optris® PI LightWeight Kit

Miniature lightweight PC with IR camera for flight applications

Operators manual

optris
infrared thermometers

CE-Conformity

The product complies with the following standards:

EMC:	EN 61326-1:2006 (Basic requirements) EN 61326-2-3:2006
Safety Regulations:	EN 61010-1:2001

The product accomplishes the requirements of the EMC Directive 2004/108/EG and of the Low Voltage Directive 2006/95/EG.

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Read the manual carefully before the initial start-up. The producer reserves the right to change the herein described specifications in case of technical advance of the product. References to other chapters are marked as [► ...].

Warranty

Each single product passes through a quality process. Nevertheless, if failures occur please contact the customer service at once. The warranty period covers 24 months starting on the delivery date. After the warranty is expired the manufacturer guarantees additional 6 months warranty for all repaired or substituted product components. Warranty does not apply to damages, which result from misuse or neglect. The warranty also expires if you open the product. The manufacturer is not liable for consequential damage or in case of a non-intended use of the product.
If a failure occurs during the warranty period the product will be replaced, calibrated or repaired without further charges. The freight costs will be paid by the sender. The manufacturer reserves the right to exchange components of the product instead of repairing it. If the failure results from misuse or neglect the user has to pay for the repair. In that case you may ask for a cost estimate beforehand.

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Description

Thank you for choosing the optris PI LightWeight Kit!
The optris PI LightWeight Kit consists of a miniaturized lightweight PC (PI NetBox LW) and a weight-optimized optris PI400 LW or PI450 LW infrared camera. With 380 g the system is ideally suited for radiometric infrared recordings from the air like for maintenance work and quality inspections of solar and wind power systems and for building thermography.
The PI NetBox LW (Miniature-PC) includes a Windows XP Professional operating system that allows on-flight recording of infrared videos with up to 35 Hz.
The optris PI400 LW or 450 LW calculates the surface temperature based on the emitted infrared energy of objects **[► Basics of Infrared Thermometry]**. The two-dimensional detector (FPA - focal plane array) with 382 x 288 pixels allows a measurement of an area which will be shown as thermal image using standardized color palettes. The radiometric processing of the picture data enables the user to do a comfortable detailed analysis with the software PI Connect after flight.

Scope of Supply

- PI NetBox LW (LightWeight) incl. micro SDHC card (8 GB)
- Power supply (100-240 VAC / 24 VDC)
- Power cable (with open ends for direct connection to a Lithium battery)
- Video adapter cable
- Ethernet cable, 1 m
- USB Recovery stick (2 GB)
- optris PI400 LW or PI450 LW (LightWeight) with one lens and fixed mounted USB cable (30 cm)
- Software PIConnect
- Operators manual

Important Notes

- The optris PI is a precise instrument and contains a sensitive infrared detector and a high-quality lens. The alignment of the camera to intensive energy sources (high power laser or reflections of such equipment, e.g.) can have effect on the accuracy of the measurement or can cause an irreparable defect of the infrared detector.
- Avoid static electricity, arc welders, and induction heaters. Keep away from very strong EMF (electromagnetic fields).
- Avoid abrupt changes of the ambient temperature.
- In case of problems or questions which may arise when you use the infrared camera, please contact our service department.

Cleaning

The housing of the NetBox LW can be cleaned with a soft, humid tissue moistened with water or a water based cleaner.

PLEASE NOTE: Never use cleaning compounds which contain solvents. Take care that no moisture infiltrates into the housing.

Lens cleaning

Blow off loose particles using clean compressed air. The lens surface can be cleaned with a soft, humid tissue moistened with water or a water based glass cleaner.

Take care that no foreign substances penetrate into the venting slots of the NetBox LW.

Technical Data NetBox LW

General Specifications

Operating temperature	0...50 °C
Storage temperature	-20...75 °C
Relative humidity	10...95 %, non condensing
Material (housing)	Anodized aluminum
Dimensions	112 mm x 58 mm x 54 mm (L x W x H)
Weight	160 g
Vibration	IEC 68-2-6: 3G, 11 – 200 Hz, any axis
Shock	IEC 68-2-27: 50G, 11 ms, any axis
Operating system	Windows XP Professional

Electrical Specifications

Power supply	8...48 VDC or Power over Ethernet (PoE/ 1000BASE-T)
Power consumption	9,5 W (+ additional 2,5 W for PI camera)
Cooling	passive (active via integrated fan for ambient temperatures > 50 °C
Board	COM Express mini embedded board
Processor	Intel® Atom™ Z530/ 1,6 GHz
Hard disc	2 GB SSD
RAM	512 MB (DDR2, 533 MHz)
Ports	3x USB 2.0 1x Mini-USB 2.0 (slave mode) VGA/ TV_{out} Ethernet (Gigabit Ethernet)
Extensions	microSDHC card (up to 32 GB)
Additional functions	6x Status LEDs (L1-L6)

Technical Data PI 400 LW / PI 450 LW

General Specifications

Environmental rating	IP67 (NEMA-4)
Ambient temperature	0...50 °C [PI 400 LW] / 0...70 °C [PI 450 LW]
Storage temperature	-40...70 °C [PI 400 LW] / -40...85 °C [PI 450 LW]
Relative humidity	10...95 %, non condensing
Material (housing)	aluminum, anodized/ plastic
Dimensions	46 x 56 x 84 - 88 mm (depending on lens)
Weight (incl. lens)	220 g
Cable length (USB 2.0)	30 cm
Vibration	IEC 68-2-6: 3G, 11 – 200Hz, any axis
Shock	IEC 68-2-27: 50G, 11ms, any axis

Electrical Specifications

Power Supply	5 VDC (powered via USB 2.0 interface)
Current draw	max. 500 mA
Digital interface	USB 2.0

Measurement Specifications

Temperature ranges	-20...100 °C; 0...250 °C; 120...900 °C
Detector	UFPA, 382 x 288 pixels
Spectral range	7.5...13 µm
Lenses (FOV)	38° x 29°; 62° x 49°
System accuracy [1)]	±2 °C or ±2 %

[1)] At ambient temperature 23±5 °C; whichever is greater

Temperature resolution (NETD)	PI 400 LW [1]: 0,08 K with 38° and 62°; 0,1 K with 13°
	PI 450 LW [1]: 0,04 K with 38° and 62°; 0,06 K with 13°
Frame rate	80 Hz
Emissivity	0,100...1,000 (adjustable via software)
Software	PI Connect

Optical Specifications

For the PI 400 LW and PI 450 LW two different lenses are available: 38° x 29° and 62° x 49° FOV. Different parameters are important if using infrared cameras. They display the connection between the distance of the measured object and the size of the pixel (please see table at the end of this section).

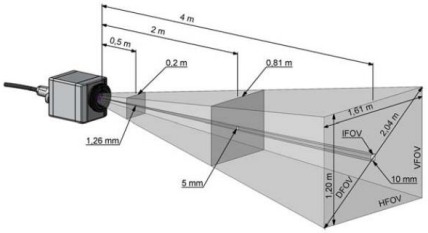
Note
Please make sure that the focus of the infrared camera is adjusted correctly. For focusing please turn the lens.

[1] Value is valid at 40 Hz and 25°C room temperature

PI400/450 382 x 288 px	Focal length	Angle	Minimum distance*	Distance to object [m]												
					0.02	0.1	0.2	0.3	0.5	1	2	4	6	10	30	100
O38 Standard lens	15 mm	38°	0.2 m	HFOV [m]	0.014	0.07	0.14	0.21	0.35	0.69	1.39	2.77	4.16	6.9	20.8	69.3
		29°		VFOV [m]	0.010	0.05	0.10	0.15	0.25	0.51	1.02	2.03	3.05	5.1	15.2	50.8
		49°		DFOV [m]	0.018	0.09	0.18	0.28	0.46	0.92	1.84	3.68	5.52	9.2	27.6	92.0
		1.81 mrad		IFOV [mm]	0.036	0.18	0.36	0.54	0.91	1.81	3.63	7.25	10.88	18.1	54.4	181.3
O62 Wide angle lens	8 mm	62°	0.5 m	HFOV [m]	0.024	0.12	0.24	0.36	0.60	1.20	2.40	4.80	7.20	12.0	36.0	119.9
		49°		VFOV [m]	0.018	0.09	0.18	0.27	0.45	0.90	1.80	3.60	5.41	9.0	27.0	90.1
		74°		DFOV [m]	0.030	0.15	0.30	0.45	0.75	1.50	3.00	6.00	8.99	15.0	45.0	149.9
		3.14 mrad		IFOV [mm]	0.063	0.31	0.63	0.94	1.57	3.14	6.28	12.56	18.84	31.4	94.2	314.0

Table with examples showing what spot sizes and pixel sizes will be reached in which distance. For individual configuration there are different lenses available. Wide angle lenses have a radial distortion due to their large opening angle; the software PIConnect contains an algorithm which corrects this distortion.
**Note: The accuracy of measurement can be outside of the specifications for distances below the defined minimum distance.*

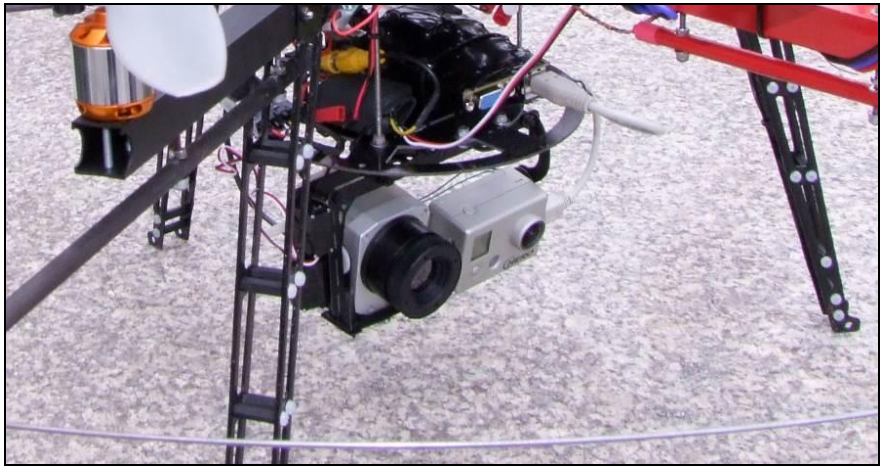
- **HFOV**: Horizontal enlargement of the total measuring field at object level
- **VFOV**: Vertical enlargement of the total measuring field at object level
- **IFOV**: Size of the single pixel at object level
- **DFOV:** Diagonal dimension of the total measuring field at the object level
- **MFOV**: Recommended, smallest measured object size of 3 x 3 pixel



Measurement field of the optris PI representing the 23° x 17° lens

Installation

The PI 400 LW/ 450 LW are equipped with two metric M4 thread holes on the bottom side (6 mm depth) and can be installed either directly via these threads or with help of the tripod mount (also on bottom side).
The separate PI camera sensing head can be mounted on the stabilization platform of a drone together with a visual camera (in the picture: GoPro camera). The NetBox PC can be mounted separate.

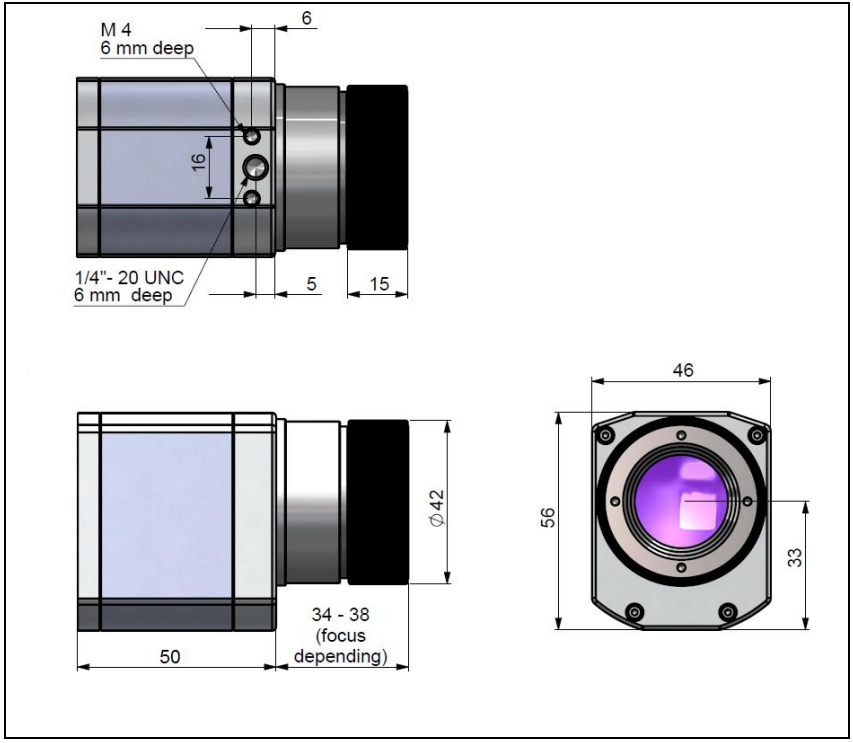


Installation PI LightWeight on a drone together with GoPro HD camera

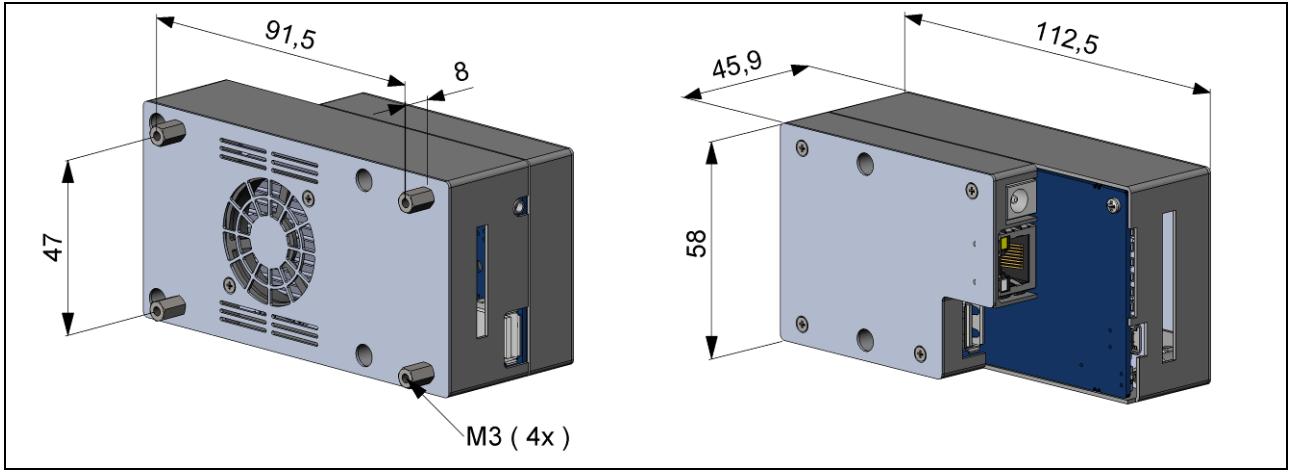
The IR camera PI4xx LW will be delivered in an alu case; the NetBox LW incl. accessories will be delivered in a slider carton box. ► **Scope of Supply**
For a mobile use you can arrange all components of the system also inside the camera case as shown in the below picture. Single foam parts of the case can be easily removed for that purpose.

Arrangement of the PI LightWeight kit inside the camera case

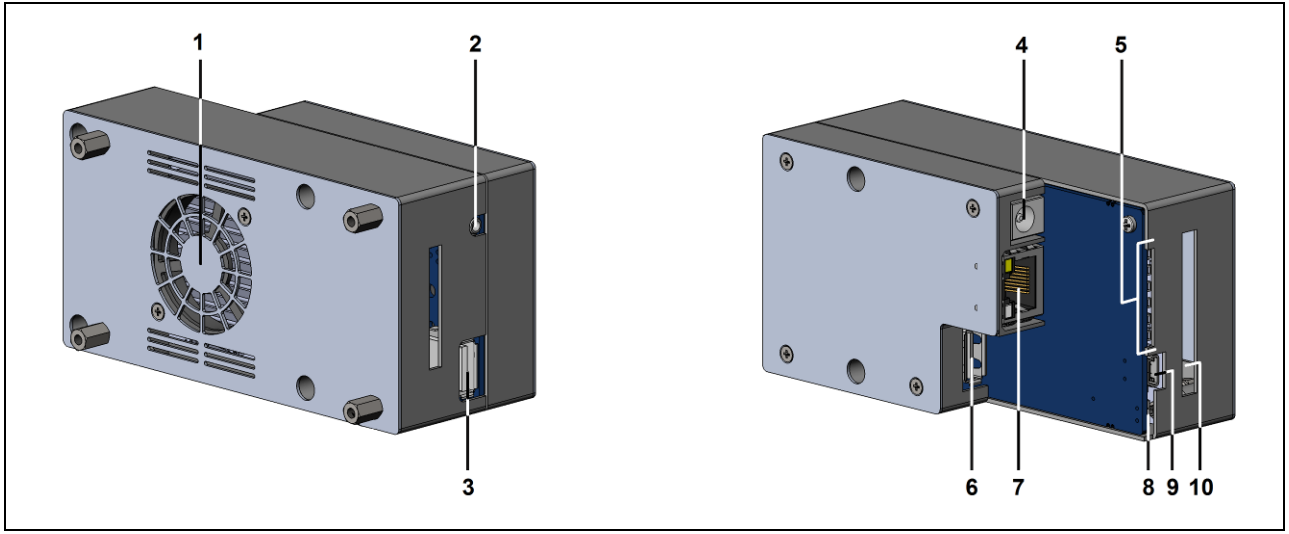
Dimensions PI 400 LW/ PI 450 LW



Dimensions PI NetBox LW



Controls and Connections

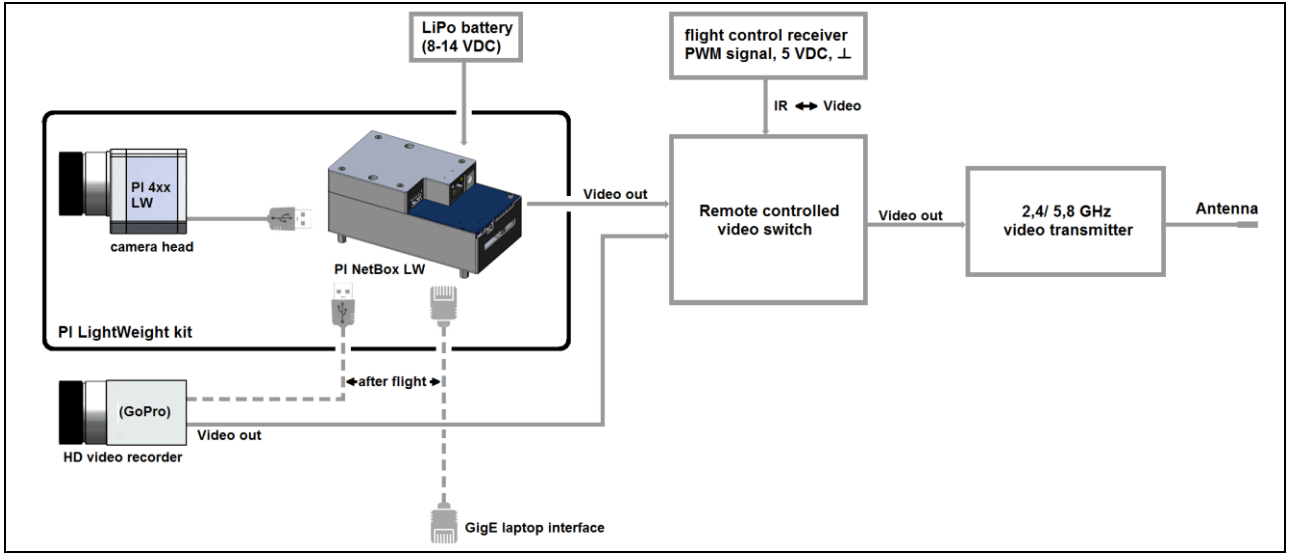


1	**Cooling fan**	**6**	**USB 2.0 socket**
2	**Video$_{out}$ socket**	**7**	**Ethernet socket**
3	**USB 2.0 socket**	**8**	**Mode switch (S1/ S2)**
4	**Power supply socket**	**9**	**Mini USB socket (slave mode)**
5	**Status-LEDs (L1-L6)**	**10**	**microSDHC card slot**

Operation

Stand-alone Operation

As a stand-alone PC the NetBox LW expands the IR cameras PI400 LW and PI450 LW to a system for radiometric infrared video recording. For a self-contained power supply we recommend a lithium-polymer battery with a voltage between 8 and 14 VDC.



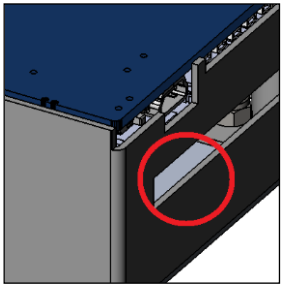
Recommended video system integration of the PI LightWeight

After powering the NetBox LW the system will boot and is ready after 2-3 minutes. A video monitor which is connected to the system will show then the IR live picture of the camera in full screen mode.

Start a Recording

At the backside of the IR camera you will find a red sliding switch. To start a recording please move the switch into the **right position**.
If you move the switch back into the left position the recording will be stopped.

SD Card



The NetBox LW will be delivered with a 8 GB SDHC card which is already installed on the unit. If required you can exchange this card. The NetBox is supporting SD cards up to **32 GB** capacity. To remove the card please take a ball pen or similar and push onto the card from outside carefully. Please take care when you insert a card that it is placed correctly into the according guide slot.

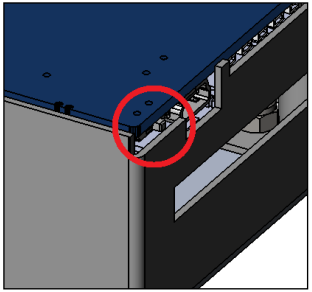
Status LEDs

The NetBox LW is equipped with 6 status LEDs (L1-L6).

LED	Function	LED lights up if…
L1	Power	NetBox is powered via PoE or by power supply (via power connector)
L2	Power out	NetBox is powered via PoE and (in this case) supplies 12V at the power connector
L3	Net data	video frames are continuously transmitted through the network connection (flashing)
L4	USB data	the imager is connected to an USB port, calibration files are loaded, and raw data frames are continuously delivered by the imager (flashing)
L5	Application OK	the main application (PIConnect or Imager Net Server) is running
L6	Mini USB port	a PC is connected to the mini USB port

Switch Positions

The mode switch is set default to S1. At position S2 the IR camera which is connected to the USB-A socket will be linked directly with the Mini-USB socket. With this you get a direct access to the IR camera from a PC which is connected to the Mini USB socket without changing cables on the NetBox LW.



Mode switch (S1/ S2)

Operation Modes of the NetBox LW

The NetBox LW can be used in three different operation modes:

1. Stand-alone operation with an IR camera (Standard mode)
2. Ethernet direct connection to a PC (point-to-point connection)
3. Ethernet communication via a network or via the internet

For powering the NetBox you can use instead of a lithium-polymer battery also the supplied power adapter. Alternatively the NetBox can also be powered via the Ethernet cable (PoE – Power over Ethernet). For this purpose a PoE injector is needed [part#: ACPIPOE].

Remote Access to the NetBox LW

For settings on the NetBox LW you can connect a keyboard and a mouse to the available USB sockets as well as a monitor to the VGA socket (or a TV monitor via the TV_{out} adapter cable).

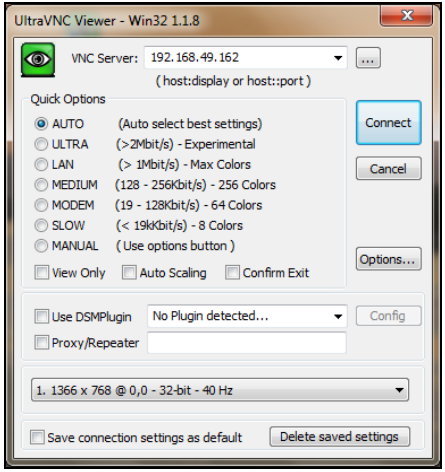
► Stand-alone Operation

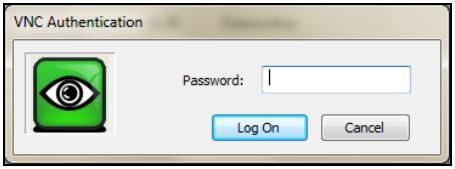
Another very simple way are remote control software, for example remote desktop (RDP) which is available on each Windows system or **Ultra VNC** which you will find on your software CD. After installation you can have access to the NetBox either from a PC directly connected over an Ethernet cable or from a PC which is located anywhere and connected to the same network. Also remote connection via the internet is possible.[1)]
To install Ultra VNC on your PC please start **install.bat** which is located on your PIConnect-CD in the folder **\PI NetBox**. After installation you will find the following short cuts on your desktop:

Please use the short cut **PI-NetBox UVNC** for access to a NetBox which is directly connected to your PC over an Ethernet cable. After starting the UVNC viewer using this shortcut you should see immediately a window which shows the screen of the NetBox.

Please use the short cut **UltraVNC Viewer** for access to a NetBox inside your network. After starting UVNC using this short cut you should see at first the following screen:

[1)] For remote access from outside to a NetBox LW connected to a company network please ask your system administrator for possibly necessary settings.



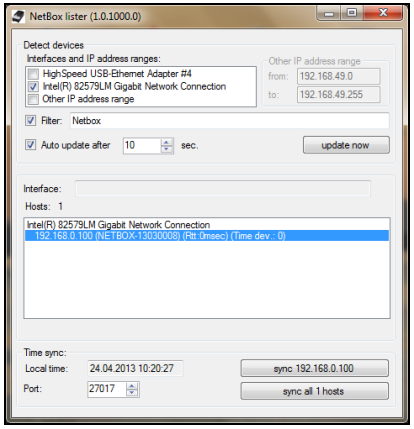


UltraVNC viewer setup

After input of the IP address of the NetBox, which in this case comes from a DHCP [1)] server, please press **Connect**. In the following screen you have to enter the password **Remote** and after this press **Log On**. Now you should see the screen of the NetBox.
In chapter ► **Ethernet Network Communication** you will find an explanation how to figure out the IP address of the NetBox.
With the UltraVNC Viewer it is possible to have *simultaneous* access to one NetBox from different PCs inside a network.

[1)] DHCP – **D**ynamic **H**ost **C**onfiguration **P**rotocol: allows the automatic integration of a computer into an existing network.

With **NetBox Lister** you can start a tool which will list all NetBoxes located in your network or directly connected to your PC. With this tool you can also do a time synchronization. You can scan either the whole network or a certain IP address range. The filter function allows a selective search for NetBoxes only.
If you press one of the **sync** buttons you can synchronize all NetBoxes simultaneously or a previously selected one with the system time of your local PC (where NetBox Lister is running).



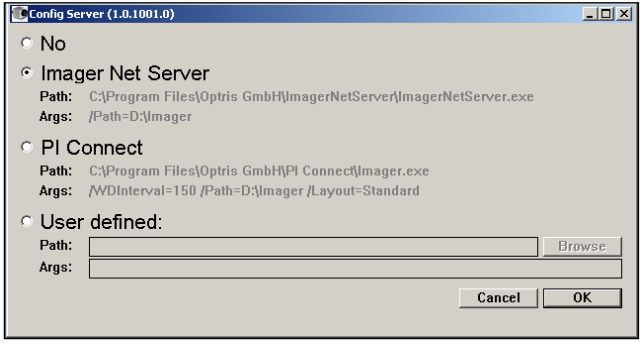
The NetBox is factory default set to Central European Time (CET or CEST).
Depending on the time zone setting of your local PC time differences after synchronizations are possible. In this case you have to change the time zone settings on the NetBox.
► **System time**

The short cut **NetBox Maintain** is synchronizing the time automatically with a directly connected NetBox and is starting then automatically the UltraVNC viewer.

Applications and Start Options

On the Desktop of the NetBox LW you will find the following short cuts:

Application Start Config starts the configuration dialog **(Config Server)**
Application Start Manager starts the program selected in the configuration dialog



In the configuration dialog you can select programs which start automatically after booting the NetBox:

No	**no automatic program start**
Imager Net Server	**automatic start of the server application**
PI Connect	**automatic start of the PI Connect**
User defined	**user defined start of one of the both programs above**

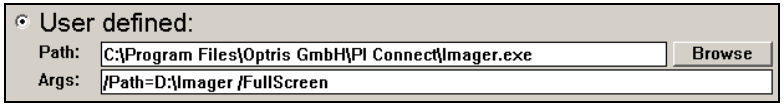
After booting the system the factory default setting of the NetBox LW starts the **PI Connect** in full screen mode with a special flight layout (Selection: **User defined** in Application Start Config).

The **Imager Net Server** application is needed for the operation modes:

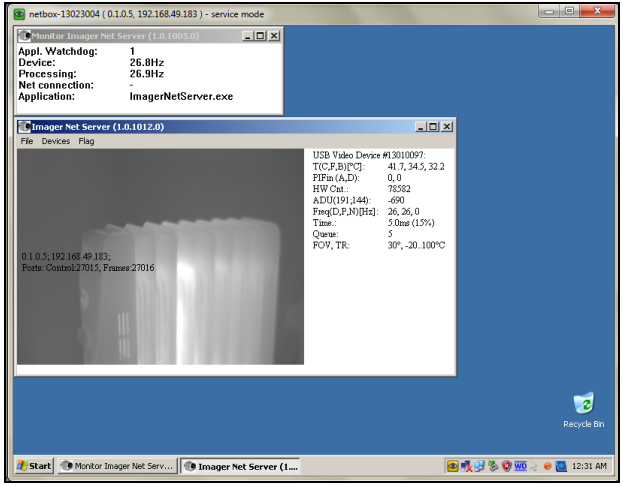
- Ethernet direct connection to a PC (point-to-point connection)
- Ethernet communication via a network or via the internet

In case you would like to start PI Connect or Imager Net Server with changed command line parameters [Args] please select **User defined**.

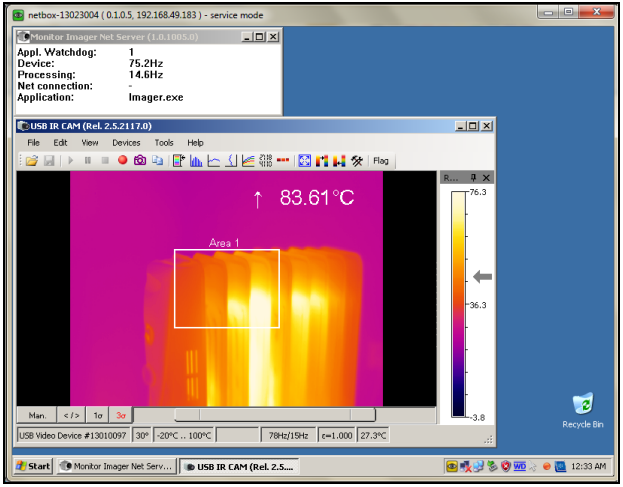
Example
The following configuration starts the PIConnect in the full screen mode:



The start options selected in the configuration dialog are saved automatically in the NetBox and are available after a restart.



Screen of the NetBox LW – Imager Net Server



Screen of the NetBox LW – PI Connect

If an imager is connected to the NetBox you should see two active applications:
Monitor Imager Net Server and **Imager Net Server** or **PI Connect**.

Appl. Watchdog	Counter for the application monitoring function
Device	Device frequency
Processing:	Processing frequency
Net connection	Network frequency
Monitor	Display mode (VGA or TV-Out)
Application	monitored software application

Information in the *Monitor Imager Net Server* – application window

Menu	**File**	**exit of the program**
	Devices	**shows the connected imager**
	Flag	**manual operation of the camera flag**

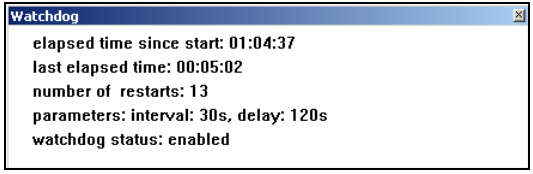
USB-Videogerät	Serial number of the connected imager device	
T (C, F, B)	Device temperatures (°C):	C: FPA-Chip
		F: Flag temperature
		B: Housing temperature
PIFin (A, D)	Status of the PIF input:	A: Analog IN (AI)
		D: Digital IN (DI)
HW Cnt.	Hardware-Counter (frame counter)	
ADU (192, 144)	ADU value of the center pixel (e.g. 192, 144 at PI4xx)	
Freq (D, P, N)	Frequency (Hz):	D: Device/ P: Processing/ N: Network
Time	Time per single frame	
Queue	Number of frames in network queue	
FOV, TR	Field of view (horizontal) of the imager lens, Temperature range	

Information in the *Imager Net Server* – application window

Watchdog

If, for any reason, the main software application (**Imager Net Server** or **PIConnect**) does not work properly (software hang-up or crash) or if the main application will be closed, the monitoring application (**Monitor Imager Net Server**) is restarting the program automatically.
In addition also the Windows operating system is monitored permanently by a watchdog application – you see the symbol [**WD**] in the right part of the task bar:

If the watchdog is recognizing a system error or problem it will restart the NetBox automatically.
If you click with the right mouse button on this symbol you can open the watchdog window:

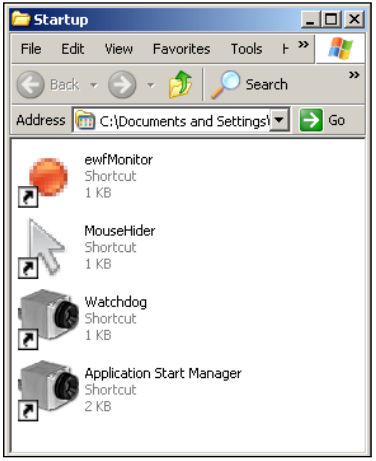


Beside a status information and internal set parameters you can see the elapsed time since you started the NetBox and also the elapsed time of the operation period before the last restart. The number of restarts can be reset (right mouse button on WD symbol – **Reset counter**).
Please note that all restarts (also not by the Watchdog initialized ones) will be counted here.

Autostart

In the Windows Autostart folder of the NetBox LW the following shortcuts are set default:

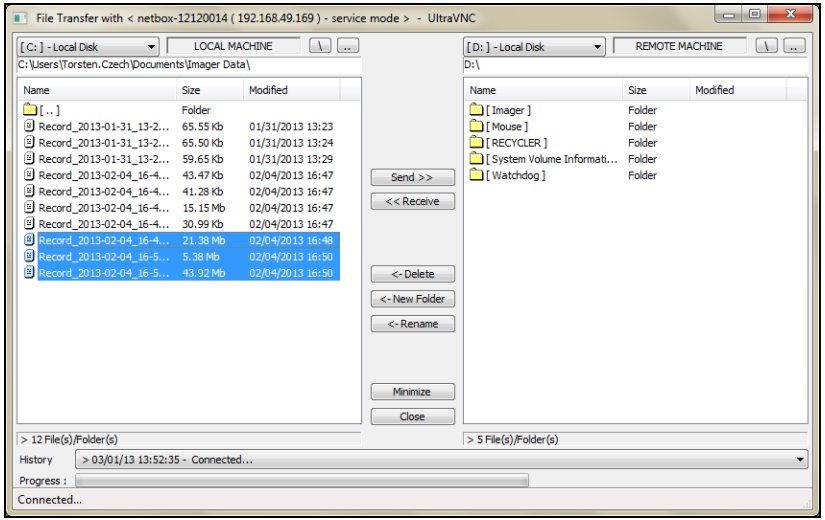
ewfMonitor	Write protection filter
MouseHider	hides the mouse pointer after 10s of inactivity
Watchdog	starts the Watchdog application
Application Start Manager	starts the program which was selected in Application Start Config



File transfer between NetBox LW and PC

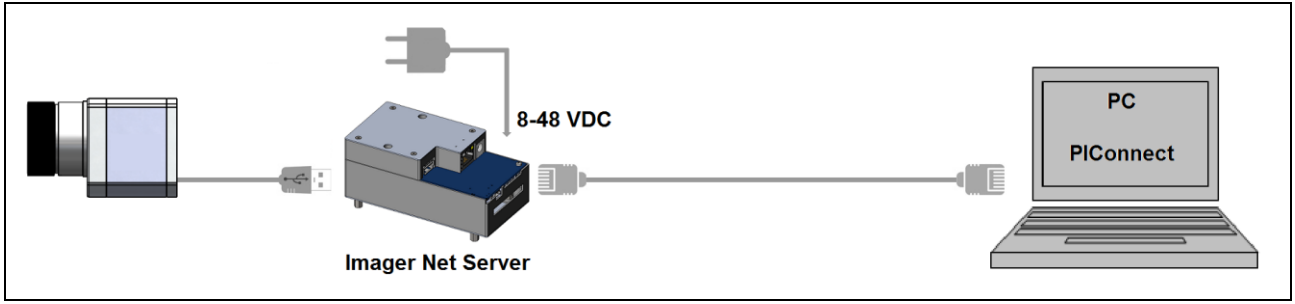
To exchange files between the NetBox and a directly connected or in the network located PC please move the cursor to the title bar of the **UltraVNC Viewer** window and press the right mouse button. Start **File Transfer**. Alternatively you can also press the following button in the tool bar:

In the following explorer window you see on the left side your local PC (LOCAL MACHINE) and on the right side the NetBox (REMOTE MACHINE). Now you can copy files between both computers via the network link by marking them and pressing **Send** or **Receive**.



Ethernet Direct Communication

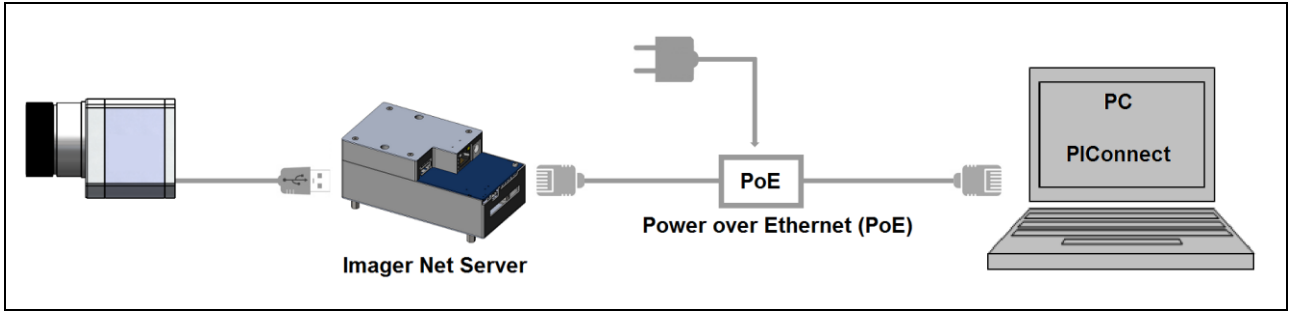
Please connect your imager with the supplied USB connection cable with the NetBox. Please connect your PC with an Ethernet cable with the NetBox. Now connect the power supply to the NetBox and to the mains. The NetBox will start to boot the system and should be ready to use after 2-3 minutes.
You can check the status with the LEDs. At proper functioning now L1 and L5 should light up.



Ethernet direct connection (point-to-point connection)/ NetBox LW powered via power supply

If you use a PoE injector the power supply for the NetBox is not needed. In this case please connect the PoE injector as shown in the drawing below. At proper functioning now L1, L2 and L5 should light up.

The used Ethernet cables should be at least category 5 cables (Cat-5 according ISO/IEC 11801).

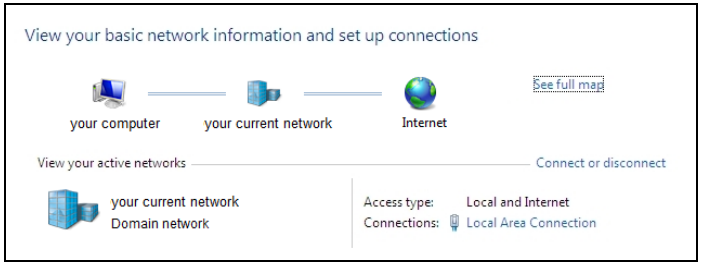


Ethernet direct connection (point-to-point connection)/ NetBox LW powered via PoE injector

Connection to the NetBox LW

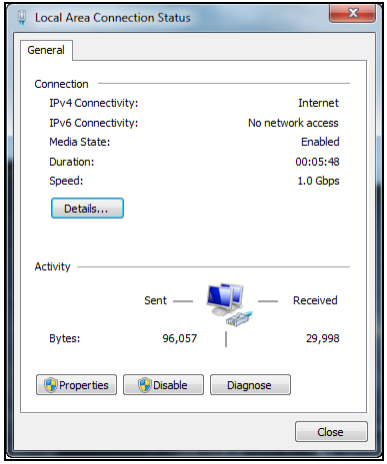
The communication with the NetBox is done via the TCP/ IP protocol (**T**ransmission **C**ontrol **P**rotocol/ **I**nternet **P**rotocol). The NetBox can get its IP address (**I**nternet **P**rotocol address) either from a DHCP server or it can work with a fixed IP address.
On a direct connection to a PC both, the NetBox as well as the PC must use a fixed IP address because no DHCP server is available here. The NetBox is using in this case the IP address **192.168.0.100**. On your PC you have to do the following settings once (depending on the operating system the procedure can differ from the here shown – the following description refers to a Windows 7 system).

1. Go to **System controls**; open **Network and Sharing Center.**
2. If you have an existing connection to a network (company network e.g.) you should see the following information:

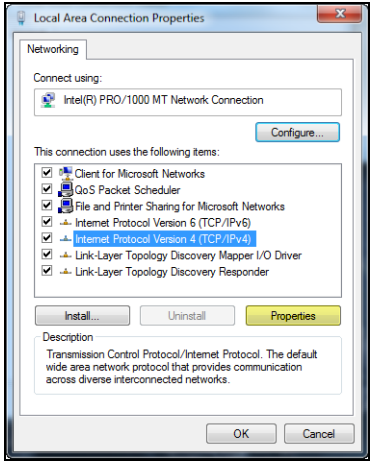


If your PC is not connected to any network, please go to **Change adapter settings** after you opened the **Network and Sharing Center**. Now go to **Local Area Connection**, right mouse button: **Properties**.
[continue at item 4]

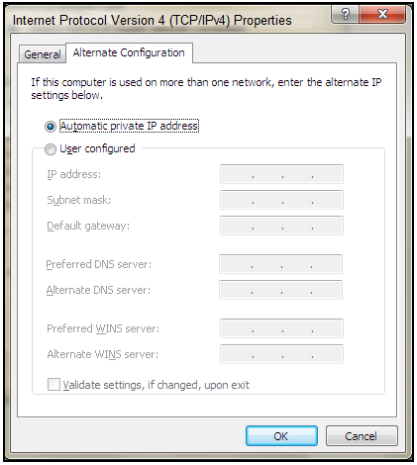
3. Go to **Local Area Connection** – a status screen according [1] will be shown. Then go to **Properties.**
4. In the following window [2] mark **Internet protocol Version 4 (TCP/IPv4)** and go again to **Properties**.



[1]



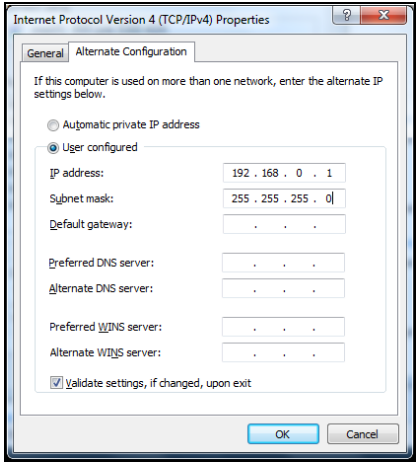
[2]



[3]

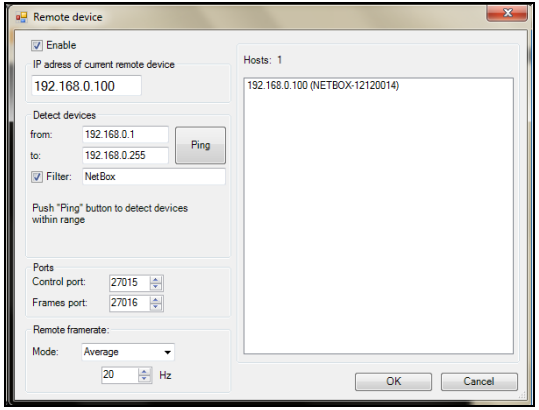
5. Please open now in window [3] the register **Alternate Configuration** and activate the checkbox **User configured**.

6. Now you can enter a user defined IP address for your PC. Please take care that the network part of the address has to be identical with the network part of the IP address of the NetBox, thus **192.168.0**. For the host part you have to use an address which is different from the one of the NetBox (100), so you may use **1** for example.

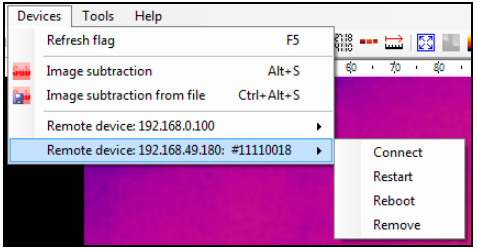


After you have made these settings and connected your PC with the NetBox using an Ethernet cable your PC will establish a point-to-point connection. This procedure can take several minutes.
In the **Network and Sharing Center** your network will now be shown up as a *non-identified network*.

Please start now the PIConnect on your PC and open the menu item **Tools/ Extended/ Remote devices...**. In the window which is appearing you should set a hook on **Enable** and enter the IP address of the NetBox (**192.168.0.100**). Press OK. The software will establish a connection to the remote device (imager) automatically.



Search for network devices in PIConnect

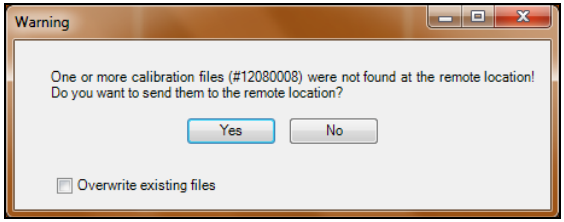


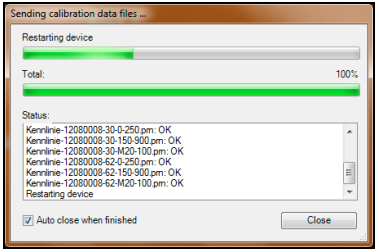
Device selection in PIConnect

Under **Remote framerate** you can enter the desired frame rate which should be transmitted via the network. Under the menu item **Devices** the imager which is connected to the NetBox shows up now. The following functions can be selected here:

Connect	**manual connection with the remote device**
Restart	**restart of the Imager Net Server application on the NetBox**
Reboot	**reboot of the NetBox**
Remove	**remove of the device entry in this menu**

If the used imager is connected for the first time to the NetBox the following message appears:

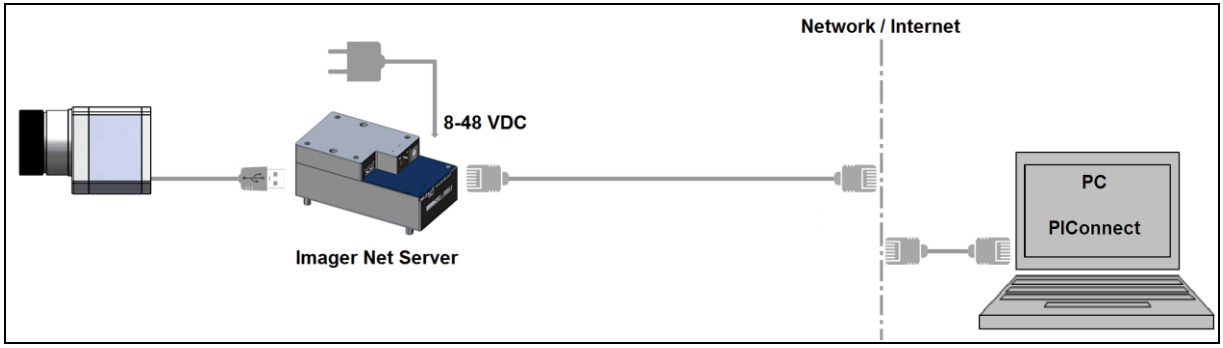




Please confirm with **Yes**. The calibration files will be transferred automatically from your PC to the NetBox and stored there. Now you should see the live picture from the imager on your PC.
Alternatively you can copy the calibration data also manually via an USB stick into the NetBox folder **D:\Imager\Cali**.

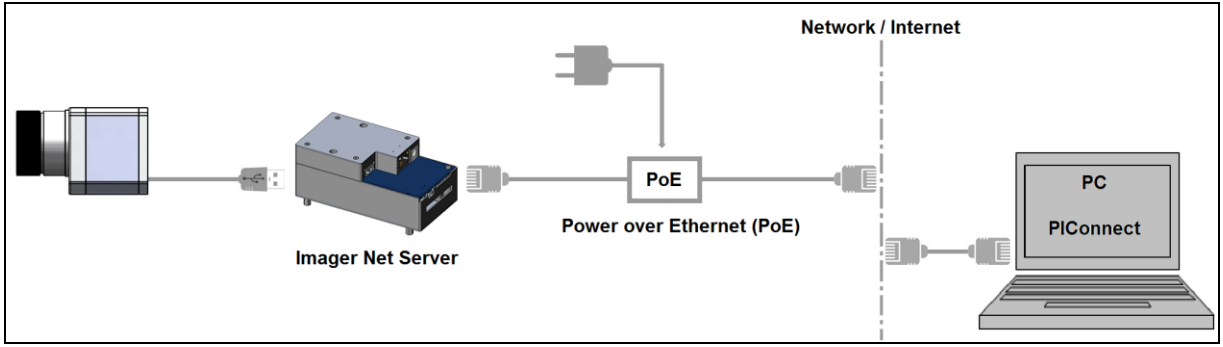
Ethernet Network Communication

Please connect your imager with the supplied USB connection cable with the NetBox. Please connect the Ethernet connection of the NetBox with a network or internet (via a router e.g.). Now connect the power supply to the NetBox and to the mains. The NetBox will start to boot the system and should be ready to use after 2-3 minutes.
You can check the status with the LEDs. At proper functioning now L1 and L5 should light up.



Ethernet network connection/ NetBox LW powered via power supply

If you use a PoE injector the power supply for the NetBox is not needed. In this case please connect the PoE injector as shown in the drawing below. At proper functioning now L1, L2 and L5 should light up.

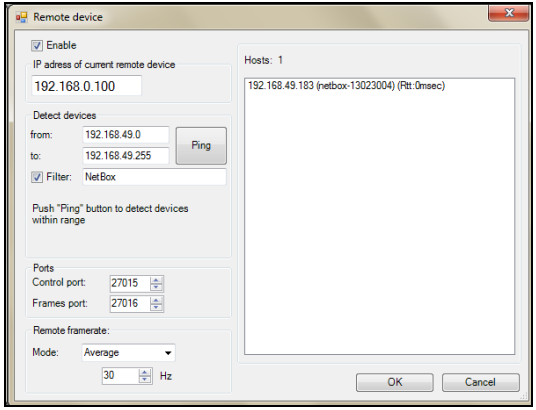


Ethernet network connection/ NetBox LW powered via PoE injector

If the NetBox is used in a network it gets its IP address from a DHCP server. In order to find the NetBox in the PIConnect of your local PC the address range of the local network must be known.
For this purpose please start the program **NetBox Lister**.

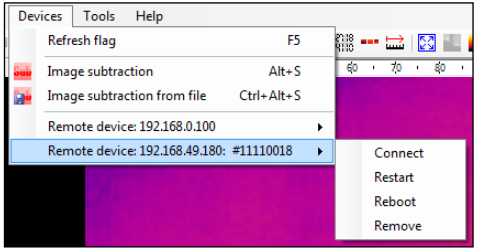
► Remote Access to the NetBox

Please start now the PIConnect on your local PC and open the menu **Tools/ Extended/ Remote devices...**. In the window which opens set a hook on **Enable** and enter the address range of your local network under **Detect devices**. The fourth block should have the range **0** to **255**. If you now press **Ping** all computers inside the selected address range will be shown.
Under **Remote framerate** you can enter the desired frame rate which should be transmitted via the network.



For a faster search you should activate the **filter** and enter *NetBox.* Now only computers with *NetBox* in their name will be shown.

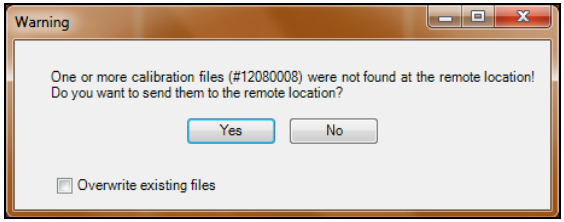
Under **Hosts** you should see now your NetBox. Please mark this and press **OK**.

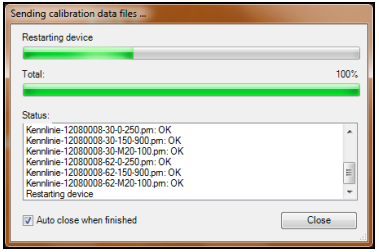


Under the menu item **Devices** the imager which is connected to the NetBox shows up now. The following functions can be selected here:

Connect	**manual connection with the remote device**
Restart	**restart of the Imager Net Server application on the NetBox**
Reboot	**reboot of the NetBox**
Remove	**remove of the device entry in this menu**

If the used imager is connected for the first time to the NetBox the following message appears:





Please confirm with **Yes**. The calibration files will be transferred automatically from your PC to the NetBox and stored there. Now you should see the live picture from the imager on your PC.
Alternatively you can copy the calibration data also manually via an USB stick into the NetBox folder **D:\Imager\Cali**.

USB Driver

The USB-IR-camera as well as USB sticks, USB keyboards or USB mouses don’t need a special device driver. System messages to new installed USB hardware devices are therefore suppressed to ensure a most comfortable use of the NetBox with the recommended standard components.

If you connect other USB devices which need a specific driver installation it might be necessary to start the installation process manually in the device manager.

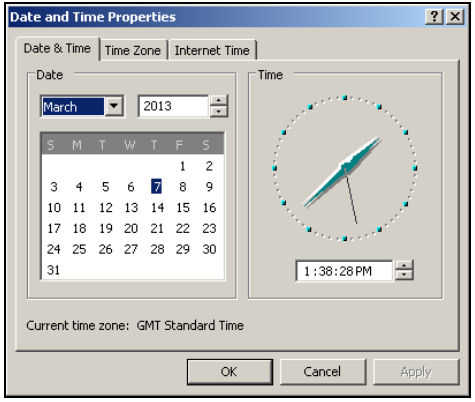
System time

The NetBox LW does not contain a CMOS battery which is normally used for keeping the system time if the computer is switched off. On the NetBox therefore the current time will be saved regularly during operation. On a restart of the NetBox the system time is proceeding automatically starting at the last saved time. With this you have a chronology of imager recordings which use an automatic file name generation.

If the NetBox has a connection to the internet, the current time will be synchronized automatically via an internet time server after a certain period.

A manual time synchronization can be done with the tools **NetBox Maintain** und **NetBox Lister** from a PC which is directly or via network connected.

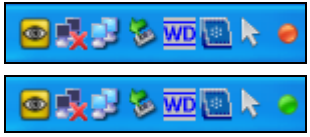
► **Remote Access to the NetBox**



You can change the set time zone in the tab **Time Zone**.
To save the new setting permanently you have to deactivate the ► **Write Protection Filter** temporarily.

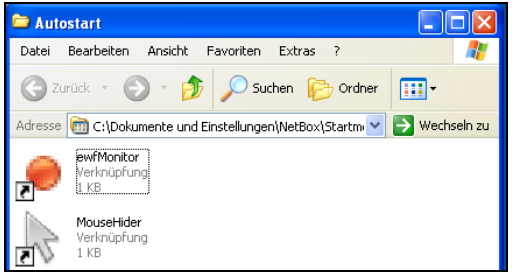
Write Protection Filter

The NetBox LW has a factory pre-installed write protection filter. This filter is protecting reliably the operating system and the complete drive C and allows a switch-off of the device without a shut down of the operating system.
The write protection filter (ewfMonitor) can be seen as shortcut in the start menu and as symbol in the task bar.
The colors have the following meaning:



red dot: **safe mode**

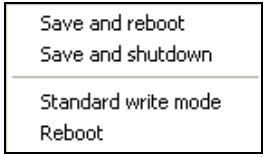
green dot: **write mode**



The NetBox should be used only with an activated write protection filter [red dot].

Write protection filter as short cut in folder Autostart

To save changed settings or if you want to install additional software the write protection has to be deactivated temporarily. To do this please move the cursor to the red dot in the task bar and push the right mouse button:



You can select between four different actions:

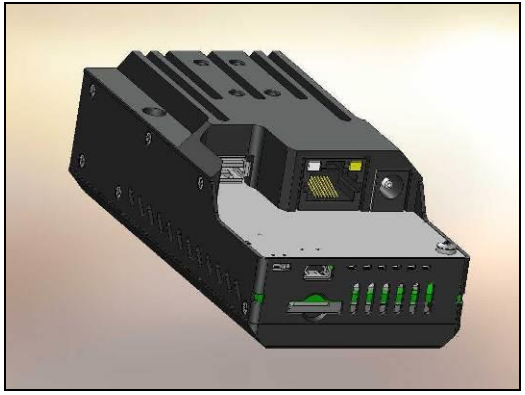
Save and reboot	**Changes will be saved + Restart**
Save and shutdown	**Changes will be saved + shut down**
Standard write mode	**Switch into the write mode (green dot)**
Reboot	**Restart without saving of changes**

The SSD drive of the NetBox has by factory default two partitions. The write protection refers to partition C only. On the partition D you can save application data. On drive D also the calibration data of the infrared imager are stored.

System Recovery

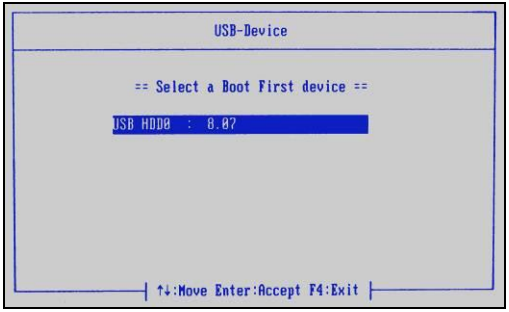
In case a recovery of the Windows operating system of the NetBox LW is necessary you should use the supplied USB recovery stick. Follow the steps described hereafter. **Do not disconnect power from the NetBox during the recovery procedure.**
After the system recovery the NetBox has the factory default settings. All data which was stored before on the SSD will get lost.

Step 1:
Please connect a VGA monitor and a USB keyboard with the NetBox. Connect the USB recovery stick to a free USB port and switch on the NetBox. If you see the following start screen please press the **ESC** button for at least **2 seconds** (keep pressed).

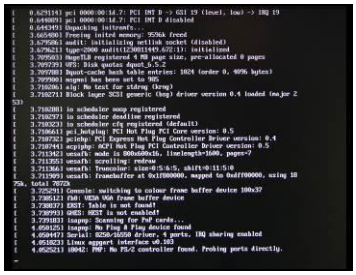


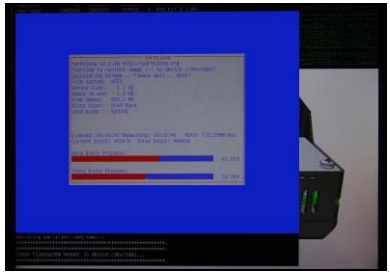
Start screen of the NetBox LW

Step 2:
Now you should see the following screen – select **USB device** and then press **Enter**.
The next screen shows the available USB stick. Please confirm with **Enter**.



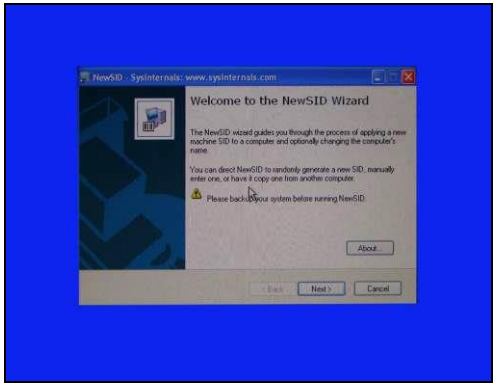
Confirm with <u>Enter</u>



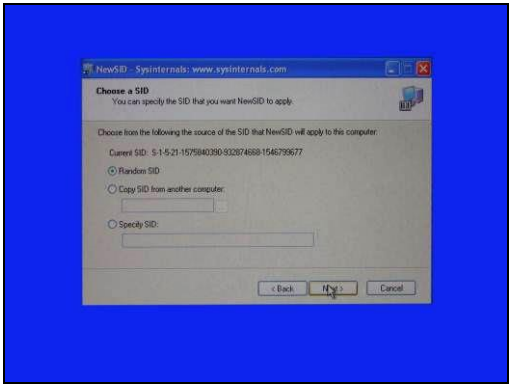


Screens during system recovery

Step 3:
After the complete system recovery the NetBox will be automatically shut down and switched off (all LEDs are off). Now you should disconnect for a short time the power (disconnect the power supply). After reconnecting power and booting of the system you should see the following message:

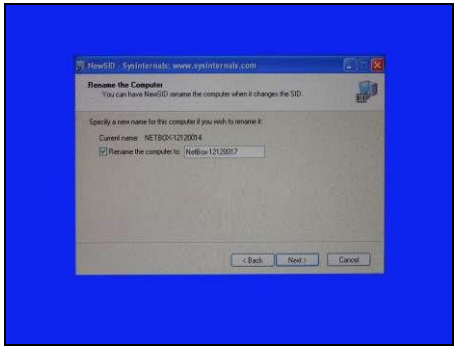


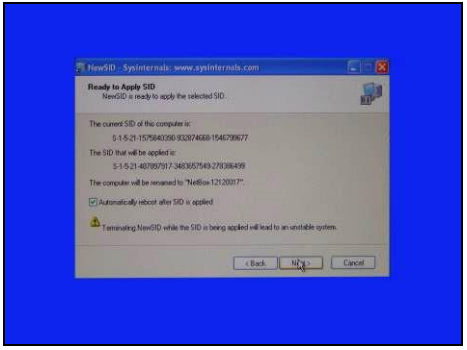
Please press <u>Next</u>



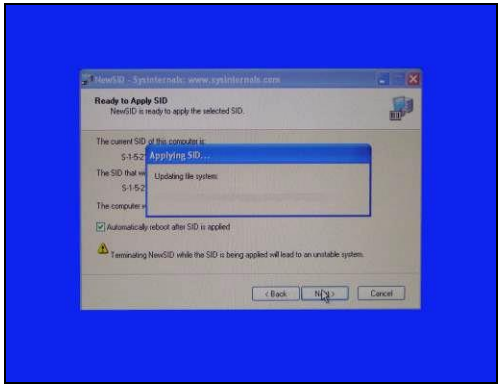
Select <u>Random SID</u> and then <u>Next</u>

Step 4:
In the next window you can rename the NetBox (optional). Please note that the new name should have at maximum 15 characters.
Press two times **Next**. Now the system will be shut down again.
Your NetBox is now ready for use again.





Rename the NetBox (optional)



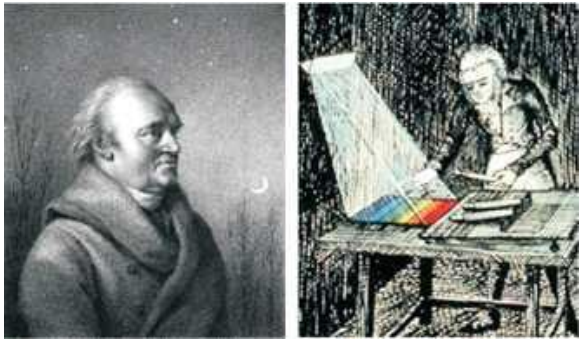
Basics of Infrared Thermometry

Depending on the temperature each object emits a certain amount of infrared radiation. A change in the temperature of the object is accompanied by a change in the intensity of the radiation.

Searching for new optical material William Herschel by chance found the infrared radiation in 1800.

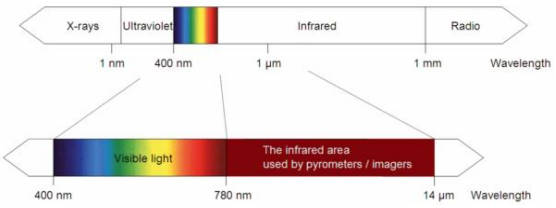
He blackened the peak of a sensitive mercury thermometer. This thermometer, a glass prism that led sun rays onto a table made his measuring arrangement.

With this, he tested the heating of different colors of the spectrum. Slowly moving the peak of the blackened thermometer through the colors of the spectrum, he noticed the increasing temperature from violet to red.
The temperature rose even
more in the area behind the red end of the spectrum. Finally he found the maximum temperature far behind the red area. Nowadays this area is called “infrared wavelength area”.



William Herschel (1738 - 1822)

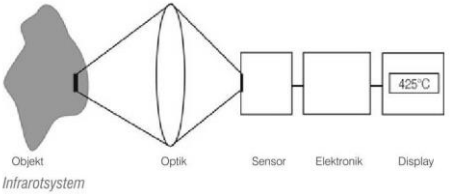
For the measurement of “thermal radiation” infrared thermometry uses a wave-length ranging between 1 µ and 20 µm.
The intensity of the emitted radiation depends on the material. This material contingent constant is described with the help of the emissivity which is a known value for most materials (see enclosed table emissivity).



The electromagnetic spectrum and the area used for temperature measurement

Infrared thermometers are optoelectronic sensors. They calculate the surface temperature on the basis of the emitted infrared radiation from an object. The most important feature of infrared thermometers is that they enable the user to measure objects contactless. Consequently, these products help to measure the temperature of inaccessible or moving objects without difficulties. Infrared thermometers basically consist of the following components:

- lens
- spectral filter
- detector
- electronics (amplifier/ linearization/ signal processing)



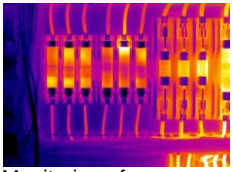
Infrarotsystem

The specifications of the lens decisively determine the optical path of the infrared thermometer, which is characterized by the ratio Distance to Spot size. The spectral filter selects the wavelength range, which is relevant for the temperature measurement. The detector in cooperation with the processing electronics transforms the emitted infrared radiation into electrical signals.

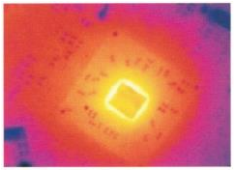
The advantages of non-contact temperature measurements are clear - it supports:

- temperature measurements of moving or overheated objects and of objects in hazardous surroundings
- very fast response and exposure times
- measurement without inter-reaction, no influence on the
- measuring object
- non-destructive measurement
- long lasting measurement, no mechanical wear

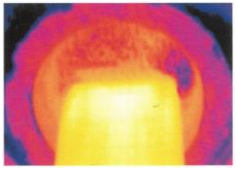
Application examples:



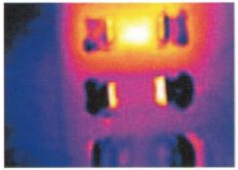
Monitoring of electronic cabinets



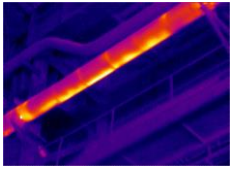
R&D of electronics



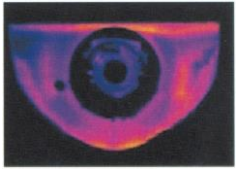
Process control extruding plastic parts



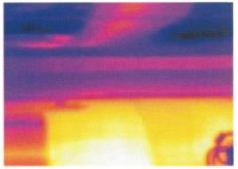
R&D of electronic parts



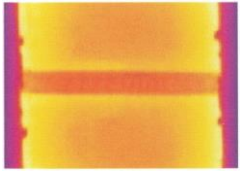
Monitoring of cables



R&D of mechanical parts



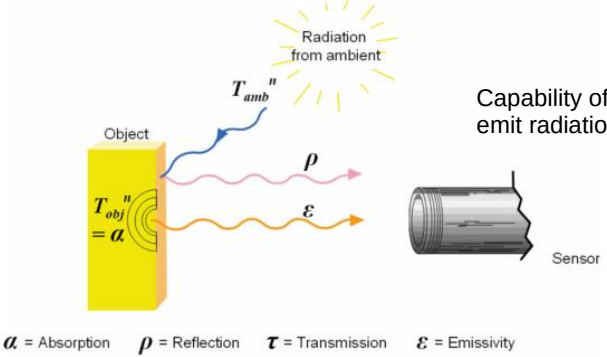
Process control at calendering



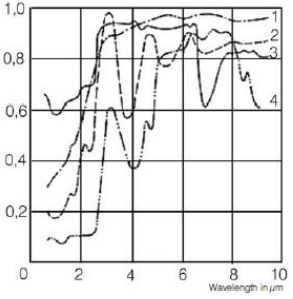
Process control manufacturing solar modules

Emissivity

Definition: The intensity of infrared radiation, which is emitted by each body, depends on the temperature as well as on the radiation features of the surface material of the measuring object. The emissivity (ε – Epsilon) is used as a material constant factor to describe the ability of the body to emit infrared energy. It can range between 0 and 100 %. A “blackbody” is the ideal radiation source with an emissivity of 1,0 whereas a mirror shows an emissivity of 0,1.
If the emissivity chosen is too high, the infrared thermometer may display a temperature value which is much lower than the real temperature – assuming the measuring object is warmer than its surroundings. A low emissivity (reflective surfaces) carries the risk of inaccurate measuring results by interfering infrared radiation emitted by background objects (flames, heating systems, chamottes). To minimize measuring errors in such cases, the handling should be performed very carefully and the unit should be protected against reflecting radiation sources.



Capability of an object to emit radiation



Spectral emissivity of some materials
1 Enamel, 2 Plaster, 3 Concrete,
4 Chamotte