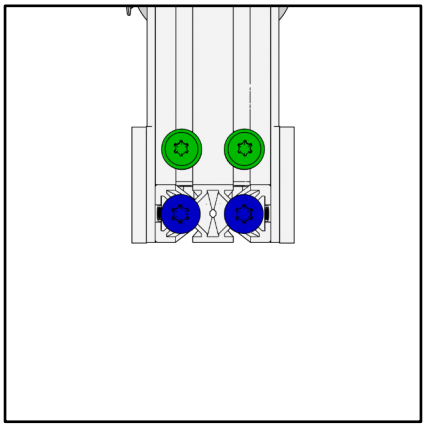


Step 12

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 iin green) from step 11 and then the two screws from step 10.

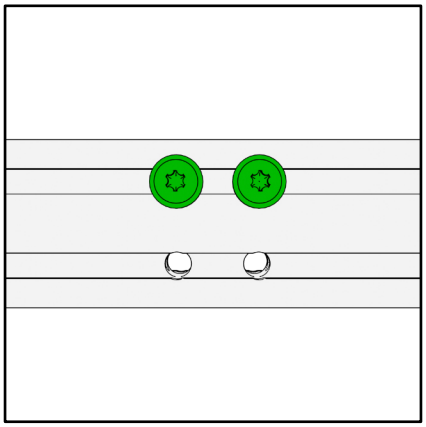
Continue to step 28



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

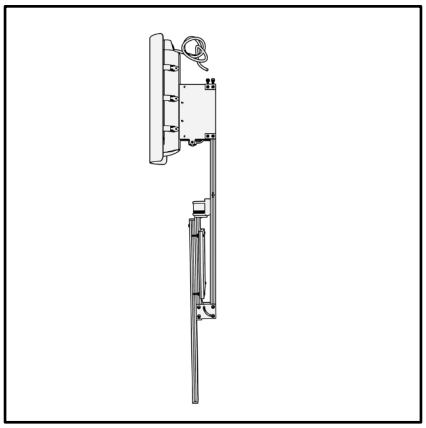


Step 14

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

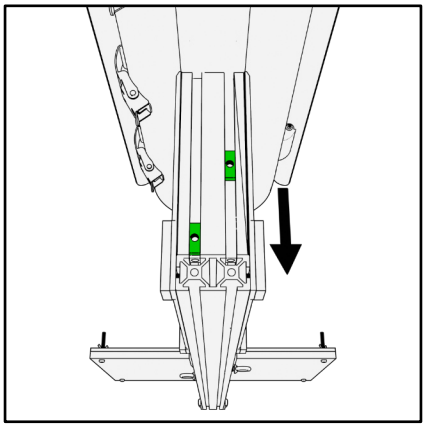
Step 15

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



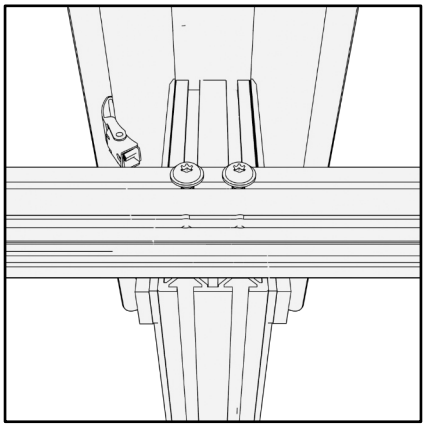
Step 16

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

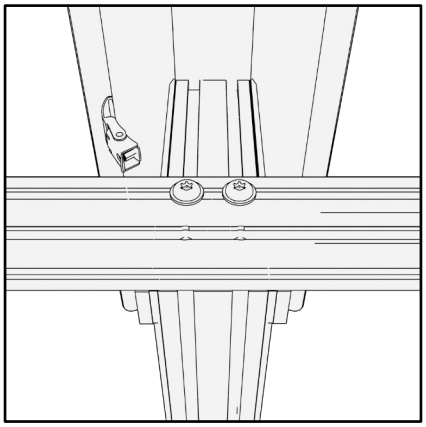
Pull the two slotted nuts (marked in green) in the direction of the arrow until they stop.



Step 18

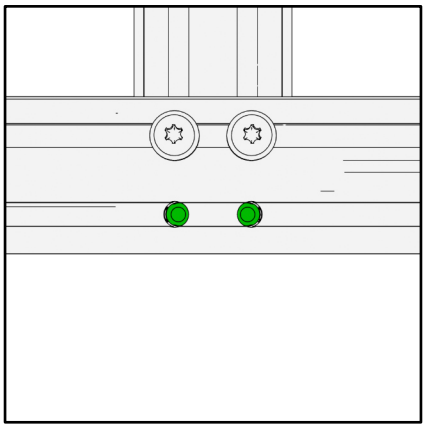
Place the cross strut of the pair of legs on the upper end of the longitudinal strut so that the screws are in the same position as the slotted nuts in the frame.

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



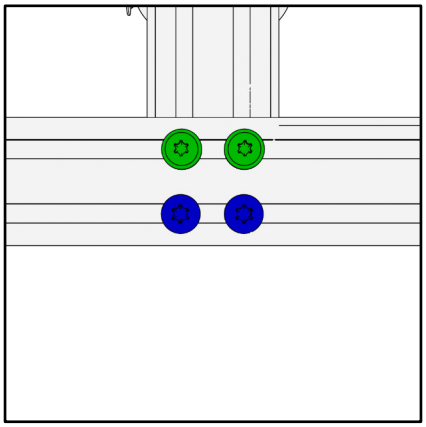
Step 19

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.



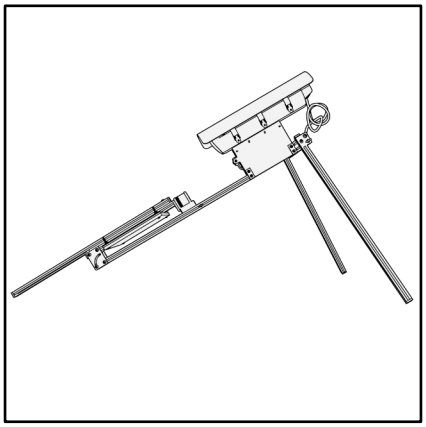
Step 20

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



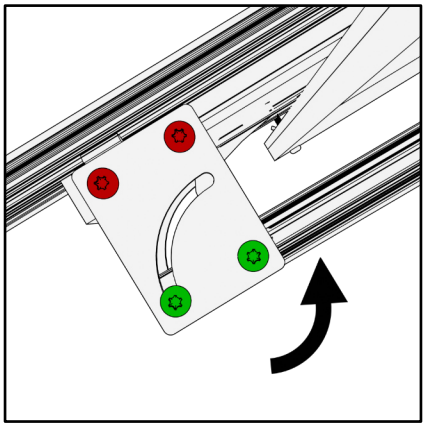
Step 21

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



Step 22

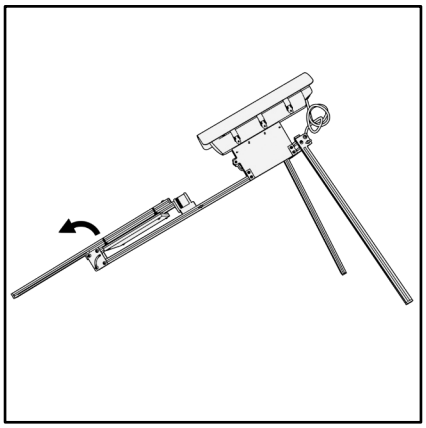
Place ARNI back on the floor.



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.

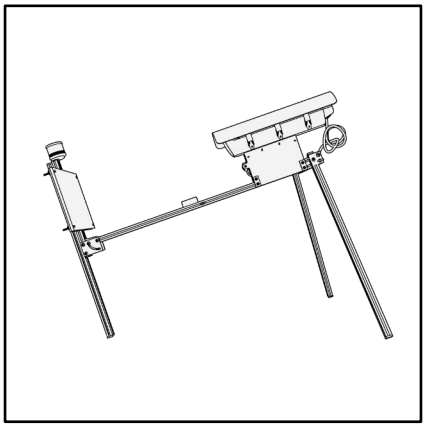
Both screws marked in green sit on springs. Therefore, the screws must never be turned too loosely to prevent the springs from being lost. In addition, the hinge can slip if the screws are too loose.



Step 24

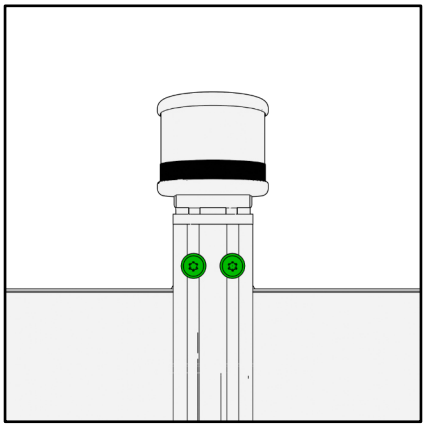
Open the hinge completely and raise ARNI in the direction of the arrow.

Back to step 4



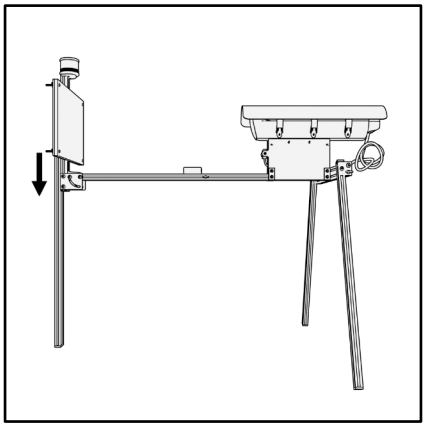
Step 25

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



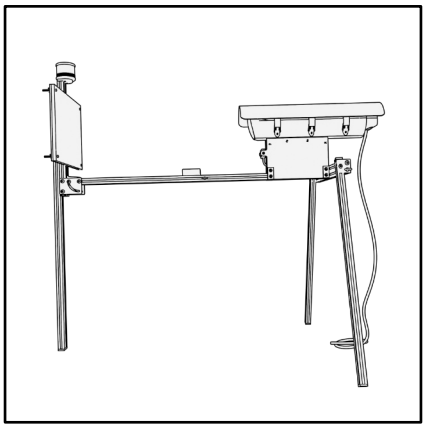
Step 26

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



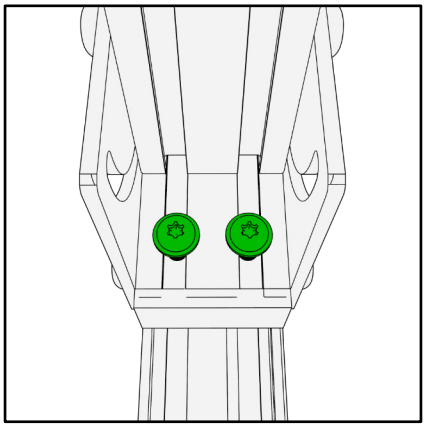
Step 27

Extend the support leg to the desired height.



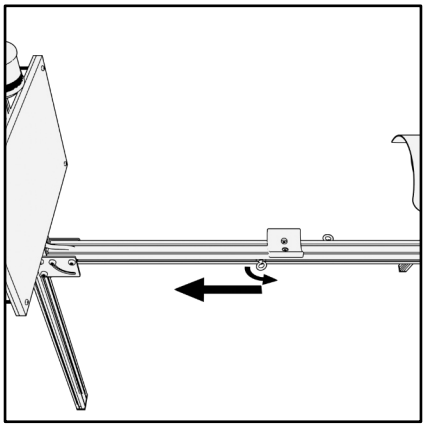
Step 28

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.

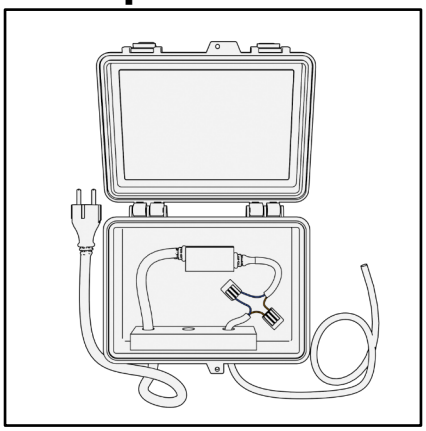


Step 30

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.

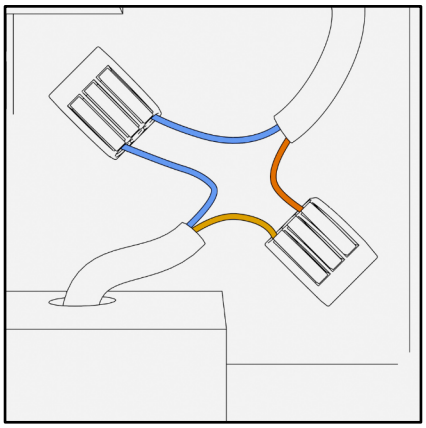
5 Power connection

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

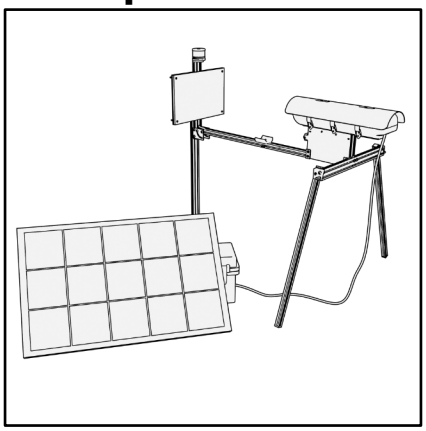
The connection to the power supply unit is made using WAGO terminals. Blue must be connected to blue (ground) and orange to brown (positive pole).

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

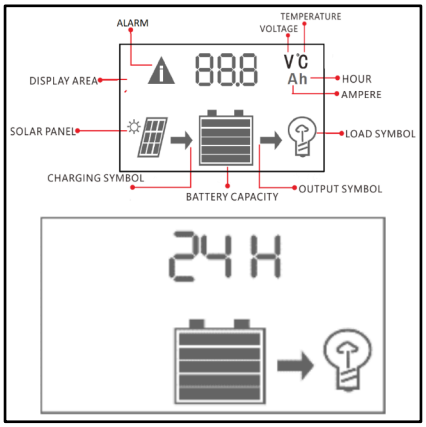
ARNI can be operated independently with a PV system. This unit is not included in the standard scope of delivery of ARNI. Devices loaned out by the LEPMON project can be shipped with a PV box. Important: This box includes a charge controller, protective box and connection cables.

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

Charge controller

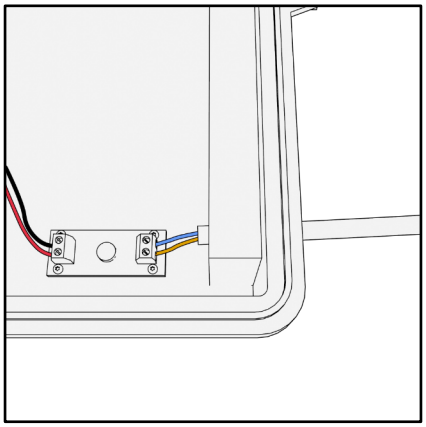
The PV units are equipped with a controller from Victron Energy and a converter. Detailed instructions for the control unit can be downloaded from the Victron Energy website:

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 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

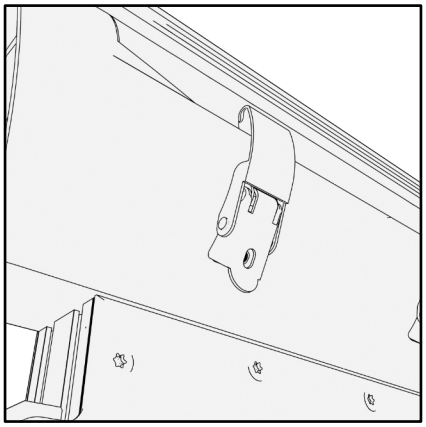
Pro_Gen_4, CSS_Gen_1 and CSL_Gen_1 only:

ARNI has integrated protection against deep discharge to protect the battery. This threshold is 9.7 V input voltage.

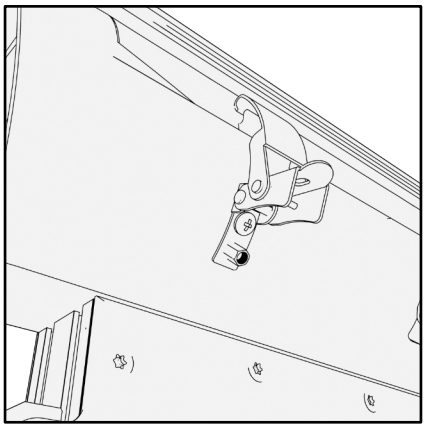
ARNI measures the current regularly. Nevertheless, it may switch off without prior warning.

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.

6 Opening/closing the camera housing



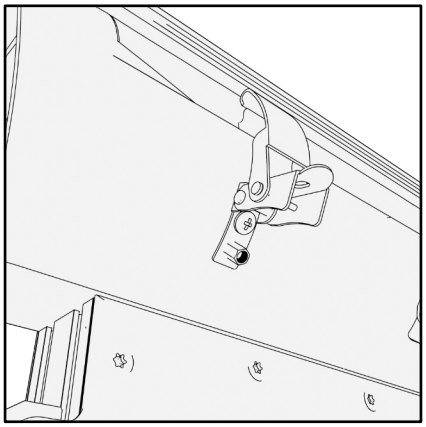
The camera housing has a hinge on the right-hand long edge (viewed from the camera) and three snap locks on the left-hand side. These snap locks are located under the sun visor.



Opening

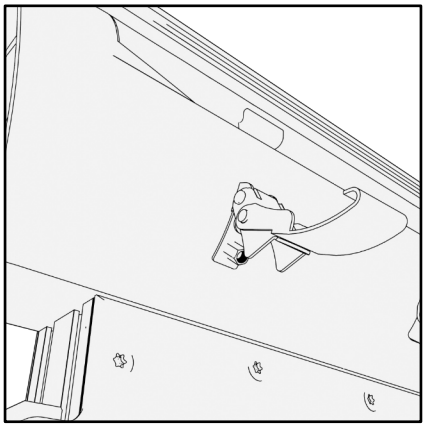
To release the snap locks, carefully press the handle upwards. This releases the barb from its counter bearing and allows it to be moved around it. Once all three locks have been released, the cover can be lifted upwards.

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.



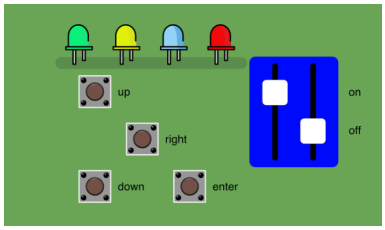
Caution

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

Do not open the camera housing in the rain!

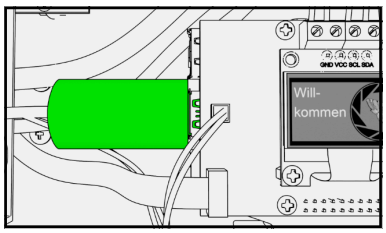
When closing the camera housing, it is essential to ensure that no cables are trapped.

7 Switch on

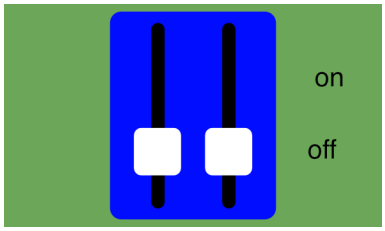


User interface with four buttons, four control LEDs, and the on/off switch (OLED panel not shown).

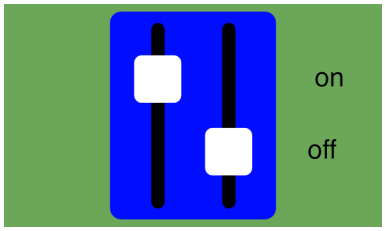
The buttons are small. Use a toothpick or small screwdriver (included) to move the controls. Never use a twig or tool that is too coarse to operate the buttons!



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

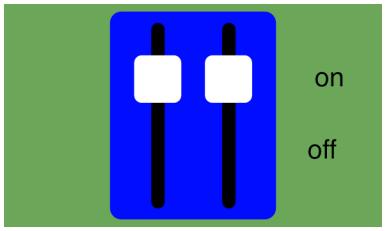


All ARNI variants are switched off when both switches are set to ‘off’.



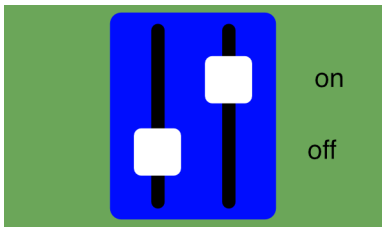
First, switch the left on/off switch to ‘on’ (up). The green control LED will start flashing and the LEDs on the Raspberry Pi (not the control LEDs next to the on/off switch) will light up.

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.



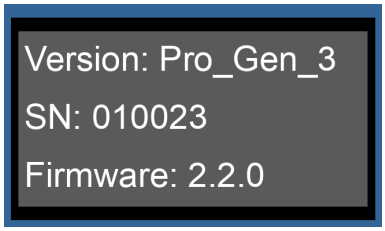
When switched off on the left and on on the right, the ARNI cannot be operated.

Start

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 todownload it from the project website:

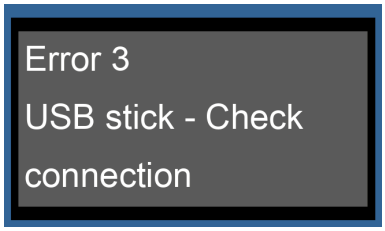
https://lepmon.de/en/software-and-documentation/



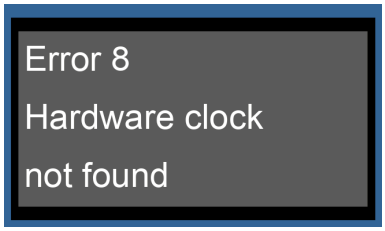
ARNI displays important device data:

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

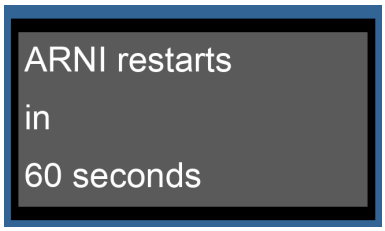
After a short time, ARNI displays the start sequence. The LEPMON logo appears. If ARNI does not display anything and the red control LED flashes repeatedly, there is a fault with the display. The display is plugged in and secured with a screw. Check this plug connection and restart manually.



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.

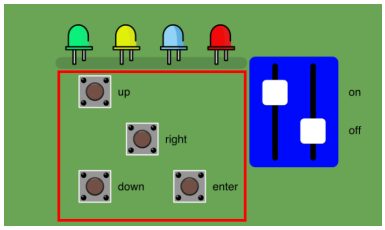


If there is a problem with the hardware clock, ARNI will indicate this (repeatedly) in the start sequence. The time can only be set in the menu on the Raspberry itself. However, this time quickly becomes inaccurate.



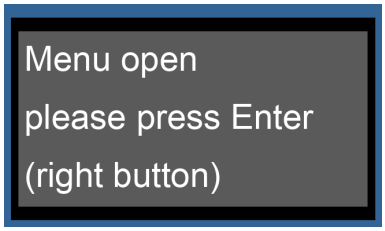
If one of these problems persists, ARNI will start a countdown to restart. Wait for this countdown to finish and let ARNI restart on its own. Reinsert the USB stick during the restart.

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.

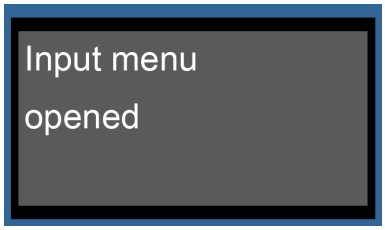
The coordinates only need to be entered the first time or when changing location. These can be determined using an external GPS device or a smartphone and a navigation app. ARNI uses the WGS-84 format.

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.

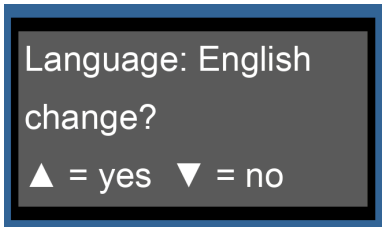
The date and time must be reset each time the device is started manually or the memory is changed. This is necessary because the device's internal clock may deviate from the actual time over time.

10 Hidden menu

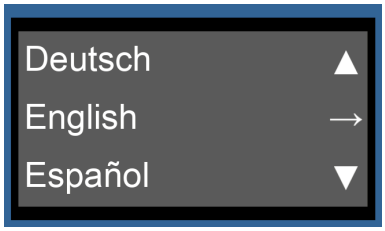
10.1 Change language



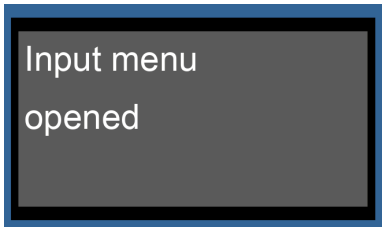
When the input menu is opened with **Enter**, ARNI displays a message. If you press **down** during this display, the language menu opens.



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.



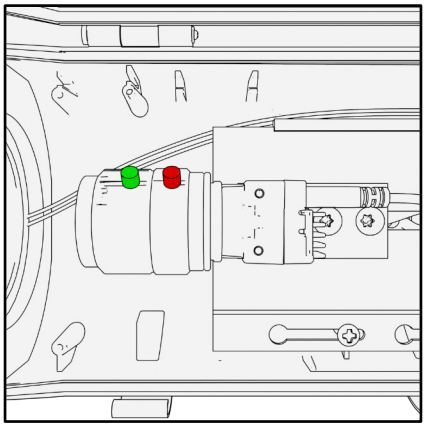
When the **up** is pressed, ARNI displays the supported languages. By selecting:
up = German
right = English
down = Spanish
the new language is selected and displayed with an “x”.



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

Menu hidden

10.2 Focus

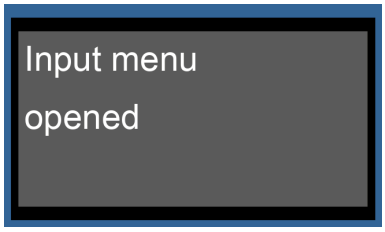


Not CSS_Gen_1:

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.

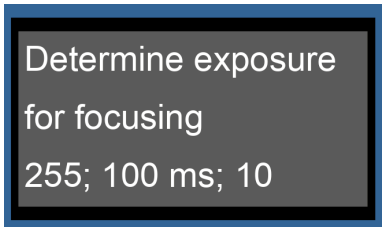
Never unscrew the screw completely! Do not turn the rear red screw!

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.

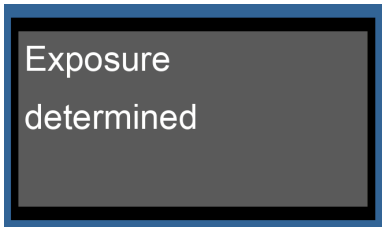


When the input menu is opened with **Enter**, ARNI displays a message. If you press **right** while this message is displayed, the focus menu opens.

Menu hidden

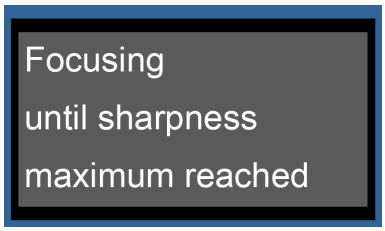


ARNI runs through a series of exposures and attempts to find the optimal exposure. To do this, the illuminator is switched on. ARNI captures frames and calculates their average brightness (e.g., 150.7) and displays the current exposure time (140 ms) and sensor sensitivity (gain 4).

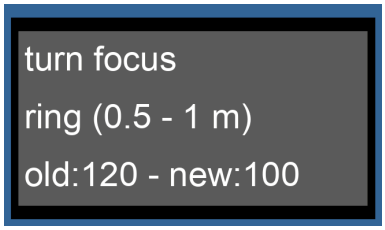


Once a good exposure has been found, ARNI will notify you.

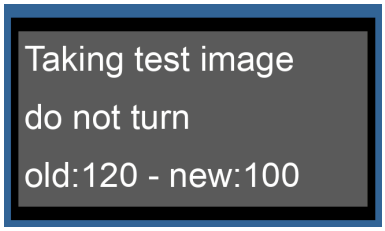
Note: If one of the following displays appears permanently and without change, ARNI is “frozen.” It must be restarted and focusing must be restarted.



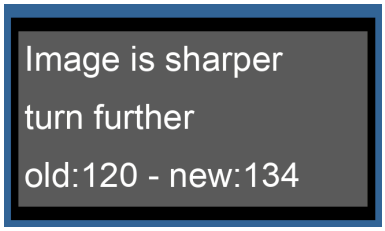
ARNI starts recording frames again. ARNI calculates the Gaussian blur of each frame. During recording, the blue control LED is off and the lens must not be adjusted! The OLED panel also indicates when the lens (green screw area) can be focused/rotated.



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.



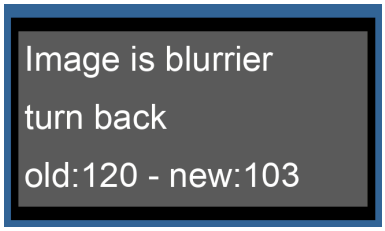
As soon as the display changes to “Record test image, do not turn”, do not rotate the lens. The blue indicator LED is off.



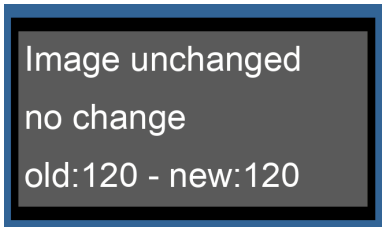
After evaluating the frame, ARNI indicates whether the focus has improved or not. To do this, note the values for “old” and “new.”

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

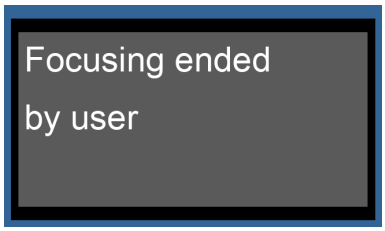
Menu hidden



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

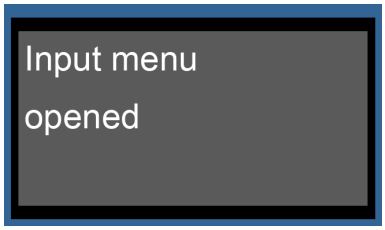


If “no change” is displayed, turn the focus ring in the other direction the next time you hear “now turn focus ring.” If this display is reached continuously, the focus is set.

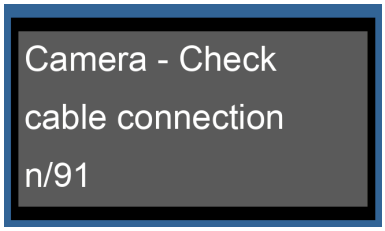


The focus menu can be closed by the user. To do this, hold down the **right** and **Enter**.

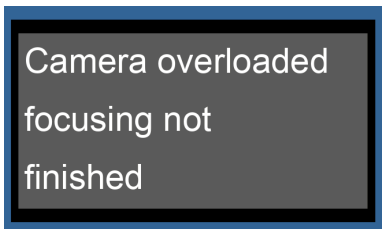
Tighten the screw marked green on the lens again. Do not change the alignment of the camera under any circumstances.



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

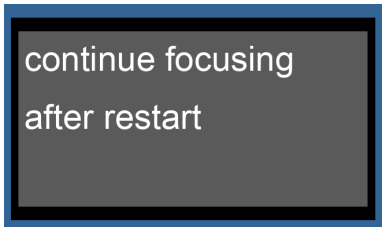


If an error occurs in the communication between the camera and the Raspberry, ARNI indicates that the cable connection must be checked. The Raspberry attempts to access the camera and displays the number of attempts (n).

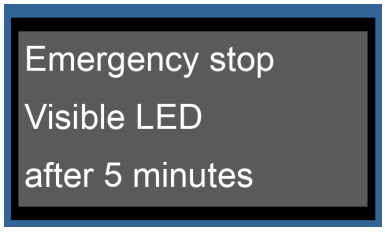


If the camera has been unable to create frames multiple times, it is overloaded.

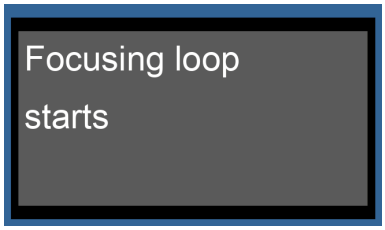
Menu hidden



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

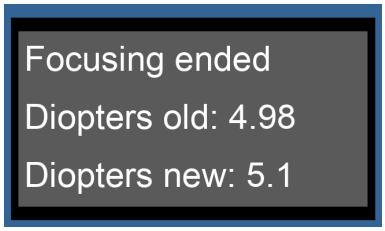


If the focus menu is open for too long and the spotlight stays on for too long, there is a risk that the spotlight's LED will burn out. ARNI therefore switches off the spotlight in an emergency.



CSS_Gen_1 only:

ARNI starts the focus loop automatically.

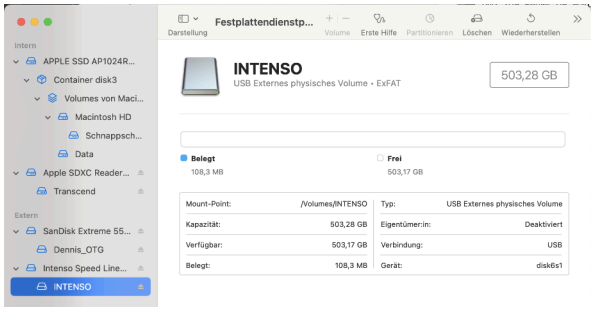


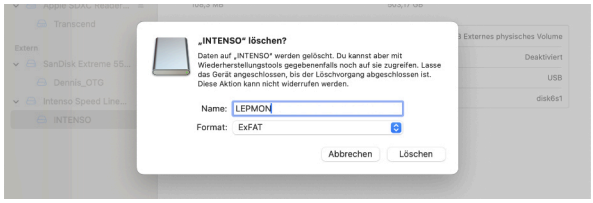
After completing this loop, it displays the newly found focus value in diopters.

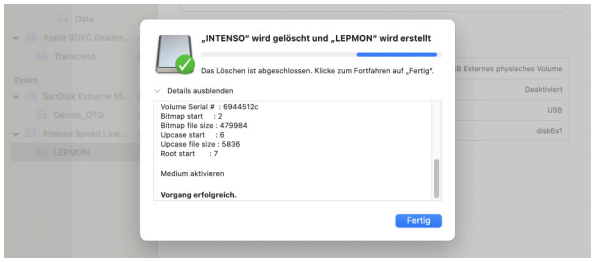
Menu hidden

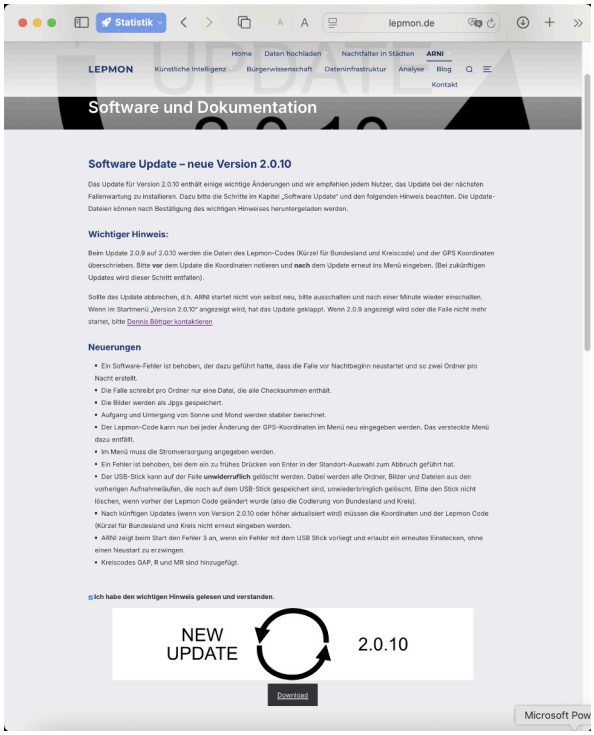
10.3 Firmware update

The microcontroller (Raspberry Pi 4B) uses Linux/RaspberryOS Bookworm as its operating system. The ARNI firmware is written in Python 3. This chapter describes how to update the firmware using an USB stick and the user interface.









Preparation

The firmware update can be performed using the USB stick provided by the LEPMON project. After uploading the images, this stick should be formatted. Select FAT32 or exFAT as the file system.

Windows:

Right-click on the drive => “Format...” => File system: FAT32 or exFAT => Quick format

Mac:

Disk Utility => Erase => Format: MS-DOS (FAT)

Note:

Do not use special characters when creating the drive. The USB stick can be named, for example, “Lepmon.”

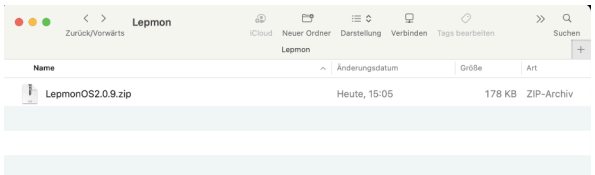
Download

The firmware update can be downloaded as a zip file from the project website:

lepmon.de/en/software-and-documentation/

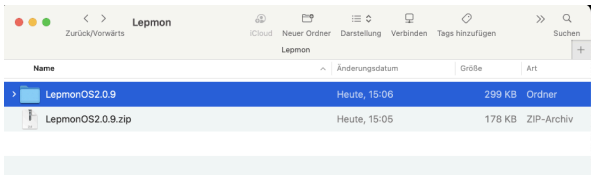
Save the downloaded file to the freshly formatted USB stick.

Menu hidden



Prepare the USB stick

Unzip the zip file by double-clicking or right-clicking on it.



Move the contents of the unzipped subfolder directly to the USB stick.

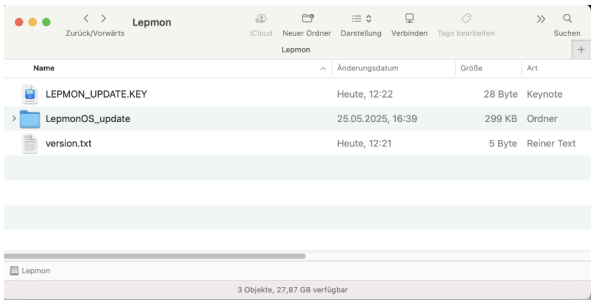
The finished USB stick contains 2 files and 1 folder:

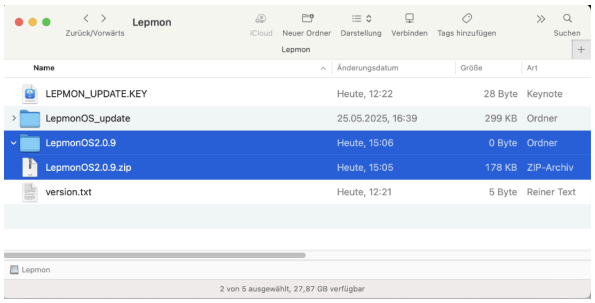
USB-STICK/

– LEPMON_UPDATE.KEY

– LepmonOS_update/

– version.txt

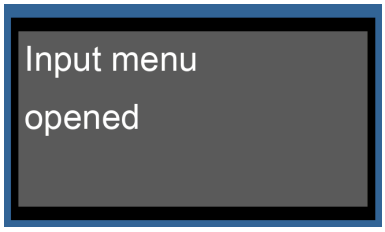




If there are any other folders on the prepared USB stick, such as “MACOSX,” “.Spotlight-V100,” or “System Volume Information,” these can be deleted. They are not relevant for the firmware update. Metadata files for the files may also be displayed. These begin with “._” in the file name. These files can be ignored or deleted. Finally, delete the empty subfolder (which has the same name as the zip file) and the zip file itself.

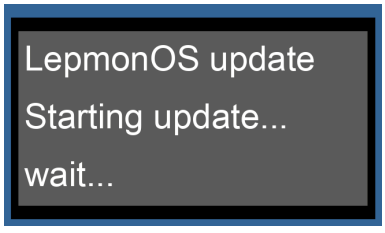
Menu hidden

Installation auf ARNI

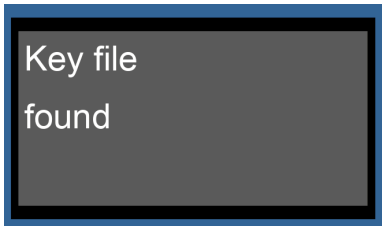


When the input menu is opened with **Enter**, ARNI displays a message. If you press **up** during this display, the update menu opens. ARNI runs through this menu without further input.

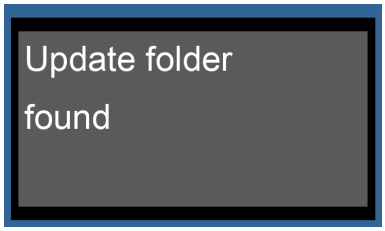
Do not switch off ARNI during this installation!



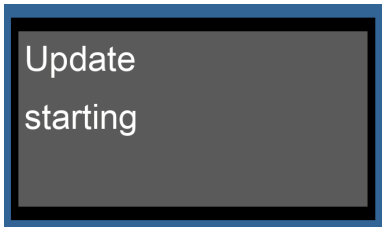
ARNI starts the firmware update.



ARNI also checks the key file to prevent malware. If this file is legitimate, ARNI continues with the process.

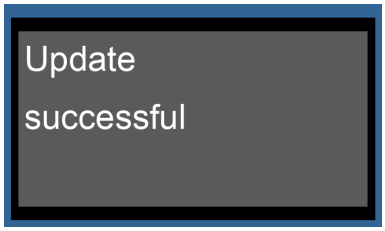


ARNI indicates whether the “LepmonOS_update” folder was found.



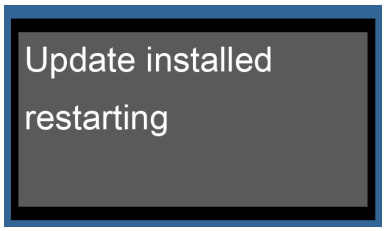
The firmware update is initialized.

Menu hidden

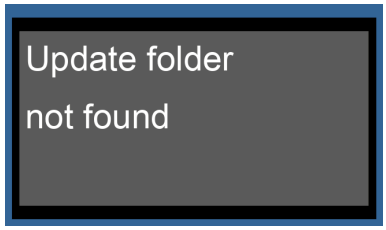


The new firmware is installed but not yet applied.

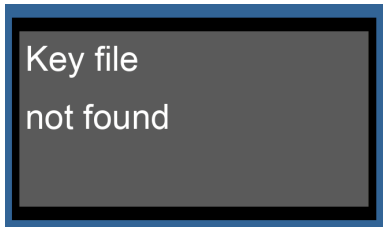
The new version number is displayed.



ARNI has completed the update and is restarting to apply this firmware update.

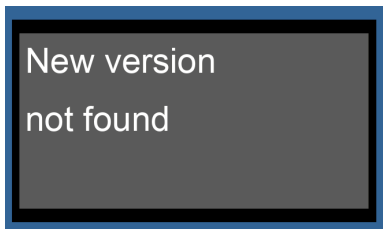


If ARNI indicates that the update folder cannot be found, check the contents of the USB stick and, if necessary, download the firmware update again and prepare the stick again.



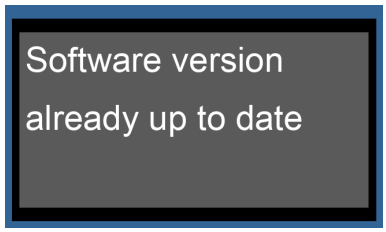
All necessary files are included in the zip file. If a folder has been deleted or renamed in the meantime, a file will be missing. A firmware update will not be possible.

The key file is the identifier for the firmware update. If it cannot be found, ARNI will abort the update.

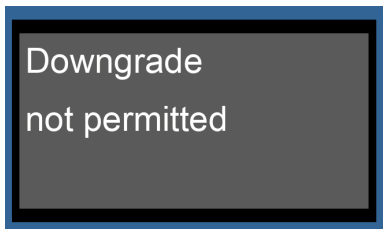


A missing version label or an older version will cause the firmware update to be aborted. In this case, ARNI can continue to be operated and adjusted.

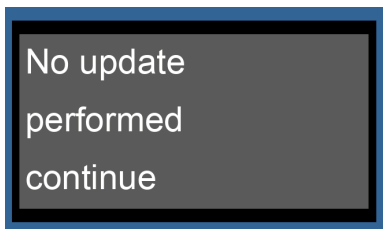
Menu hidden



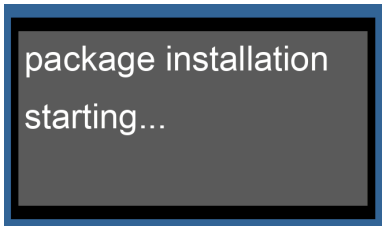
If ARNI already has the latest firmware, it will not proceed with the firmware update.



If a more recent version is already installed on the ARNI than the one on the USB stick, it will cancel the process.

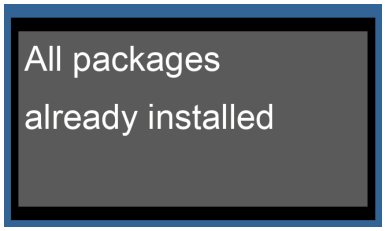


If one of these messages appears, ARNI informs you that no firmware update has been performed. However, ARNI can still be operated.

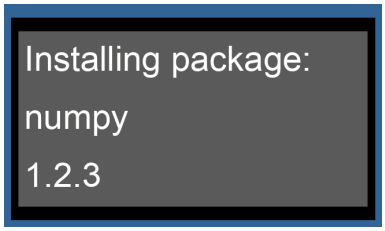


A firmware update may also include additional Python packages. The required files are already included in the zip file. The installation is performed automatically after restarting ARNI, between the start sequence and the input menu.

Do not switch off ARNI during this installation!

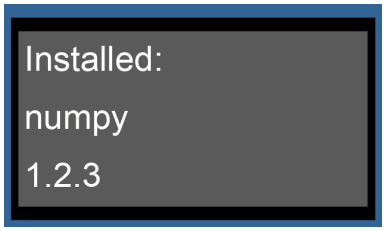


If all packages are already present, the installation is complete and the visible menu is displayed.

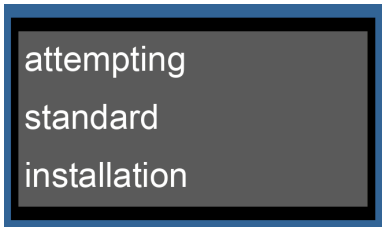


ARNI installs each package individually and displays the version number.

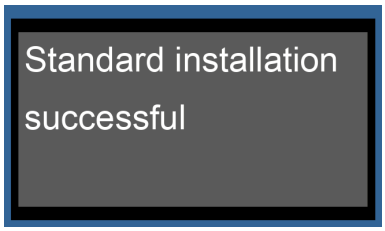
Menu hidden



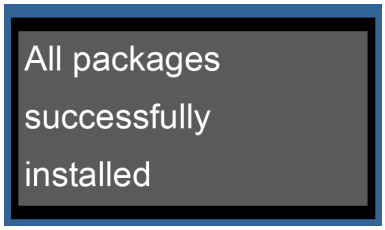
If the installation was successful, ARNI will display a success message.



If the installation fails, ARNI attempts a second mode, the “standard installation.” If this also fails, error 15 is triggered. Contact the LEPMON team immediately.



If the standard installation was successful, ARNI will display a success message.



All packages are now installed. ARNI will restart to load these packages and enable the new firmware to function.

Note: The log file contains a detailed report. To avoid version conflicts, ARNI first uninstalls the corresponding packages. This is noted in the log file and is not displayed on the OLED display to avoid confusion.

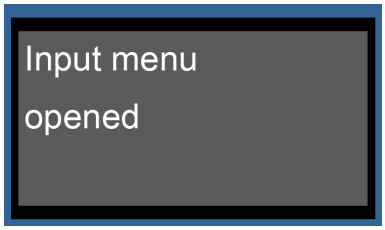
CSS_Gen_1 only:

After the update (and installation of new packages, if applicable), ARNI refocuses the camera. The focus menu opens automatically and cycles through the options.

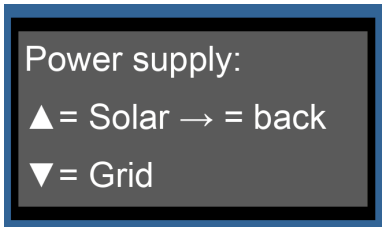
Menu hidden

11 Visible menu

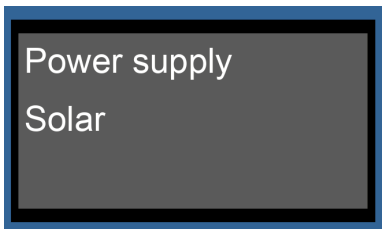
11.1 Power supply, storage deletion, heating



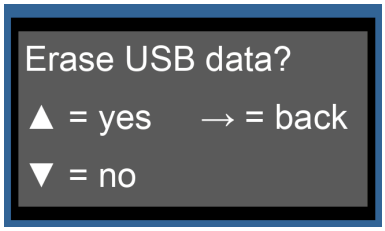
When **Enter** is pressed, ARNI indicates that the input menu is open. If no button is pressed during this display, ARNI switches to the visible menu.



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.

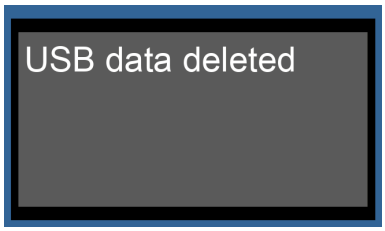


ARNI displays the selected power supply.



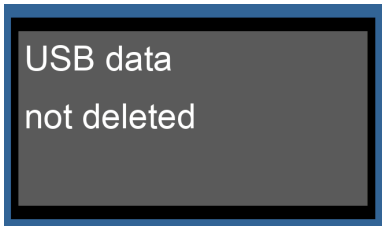
Images already uploaded to LAUP can be deleted from the USB stick. ARNI provides a function for this purpose: ARNI asks whether the USB stick should be deleted. This will permanently delete all folders, images, and files from previous recording sessions that are still stored on the USB stick.

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.

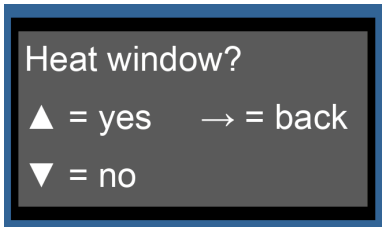


Once all folders have been deleted, ARNI will display a success message.

Note: This action cannot be undone.

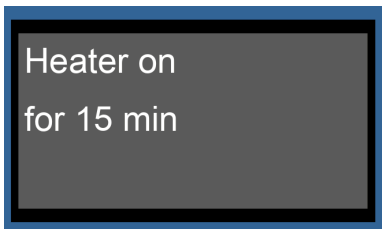


If the question is rejected with “no” (pressing the down button), ARNI continues without deleting.



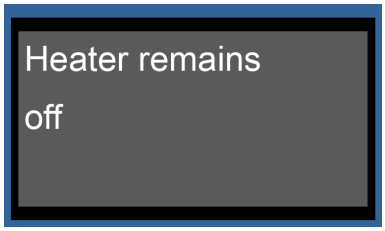
Only Pro_Gen_2; 3; 4:

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.



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.

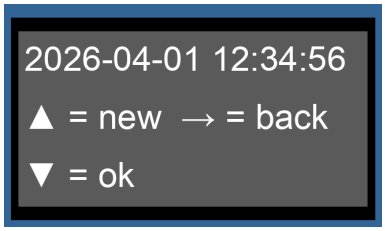
Menu



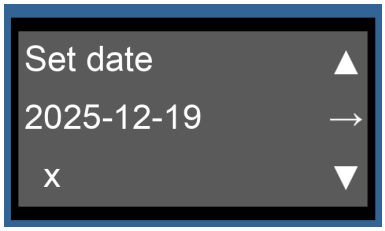
Alternatively, the heating remains switched off.

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.

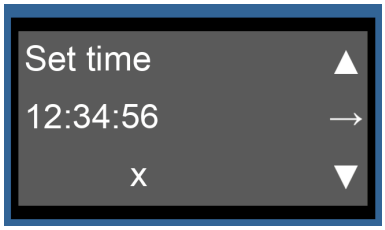
Each individual digit of the year, month, and day can be changed by pressing **up**/**down** to increase or decrease the value by 1. This is done from left to right:

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**.

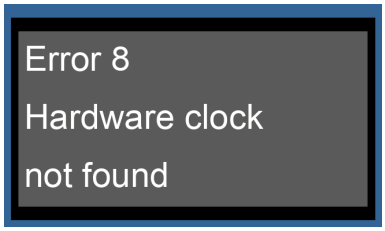
If a correction is necessary, press **right** until the incorrect digit is reached. Pressing the **up**/**down** buttons again allows you to make the correction. Once all digits are correct, press **Enter** to save the displayed value.

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

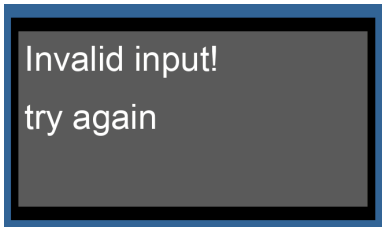
Menu



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.

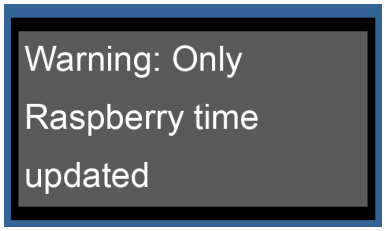


If ARNI already displays error 8 here, there is a problem with the hardware clock. Only the Raspberry's clock can be set, but it becomes inaccurate after a short time.



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.

Menu



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

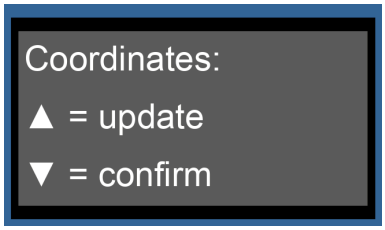
Tip:

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

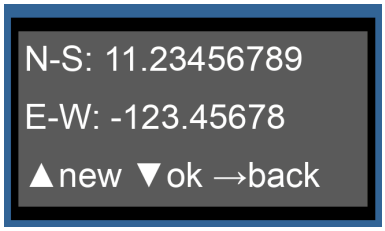
Note:

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.

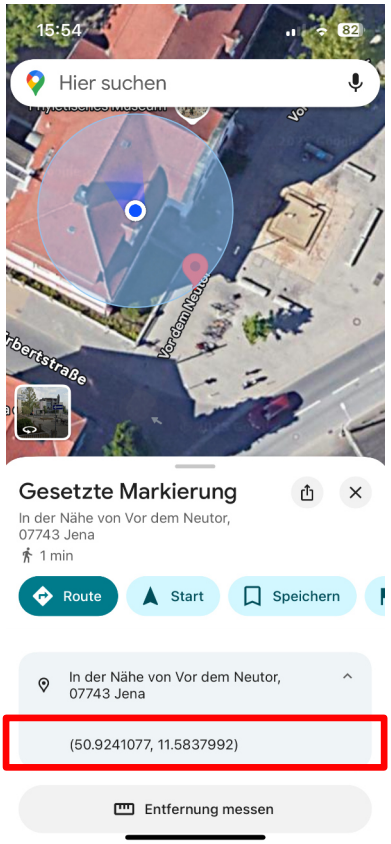
11.3 Enter GPS coordinates



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.



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.

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.

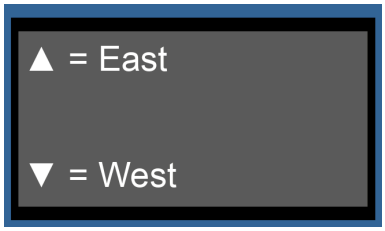
First, the hemispheres must be entered for north/south or east/west.

Menu

ARNI first queries the northern/southern hemisphere:

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

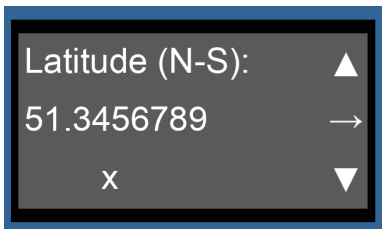
Germany: “North”



Next, the east/west hemisphere is queried:

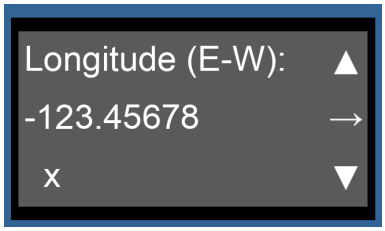
Up selects the eastern hemisphere and **down** selects the western hemisphere.

Germany: “East”

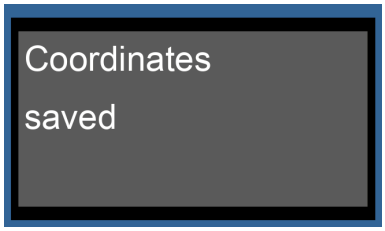


First, ARNI displays “Latitude (N-S)” and the currently set latitude. ARNI remembers the hemispheres from the previous step and displays a minus sign for “South.” If all positions are correct, the latitude can be saved by pressing **Enter**.

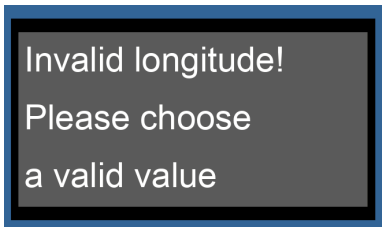
Menu



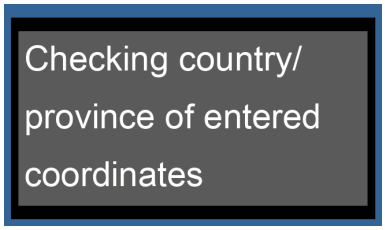
Now enter the longitude (E-W). Here too, ARNI remembers the hemisphere and displays a “minus” for west. As soon as the longitude is confirmed with **Enter**, ARNI saves the current position. The next time it is started, it displays the latitude and longitude values again. If ARNI's position is unchanged,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



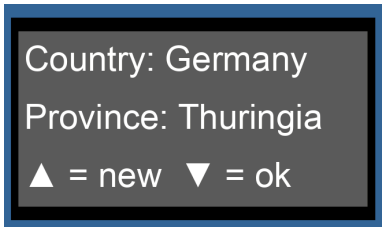
ARNI indicates that the save was successful.



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.



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.



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

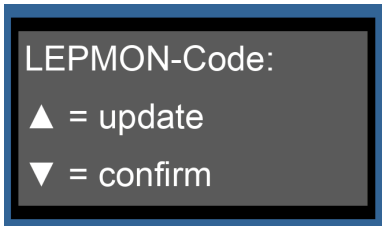
When entering latitude and longitude, each individual digit can be changed by pressing the **up**/**down** to move up or down one position. This is done from left to right:

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.

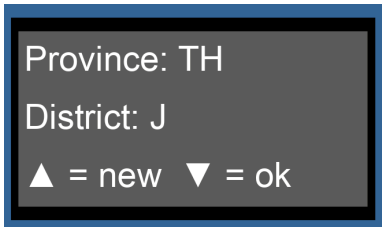
If ARNI is already displaying the correct coordinates, they can be saved by pressing **Enter**.

11.4 Enter LEPMON code



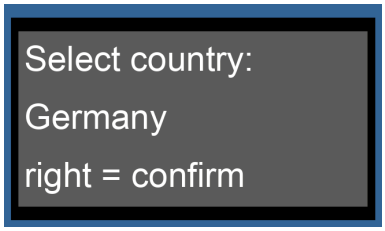
Once the coordinates have been entered, the LEPMON code can be set. The code is a location stamp consisting of the country, province, and city. The city follows the region's license plate code.

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



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.

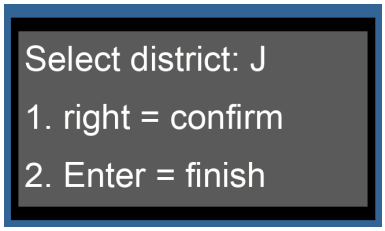
When **down** is pressed, ARNI prompts for the state, province, and city codes.



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**.

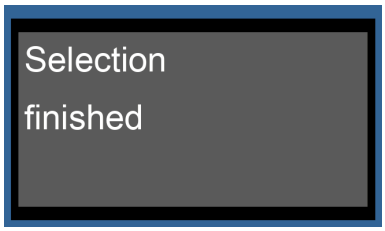
Menu

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**.

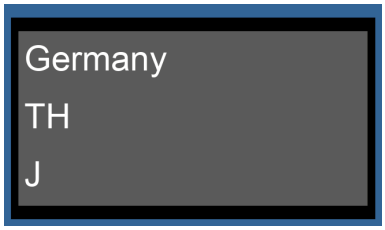


ARNI prompts you to enter the district. Select the abbreviation for the region's license plate here. Use **up**/**down** to scroll through the list of license plates until the desired district is displayed. A list of available license plates can be found at the end of this document.

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

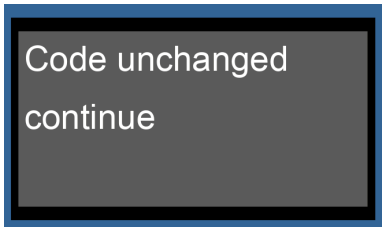


The selection is now complete...



...and ARNI displays the new LEPMON code.

(here, TH = Thüringen and J = Jena)



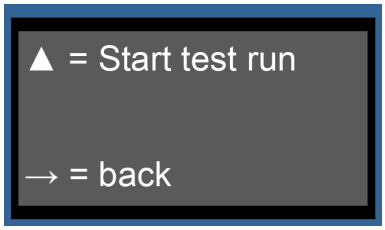
If the code is unchanged, ARNI continues normally.

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.

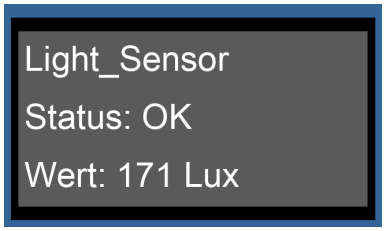
Menu

12 Diagnostics

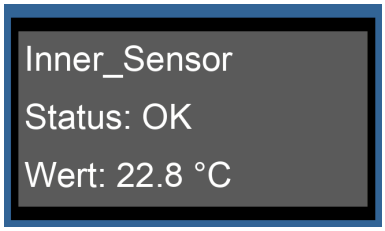
12.1 Sensors



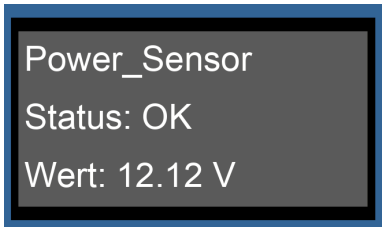
After the visible menu has ended, a test run can be started immediately with **up** or you can navigate back to the coordinates menu with **right**. ARNI will start the test run automatically after 2 minutes at the latest. ARNI tests all essential components and displays their status:



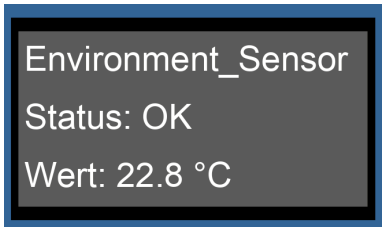
- Brightness (ambient light)



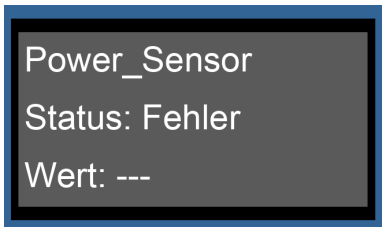
- Internal temperature (inside the camera housing)



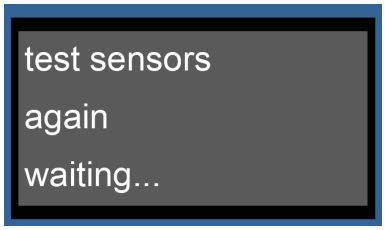
- Current meter (supply from ARNI)



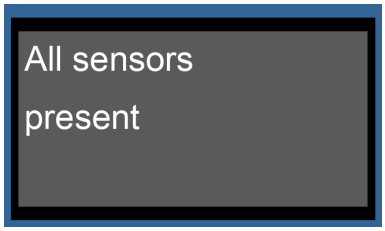
- Air pressure and humidity (ambient air)



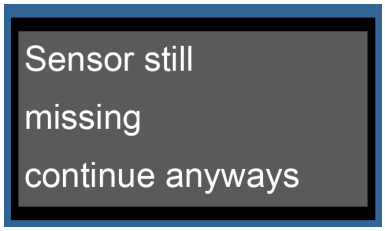
If a sensor cannot be found, its status is displayed as an error. ARNI initiates a series of accesses to the sensors so that, for example, the sensor cable can be checked.



During the loop, ARNI displays the corresponding error codes. In addition, the control LEDs light up during sensor access.

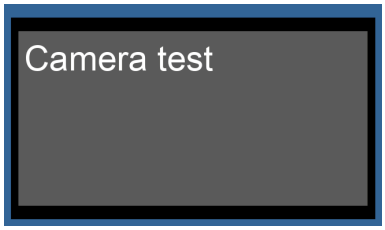


If all problems have been resolved, ARNI displays a success message and shows all current sensor values.

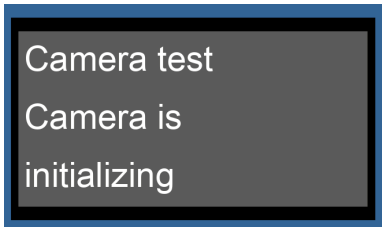


If access to one or more sensors fails, ARNI will inform you of this, but will continue with the diagnosis in the input menu.

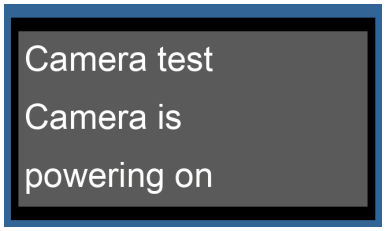
12.2 Camera



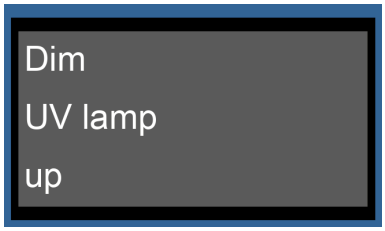
ARNI is now testing the camera.



To do this, it is initialized...



... and switched on.

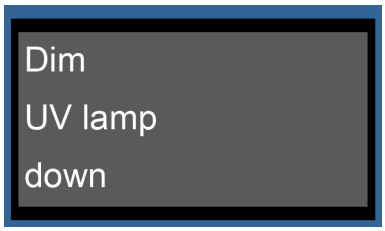


Both lamps dim up.

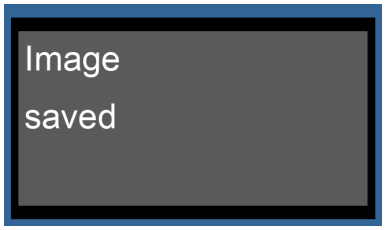
Diagnos-
tics

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

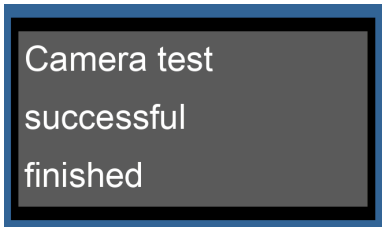
The radiation is largely invisible and only a faint violet color is visible. Maintain a distance of at least 50 cm from the UV lamp during operation!



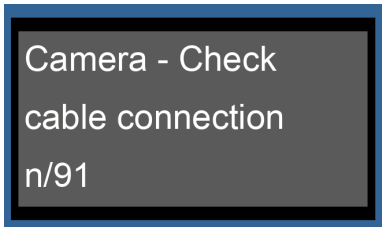
After a test image has been captured, the lamps immediately dim.



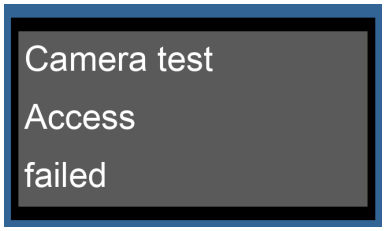
When the camera has been activated and the image has been successfully saved, ARNI will confirm this.



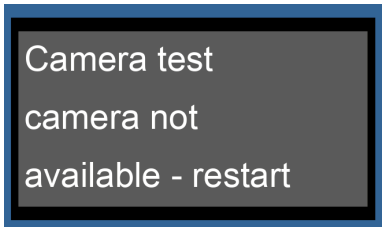
The camera test has been successfully completed.



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).

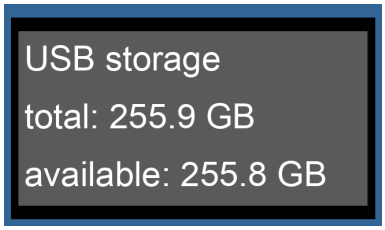


If 91 attempts were unsuccessful, access has failed. ARNI initializes the camera again.

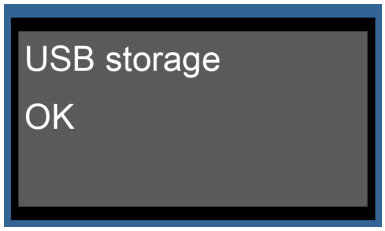


If the camera cannot be accessed even after multiple initializations, ARNI will restart. After restarting, open the input menu again.

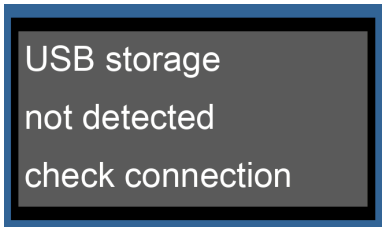
12.3 USB and twilight times



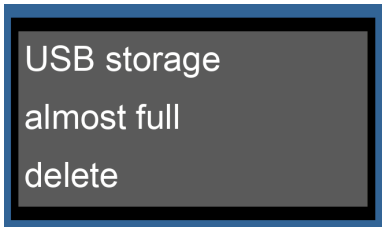
The memory device that was inserted into the USB slot before switching on is then queried. The values are displayed in gigabytes (GB). The capacity and the amount of free storage space available are determined.



If the memory is OK, ARNI displays “OK.”

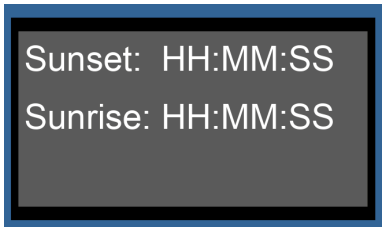


If the memory is not recognized, ARNI displays a warning.



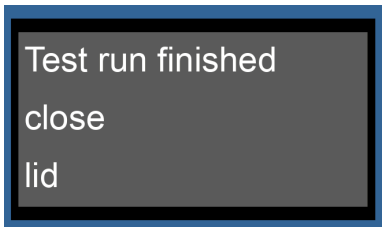
If the USB stick has less than 16 GB capacity or the USB stick is not readable, ARNI will indicate that the stick has not been recognized.

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



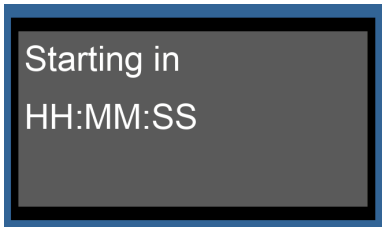
Finally, ARNI displays the sunrise and sunset times for the location in HH:MM:SS format.

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

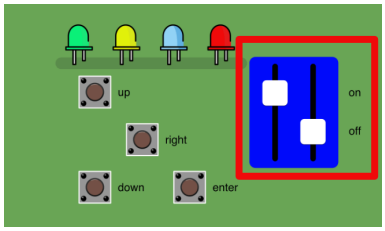


The diagnosis is complete. ARNI reminds you to close the lid.

If a new LEPMON code has been entered, ARNI now applies the changes and logs them.



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.”

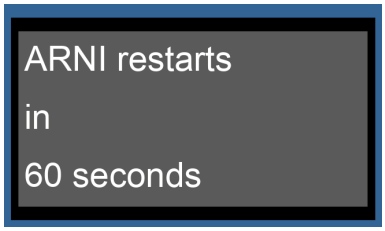


Pro_Gen_3 only: leave the power switches in the “Adjustment” position. This means that the left switch on the left channel is up and the right switch is down.

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!



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

13 Maintainance

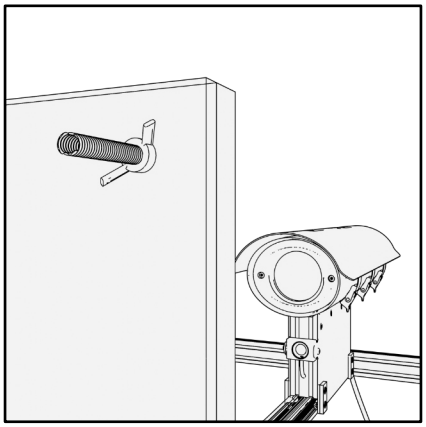
13.1 During the season

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. 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/

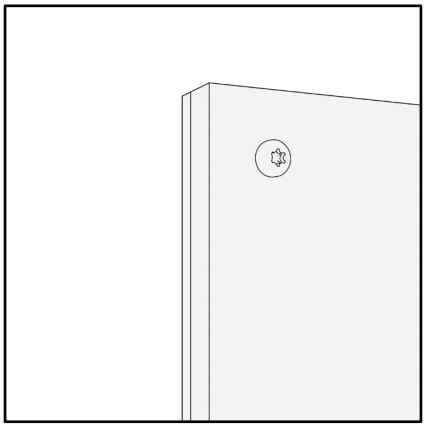
13.2 After the season



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 e 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.

14 errors

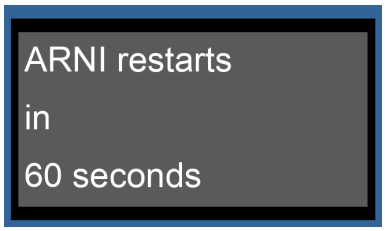
ARNI can display various errors. There are two types of errors:

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.

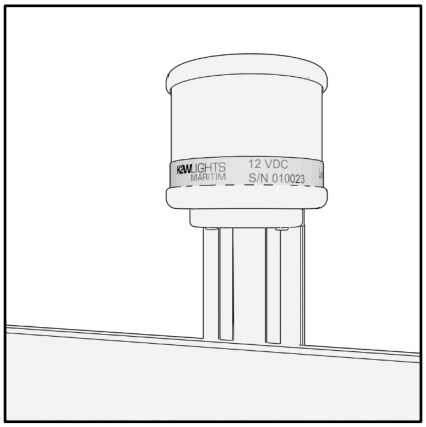
Critical errors:

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 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.

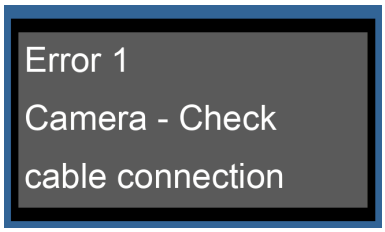
The program is designed to attempt to correct critical errors by restarting if no interaction is performed by the user.



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

Critical error



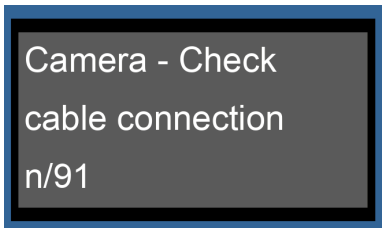
Error in communication between the camera and the Raspberry Pi. ARNI was unable to capture images.

error handling

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

Critical error



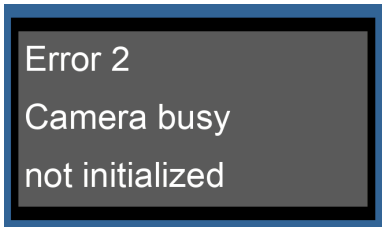
Error in communication between the camera and the Raspberry Pi. The Raspberry Pi is attempting to access the camera and displays the number of attempts (n). No image has been captured yet.

error handling

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

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.

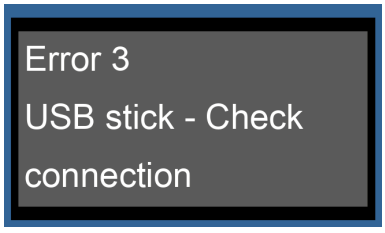
error handling

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

Errors

3

Critical error



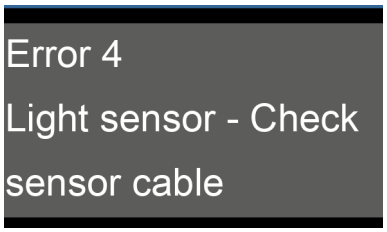
ARNI was unable to access the (connected) USB stick.

error handling

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

deficiency



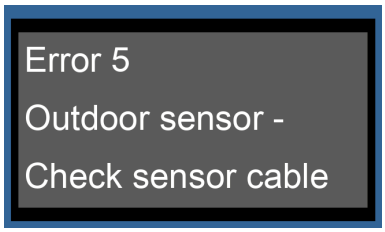
The integrated light sensor does not communicate with the Raspberry. To ensure data collection, a threshold value for ambient light is assumed (90 lux) and ARNI generates data between 15 minutes before dusk and 60 minutes before dawn.

error handling

During the input menu, note the accesses and check the cable connections on the circuit board.

5

deficiency



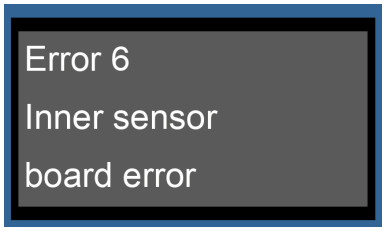
The integrated environmental sensor does not communicate with the Raspberry. ARNI does not record outside temperature, air pressure, or humidity.

error handling

During the input menu, note the accesses and check the cable connections on the circuit board.

6

deficiency



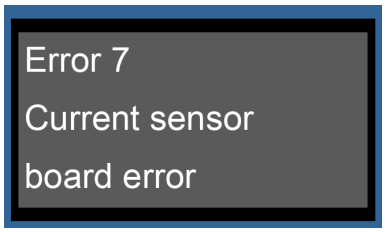
The integrated indoor sensor does not communicate with the Raspberry. ARNI does not record indoor temperature.

error handling

Pay attention to accesses during the input menu. If the error persists, contact the LEPMON team immediately.

7

deficiency

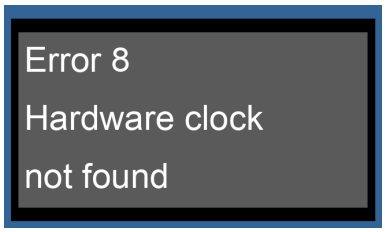


The integrated current sensor does not communicate with the Raspberry. ARNI does not measure power consumption or the status of the spotlight. When operating on solar power, the battery is not monitored.

error handling

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

8 deficiency

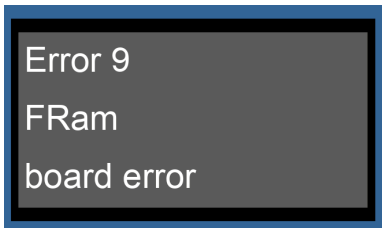


Error in communication with the external clock. This error may occur if an invalid format was entered when setting the time or if the external clock is not accessible.

error handling

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 deficiency

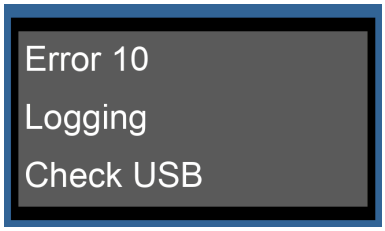


Error in communication between Raspberry and Fram module.

error handling

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

10 deficiency

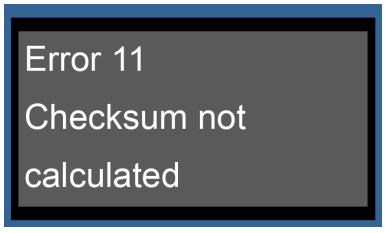


ARNI was unable to create the log file or write an entry to it.

error handling

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.

11 deficiency

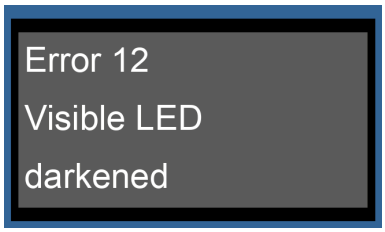


ARNI creates a so-called checksum for each file. This is determined after the file has been saved. If the file is not available because it has not been created, error 11 is logged.

error handling

Check the log file on the USB stick.

12 deficiency

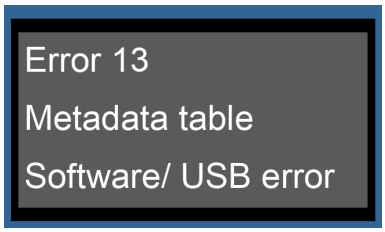


The illumination LED is dimmed and the screen is not fully illuminated during image capture.

error handling

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 deficiency

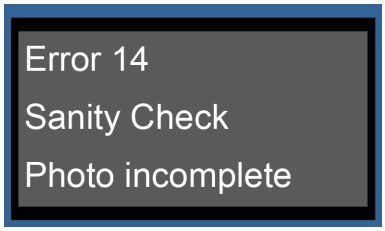


Current data such as measured values, image name, or timestamp could not be written to the metadata table.

error handling

Turn ARNI off and then on again

14 deficiency

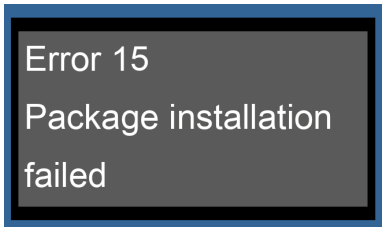


The current image has not passed the completeness check and will be re-recorded.

error handling

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.

15 Critical error

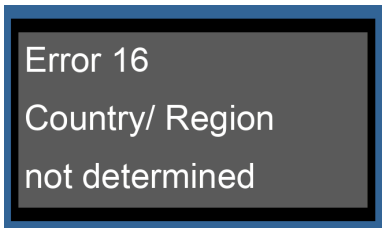


An error occurred while installing additional Python packages. This may cause parts of the firmware to no longer function or to exhibit unexpected behavior.

Fehlerbehandlung

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



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.

15 Promotion

The project on which this report is based was funded by the German Federal Ministry of Education and Research within the Research Initiative for the Conservation of Biodiversity (FEdA) under the funding code 16LW0653K. The responsibility for the content of this publication lies with the authors.

Errors

16 Output

16.1 Sample log file

Note:
ARNI always writes the log file in German, regardless of the language setting.

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; 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
20:41:02; ARNI run: SN010023__0016
20:41:02; Firmware: 2.2.0 vom 2026-03-02
20:41:10; ----------
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; 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
20:41:35; ----------
20:41:37; ----------

Installing new dependencies:

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
20:41:41; h3 ist bereits installiert und wird deinstalliert
20:41:48; h3 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, h3, 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
20:42:02; Versuche Installation von h3-3.7.6-cp311-cp311-manylinux_2_17_aarch64.manylinux2014_aarch64.whl ...
20:42:11; h3-3.7.6-cp311-cp311-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; ----------
20:42:50; ----------

Opened menu:

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

Missing update on the USB drive

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; Eingaben beendet
20:45:11; ----------
20:45:14; Starte Systemcheck

Output

In the event of an error in the connection to the sensors:

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

If camera is not connected or connected incorrectly:

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

If USB stick is full:

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; ##########

Start capturing.

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
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
20:50:33; Warten bis zur nächsten Aufnahme: 87.0 Sekunden
20:52:24; Bild gespeichert: /media/Ento/INTENSO/Lepmon#SN010023_TH_J_2026-05-14_T_2041/Lepmon#SN010023_TH_J_2026-05-14_T_2052.jpg
20:52:30; Warten bis zur nächsten Aufnahme: 90.0 Sekunden
20:54:23; Bild gespeichert: /media/Ento/INTENSO/Lepmon#SN010023_TH_J_2026-05-14_T_2041/Lepmon#SN010023_TH_J_2026-05-14_T_2054.jpg
20:54:29; Warten bis zur nächsten Aufnahme: 90.0 Sekunden
20:54:16; Sowohl Exposure als auch Gain haben das Maximum erreicht. Keine weitere Erhöhung

Output

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
21:00:38; Bilder der AV__Alvium_1800_U-2050 sind scharf: Schwellenwert: 100, gemessene Fokusvarianz: 100,21

Image not stored properly

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."

Blurred images of all Pro generations and CSL_Gen_1

21:00:38; WARNUNG: Bilder der AV__Alvium_1800_U-2050 sind verschwommen: Schwellenwert: 100, gemessene Fokusvarianz: 89,39

Blurry images CSS_Gen_1

21:00:38; WARNUNG: Bilder der RPI_Module_3 sind verschwommen: Schwellenwert: 100, gemessene Fokusvarianz: 56,32
21:00:38, Unscharfe 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; 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; ##

Time change in spring and autumn during the night:

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

changing the time + intermittent power failure

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

When restarting during the night:

21:14:25; ##
21:14:25; ### Letzter Durchlauf nicht ordnungsgemäß beendet. Fahre mit dem alten Ordner fort ####
21:14:25; ##
20:41:20; ------------------
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

16.2 Metadata table

#Machine ID:	SN010023
#Software:	2.2.0 vom 2026-03-02
#ARNI-Generation:	Pro_Gen_3
#Kamera	AV__Alvium_1800_U-2050
#Sensor	imx183
#Auflösung	5496 x 3672
#Stromversorgung:	Netz
#UTC Time:	2026-05-14 20:41:58
#Longitude:	11.5837985
#Latitude:	50.9241072
#Sonnenuntergang:	2026-05-14 20:53:04
#Sonnenaufgang:	2026-05-15 05:27:51
#Mondaufgang:	2026-05-15 04:11:56
#Monduntergang:	2026-05-14 18:08:40
#Mondphase:	6.3
#Maximale Kulminationshöhe:	55.56
#Beginn Monitoring:	20:38:04
#Ende Monitoring:	04:27:51
#Dämmerungs-Schwellenwert:	90 Lux
#Aufnahme Intervall:	2 min

Code/Spannweite	time_read	LUX	Temp_in	Inner_Sensor	bus_voltage	shunt_voltage	current	power	Power_Sensor	Temp_out	air_pressure	air_humidity	Env._Sensor	Status_Kamera	Expo sure	Gain	Bright ness	Visible_LED	Power_Vis._LED	Lepi LED	Gamma _Corr
Einheit	Uhrzeit	Lux	°C	Status	V	V	mA	W	Status	°C	hPa	%	Status	Status	ms	0-27	0-255	Status	W	Status	1-2
Lepmon#SN010023_TH_J_2026-05-14_T_2041	20:41:25	20.01	35.00	1	11.72	0.85	163.57	1.93	1	21.41	996.01	37.81	1	1	140	5.0	133.0	1	4.70	active	1.5
Lepmon#SN010023_TH_J_2026-05-14_T_2043	20:43:03	17.98	34.75	1	11.72	0.84	162.96	1.93	1	21.38	996.06	37.66	1	1	145	5.0	138.0	1	4.68	active	1.5
Lepmon#SN010023_TH_J_2026-05-14_T_2045	20:45:01	16.32	35.38	1	11.72	0.84	162.96	1.93	1	21.34	996.01	37.69	1	1	145	5.0	171.0	1	4.70	active	1.5
Lepmon#SN010023_TH_J_2026-05-14_T_2047	20:47:01	14.52	35.38	1	11.72	0.84	162.96	1.93	1	21.31	995.97	37.79	1	1	145	5.0	172.0	1	4.70	active	1.5
Lepmon#SN010023_TH_J_2026-05-14_T_2049	20:49:01	11.21	35.50	1	11.72	0.85	163.57	1.93	1	21.28	996.00	37.77	1	1	150	5.0	105.0	1	4.70	active	1.5
Lepmon#SN010023_TH_J_2026-05-14_T_2051	20:51:01	9.58	35.25	1	11.72	0.84	162.96	1.93	1	21.26	995.99	37.99	1	1	150	5.0	176.0	1	4.70	active	1.5

Output

16.3 images

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

Moth sample from 2025

Output

17 Available LEPMON-Codes

LEPMON Code

Albania

- Berat
  - BR
  - KV
  - SK
- Dibër
  - DI
  - BZ
  - MT
- Durrës
  - DR
  - KR
- Elbasan
  - EL
  - GR
  - LB
  - PE
- Fier
  - FR
  - LU
  - MK
- Gjirokastër
  - 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
- 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
GAP
GEO
GRA
GRI
GUN
GZ
HAB
HAS
HEB
HIP
HO
HOH
HOS
ILL
IN
KC
KE
KEH
KEM
KF
KG
KON
KOZ
KRU
KT
KU
LA
LAN
LAU
LF
LI
LIF
LL
M
MAI
MAK
MAL
MB
MET
MIL
MM
MN
MOD
MSP
MU
MUB
N
NAB
NAI
ND
NEA
NEC
NEN
NES
NEW
NM
NO
NU
OA
OAL
OBB
OCH
OVI
PA
PAF
PAN
PAR
PEG
R
REG
REH
REI
RH
RID
RO
ROD
ROL
ROT
SAD
SAN
SC
SEF
SEL
SMU
SOB
SOG
SR
STA
STE
SUL
SW
TIR
TOL
TS
UFF
VIB
VIT
VOH
WEN
WER
WM
WOR
WOS
WS
WU
WUG
WUM
WUN

Berlin

BE

Brandenburg

BB
BAR
BER
BRB
BSK
CA
CB
EE
EH
EW
FF

LEPMON Code

FI
FOR
FRW
FW
GUB
HVL
KW
KY
LC
LDS
LIB
LN
LOS
MOL
NAU
NP
OHV
OPR
OSL
P
PM
PR
PZ
RN
SDT
SEE
SFB
SPB
SPN
SRB
TF
TP
UM
WK

Bremen

HB

Hamburg

HH

Hessen

HE
BUD
DA
DI
DIL
ERB
ESW
F
FB
FD
FKB
FZ
GG
GI
GN
HEF
HG
HOG
HP
HR
HU
KB
KS
LDK
LM
MEG
MKK
MR
MTK
OF
ROF
RUD
SLU
SWA
USI
VB
WA
WEL
WI
WIZ
WOH
WZ

Mecklenburg-Vorpommern

MV
AT
BUZ
DBR
DM
GDB
GMN
GU
GVM
GW
HGN
HGW
HRO
HST
HWI
LBZ
LRO
LUP
LWL
MC
MSE
MST
MUR
NB
NVP
NWM
NZ
OVP
PCH
PW
RDG
RM
ROS
RUG
SBG
SN
STB
TET
UEM

LEPMON Code

UER
VG
VR
WIS
WLG
WRN

Niedersachsen

NI
AUR
BRA
BRL
BRV
BS
BSB
CE
CLP
CLZ
CUX
DAN
DEL
DH
DUD
EIN
EL
EMD
FRI
GAN
GF
GO
GS
H
HE
HI
HK
HM
HMU
HOL
LER
LG
MEL
NI
NOH
NOM
NOR
OHA
OHZ
OL
OS
PE
RI
ROW
SHG
STD
SY
SZ
UE
VEC
VER
WF
WHV
WL
WOB
WST
WTL
WTM

Nordrhein-Westfalen

NW
AH
BE
BF
BI
BLB
BM
BN
BO
BOH
BOR
BOT
BUR
CAS
COE
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DIN
DN
DO
DU
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EN
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EU
GE
GEL
GK
GL
GLA
GM
GT
GV
HA
HAM
HER
HF
HS
HSK
HX
JUL
K
KK
KLE
KR
LEV
LH
LIP
LP
LUN
ME
MG
MH
MI
MK
MO
MON
MS

LEPMON Code

NE
OB
OE
OP
PB
RE
RS
SG
SI
SLE
SO
ST
SU
TE
UN
VIE
W
WAF
WAN
WAR
WAT
WES
WIT

Rheinland-Pfalz

RP
AW
AZ
BIN
BIR
BIT
BKS
COC
DAU
DIZ
DUW
EMS
FT
GER
GOA
GOH
KH
KIB
KL
KO
KUS
LD
LU
MY
MYK
MZ
NR
NW
PRU
PS
ROK
RP
SAB
SIM
SP
SUW
TR
WIL
WO
WW
ZEL

Saarland

SL
IGB
MZG
NK
OTW
SB
SLS
VK
WND

Sachsen

SN
ANA
ASZ
AU
BED
BIW
BNA
BZ
C
DD
DL
DW
DZ
EB
ERZ
FG
FLO
FTL
GC
GHA
GR
GRH
GRM
HC
HOT
HY
KM
L
LOB
MAB
MEI
MEK
MTL
MW
NOL
NY
OVL
OZ
PIR
PL
RC
RG
RIE
RL
SEB
STL
SZB

LEPMON Code

TDO
TG
TO
V
WDA
WSW
WUR
Z
ZI

Sachsen-Anhalt

ST
ASL
AZE
BBG
BK
BLK
BO
BRG
BTF
DE
EIL
GA
GHC
GNT
HAL
HBS
HDL
HET
HHM
HV
HZ
JE
JL
KLZ
KOT
MD
MER
ML
MQ
MSH
NEB
NMB
OBG
OC
OK
QFT
QLB
RSL
SAW
SBK
SDL
SFT
SGH
SK
SLK
WB
WMS
WR
WSF
WZL
ZE

Schleswig-Holstein

SH
HEI
HL
IZ
KI
MED
NF
NMS
OD
OH
PI
PLO
RD
RZ
SE
SL

Thüringen

TH
AP
APD
ARN
ART
EA
EF
EIC
EIS
G
GRZ
GTH
HBN
HIG
IK
IL
J
KYF
LBS
LSZ
MGN
MHL
NDH
NH
PN
RU
SCZ
SDH
SHK
SHL
SLF
SLN
SLZ
SM
SOK
SOM
SON
SRO
UH
WAK
WBS
WE

LEPMON Code

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

LEPMON Code