Workswell Thermal Vision

Thermal Imaging System for UAV

User Manual

Version: 1.0

Compatible with *Workswell Thermal Vision Light*: 1.0

Release Date: 24.6.2015

Introduction

Workswell Thermal Vision Light is the thermal imaging system for unmanned aerial vehicles (UAVs, drones). It is a lightweight system equipped with a thermal imaging camera. The aim of the whole system is the simple transfer of radiometric (temperature) data directly from an unmanned aerial vehicle (drone) and displaying the data on the screen of the UAV remote control in real time. The system also offers a variety of palettes and alarm (security) modes.

Workswell Thermal Vision Light can be configured prior to flight using a standard PC with Workswell CorePlayer software installed.

Workswell Thermal Vision Light

User Manual

Legal Disclaimer

All products (software, hardware or firmware) manufactured by Workswell s.r.o. are warranted against defective materials and workmanship for a period of two (2) years, provided such products have been under normal storage and use in accordance with herein instructions.

The warranty extends only to the original purchaser and is not transferable. It is not applicable to any product which has been subjected to misuse, neglect, accident or abnormal conditions of operation.

In the case of a defect in a product covered by this warranty the product must not be further used in order to prevent additional damage. The purchaser shall promptly report any defect to Workswell s.r.o. or its authorized distributor or this warranty will not apply.

Workswell s.r.o. will, at its option, repair or replace any such defective product free of charge if, upon inspection, it proves to be defective in material or workmanship and provided that it is returned to Workswell within the said two-year period.

Nobody but Workswell s.r.o. is allowed to open or modify such product.

Workswell s.r.o. has no other obligation or liability for defects than those set forth above. No other warranty is expressed or implied. Workswell s.r.o. shall not be liable for any direct, indirect, special, incidental or consequential loss or damage, whether based on contract, tort or any other legal theory.

Copyright

Contents

1 Warnings and Cautions

Warnings

Before using the product , please check that there is no visible damage or malfunction . If there are any visible signs of damage or other defect on the device, then on no account should it be installed or put into operation.

Any interference and noncertified service operations into the product leads to an automatic loss of warranty.

Notifications

Do not use or store the device in conflict with the storage and operating conditions laid down in this manual (only for hardware).

- Do not point the infrared camera (with or without the lens cover) at strong energy sources, for example, devices that cause laser radiation, or the sun. This can have an unwanted effect on the accuracy of the camera. It can also cause damage to the detector in the camera.
- Do not use the *Workswell Thermal Vision* system in temperatures more than +45°C (+122°F). High temperatures can cause damage to the camera.
- Do not apply solvents or equivalent liquids to the control unit, the cameras, the cables, or other items. Damage to the items can occur.
- Be careful when you clean the infrared lens. The lens has an anti-reflective coating which is easily damaged. Do not use too much force to clean the infrared lens. This can cause damage to the anti-reflective coating.
- The encapsulation rating is only applicable when all the openings on the all components of the system are sealed with their correct covers, hatches, or caps. This includes compartments for data storage, batteries, and connectors.

2 Standard Package Content

Package Content

Inside the *Workswell Thermal Vision Light* package you will find following items:

- Thermal imaging camera with USB3 and AV output
- Focus tool (for thermal imaging camera)
- USB 3.0 A-microB cable
- micro USB 3.0 power supply cable
- AV cable
- Quick Start Guide
- Download Card

Dowload Card

The Download Card gains the cardholder access to dowload the relevant documents, including the user manual in electronic form, and software on the website www.workswell.eu.

3 User Information

Typographic Conventions	Following typographic conventions are used in this User Manual: ▪ UPPER CASE is used for the names of keys, buttons and menu items ▪ `COURIER` is used for filenames and paths ▪ *Italic* is used for important information and document names ▪ **bold** is used for the links to other sections, for function names or internet sites
Help and Community Forum	For technical questions that were not answered in this User Manual feel free to contact your dealer or visit the product website at **http://www.drone-thermal-camera.com.**Try to find an answer by searching the Community Forum and if there is not such answer please send an email on **info@workswell.cz.**
Updates	The primary aim of Workswell s.r.o. company is to supply their products in a way to meet the current needs of its users and at the same time to remove all the weaknesses that were found in their use as soon as possible. For this reason, Workswell s.r.o. regularly releases updates for all their products.
Firmware	Firmware is the „internal“ control program of the device. From the user's point of view, only the current version of the firmare that is loaded in the device at the time of use is essential.

4 Help and FAQ

General Instructions

While looking for a solution of any technical problem we recommend following these steps:

- try to find an answer by searching this User Manual
- contact your dealer,
- search Workswell s.r.o. website at **http://www.drone-thermal-camera.com**,
- send an email to **info@workswell.cz**.

5 System Assembly

General Description

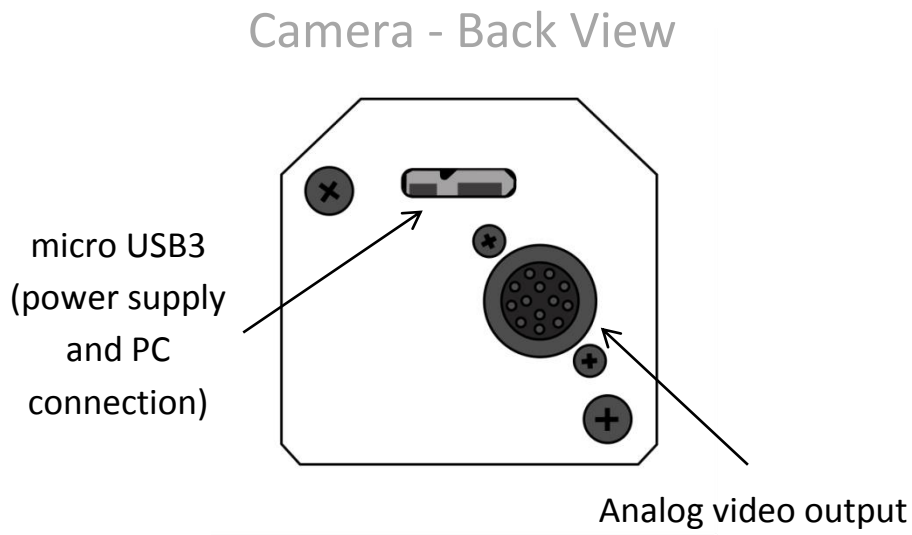
The *Workswell Thermal Vision Light* system consists of several parts. The system has to be assembled prior the first use. We recommend to check the system prior to any further use.

Follow these steps to comission the system:

1) Connect the camera to PC (for changing the camera configuration)

OR

2) Connect the camera to TV or AV transmitter
3) Connect the camera to power supply



Connecting the camera to a PC

The thermal imaging camera is connected to the PC using USB 3.0 A-microB cable, which is supplied. The camera can be connected to any USB 3.0 (fast) port on the computer. The USB 3.0 port serves as a power supply too, so there is no need to use any additional power supply.

The camera can be configured via CorePlayer application which is designed to make the camera settings as easy as possible. CorePlayer also shows a data from the camera in real time. CorePlayer can be downloaded at:

http://www.workswell.eu/CorePlayer

More information about the camera configuration procces can be found in **CorePlayer – Camera settings** section.

Connecting the camera to a TV or AV transmitter

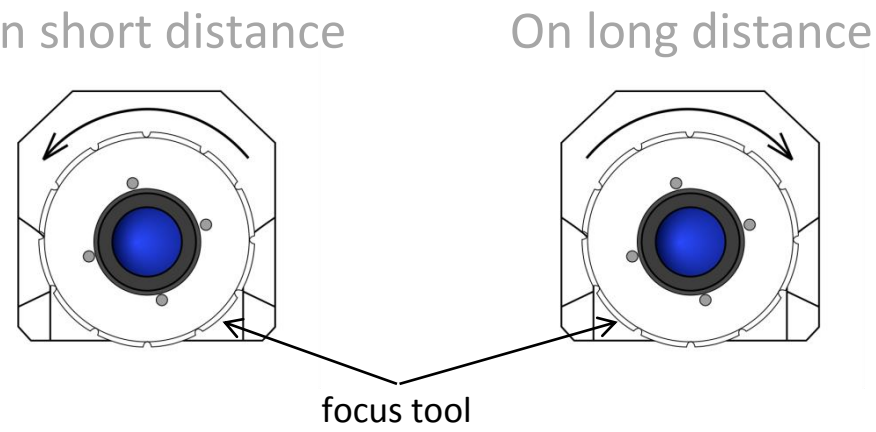
The thermal imaging camera is equipped with an analog video output. Using AV cable which is supplied, the camera can be connected to any TV or analog video transmitter with RCA (cinch) connector input.

Connecting the camera to a power supply

The camera is powered by +5V DC via micro USB 3.0 connector which is located on the rear of the camera. It is possible to use the supplied USB3 A-microB cable that can be plugged into a standard PC USB port or into a 5V adapter with USB output. Another option is to use the supplied micro USB3 cable with a pair of wires on the other end. The black wire is connected to the ground (GND), the red wire to +5V DC.

Focusing the thermal imaging camera

The infrared camera has adjustable focus. The focus can be set using the supplied focus tool.

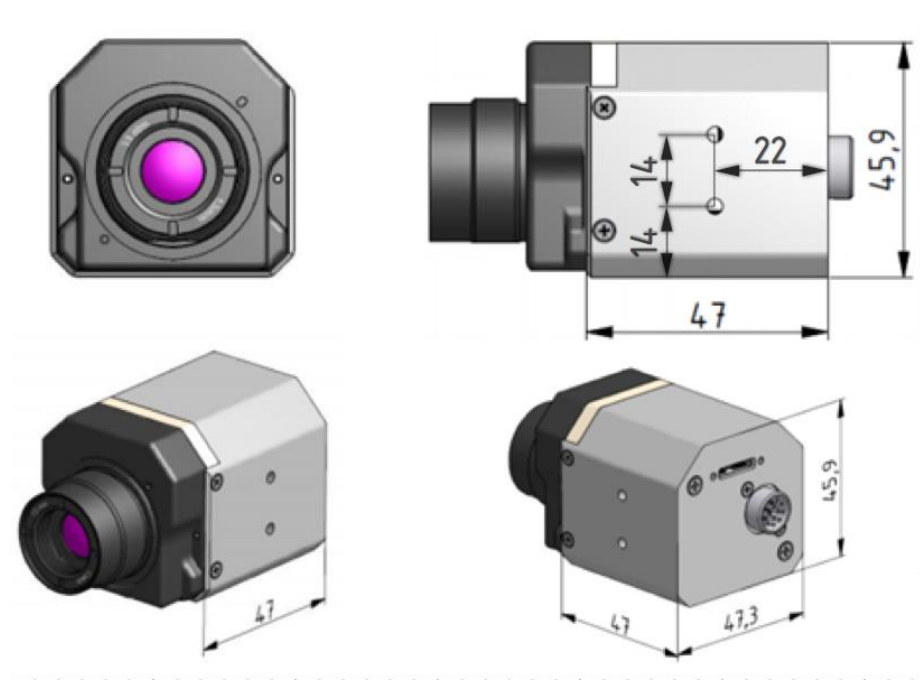


In order to focus on short distance gently rotate the lens counterclocwise. During this movement, the lens extends from the camera body. If the lens can rotate too easily, you probably get on the edge of the focus range. Trying to rotate the lens more may cause the lens to fall out.

In order to focus on long distance (or infinity) gently rotate the lens clocwise. During this movement, the lens retracts to the camera body. If the lens can rotate too hard, you probably get on the edge of the focus range. Trying to rotate the lens more may cause the lens to damage. Infinity focus is recommended for most of the applications.

Mounting the thermal imaging camera

The thermal imaging camera can be mounted to the drone using the 4 threaded mounting holes M3x6. Mounting holes are located on the left/right of the case.



6 CorePlayer – Camera Settings

General Info

The thermal imaging camera offers a variety of palettes and alarm (security) modes which can be set before take off. All camera settings can be done via PC with Workswell CorePlayer software installed. Workswell CorePlayer software can be also used for real-time scan and data evaluation, since the data are sent directly to the CorePlayer when the camera is connected.

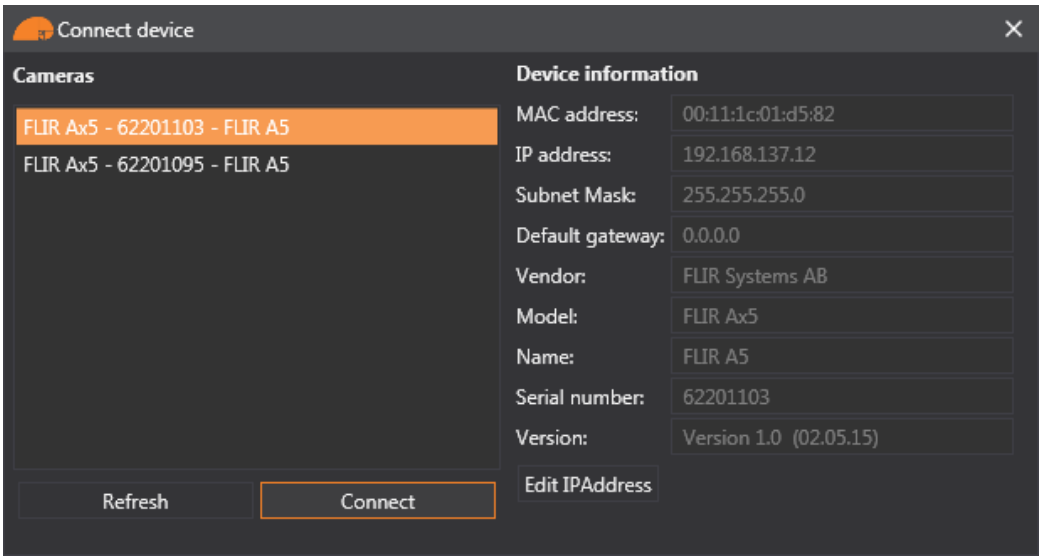
In order to install Workswell CorePlayer software please follow the *Install Guide – CorePlayer.pdf*

http://www.workswell.eu/documents/

More information about CorePlayer can be found in *User Manual – CorePlayer.pdf*.

Connecting the camera

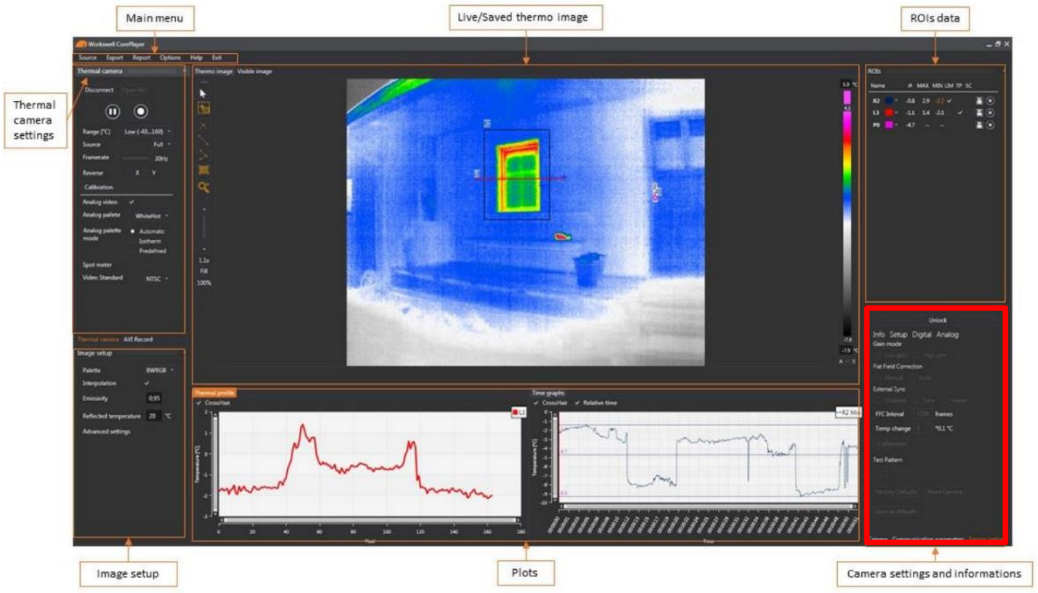
Click CONNECT CAMERA to choose camera device which you want to connect. Following dialog will be shown. Select camera and click CONNECT.



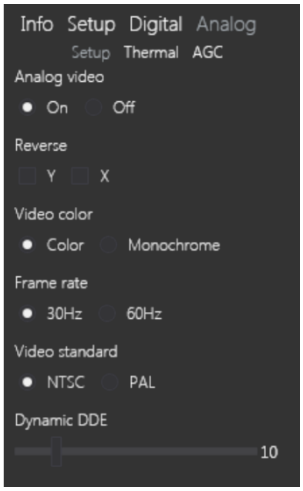
First time the camera is connected, authentification dialog window will appear. Please follow the instructions in *User Manual – CorePlayer.pdf*.

Setting the analog video

When the camera is successfully connected to Workswell CorePlayer Software, many options become available. Analog Video Setup is the most important section because it allows you to set the camera behavior before take off. Analog Video setups takes place in the bottom right corner of the screen.



Analog Video Setup consists of three tabs – SETUP, THERMAL and AGC.

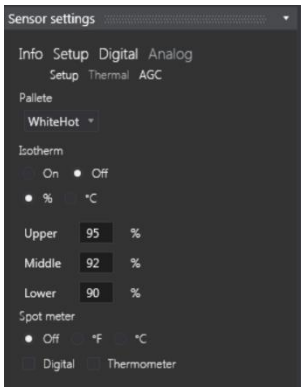


SETUP

- On/Off Analog video
- Reverse video
  - Upside down (X), Leftside right (Y)
  - Affects digital output
- Video color
  - Color/Monochrome
- Frame rate
  - Doubles framerate – 25/50Hz, 30/30Hz
- Video standard
  - NTSC/PAL
  - FFC should be execute afterward
- Dynamic DDE
  - Digital-data-enhacement algorithm which can be used to enhance image details and/or suppress fixed pattern noise
  - DDE parameters are computed automatically based on scene contents. DDE index (which supplants the spatial-threshold parameter used in the manual algorithm) is the only controlling parameter and ranges from 0 to 63, with higher values representing higher degrees of detail enhancement.

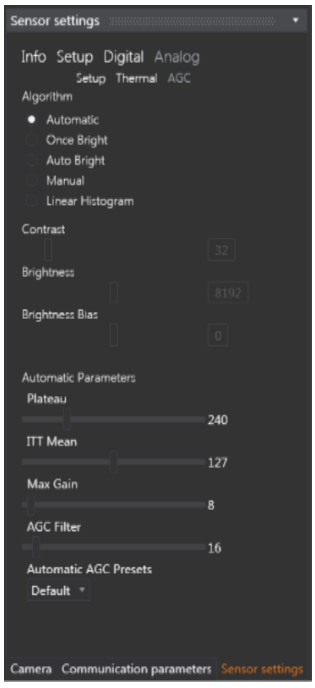
- If no enhacement is desired, the value should be set to 17.
- Values less than 17 soften the image and filter fixed pattern noise.
- Values greater than 17 sharpen the details in the image.

THERMAL



- **Palette**
  - Changes color palette
  - Color depends on isotherm setup
- **Isotherm**
  - Portions of the scene exceeding a user-selectable threshold are mapped to different portions of the palette
  - Three user-specified thresholds are applicable to the isotherm mode.
  - Specified either in degrees Celsius (°C) or in percentage (%) of full-scale
  - Upper threshold above which pixels will be mapped to the top shades of the palette (224 to 255)
  - Middle threshold pixels with value between the middle and upper threshold are mapped to shades 176 to 223.
  - Lower threshold pixels with value between the lower and middle threshold are mapped to shades 128 to 175
- **Spot meter**
  - Temperature-measurement capability via a spot meter in the central 4x4 area.
  - Accuracy of the spot meter is ±20 °C in high-gain state and the greater of ±20% or ±20 °C in low-gain state
  - Can be shown as Digital numeric value and/or thermometer-style gauge.
  - The numeric indicator and gauge can be shown in degrees Celsius (°C) or Fahrenheir (°F)

AGC



- The camera provides multiple AGC algorithms used to transform 14-bit data to 8-bit.
- Not available in isotherm mode.
- **Algorithm**
  - **Automatic**
    - Automatic parameters adjustable
  - **Once Bright**
    - Contrast adjustable
  - **Auto Bright**
    - Contrast, Brightness Bias and AGC Filter adjustable
  - **Manual**
    - Contrast and Brightness adjustable
  - **Linear Histogram**
    - ITT Mean, Max Gain and AGC Flter adjustable

- **Contrast**
  - Image contrast
- **Brightness**
  - Image brightness
- **Brightness bias**
  - Once Bright mode only
- **Automatic parameters**
  - Plateau
    - When plateau valu eis set high, the algorithm approaches the behavior of classic histogram equalization – gray shades are distributed proportionally to he cumulative histrogram, and more gray shades will be devoted to large areas of similar temperature in a given scene. On the other hand, when plateau value is set low, the algorithm behaves more like a linear AGC algorithm – there is little „compression“ in the resulting 8-bit histogram.
  - ITT Mean
    - The ITT Midpoint can be used to shift the 8-bit histogram darker or brighter. The nominal value is 128. A lower value causes a darker image. A darker image can help improve the perceived contrast, but it is important to note that more of the displayed image may be railed (8-bit value = 0 or 255) by moving the midpoint away from 128.
  - Max Gain
    - For scenes with high dynamic range (that is, wide 14-bit histrogram), the maximum gain parameter has little effect. For a very bland scene, on the other hand, it can significantly affect the contrast of the resulting image.
  - AGC Filter
    - The IIR filter is used to adjust how quickly the AGC algorithm reacts to a change in scene or parameter value.
  - Automatic AGC Presets
    - These presets apply only to the Automatic AGC algorithm and set predefined values that are stored in the GUI for Plateau Value, ITT Mean, and Max Gain. These presets have been empirically determined for different scenarios. These settings are intended to be used as guidelines and are not guaranteed to be the optimum values for any particular scenario. It is recommended to fine-tune settings for preference and scene conditions.

7 Enviroment Conditions

Enviroment Conditions

You should follow these storage and operating conditions for proper function of the *Workswell Thermal Vision Light* system:

Operation temperature range	from -15°C to +50°C
Storage temperature range	from -30°C to +60°C
Humidity	5-95%, non-condensing
Maximum irradiance	100W/cm^2

If you use the product in coflict with these conditions, damage to the *Workswell Thermal Vision* system can occur.

8 Infrared camera warp-up

General description

Modern infrared cameras are based on a sensor (microbolometer array) that needs to be warmed-up to the working temperature before it can be used. The sensor starts warming-up automatically when you connect the infrared camera to the power supply. The infrared camera is usually ready in less than 5 minues.

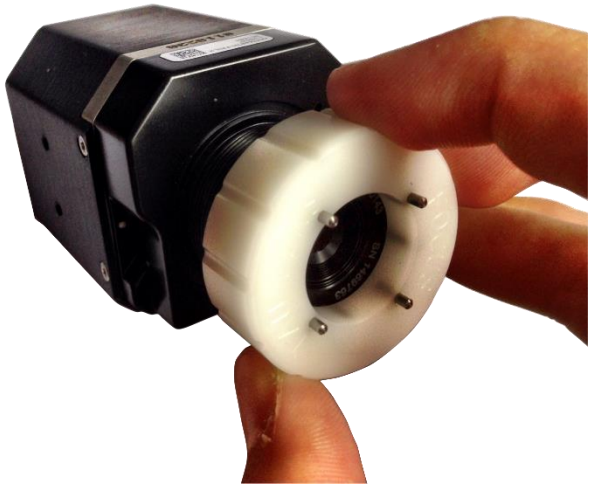
During the warm-up proces the accuracy of the measured temperature data is lower and various defects can appear in the thermal image. Therefore, we recommend to let the infrared camera warm before using it.

9 Infrared lens replacement

Lens replacement

Follow these stept when replacing infrared lens:

1) Use the focus tool to unscreew the lens counterclockwise.



2) Perform lens replacement pointing the lens pointing downwards. This prevents the dirt settlement on infrared chip. Never point infrared camera without lens to any light source.

Be careful when you replace the infrared lens. The lens has a delicate anti-reflective coating.

In order to retracts the lens back to the camera body gently rotate the lens clocwise. If the lens can rotate too hard, you probably get on the edge of the focus range. Trying to rotate the lens more may cause the lens to damage.

10 Maintanance

Cleaning the camera housing and cables

Liquids:

Use one of these liquids:

- Warm water
- A weak detergent solution

Equipment:

A soft cloth

Procedure:

1) Soak the cloth in the liquid.
2) Twist the cloth to remove excess liquid.
3) Clean the part with the cloth.

Cleaning the infrared lens

Liquids:

Use one of these liquids:

- A commercial lens cleaning liquid with more than 30% isopropyl alcohol.
- 96% ethyl alcohol (C_2H_5OH)
- DEE (= „ether“ = diethylether, $C_4H_{10}O$)
- 50% acetone (= dimethylketone, $(CH_3)_2CO$)) + 50% ethyl alcohol (by volume). This liquid prevents drying marks on the lens.

Equipment:

Cotton wool

Procedure:

4) Soak the cotton wool in the liquid.
5) Twist the cotton wool to remove excess liquid.
6) Clean the lens one time only and discard the cotton wool.

Warning:

Make sure that you read all applicable MSDS (Material Safety Data Sheets) and warning labels on containers before you use a liquid: the liquids can be dangerous.

Caution:

- Be careful when you clean the infrared lens. The lens has a delicate anti-reflective coating.
- Do not clean the infrared len stoo vigorously. This can damage anti-reflective coating. Re-applying antireflective coating is not possible and is required to change the lens.