seitz
made in switzerland

roundshot
fast 360 degree panoramic equipment

Instruction Manual

Roundshot D3 with Seitz D3 / D3-2500 Digital Scan Back

Software release: *4.07 (May 2017)*

Please note throughout the document that “Seitz D3 digital scan back” applies equally to the “Seitz D3 2500 digital scan back”. Differences between the two versions are mentioned wherever relevant and necessary.

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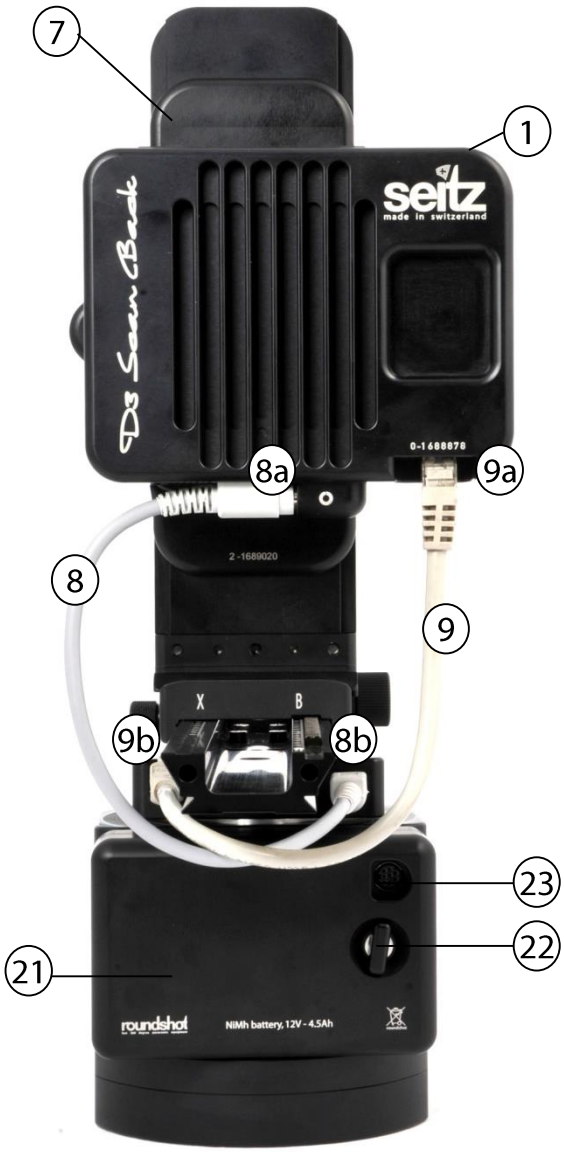
1. System Overview

1.1 Roundshot D3



1. Seitz D3 Digital Scan Back
2. Camera body
3. Lens tube / lens mount
4. Lens brackets
5. Lens
6. Shift break
7. Shift plate
8. Power cable/connectors (a/b)
9. Ethernet cable/connectors (a/b)
10. Rotation point adjustment
11. Optical bench
12. Optical bench break
13. Camera body release
14. Water bubble indicator
15. Motor
16. LED (control light)
17. On/off, start/stop button
18. Socket for external starter cable
19. Socket for external power cable
20. Ethernet plug (to computer)
21. Battery
22. Battery release
23. Socket for battery charger

1.2 Other compatible cameras

The Seitz D3 Digital Scan Back can be removed from the Roundshot D3 and attached to other camera bodies. At the moment of release of this manual it can be used with:

Seitz 6x17 Digital

The D3 software detects the attached camera and adapts its software parameters automatically (for example, the image format).

1.3 Computer / tablet PC

The camera is controlled by a connected computer (tablet PC) which also serves to visualise and store the images. For best convenience we recommend using a tablet PC with touch screen, for example a Motion Tablet PC:

It is also possible to use the camera with other computers. Important factors when selecting a suitable computer are:
- speed of operating system (32-bit or 64-bit) – ideally 64-bit machines
- speed of the processing unit (dual core, quad core)
- available RAM,
- Gigabit Ethernet (for fast image transfer)
- size and speed of the hard disks (preferrably fast SSD drives for fast image saving)

Currently the following operating systems can be used (both 32-bit and 64-bit):

- Windows XP
- Windows VISTA
- Windows 7

With Intel processors only:
- Mac OS 10.5
- Mac OS 10.6

1.4 Accessories

Tablet PCs and accessories:

Motion J3500

Mobile Keyboard for Motion J3500

Battery charger

Power supply (mains adaptor)

Laptop holder to attach on a tripod

NiMh battery 12V 4.5A

USB GPS device: GlobalSat BU-353 USB

Digital compass

1.4 Accessories (continued)

Power plugs for different countries:

Continental Europe

United Kingdom

North America (USA,
Canada, Mexico) & Japan

Australia & New Zealand

Lens mounts:

Nikon

Mamiya 645

Hasselblad

Please note that Schneider and Rodenstock medium format lenses are mounted on lens tubes and are attached directly to the camera without lens mount

1.4 Accessories (continued)

Various additional accessories:

Starter cable

Counterweight

Compendium for Schneider Apo Digitar lenses

Compendium for 24mm Mamiya 645 fisheye lens

Front glass cover for the Seitz D3 digital scan back

Lens mount protection cover

Back mount protection cover

Waterproof housing with motor

2. How To Get Started

2.1 Step 1: Get the camera ready

The Roundshot D3 camera is delivered fully assembled. When disassembled it can be reassembled in the following way:

Ethernet and power cable

Lens

Optical bench

Camera body

Battery

Motor

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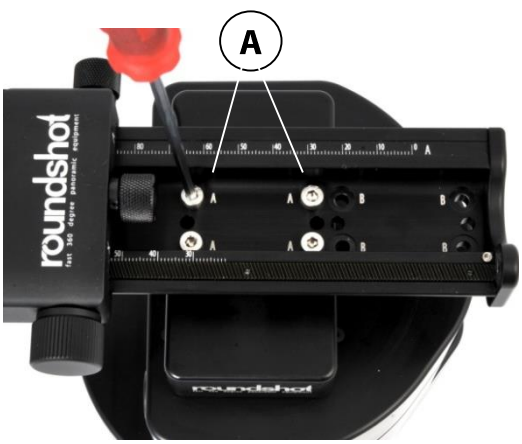
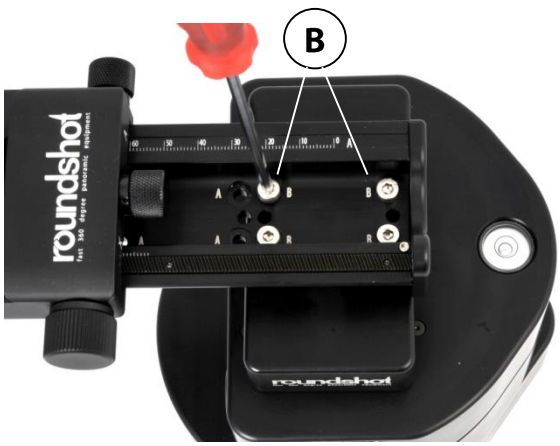
1. Fix the optical bench to the motor using a screw driver. Depending on the size of the lens it is possible to attach the optical bench at 2 positions (A or B). A is optimised for short lenses and B for long lenses.



Short lenses



Long lenses

2.1 Step 1: Get the camera ready (continued)

2 Slide the camera body into the optical bench holder and close the camera body release firmly:

3 Attach the Seitz D3 digital scan back to the camera body and make sure to close the four lens brackets (4) firmly:

2.1 Step 1: Get the camera ready (continued)

4 Now connect the power and ethernet cables (8+9) between the Seitz D3 digital scan back and the engine.

Connect the power cable (8) in the roundshot connectors:

Connect the ethernet cable (9) in the ethernet connectors:

5 Connect the battery by placing the battery connector firmly into the socket and by fastening the battery release tightly (22):

2.1 Step 1: Get the camera ready (continued)

6 Attach the lens to the camera body. Schneider and Rodenstock lenses come on an Alpa lens tube and are attached directly to the camera body. Other brands (for example: Mamiya 645) have a separate lens mount (tube) on which the lens is attached with a bayonet mount.

Make sure to close the two black lens brackets (4) firmly:

2.1 Step 1: Get the camera ready (continued)

7 Place the camera on a solid tripod. The Roundshot D3 camera comes with a large (3/8“) thread. For smaller tripods (1/4“ thread) can be inserted into the camera bottom plate.

Make sure that the spirit bubble of the camera is level.

8 Connect the 3m ethernet cable* by inserting it into the ethernet plug on the motor and the computer**:

* The ethernet cable can be of any distance
** It is also possible to operate the camera in a network

2.2 Step 2: Get the computer ready

2.2.1 With tablet PC (supplied with camera)

For cameras supplied with a tablet PC the Seitz Roundshot D3 software is already installed on the tablet PC and the network configuration is complete.

Start the tablet PC by pushing the on/off button on the right side of the computer. The start-up takes approximately one minute:

„on/off" button

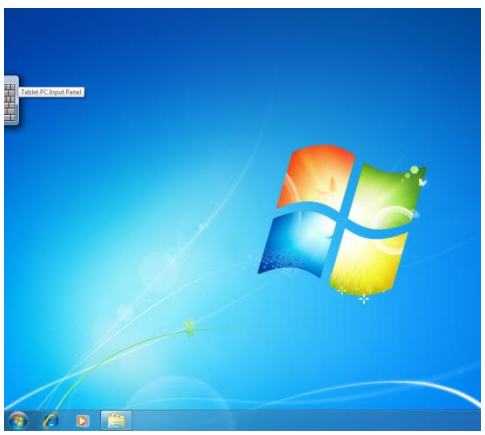
The tablet PC is operated with the supplied digital pen via touch screen. To activate the „right mouse click" press the button and hold:

„right mouse click"

When the computer has been idle and goes to standby, it can be reactivated by pushing the on/off button.

If a password for the tablet PC has been set and the tablet PC is already part of a domain, the logon screen will appear.

electronic keyboard Windows 7



Activate the electronic keyboard by sliding the digital pen over the left margin of the screen..

2.2 Step 2: Get the computer ready

2.2.2 With all other computers

For all other computers download the latest software version from the „Club D3“ website (www.roundshot.ch) and load the Seitz Roundshot D3 installer program (exe) on your computer. For more information on how to access the „Club D3“ website please refer to section 6.4.

Important: Make sure to install the software using an account which has **administrator rights**.

SeitzRoundshot-4.0-windows-installer.exe

Double click the icon. The program set-up will start automatically and the software will be installed in the following directory:
C:\Program Files\Seitz\Digital3

The program directory contains two folders:
- HMI (Human Machine Interface)
- PDS (D3 Imaging Server)

The „Human Machine Interface“ represents the graphical user interface by which the camera is controlled and the images are displayed. The „D3 Imaging Server“ handles all image data.

Create the following shortcuts on your desktop:

Starts the Seitz Roundshot D3 software

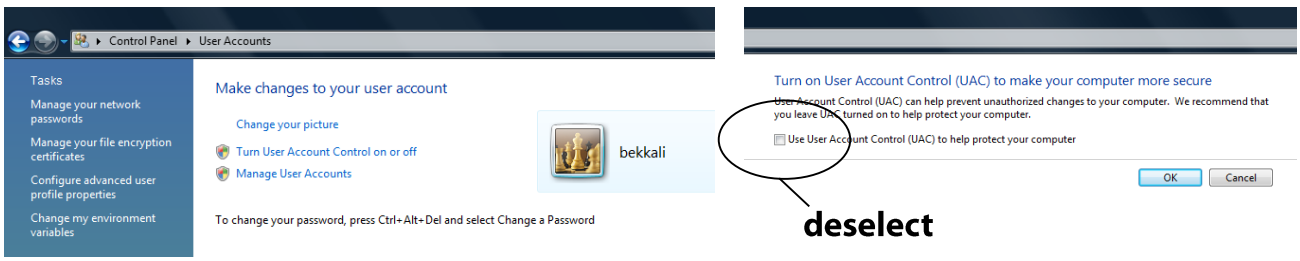
Shortcut to the Digital3 images folder
(to C:\Program Files\Seitz\Digital3\PDS\images)

2.2 Step 2: Get the computer ready

2.2.2 With all other computers (continued)

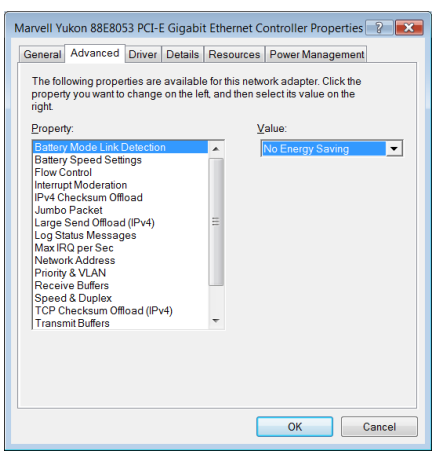
Deactivate User Account Control for Windows VISTA or Windows 7

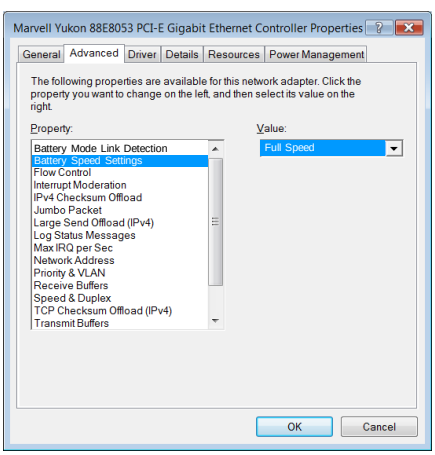
Windows VISTA and 7 have an additional security layer built in which prompts the user before execution of an application. To run the Seitz Roundshot D3 software this additional security layer needs to be turned off. Open control panel, select user account, select "Turn user account control on or off", deselect the "Use user account control":



Set up gigabit ethernet controller for maximum speed (Windows XP, VISTA or 7)

By default the gigabit ethernet controller card in Windows XP, VISTA or 7 is set to maximum battery saving. To connect to the camera quickly and to allow a maximum transfer speed it is necessary to change the battery speed and link detection speed. Open the device manager, right mouse-click on properties of the gigabit ethernet controller, select tab "Advanced":





Turn off all non-essential computer functions and adjust screen brightness

Functions such as **WLAN** and **bluetooth** are not essential for image-taking and should therefore be turned off. This can be done most easily in the computer BIOS when starting up the computer (for tablet PCs right mouse click, select "BIOS"). The screen settings for a Motion tablet PC can be set using the Motion dashboard (click button on the right of the screen).

2.2 Step 2: Get the computer ready (continued)

2.2.2 With all other computers (continued)

Start the Seitz D3 software by double-clicking the shortcut on the desktop:

The software opens directly in the **"Shoot"** menu:

Shoot menu

Parameter menu

The **"Shoot"** menu is used for operating the camera, image taking, displaying previews, and saving. It also allows quick access to most frequent image capture parameters such as lens (favourite lens list), exposure time, white balancing mode or ISO/ASA. Camera status information such as connection or battery level and image data such as histogram or size is indicated in the information tab.

The **"Parameter"** menu contains camera, software and image workflow advanced parameters. It is structured into different tabs for better accessibility. 9 tabs are available:

- Colour: raw conversion parameters
- Save: the output file options
- Lens: manufacturer lens list and special lenses
- Camera parameters: camera adjustment parameters
- External device: allows to connect and control external devices (GPS, Compass)
- Scheduler: programming of camera tasks
- HDR: mixing of DNG files into 32bit ".exr" files
- Custom: interface options
- Info: camera software and firmware information and a service menu

To open or close the **"Parameter"** menu press:

2.2 Step 2: Get the computer ready (continued)

Press the „power on“ button on the camera to start the camera connection process. The network connection icon shows the ongoing process. A network pop-up confirms that the connection is established.

The green LED (previously continuous green) now starts to blink. The connection is confirmed in the D3 software by the **„Camera ready“** message which appears in the lower right hand corner of the software. At the same time a small pop-up window showing camera information as IP address will appear in the lower right hand corner of the software:

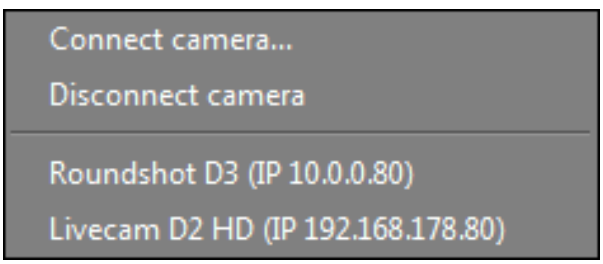
Camera ready

Connected Camera:
MAC MAC 00:50:c2:5e:31:ab
IP 10.0.0.80
Version V3.22b-V1.8
Temperature 32°

If the camera connection cannot be established automatically the **“Camera not connected”** message appears in the lower left hand corner of the software:

Camera not connected

In the **“shoot”** menu click right on the camera connection icon:



The software searches in the network for **available cameras** and displays them in a list (with their IP addresses).

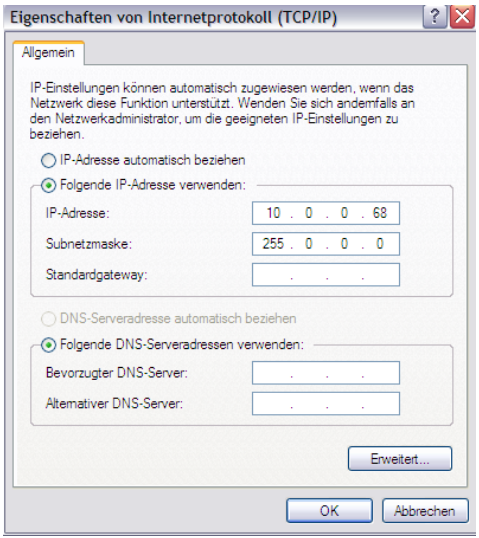
Click on the camera name to start the connection.

If the camera cannot be connected it is possible to **establish the connection** by clicking on

Establish the camera connection by confirming with **“OK”**.

2.2 Step 2: Get the computer ready (continued)

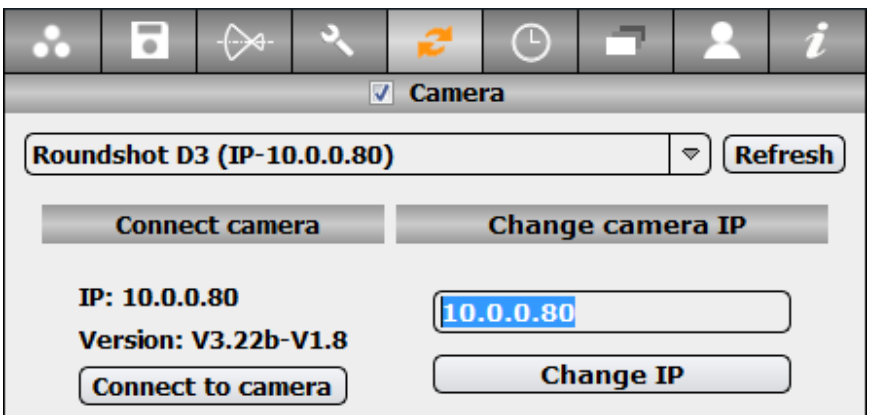
If the camera cannot be detected, open the **network properties** and check the settings. It is important that the network uses an IP in the **same range** (but not identical) as the IP of the camera (digital scan back) and that both are located in the **same subnet**:



Open network connections of your computer.
Open LAN connection.
Choose „internet protocol TCP/IP“ and „properties“.
Choose „fixed IP“ and enter the following IP address: 10.0.0.68
Subnet mask: 255.0.0.0

If you would still like to connect to internet while working with the camera, then set the same standard gateway network IP as your network (for example **192.168.178.xx**), the same subnet (for example 255.255.255.0) and the same DNS server (for example **192.168.178.1**). Ask your system operator for assistance.

It is also possible to change the camera IP to bring it into a desired range (for example: 192.168.178.xx). It is important that the computer TCP/IP properties has the same IP range than the camera (for example: 192.168.178.10). Open the external device tab (see section 3.2.5 for more details), select the camera and change its IP address :

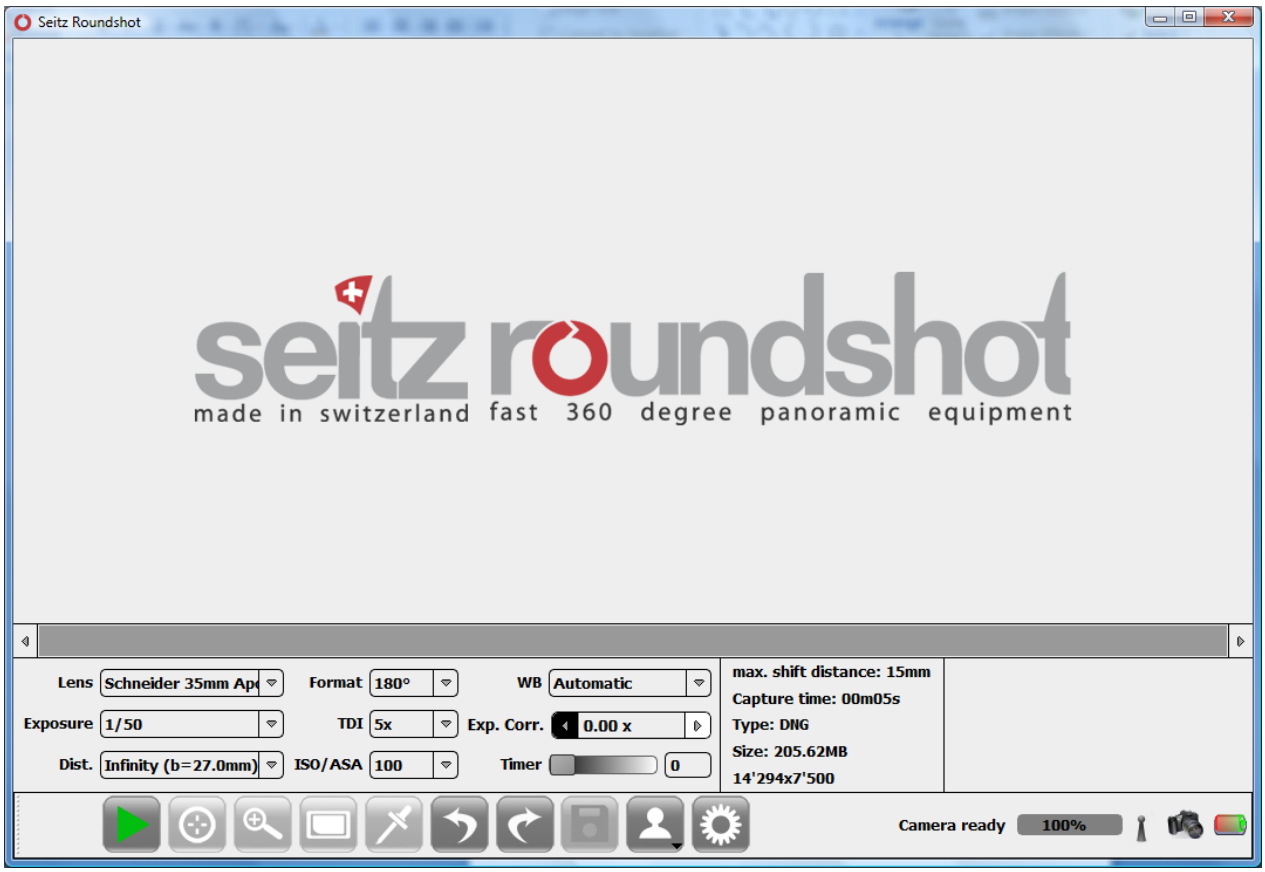


2.2 Step 2: Get the computer ready (continued)

The Roundshot D3 is now ready for image taking.

2.3 Step 3: Select shoot settings

The next step consists in defining the parameters for image taking. Here is an example of possible settings for a first image:

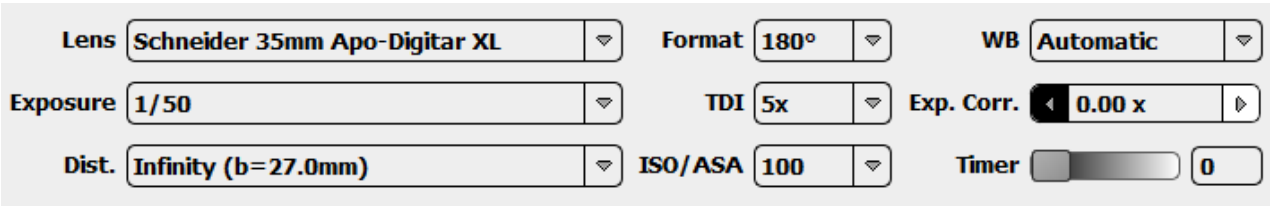


Select the desired shoot parameters: lens, exposure time, focusing distance, angle, TDI stages and ISO/ASA.

If the desired lens is not in the list press the parameter button and select the values in the **"Parameter/lens"** menu. For more detailed information on image parameters and software functions please consult section 3.2 "Parameter menu".

Press  to start a scan.

2.4 Step 4: Adjust your settings



Adjust the settings. For example, change the image angle, the exposure speed or the sensitivity of image capture (TDI Stages, ISO/ASA).

Fine control the exposure time using the exposure correction slider. It is also possible to change the white balancing mode from automatic to presets or manual modes .

Create another scan.

Focus with the focusing assistant, don't forget to adjust the distance setting and the rotation point on the optical bench (b-value).

Zoom to check the sharpness.

Repeat these steps until the image is perfect.

2.5 Step 5: Save the image

Save the image and transfer the image on your computer for post-processing.

Once the image has been saved the icon turns green.

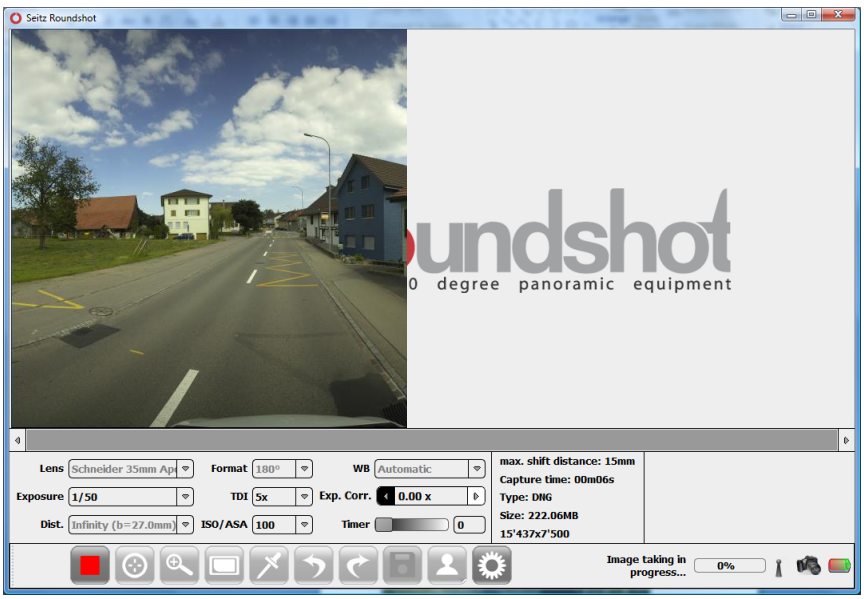
3. Seitz Roundshot D3 Capture Software

3.1 Shoot menu

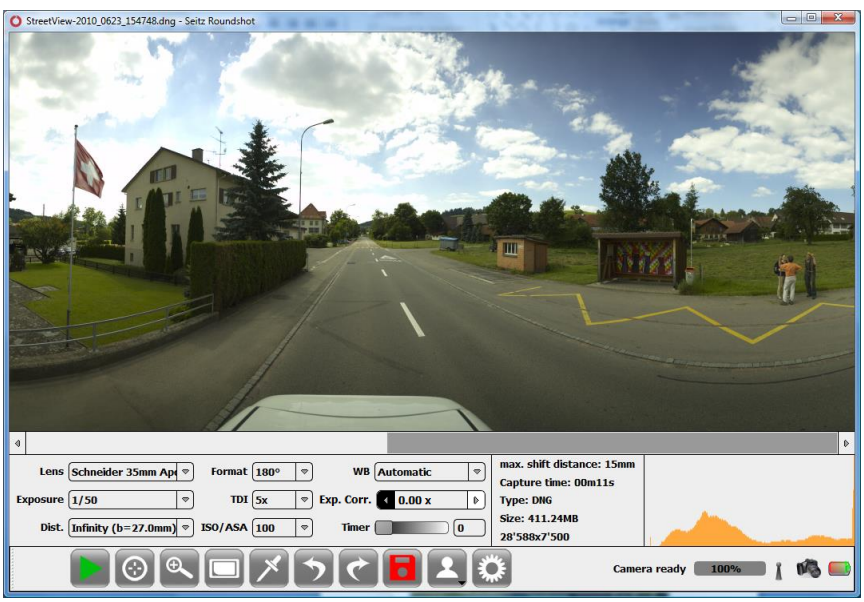
The **„Shoot“** menu allows to operate the camera (position of camera head, start and stop, focus, rescan), zoom into the preview, apply white balancing to the image and save the panorama.

Press the **„Start“** button to start the image taking process:

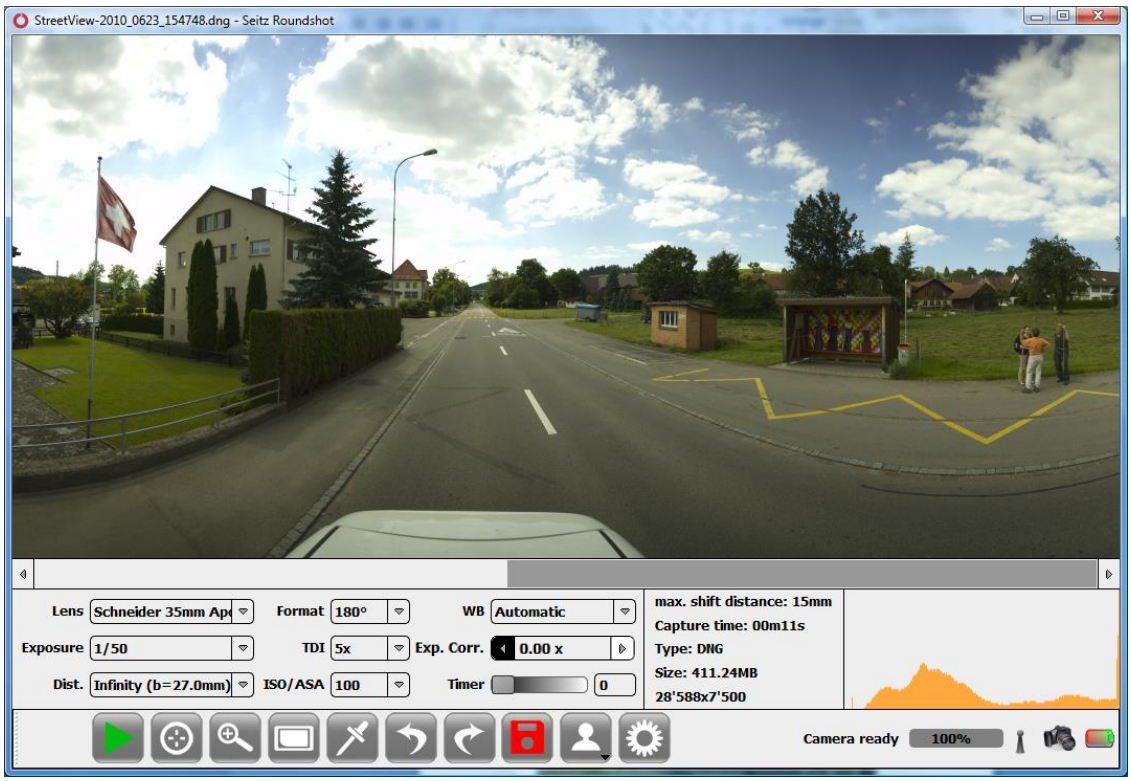
The preview shows the image as it is built up by the scan. The ongoing scan is indicated by the message **„Image taking in progress“** on the lower right hand side of the computer screen:



Once the scan is fully transferred to the computer RAM, the **„Camera ready“** message and the **image histogram** appear:



The **„Shoot“** menu is controlled using the following buttons and graphical elements:



Start

Stop

Resume after pause

Focusing Assistant

Zoom

Fit on screen

White balancing pipette

Rotate camera right

Rotate camera left

Save button (not yet saved)

Save button (already saved)

Profile Load/save

Parameter menu open/close

100%

Progress bar

GPS status symbol

Camera connection tool

Connected Camera:
MAC MAC 00:50:c2:5e:31:ab
IP 10.0.0.80
Version V3.22b-V1.8
Temperature 32°

Camera connection displayed on „mouse over“

Battery status

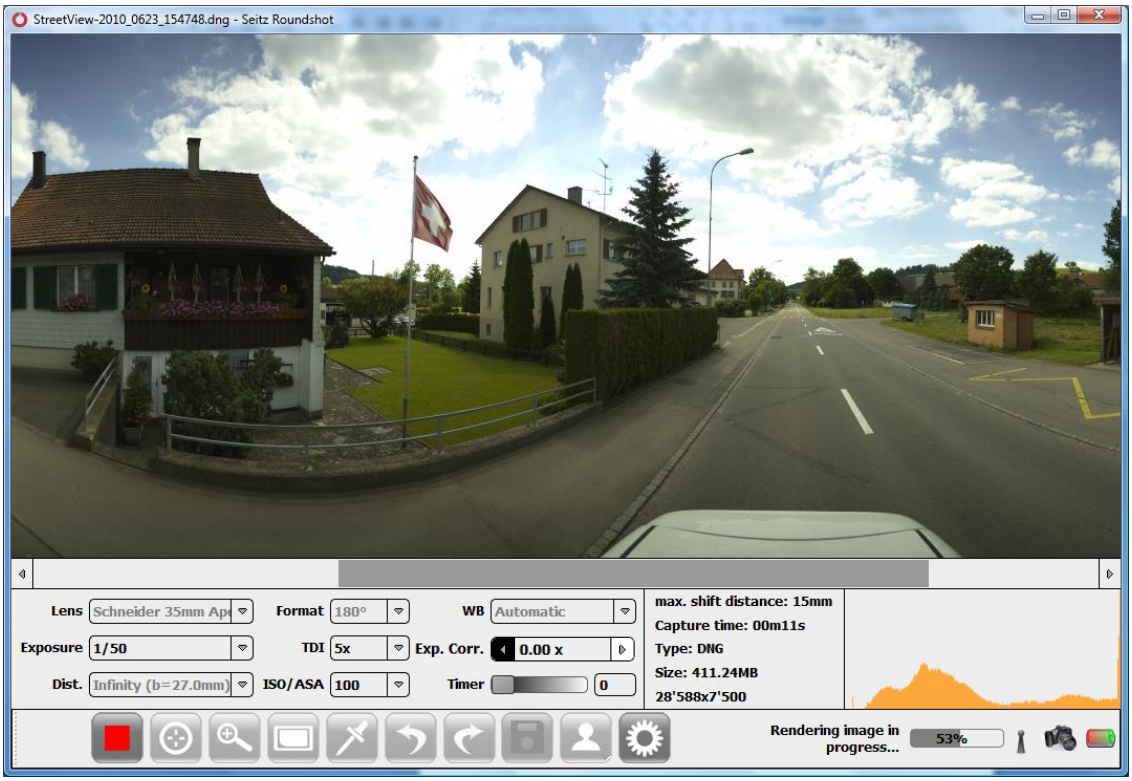
Image histogram

max. shift distance: 15mm
Capture time: 00h00m06s
Type: TIFF
Size: 665.08MB
15'437x7'500

Scan info (max shift distance, capture time, file format, file size, image pixel size)

Once the scan and preview are complete, additional post-processing steps can be performed on the image such as:

- White balance (automatic, choose in picture or presets)
- Histogram stretching (if active in parameter menu)
- Black adjust (for longer exposures when a black value interpolation is required)



The ongoing rendering process is shown on the lower right corner of the window.

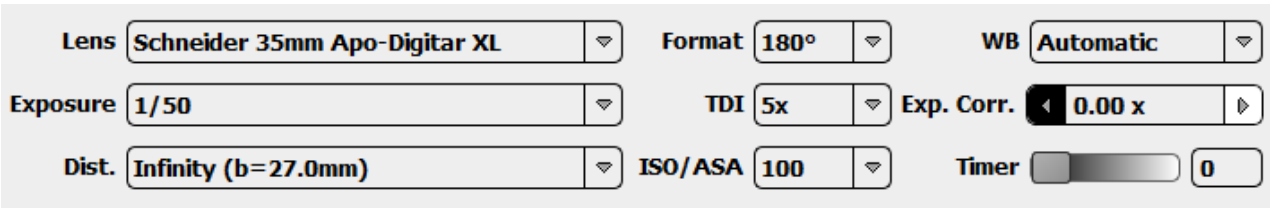
These post-processing steps can be launched automatically right after the scan (for example: Automatic white balance) or some post-processing parameters can be changed and then be applied to an existing scan (for example: „Choose in picture“ white balance, new contrast values).

These **post-processing options** are explained in more detail below.

For image-taking we recommend to focus on framing the image (angle), exposure and on sharpness and saving the image as a raw file (dng). All other adjustments such as white balance, histogram stretching, HSL etc. can be done conveniently on a calibrated screen at home / in the studio. Please refer to chapter 5 for detailed explanations on the ideal workflow (post production).

3.1.1 Shoot settings

The **„Shoot Settings“ list** allows to select and modify those parameters which are most often used during image taking:



Lens: select the correct lens from the lens list. This list contains the “favourite lenses”. If a lens is not available, open the lens tab in the parameter menu to access a full lens list. You can also create your own lens if necessary (refer to section 3.2.3)

Format: defines the image angle. It is possible to take pictures from 1° to 999°

White balance: select the white balancing mode. The “Automatic” white balancing will apply different adjustments for every light situation. It is also possible to select a predefined light condition as “Tungsten” or “Day light”. Finally there is the option to choose a grey point on the image using the white balance pipette tool.

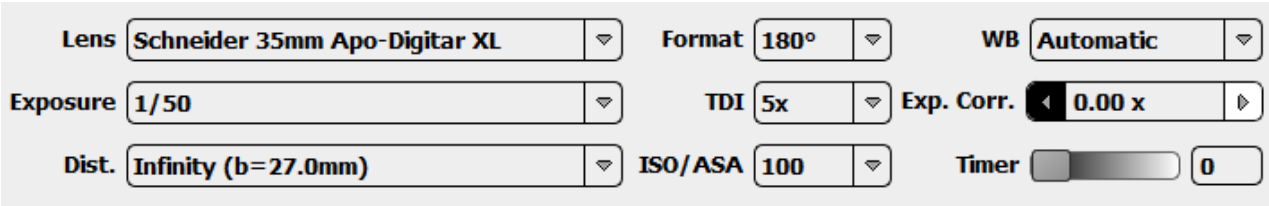
Distance: select the same focusing distance as defined on the lens. The exact distance setting is required by the software to adjust the effective focal length. Setting the distance correctly enhances sharpness.

B-value: next to the distance setting the b-value is indicated. This corresponds to the ideal position of the camera head on the optical bench. When a new distance is selected, it is recommended to change the position of the camera head accordingly. Please refer to section 4.1 “How to set the b-value (camera head position)” for more details.

„Automatic white balance“ sets the white point according to predefined assumptions. This settings works well for most situations. In situations with special light conditions select „choose in picture“ or one of the light presets (tungsten, fluorescent, direct sun, cloudy).

Technical note:
When focusing at closer distances than infinity, the effective focal length increases, which is (after entering the correct distance) automatically adjusted by the software. Also, the software adjusts the horizontal image format, as with a larger effective focal length the image becomes longer (more pixels).

3.1.1 Shoot settings (continued)



Exposure: select the image exposure mode. Several automatic modes are available in addition to fixed exposure speeds:

- **Automatic (spot):** the sensor reads the light at the current position (or at a defined measure angle). This "spot" reading is used for the entire scan.
- **Automatic (prescan):** the camera first completes a prescan to measure the actual light conditions for the chosen image angle and applies the resulting average exposure for the final (second) scan
- **Automatic (variation):** the camera adjust the rotation speed for every scan line. With the parameter 1 to 100 the degree of speed adjustment can be set (1 for weak, 100 for maximum adjustment)
- **Automatic (variation with prescan):** the camera will create a prescan for light measuring and then a second scan for exposure. During the second scan the camera adjusts the rotation speed for every scan line. With the parameter 1 to 100 the degree of speed adjustment can be set (1 for weak, 100 for maximum adjustment).

When working with automatic exposure we recommend using the prescan option as this allows the most accurate exposure control.

To freeze motion, use a fast exposure speed. This is achieved by using a smaller area of the sensor, for example TDI 5x or 10x (minimum exposure speed 1/400 and 1/200 sec). The fastest exposure speed is reached with TDI 1x (1/2'000 sec).

Depending on the available light, setting a higher ISO/ASA value or opening of the aperture may be required (for example, from f=16 to f=8).

3.1.1 Shoot settings (continued)

TDI: select the TDI level. A higher TDI means that a larger surface of the sensor is used for the scan. More pixels will be exposed simultaneously with higher TDI, making the entire scan process faster. Using higher TDI can be an advantage when working under low-light conditions (indoor).

ISO/ASA: select the ISO/ASA level to be used. Increasing the ISO level will increase the sensor sensitivity but also noise level. It is recommended to use the lowest ISO level possible for better image quality

Exp. Corr.: the exposure correction is used to fine tune the exposure speed. It is possible to select sub-f-stop adjustment for perfect image exposition (0.1f-stop)

Timer: defines the delay time before starting the scan

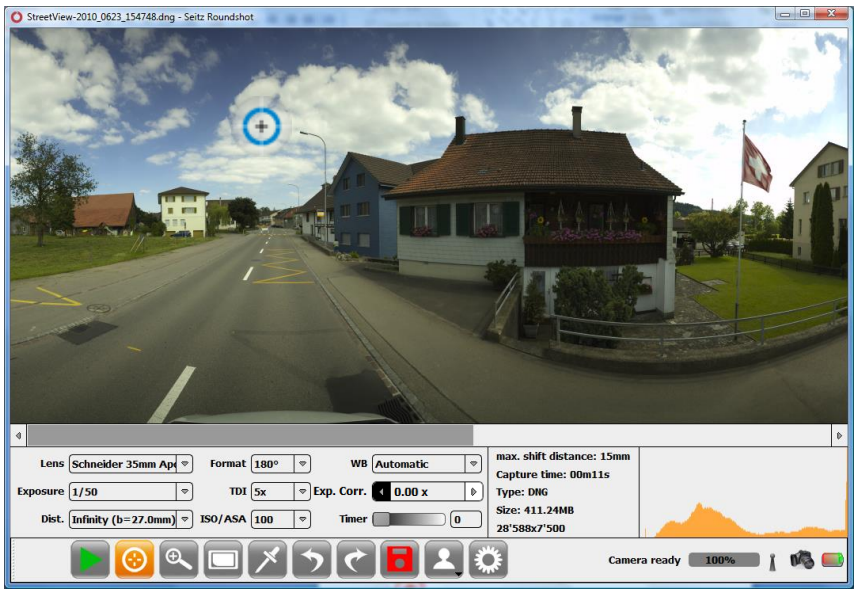
The larger the scan area of the sensor (the more TDI Stages) the steeper the angles and therefore the more critical the sharpness, especially for wide-angle lenses. Therefore it is advisable to start with smaller TDI Stages (for example TDI 5x) and increase TDI Stages only when necessary.

The exposure speed is dependent on the selected sensitivity (TDI Stages). When changing TDI Stages the exposure speeds will be changed accordingly. For more information on exposure speeds please refer to section 4 „How to".

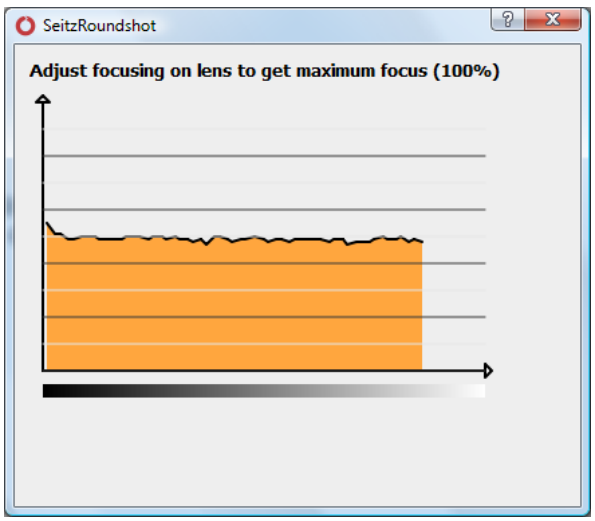
To capture static or almost static scenes where a fast exposure speed is not important, close the aperture (for example, from f=8 to f=16). This will increase sharpness and depth of field.

3.1.2 Focusing Assistant

Press the button **„Focusing Assistant“** and the focusing cross appears:



Place the focusing cross on the spot where the camera should focus.



The „Focus“ window shows the contrast metering (orange surface) for the selected focusing spot.

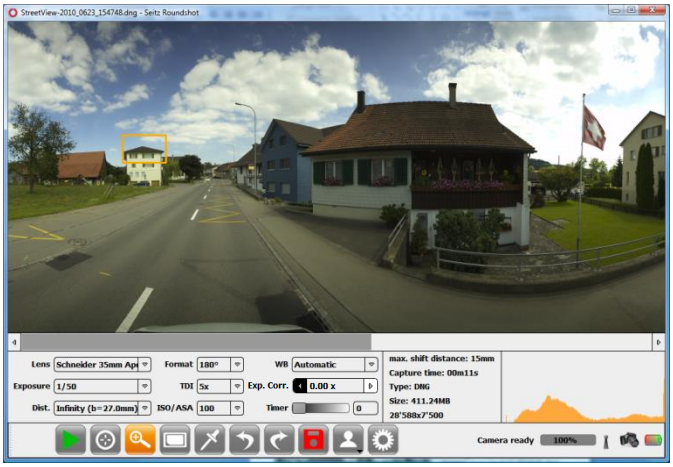
Adjust the focusing on the lens until the contrast metering shows the highest possible value.

Close the „Focusing Assistant“ window to stop the focussing assistant tool.

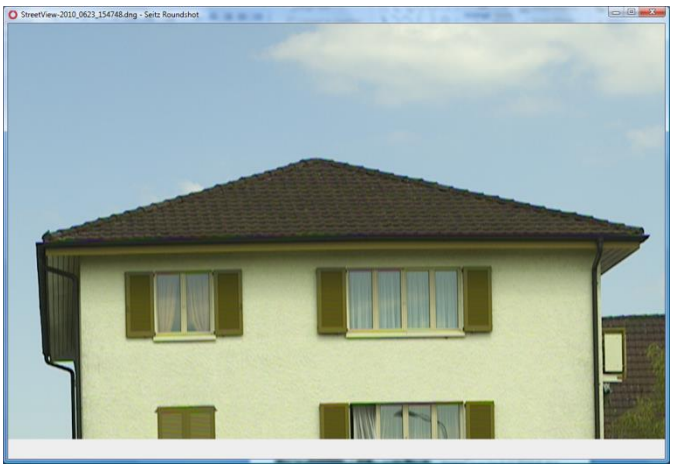
The Focusing Assistant is an additional help for the photographer to obtain the best sharpness. Set the approximate distance on the lens first and then use the Focusing Assistant to fine-tune sharpness. Choose a bright point in the preview image with structure and good contrast. Avoid uniform surfaces (such as a white wall, etc.).

3.1.3 Zoom

Press the button **„Zoom“** and the zoom rectangle appears:



Place the rectangle on the area to magnify.



The zoom window opens showing a 100% magnification* of the selected area.

Other zoom levels can be selected in „Parameter menu / custom tab”. 100% is the default zoom factor

Press anywhere on the image to close the „Zoom“ window.

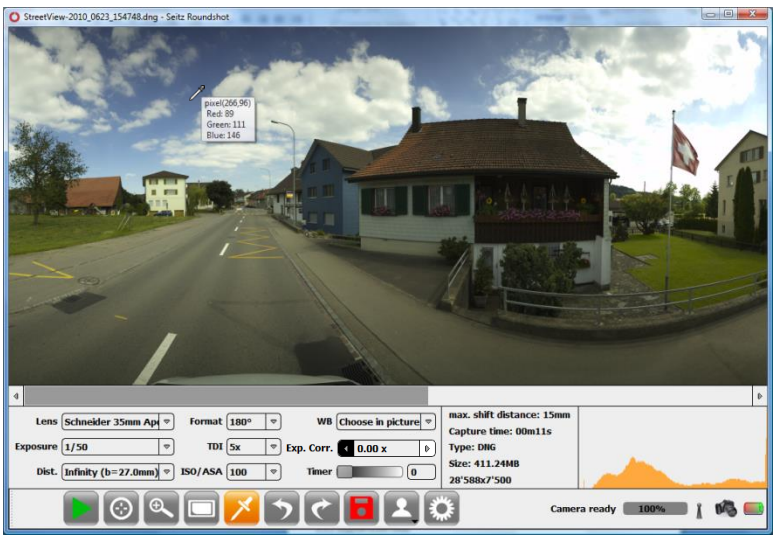
3.1.4 Fit on screen

Press the button **„fit on screen“** to display the panorama in its full width:

Press again the button **„fit on screen“** to go back to original view

3.1.5 White balancing pipette

Press the button **„White balancing pipette“** and the pipette cursor appears on the image:



Click on a neutral grey area of the image.

Standard grey cards can be included in the image to select a perfect white balance.

Please note that using the white balancing pipette will change the white balancing mode. Do not use this tool when selecting the automatic or preset modes.

Press the button **„White balancing pipette“** again to close the “choose in picture” white balancing mode.

3.1.6 Camera head position

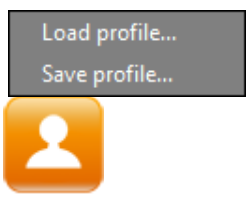
Press the **„camera head position“** buttons to turn the camera head to the desired starting position. To activate the camera rotation, the mouse/pan needs to be moved gently over the surface of the button.

The „camera head buttons“ are a useful feature when the camera is actually inaccessible (for example when it is mounted on a pole or at a distance).

Please note that the camera head can also be turned by hand without creating any damage to the camera motor. Turning the camera head by hand may be quicker in most situations.

3.1.7 Profile load/save

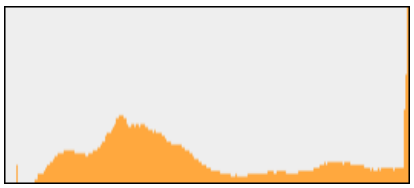
Press the button **„Profile“** and the following menu appears:



Select **“Save profile”** to store a profile containing all current shoot and image processing parameters.

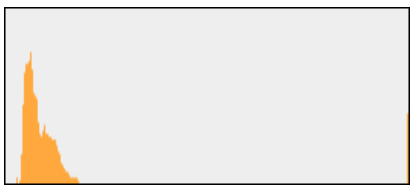
Select **“Load profile”** to load previously saved profiles.

3.1.8 Histogram

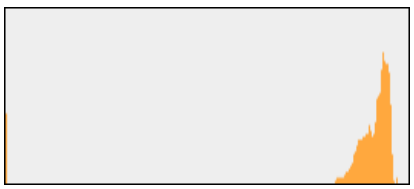


The **„Histogram“** is displayed with the image and shows the distribution of light from the very dark to the very light parts (in DNs) of the image.

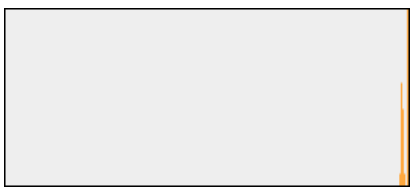
The „Histogram“ is an important tool to determine the quality of the exposure. When the image is **perfectly exposed**, the histogram shows an evenly distributed light frequency with no cropping of light at the borders like pictured above.



When the image is **underexposed**, the histogram values are situated on the left of the graph, i.e. most of the light frequency is distributed in low DN levels. Create a longer exposure or open the aperture.



When the image is **overexposed**, the histogram values are situated on the right of the graph, i.e. most of the light frequency is distributed in high DN levels. Create a faster exposure or close the aperture.



When the exposure of the image is **cropped**, the histogram becomes very flat. This happens when some extreme values are located below the minimum (0) or above the maximum (255). Adjust the exposure speed or the aperture until the cropping disappears.

The x-axis of the graph shows the light levels (in DNs) and the y-axis the frequency of these light levels in the image. It groups the DNs in classes (for example, 0-100 DN, 101-200 DN, 201-300 DN…, 15‘901 – 16’000 DN) and then plots the frequency of these classes (how many times these light levels are observed in the image) on the y-axis to show the statistical distribution.

Underexposing the image is less problematic than overexposing it. An underexposed image (for example by 1 f-stop) can quite easily be brightened or tone-mapped in post-production (with often better dynamic range), whereas darkening an overexposed image does not lead to the same results (information in bright areas is cropped).

3.1.9 Start / Stop

When no image taking, image optimisation or saving process is ongoing, the **„Start“** button is active. Press it to start a new scan.

When an image taking, image optimisation or saving process is ongoing, the **„Stop“** button is active. Press it to stop the ongoing process.

When the option „pause after prescan“ is active, the camera stops after making a prescan and the button **„resume after pause“** is active. Press it to start the image scan with the exposure time computed by the prescan.

3.1.10 Save

When the software has an existing RAW image in memory and no image taking, image optimisation or saving process is ongoing, the red **„Save“** button is active. Press it to save the image. The selected optimisation and saving settings are applied.

Once the image is saved, the icon turns green.

The time for image saving depends first of all on the speed of the hard disk and secondly on the chosen image parameters.

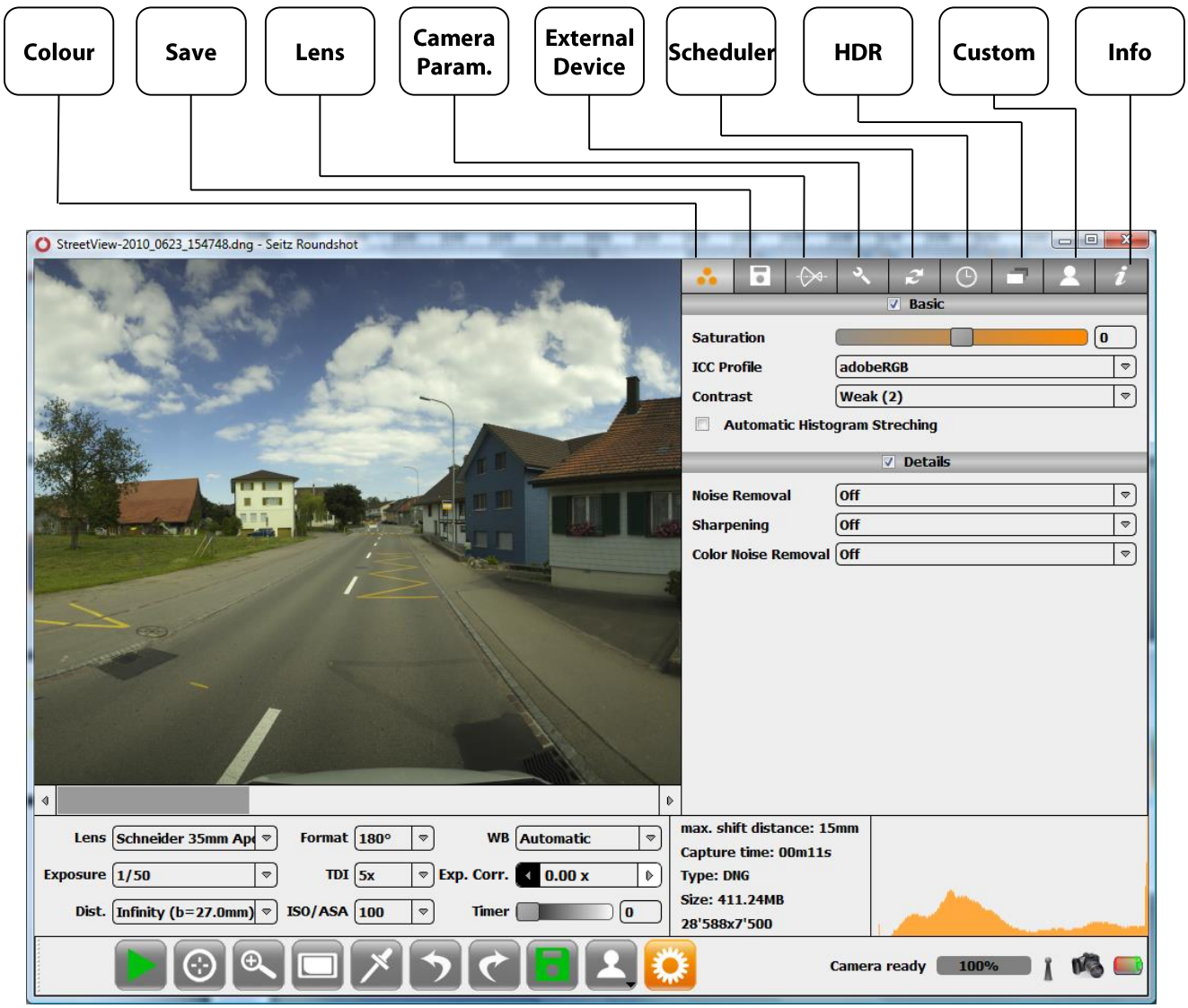
To reduce the saving time:
- Select the required image format and resolution before taking the image (for example 3x3 instead of 1x1)
- Save the image as a .dng file; do the post-processing on the image later*
- Use „sharpening“, „noise removal“ and “colour noise removal” only to a moderate extent; especially „noise removal“ increases the required saving time significantly

* Post-processing of dng files in camera raw (latest version) and Lightroom 2.0 is possible with images of up to 65,000 horizontal pixels. When using a 64-bit operating system, the Seitz Roundshot D3 capture software and the Seitz raw converter can open and process dng (raw) files of up to 4 GB and convert them to tiff files of up to 12 GB. For tiff files larger than 4 GB a special software is required (BigTiff plug-in).

3.2 Parameter menu

Press  to navigate to the **“Parameter”** menu.

The **„Parameter“** menu allows to set all parameters for image taking, processing and storage. It is structured in nine tabs as described below:

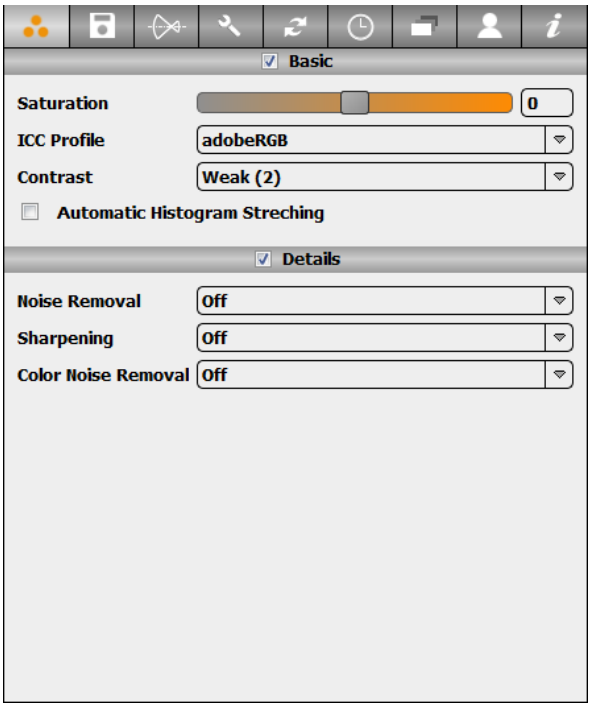


Press  again to close the **“Parameter”** menu.

3.2.1 Colour

Press the „Colour“ button in the „Parameter“ menu to activate the **„Colour“** tab:

All settings in this tab are applied on the raw image when it is converted into RGB only (for image preview and when saving the image as .tiff or .jpg). When saving a panorama as a raw image, only the white balancing values are saved with the .dng file, all other “Colour” and “Optimisation” options are not saved.



The tab contains the following options:

Saturation: define the saturation level of the image. “0 “means no image modification

ICC profile: defines the output colour space of the saved image: sRGB, or AdobeRGB.

Contrast: tone-mapping, stretching of middle tones and compression of high tones

Automatic histogram stretching: adjusts the lightness (in DN) from zero to the minimum and from 2^{16} to the maximum values observed in the image. The tool is limited to 1f-stop

Noise removal: applies a noise reduction filter to the image

Sharpening: applies an unsharp mask filter to the image to create better transitions from dark to bright pixels

Colour noise removal: applies a noise reduction filter on the high frequency parts of the image reducing the colour noise

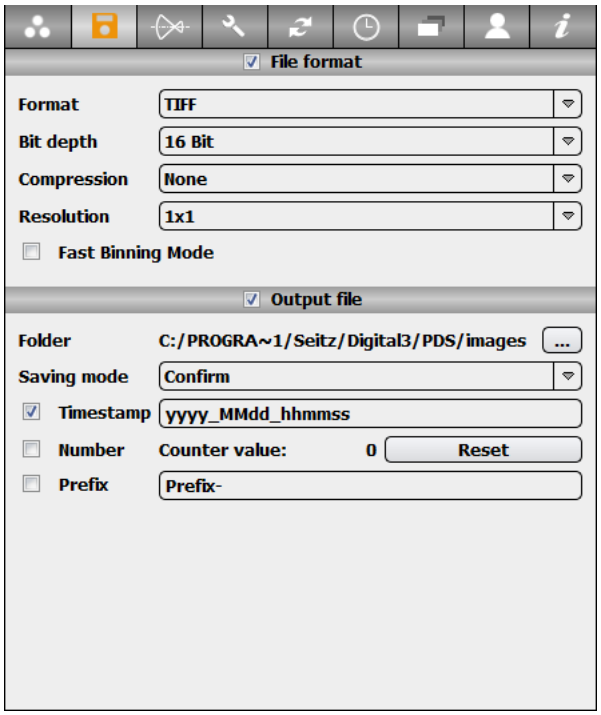
AdobeRGB is the larger colour space, so the colours will saturate more quickly in sRGB. For output requiring fine detail (such as fine-art printing) it is therefore recommendable to work in AdobeRGB.

Use only a moderate amount of sharpening or noise removal. A moderate use of sharpening and noise removal can increase the overall image quality. Please note that once the image is saved as a tiff or jpg, these modifications are permanent and cannot be reversed for the saved image. We recommend to save the image as a dng (raw) file whenever possible and to apply the optimisation only in post-production.

3.2.2 Save

Press the „Save“ button in the „Parameter“ menu to activate the **„Save“** tab:

This tab contains the following options:



Format: sets the output file format. DNG, JPEG or TIFF

Bit depth: defines the colour bit depth for TIFF files

Compression: sets the level and type of compression of the output file

Resolution: defines the final resolution of the image. DNG format is only compatible with 1x1 and 3x3 resolutions

Fast binning mode: allows faster image data transfer from camera to PC. However, this options might decrease image quality

Folder: define the location of the save files. The standard location is: C:\Program Files\Seitz\Digital3\PDS\images

Saving mode: choose between “automatic”, “save as” and “confirm” saving modes. If automatic or confirm modes are selected it is necessary to select the file naming option

- **Time stamp:** write the timestamp in the image name (yyyy-MM-ddThh-mm-ss)
- **Number:** write a number in the image name (1, 2, 3, ...). It is possible to reset the image numbering to restart from 1
- **Prefix:** add a defined prefix before the timestamp or the number

When changing resolution parameters the previous scan will be lost and the preview will disappear. A new scan of the scene is then necessary. This is required because the data transfer is optimised for a specific resolution.

3.2.2 Save (continued)

Saving the image as a **DNG file** has the advantage of significantly smaller file sizes (33% of TIFF). Also, making the demosaicing (colour conversion into RGB) and optimisations as a second step is beneficial as the original image data is left unchanged and can always be accessed later.

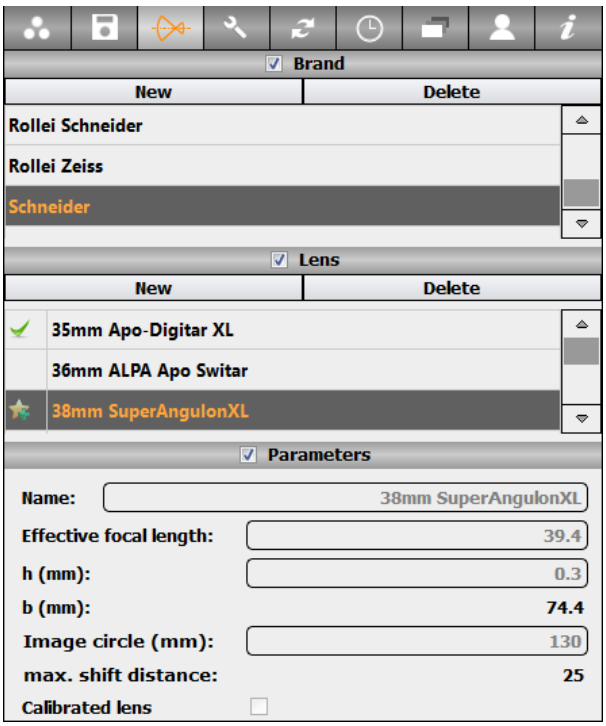
Camera raw (latest version) and **Lightroom 2.0** can convert the Roundshot D3 panorama if the image has less than 65'000 horizontal pixels.

When using a 64-bit operating system, the **Seitz Roundshot D3 software** and the **Seitz raw converter** can open dng files of up to **4 GB in raw (dng)** and create **tiff files of up to 12 GB**. For tiff images larger than 4 GB a special software reading BigTiff images (plug-in) is necessary. For more information on the ideal workflow please visit chapter 5.

3.2.3 Lens

Press the „Lens“ button in the „Parameter“ menu to activate the **„Lens“** tab:

The lens tab contains the database of all lenses that can be used with the camera. It is possible to add or remove a lens from the favourite lens list or edit properties. It is also possible to create a new lens as described below:



The tab is divided into three sections:
Brand, Lens, Parameters

Brand: contains a list of all lens brands stored in the data base

- **New:** click on **“New”** to create a new brand
- **Delete:** click on **“Delete”** to delete existing brands. Please note that factory lens brands are not removable.
- **Select:** click on any brand to display all the corresponding lenses in the next field

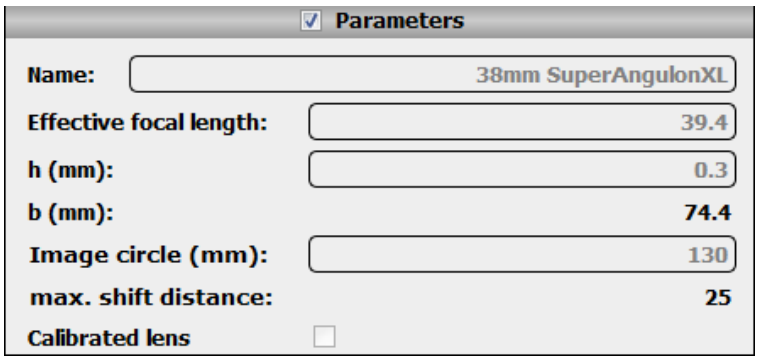
Lens: contains all lenses of the selected brand

- Click on **“New”** to create a new lens
- Click on **“Delete”** to delete existing lenses.
  Please note that factory lenses are not removable.
- **Favourite:** activate or deactivate the checkbox on the left side of any lens to add or remove the lens from the favourite lens list
- **Select:** click on any lens to display all its attributes in the next field (name, focal length...). The attributes of factory calibrated lenses cannot be edited.

Parameters: contains all the selected lens attributes (name, focal length...). It is possible to edit these attributes. Please refer to next page for detailed explanation of every attribute.

3.2.3 Lens

Every lens is defined by a set of **parameters** described below:



Name: defines the name of the lens. Both the lens list and the favourite lens list will be updated with the new name when clicking outside the field

Effective focal length: defines the effective focal length at infinity as given in the technical data sheet of the lens manufacturer. Defining the correct effective focal length at infinity is very important for optimum sharpness (see also chapter 4.1.1. „How to obtain optimum sharpness“).

H: the h-value is used for calculation purposes only and does not have any significance on its own. It defines the ideal position of the camera head on the optical bench. See next page for detailed explanation

B: the b-value is the position (in mm) on the optical bench (optimum rotation point). It is linked to the h-value and the effective focal length. See next page for a detailed explanation

Image circle: defines the image circle delivered by the lens. For lenses with an image circle of less than 60mm (for example small format lenses), the image format (vertical resolution in mm) will be automatically adjusted. This avoids black borders on the upper and lower end of the image circle. See also chapter 3.1.2 „Format“.

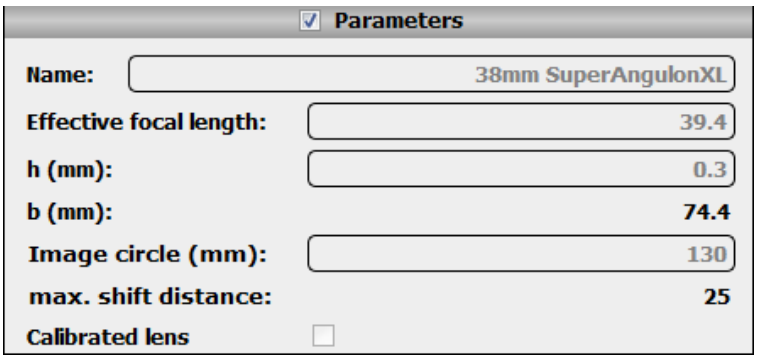
Max. shift distance: defines the maximum shift allowed with lenses with an image circle bigger than 60mm. The maximum shift value in one shift direction is indicated in the „shoot“ menu bar.

Calibrated lens: Some fisheye lenses can be used to create fully spherical panoramas. To get perfect results it is necessary to calibrate these lenses at the factory. In this case this option will be checked by default (for example the **“Mamiya 24mm Sekor C calibrated”** lens)

Set all lens parameters with the **highest possible precision** as they can have a **major effect on image quality**. Wrong parameters may lead to blurred images, stretched or compressed objects.

3.2.3 Lens

A large variety of lenses are calibrated at the factory, i.e. their rotation points (b-value) are determined for optimum sharpness. These lenses are included in the factory lens list.



The rotation point of the lens defines the position of the camera head for which the best sharpness is achieved. The optical bench of the camera allows sliding the camera head forward or backward to place it in its optimum rotation point. You will find more background information on how to obtain optimum sharpness through rotation point settings in section 4 „How to".

In case the lens is not yet on the lens list it is also possible to program a new lens.
To do this the following parameters are required:

$$h = b - f$$

where: h = h-value
b = b-value (at infinity)
f = effective focal length (at infinity)

The b-value is the position (in mm) on the optical bench (optimum rotation point).
The h-value is used for calculation purposes only and does not have any significance on its own.

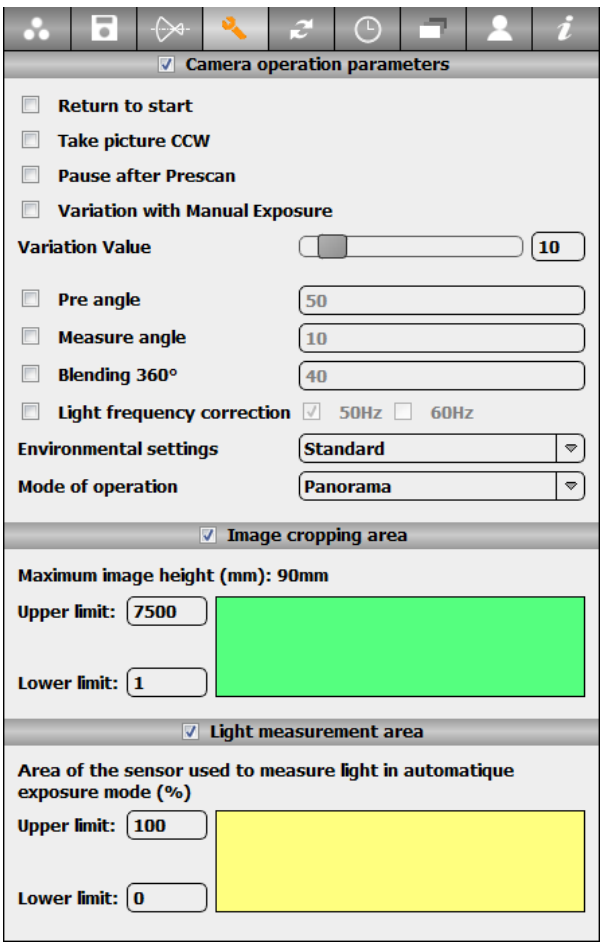
There are two ways to determine the optimum rotation point:
- By calculation (from technical data sheet) – done at factory
- Through empirical testing

For more information on the empirical testing see section 4 „How to".

3.2.4 Camera parameters

Press the „Camera parameter“ button in the „Parameter“ menu to activate the **„Camera parameters“** tab:

The settings in this tab affect the camera rotation, the vertical image format and the light metering. Any change will be applied starting from the next scan.



The tab contains the following options:

Return to start: force the camera to return to start from the same path as image scan. This is necessary for pixel-exact merging of multiple images (when combining several images by shifting or for HDR)

Take picture CCW: scan the panorama in the opposite direction(it is necessary to rotate the digital back upside-down)

Pause after prescan: after making a prescan, the camera stops at starting position. When the button “resume” is pressed the image scan is done directly using the previous exposure measurement

Variation with manual exposure: after taking an image using a fixed exposure time, it is possible to edit an exposure correction curve overlayed on the image. The image exposure time will vary within a single image according to the defined curve

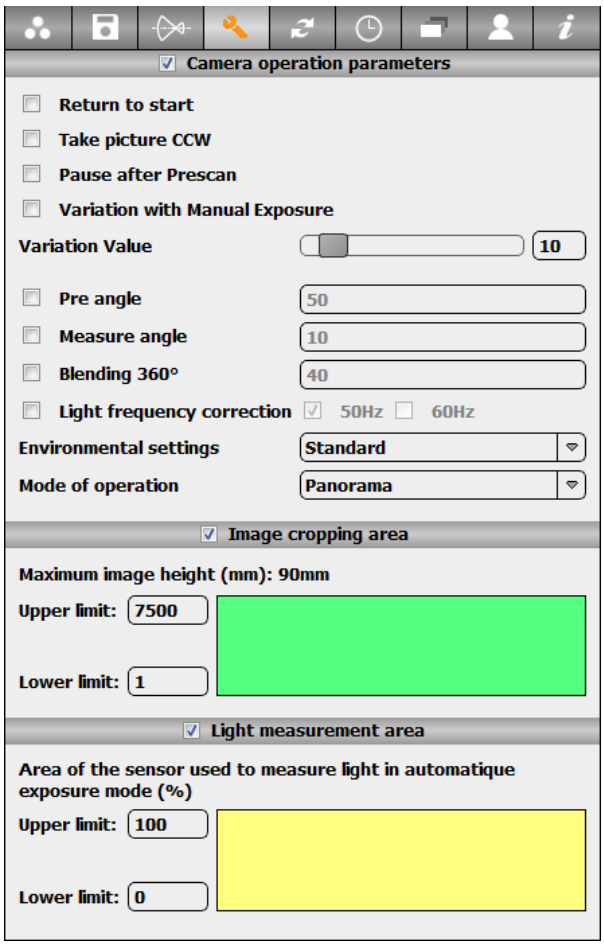
Variation parameter: defines how fast the exposure correction can be done. A small value gives a smooth adjustment, a strong value gives a sharp adjustment.

Pre-angle: sets a pre-rotation (without image taking) before the actual image capture

Measure angle: defines the horizontal angle for automatic light metering. Please note that for automatic exposure (pre-scan) the camera creates a pre-scan for exact light metering

To combine several images either for multiple HDR or for shifting / stitching it is necessary to force the motor back by a counter-clockwise rotation (option: “return to start”). This allows are very precise pixel registration and easy merging.

3.2.4 Camera parameters (continued)



Blending 360°: activates automatic blending of beginning and end of a 360° panorama. Enter the desired overlap in degrees. For example, when entering "40" the camera will capture a 400° panorama. The output will be a 360° panorama.

Light frequency correction: Compensates for indoor light frequencies (50Hz for Europe/ 60Hz for US). With fluorescent lighting and without correction the image will contain darker and lighter vertical stripes at fast scanning speeds

Environmental settings: Choose between standard and cold condition. The cold condition gives more power to the motor avoiding it to block in a low-temperature environment, but it consumes more battery

Mode of operation: Choose between the default panorama mode and the turntable mode. To use the turntable mode, a special turntable bench is required. For more information see section **"How to... create turntable scans"**

Image cropping area: The image can be cropped vertically by indicating an **upper or lower limit** (in pixels). For full resolution: 1 to 7'500. The green area in the rectangle shows the scan area

Light measurement area: defines the vertical area of the sensor used for light measurement in automatic exposure modes

"Blending 360°" works only with an angle of exactly 360°.
When selecting any other angle the blending option will be set to "off".

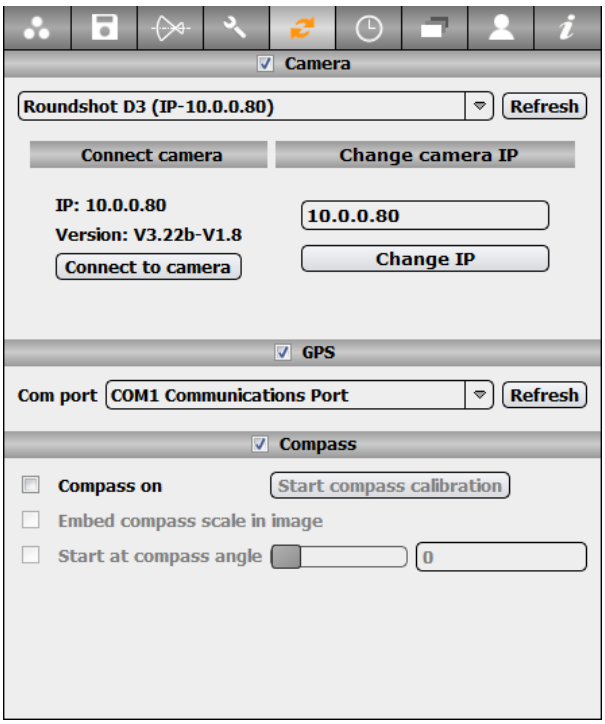
When the final output format and media (print vs. web) are not yet final, use the full image format (vertical / horizontal). On the other hand, if the final output format and media are already final, it may be beneficial to reduce the format, thus minimising the amount of data and reducing the processing and saving time of the image.

The Roundshot D3 2500 (with Seitz D3 2500 digital scan back) uses the same digital sensor like the full D3 version. It is always possible to upgrade the smaller model to the full D3 version.

3.2.5 External device

Press the „External device“ button in the „Parameter“ menu to activate the **„External device“** tab:

This menu controls the connection of the software to any external device including the camera. The external devices that can be connected to the camera are GPS and compass.

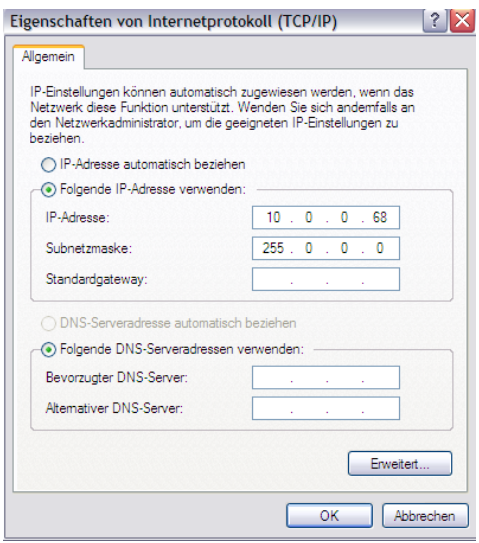


The tab contains the following options:

Camera: open the drop-down list to see all the cameras present in the network:

- **Refresh:** click on **“Refresh”** to refresh the camera list when connecting a new camera
- **Connect to camera:** after selecting the camera click on **“Connect to camera”.** The message “camera ready” should appear in the message area (bottom right)
- **Change IP:** change the camera IP address by clicking on **“Change IP”.** After refreshing the camera list it the new IP will be displayed in the camera list.

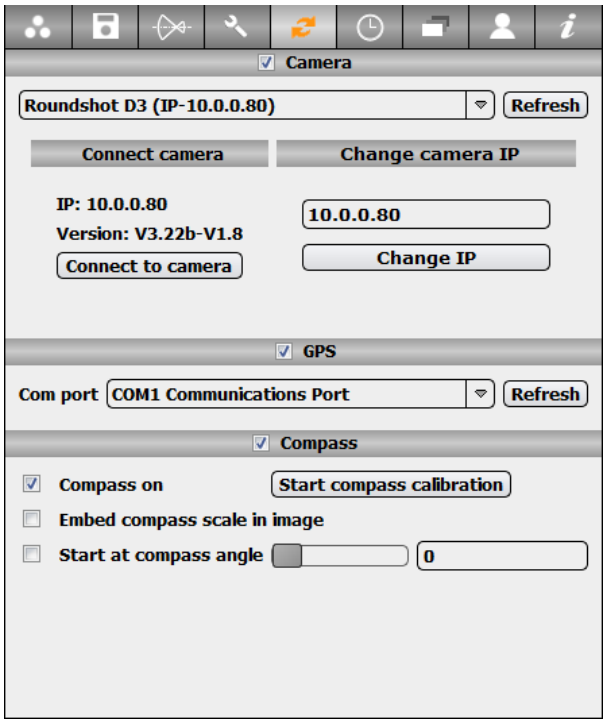
If the camera cannot be detected, open the **network properties** and check the settings. It is important that the network uses a fixed IP in the **same range** (but not identical) as the IP of the camera (digital scan back) and that both are located in the **same subnet**:



Open network connections of your computer. Open LAN connection. choose „internet protocol TCP/IP“ and „properties“, choose „fixed IP“ and enter the following IP address: 10.0.0.68
Subnet mask: 255.0.0.0

If you would like to connect to internet while working with the camera, then set an IP compatible with your network (i.e.**192.168.178.xx**), the same subnet (for example 255.255.255.0) and the same network gateway (for example **192.168.178.1**). Then change the camera IP address accordingly (for example **192.168.178.yy**)

3.2.5 External device (continued)



GPS com port: select the communication port used by the external GPS device. When an active GPS is connected, the GPS location is written automatically in the image metadata.

Three symbols show the GPS device status (bottom right of the main window):


No GPS device connected to the selected com port


GPS device detected but no position aquired


GPS device detected and GPS location acquired

When connecting a GPS device after starting the computer click on **"Refresh"** button to see this new device in the GPS list

Compass: if a compass device is connected to the camera, it is possible to activate the compass by selecting the "Compass on" checkbox. When active 3 options can be defined:

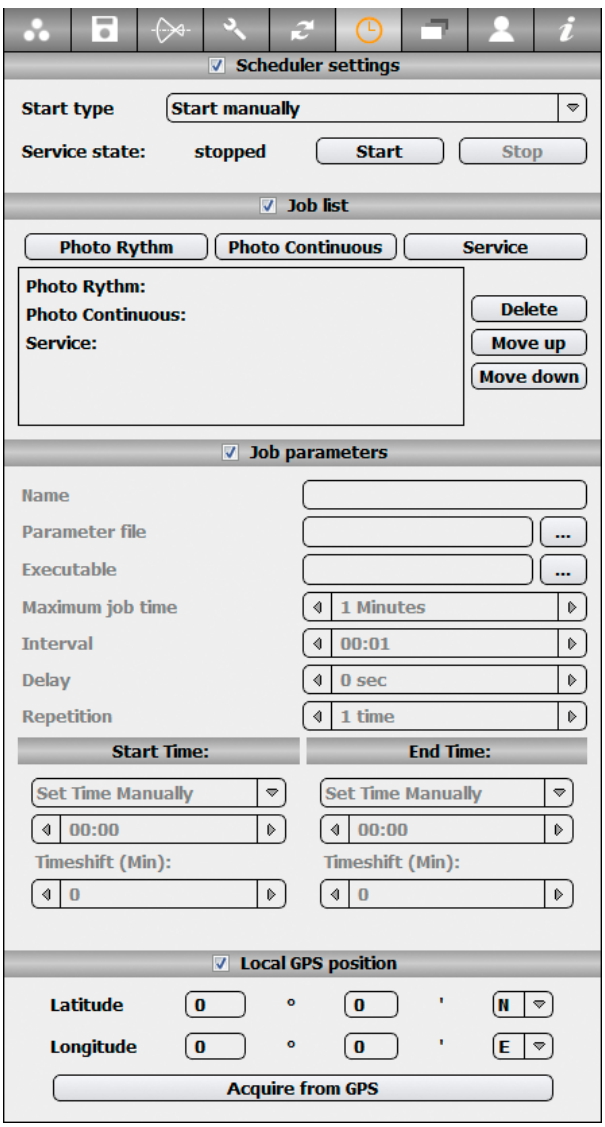
- **Start compass calibration:** press on this button to allow the compass to be calibrated on the first use. The camera will rotate 360° and the compass output will be synchronized with the motor rotation. This needs to be done only once. The calibration has to be done outside any building to avoid magnetic interferences
- **Embed compass scale in image:** allows to embed the compass output angles in the image. These angles will be visible only on tiff or jpeg images. DNG files are not modified
- **Start at compass angle:** allows to always start taking the picture at the selected compass angle no matter the initial direction of the lens. For example: when setting this angle to 0° ensures that the images will always start direction North


If any GPS or compass option is active while no GPS or Compass device is connected, the settings will be ignored.

3.2.6 Scheduler

Press the „Scheduler“ button in the „Parameter“ menu to activate the **„Scheduler“** tab:

This menu allows to program automatic image-taking with predefined parameters. For example, the “Scheduler” can be used to create a time-lapse over a day.



The tab contains the following options:

Scheduler settings: Select the start type for scheduler to use (manual/automatic).

By pressing “start” the Scheduler can be started.

Please refer to section 4.12 for a more detailed explanation on the scheduler.

Job list: define the image sequence to be done

- **Photo rhythm job:** creates a photo job that will be repeated in a fixed interval
- **Photo continuous job:** creates a photo job that will be continuously repeated until the Scheduler is stopped
- **Service job:** allows to activate external postproduction scripts at defined intervals
- **Delete/move up/move down:** allow to manage the jobs and their sequence. The first job in the list is done first followed by the second in the list.

Job parameters: define the parameters of the selected job in the list including job name, start and end times, intervals between jobs or repetition and delays for photo continuous jobs.

Assign a profile for the job to be applied for every image in **“Parameter file”**. It is also possible to automatically start post-processing scripts after image taking.

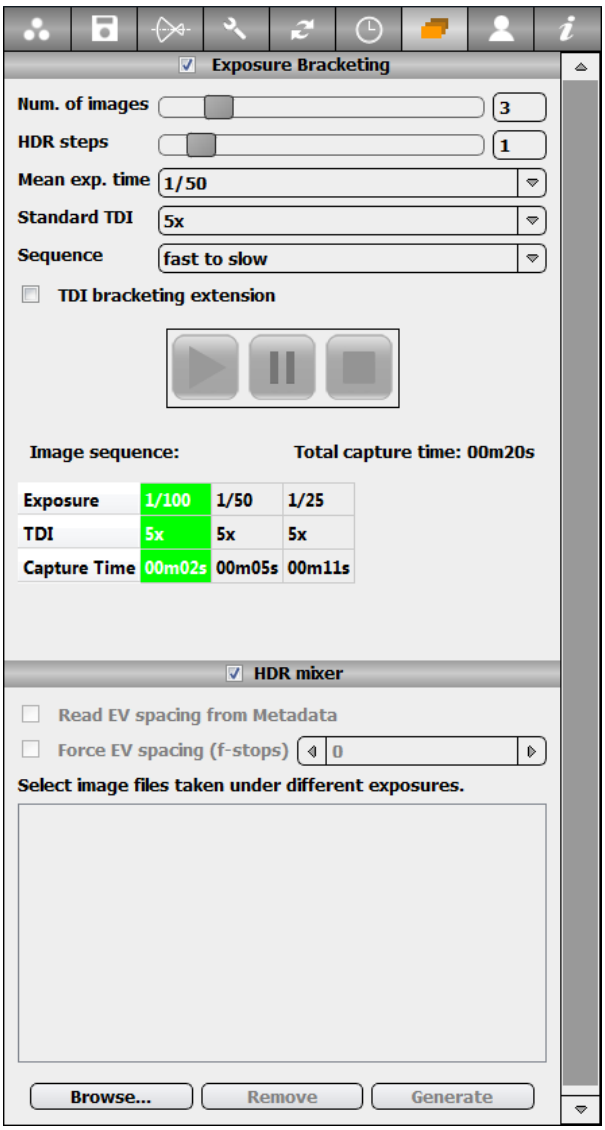
Local GPS position: define the GPS position of the camera manually. This will allow to use sunset / sunrise or nautical twilights as start/end time.

If a GPS Device is connected to the computer it is also possible to load the GPS location by clicking on “**Acquire from GPS”**

3.2.7 HDR

Press the „HDR“ button in the „Parameter“ menu to activate the **„HDR“** tab:

This menu is specific for HDR photography, it allows the automatic capture of bracketed images with defined aperture steps. It is also possible here to merge dng images into 32bit EXR files using the HDR mixer.



Exposure bracketing: defines the bracketing parameters to generate the image sequence:

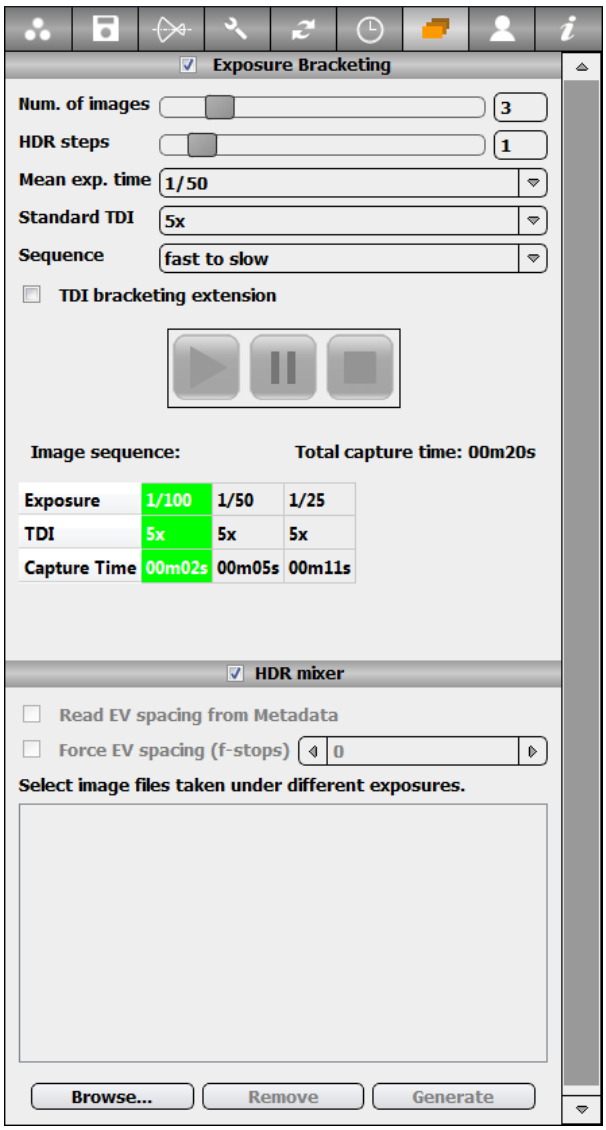
- **Number of images:** defines the number of images in the sequence.
- **HDR steps:** defines the exposure difference in f-stops between 2 consecutive images.
- **Mean Exp. Time:** defines the exposure time for the median image. It can be manually selected or automatically computed with automatic exposure modes.
- **Standard TDI:** defines the user reference TDI for the sequence. If the range of scanning speeds is sufficient, this TDI will be used for all images.
- **Sequence:** from fast to slow images or from slow to fast.
- **TDI bracketing extension:** when active some images might be taken with different TDIs if the sequence reaches the limits of the scanning speed range.

Based on all parameters an **image sequence** is generated automatically and displayed in a **table**. The capture time of every image and the total capture times are also displayed. Processing and saving times are not included in this calculation.

Then it is possible **to start the image sequence** by clicking on **the play button in this menu.** Please note that the main play button will only initiate a single image with the active parameters.

When a sequence is started it is possible to make a **pause**. This will cancel the image taken currently and by clicking it again it will restart the sequence from this image. To terminate a sequence completely, press **stop**.

3.2.7 HDR (continued)



HDR mixer: this function merges differently exposed images of the same scene into a single 32bit EXR file. The input files must be in DNG format.

Press **"Browse"** and select a set of differently exposed images of the same scene.

All the parameters necessary for generating the HDR file are stored in the image metadata (except for aperture - see hint below).

Click **"Generate".** The mixing of images into the 32-bit HDR file takes a few minutes, depending on image size and number of images. The progress of the mixing process is indicated by a percentage progress bar.

The **32bit EXR file** is saved according to the selected image saving path.

When using the exposure bracketing sequence the images are saved automatically, no matter the selected saving mode. The images are saved in the defined folder applying the selected naming options.

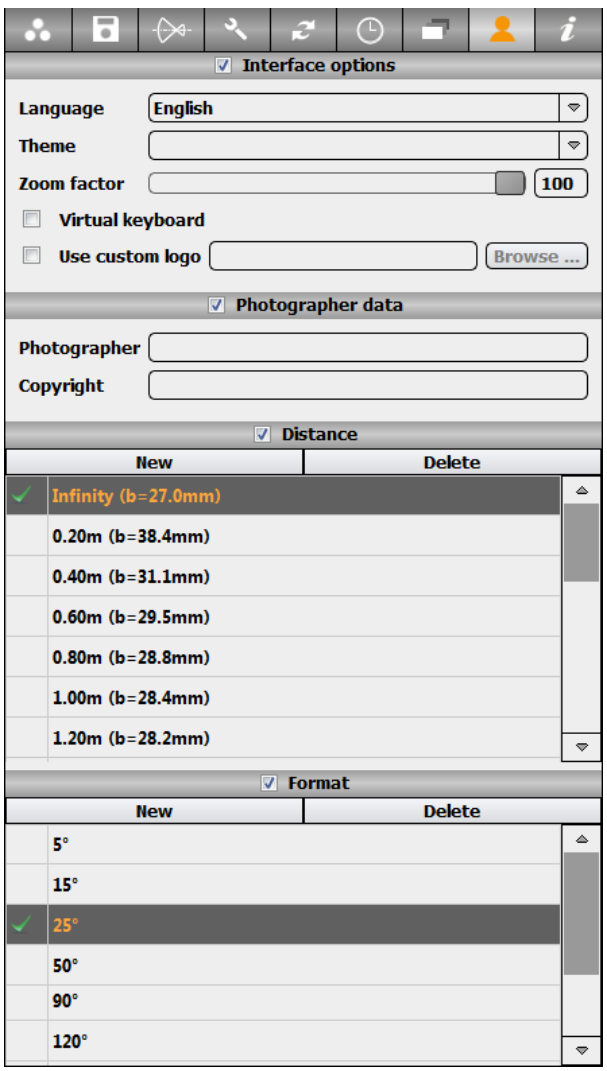
Avoid changing the lens aperture from image to image because:
- The camera can move slightly creating a misalignment between images
- The depth of field changes between images
- The aperture information is not written in the metadata and has to be corrected manually. This can be done by readjusting the exposure time in a metadata editor like PhotoMe.

To obtain a perfect pixel registration between the different images the function **"return to start" is activated automatically.** At the end of the HDR sequence it will come back to its original state.

3.2.8 Custom

Press the „Custom“ button in the „Parameter“ menu to activate the **„Custom“** tab:

This menu allows to select the interface preferences, to acquire photographer data, and to edit the distance and format lists.



The tab contains the following options:

Language: select the interface language. The available languages are:

- English
- Deutsch
- Français
- Italiano
- Español
- Simplified Chinese
- Standard Japanese

Theme: select the interface skin by changing the theme. This function will be active in a next software release

Zoom factor: define the image zoom factor when using the zoom tool. By default the zoom factor is 100%

Virtual keyboard: activate this option to access the software internal keyboard. This keyboard will appear each time an editable field will be selected

Use custom logo: customize the background of the shoot menu with a custom logo. Browse the corresponding jpeg or png file and restart the software

Photographer: enter the photographer's name or signature. This information will be stored in all image metadata and is not editable

Copyright: enter the photographers copyright to identify all the images

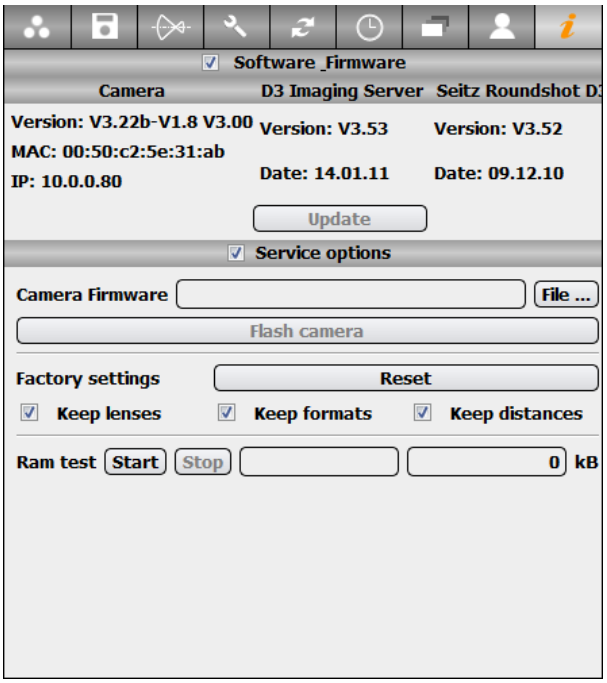
Distance: contains focusing distance list that is accessible from the shoot menu. Click on **"New"** or **"Delete"** to add or remove elements to this list. By double clicking on any item it is also possible to edit its value

Format: contains image angles list that is accessible from the shoot menu. Click on **"New"** or **"Delete"** to add or remove elements to this list. By double clicking on any item it is also possible to edit its value from 1° to 999°

3.2.9 Info

Press the „Info“ button in the „Parameter“ menu to activate the **„Info“** tab:

This menu allows to see the versions of capture software and camera firmware. By opening the service menu field it is also possible to change advanced settings as defined below.



The tab contains the following options:

Software & firmware field: the currently installed software and firmware versions are indicated in the list:

- Camera (flash file software within the Seitz D3 digital scan back)
- D3 Imaging Server
- Seitz Roundshot D3 (this software)

Service menu: activate the service menu and enter the following password **31415**. This menu contains sensitive tools that should only be used with precaution. Please follow the indications in the software and in this instruction manual carefully.

Camera firmware: this function allows to update the firmware installed in the camera. After installing a new software, connect to the camera and make sure the battery is fully charged. Then browse the new flash file “xxx.d3flash” and click on flash camera. By default the camera flash files are located in :
C:\Program Files\Seitz\Digital3\PDS\flash\flashfiles

Factory settings: by selecting “Reset” to factory settings all parameters of the software will be restored to default values. It is possible to do so by keeping lenses, formats and distances.

RAM test: please do not use this tool unless asked to do so by the Seitz team. This tool checks if the RAM of the digital back works correctly.

The camera firmware is always included in the software installer. If the capture software and camera firmware are incompatible, the installer will automatically ask for a firmware update .

Please note that a password is required to open the service menu. The password is : **31415** (the first 5 digits of π)

4. Tips & Resources (How To . . .)

Contrary to traditional digital cameras, the Roundshot D3 does not acquire the image by a „oneshot“ exposure. The image is created by a fast TDI scan. The techniques involved for this technology are different from traditional digital photography. Setting the image parameters correctly will have a visible impact on image quality.

This is why we have summarised the most important tips & resources in this section. When applied closely these tips will allow enhanced image quality (better sharpness, better exposure, limited noise and limited artefacts). Further techniques (for example shift) allow to exploit the full potential of this high resolution camera.

4.1 … set the b-value (camera head position)

The b-value indicated in the distance field of the software corresponds to the best camera head position on the optical bench. Setting the camera head position correctly is necessary to obtain the best sharpness.

The optical bench can be attached in 2 positions on the motor (A or B) as shown in the examples below. The A position is optimised for small b-values lenses (shorter lenses) while the B position allows higher b-values lenses (longer lenses).

A **A position**

B **B position**

4.1 … set the b-value (camera head position)

For each position only one scale can be used to set the b-value:

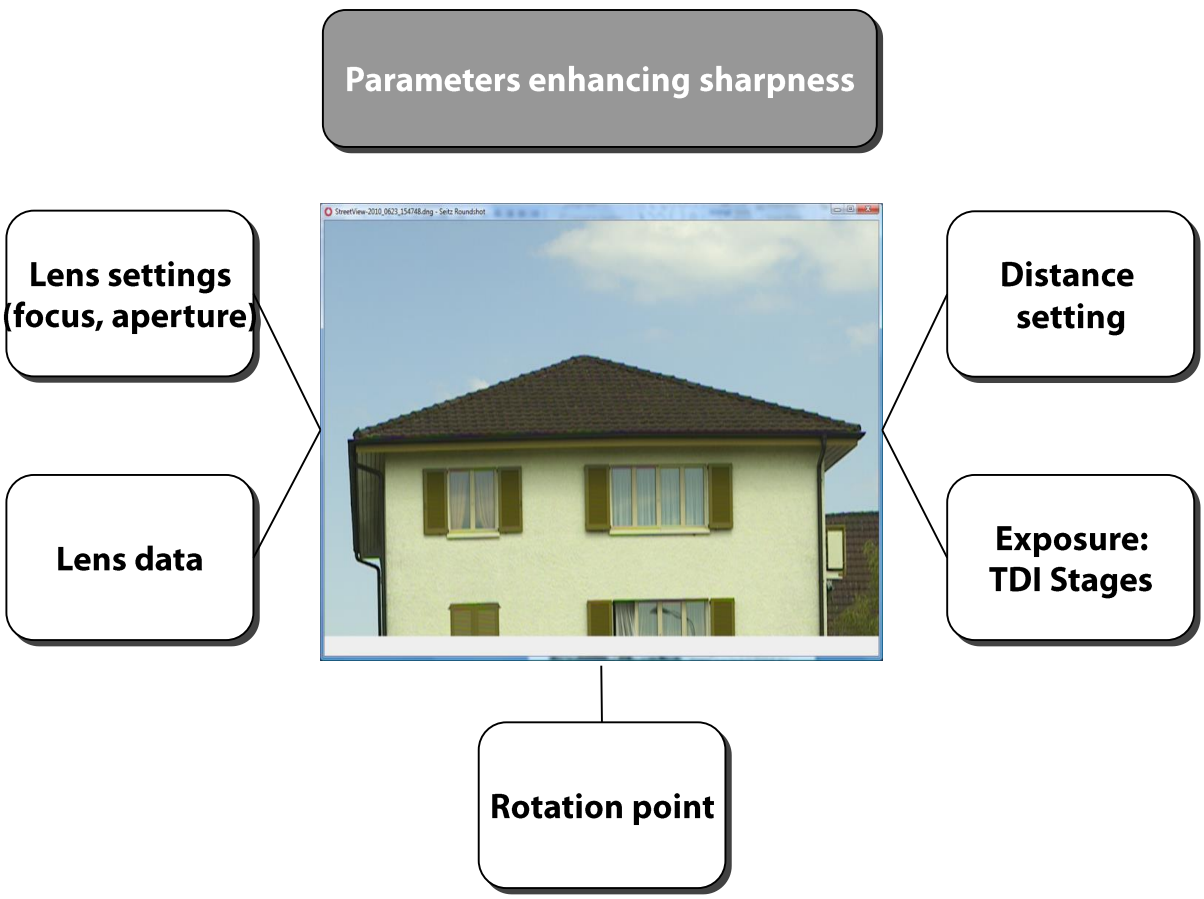
- **When using position A:** read the scale from the front side of the camera body where the mark A is printed. (image left)
- **When using position B:** read the scale at the back side of the camera body where the mark B is printed. (image right)

A **A position**

B **B position**

4.2 … obtain the best sharpness

There are several factors at work that influence the sharpness of the image:



Lens settings (focus, aperture)

Focus the lens manually and with the Focusing Assistant
Set the approximate distance on the lens first and then use the Focusing Assistant to fine-tune sharpness. Repeat this process once all other sharpness enhancements (lens data, rotation point, distance setting, exposure: TDI Stages) are complete.

Close the aperture as far as possible
Contrary to other digital cameras and digital backs the optimum sharpness is not achieved at an intermediary f-stop (such as f=11) but rather when closing the aperture as far as possible (for example, f=22 or more).

Lens data

Enter accurate lens data
Make sure that the effective focal length in the software is accurate. For example, the effective focal length for the 80mm Schneider Apo-Digitar L is not 80.0mm but 80.34mm. Setting the effective focal length precisely is important to:
- Compute and set the exact rotation point
- Calculate the exact horizontal dimensions of the panorama

Distance setting

Set the same distance in the software as set on the lens
Changing the focusing distance on the lens makes the focal length vary. Enter the exact focusing distance in the software („Distance“). The software computes the new effective focal length which in turn is needed to obtain the best sharpness.

Exposure: TDI Stages

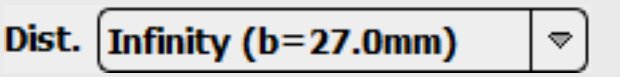
Select less TDI Stages if possible
When using fisheye lenses for spherical 180° x 360° panoramas, the angles at the edge become extreme, so there is a loss in sharpness in these areas of the image. Limiting TDI Stages to 1x or 2.5x allows a better alignment and increased edge sharpness for fisheye lenses. For other lenses it is also recommendable to use less TDI stages. Use TDI 20x when necessary (for example for indoor photography).

For a large variety of Schneider and Rodenstock lenses all lens data is known and the computation of the correct rotation points is possible. For some other medium format lenses, however, this data is not available and the lens data can be set only by approximation. In this case it is advisable to use less TDI Stages, thus allowing better pixel alignment and better sharpness.

4.2 … obtain the best sharpness (continued)

Rotation point

Set the exact rotation point (b-value) on the optical bench
When confirming the lens data or distance setting the software indicates the new rotation point (b-value) as follows (example):

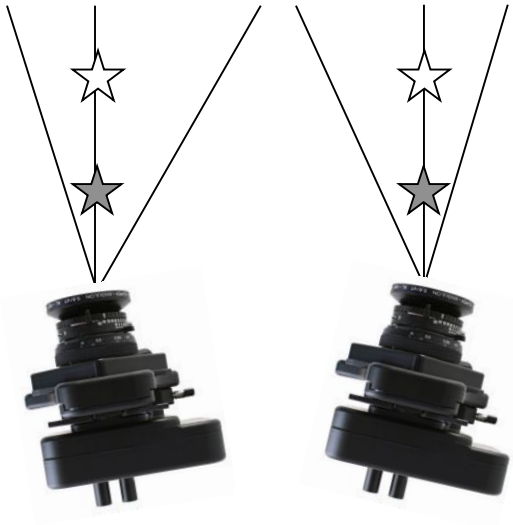


Please refer to previous section 4.1 to see how to set the correct b-value on the camera. Small deviations can make a noticeable difference in sharpness.

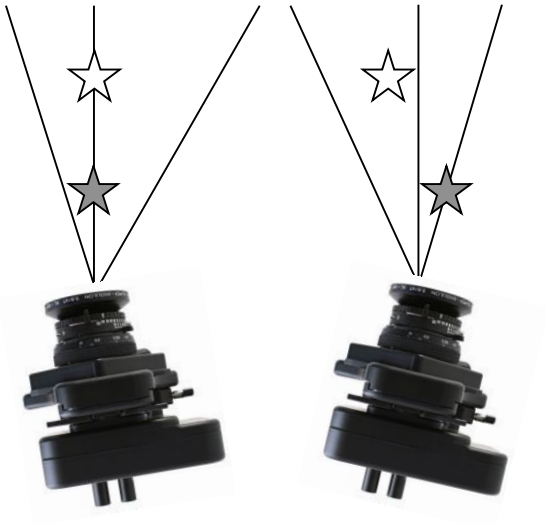
Why is the rotation point important for sharpness?

The Seitz D3 digital scan back uses a surface of the TDI sensor for simultaneous exposure of pixels. The more TDI Stages are selected, the larger this surface becomes. When the rotation point is not correctly set, two points in space do not have the same alignment on the left or the right of the sensor surface. Since for one point in space a number of pixels of the sensor are combined, the misalignment will lead to a blurred image. For a good rotation point, all pixels are aligned and the image is sharp.

Good rotation point:



Bad rotation point:



When using less TDI Stages (for example: 1x), the loss in sharpness resulting from of a bad rotation is much less than when using more TDI Stages (for example: 20x).

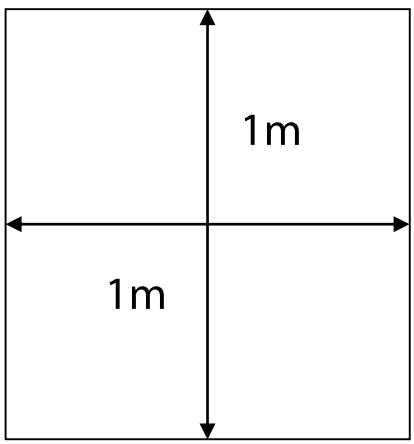
4.2 … obtain the best sharpness (continued)

How to determine the effective focal length and rotation point empirically

Many medium format lenses are calibrated at the factory and their effective focal length and rotation points are programmed in the Seitz Roundshot D3 software.

For lenses that are not in the software or in the lens lists it is also possible to determine the effective focal length empirically. This can be done in the following way:

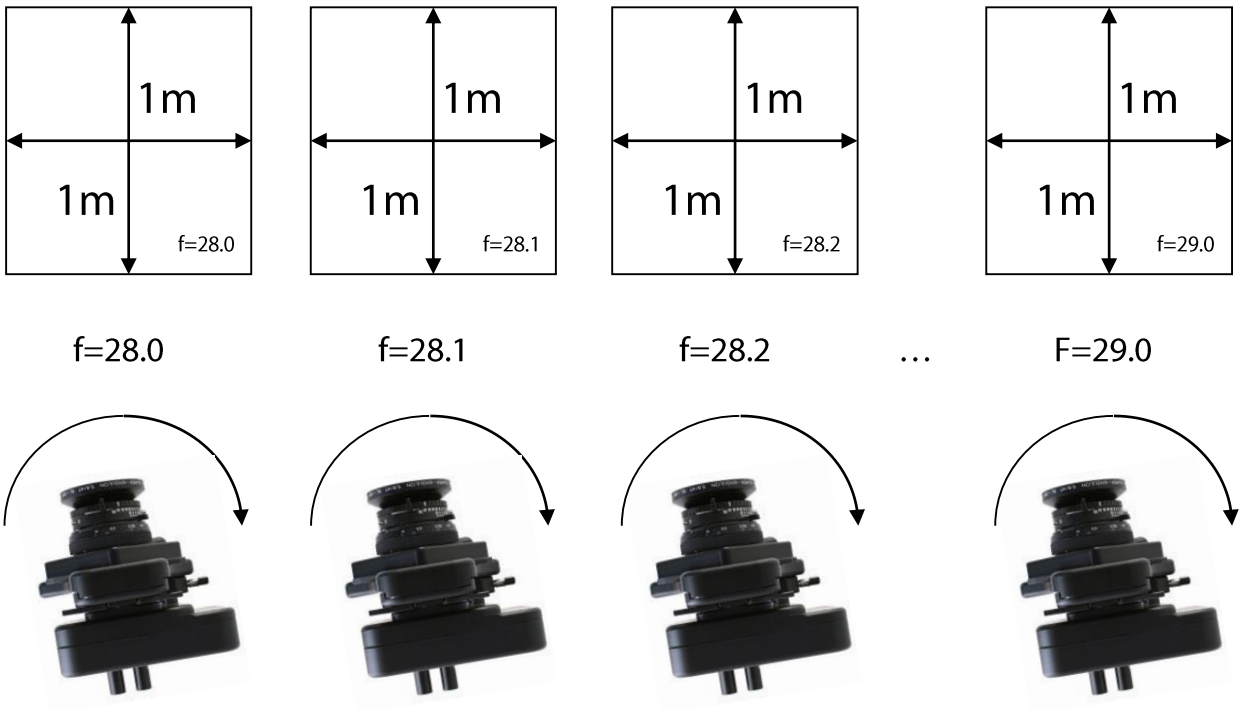
Step 1: Set up a square table at a distance of a few metres on a wall (exactly 90° angle to camera). On the table draw a cross (for example, exactly 1m vertical, 1m horizontal):



Step 2: Centre the optical axis of the Roundshot D3 camera exactly at the centre of the cross. Focus on the cross and change the distance in the software. Use TDI Stages 1x as this minimises the potential error of a wrong rotation point). Enter the effective focal length in the Seitz Roundshot D3 software, starting for example with f=28.0

4.2 … obtain the best sharpness (continued)

Step 3: Complete a series of test images with TDI Stages = 1x, each time increasing the effective focal length in the software. The Seitz Roundshot D3 software will automatically adjust the image length (amount of pixels horizontally).



Step 4: Open the test images in an image processing software. Magnify the square lines and place magnetic guides that match the square exactly. Mark the 1m x 1m table and copy it into a new file. Check the image dimensions. When you have found a perfectly square table you have found the correct effective focal length.

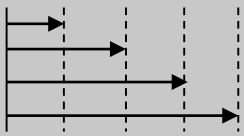
Step 5: Enter the correct effective focal length in the software. Change TDI Stages to 20x. Create test scans of the square and change the rotation point every time. Save the images and open them in an imaging processing software. A perfectly square table indicates that the right rotation point has been found.

4.3 … control the exposure

The exposure is influenced by four factors:
• TDI Stages
• ISO/ASA
• Exposure speed
• Aperture

4.3.1 Using TDI Stages to control the exposure

Simultaneous exposure of the sensor's surface with simultaneous read-out (TDI)



TDI Stages

Instead of exposing just one vertical line, the Seitz D3 Digital Scan Back exposes various vertical lines at the same time which are read out continuously with TDI technology. In other words, a surface – rather than just a line – is exposed. This is how the fast capture speed is possible.

The readout speed of the sensor is synchronised with the rotation speed of the camera head to allow perfect positioning and sharpness of the image.

The larger the scan area (the more TDI stages), the more sensitive is the scan and the faster is the image capture.

One important benefit of creating additional sensitivity by using TDI stages is that there is no additional noise.

The available TDI Stages are:
1x, 2.5x, 5x, 10x, 20x

4.3.2 Using ISO/ASA to control the exposure

Just as for traditional digital cameras the Seitz D3 Digital Scan Back can also create additional sensitivity by using gain. Increasing the gain factor amplifies the signal. This type of sensitivity is expressed in ISO/ASA values. Increasing gain, however, leads to additional noise.

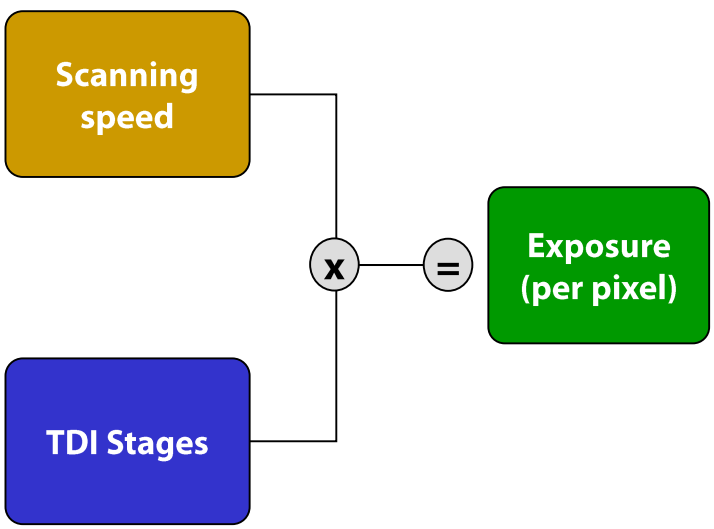
The available ISO/ASA values are 100, 200, 300, 400, 600 and 800.

4.3 … control the exposure (continued)

4.3.3 Using the exposure speed to control the exposure

Contrary to „one-shot“ photography, where the exposure is defined by the time between opening and closing of the shutter, the Seitz D3 Digital Scan Back creates the exposure by rotation*. The read-out of data (pixels) is continuous. Hence, the exposure is defined by the time the area of the sensor is exposed for one point in space.

For example, when using 10 vertical lines (10 TDI stages) for the scan, one pixel is exposed 10 x at a 10 x faster exposure speed (underexposed). The sum of the 10 exposures then gives the final pixel exposure. This is how a 10 x faster image capture can be achieved compared to scanning with just one line.



The more sensitivity is used (by using TDI stages), the longer is the equivalent exposure. In other words, when increasing TDI stages for equal lighting conditions, the photographer needs to close the aperture accordingly, otherwise the image will be overexposed.

* The exposure speed of the Seitz D3 Digital Scan Back is always an equivalent as compared to „one-shot“ photography.

4.3 … control the exposure (continued)

4.3.3 Using the exposure speed to control the exposure

The minimum exposure speed is dependent on TDI Stages:

TDI Stages	Minimum exposure speed (seconds)	
1x	0.0005	1 / 2'000
2.5x	0.0013	1 / 800
5x	0.0025	1 / 400
10x	0.0050	1 / 200
20x	0.0100	1 / 100

In certain situations full sensitivity – so full TDI Stages – are required and the minimum exposure speed is less relevant. In other situations, for example in action photography (sports or moving landscapes), it is important to work with a faster exposure speed. This is achieved by reducing TDI Stages.

4.3.4 Using the aperture to control the exposure

As for any camera the exposure of the Roundshot D3 camera can be controlled by opening or closing the aperture. This is done manually on the lens. For best results in sharpness and depth of field we recommend closing the aperture as much as possible.

4.3 … control the exposure (continued)

4.3.5 Some examples

In certain situations full sensitivity – so full TDI Stages – are required and a fast exposure speed is less relevant. In other situations, for example in action photography (sports or moving landscapes), it is important to work with a faster exposure speed which in turn requires to reduce TDI Stages.

Here are some examples:

Moving landscapes

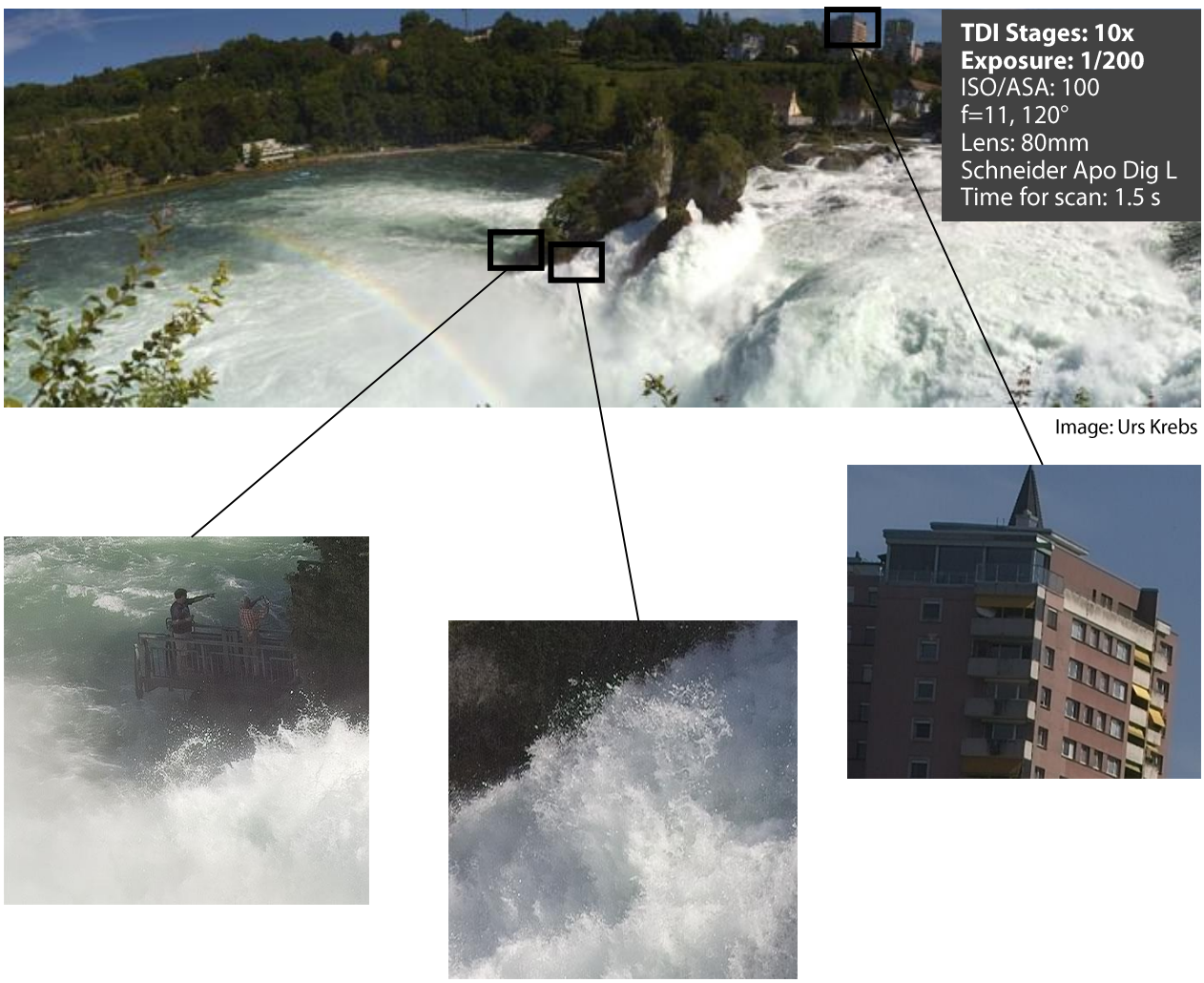


Image: Urs Krebs

To freeze the motion of the waterfall, it is necessary to reduce **TDI Stages** to **5x** or **10x**.

4.3 … control the exposure (continued)

4.3.5 Some examples (continued)

Sports

Image: Urs Krebs

The purpose of this assignment was to freeze the action of the two athletes and at the same time bring out sharpness in the background (spectators and judges). A difficult task given the challenging light conditions (indoors, daylight mixed with fluorescent). The photographer chose **maximum sensitivity** (**TDI Stages 20x, ISO/ASA 200**) and an intermediate f-stop.

4.3 … control the exposure (continued)

4.3.5 Some examples (continued)

Group photography and portraits

TDI Stages: 5x
Exposure: 1/60
ISO/ASA: 100
f=8, 80°
Lens: 80mm Mamiya Sekor C
Time for scan: 2.5s

Image: Urs Krebs

To avoid motion blur of the subject, a **medium to high exposure speed** is required for group photography and portraits. This is achieved by reducing **TDI Stages** to about **5x**. At the same time this limits the sensitivity, leaving the background intentionally unsharp. The sharpness range is placed 1m in front and the back of the people in the image.

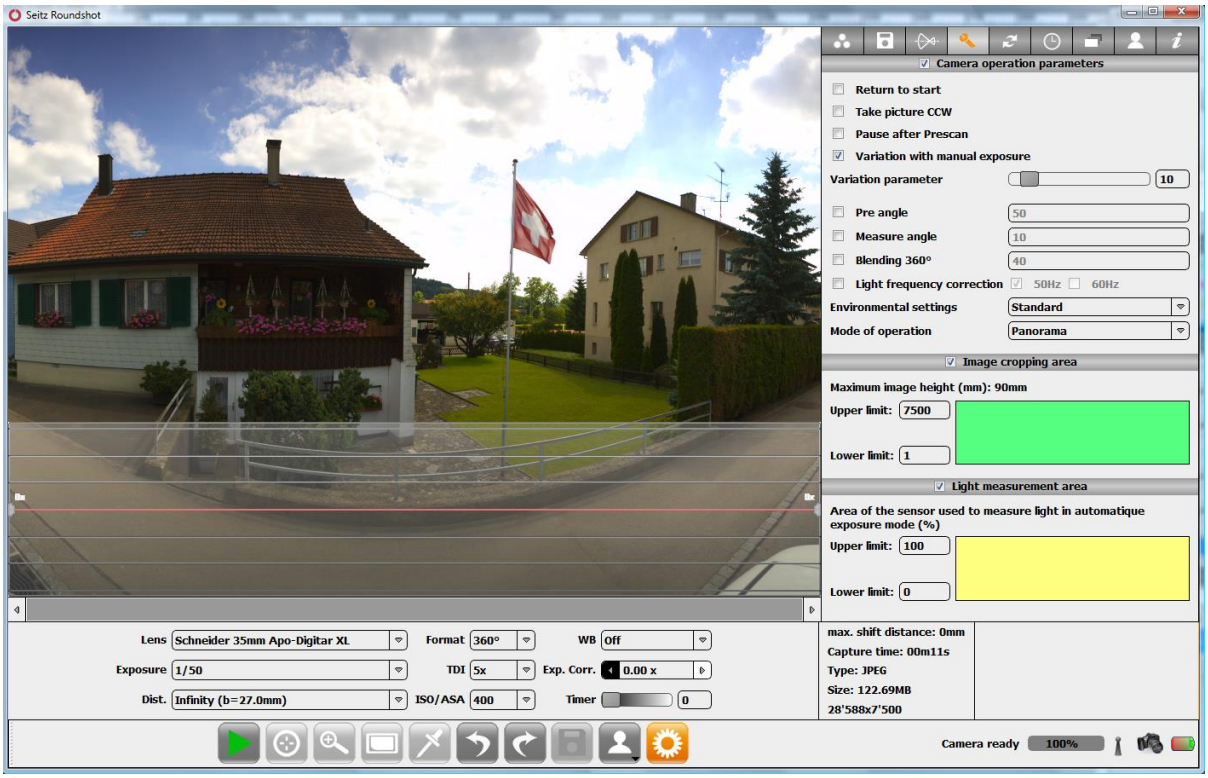
4.4 … use variation with manual exposure

The "variation with manual exposure" tool allows to manually define an exposure correction curve based on image content. This tool is very useful in difficult light conditions, especially for indoor/outdoor group photography.

Step 1: Activate the option "variation with manual exposure" in the camera parameters tab

Step 2: Select the desired "variation parameter". A large variation parameter value is used for sharp light changes. A small value is used in case of smooth light changes

Step 3: Take an image using a fixed exposure time. At the end of the scan, a flat red curve will be overlayed on the image as shown below. A flat curve corresponds to no exposure correction.

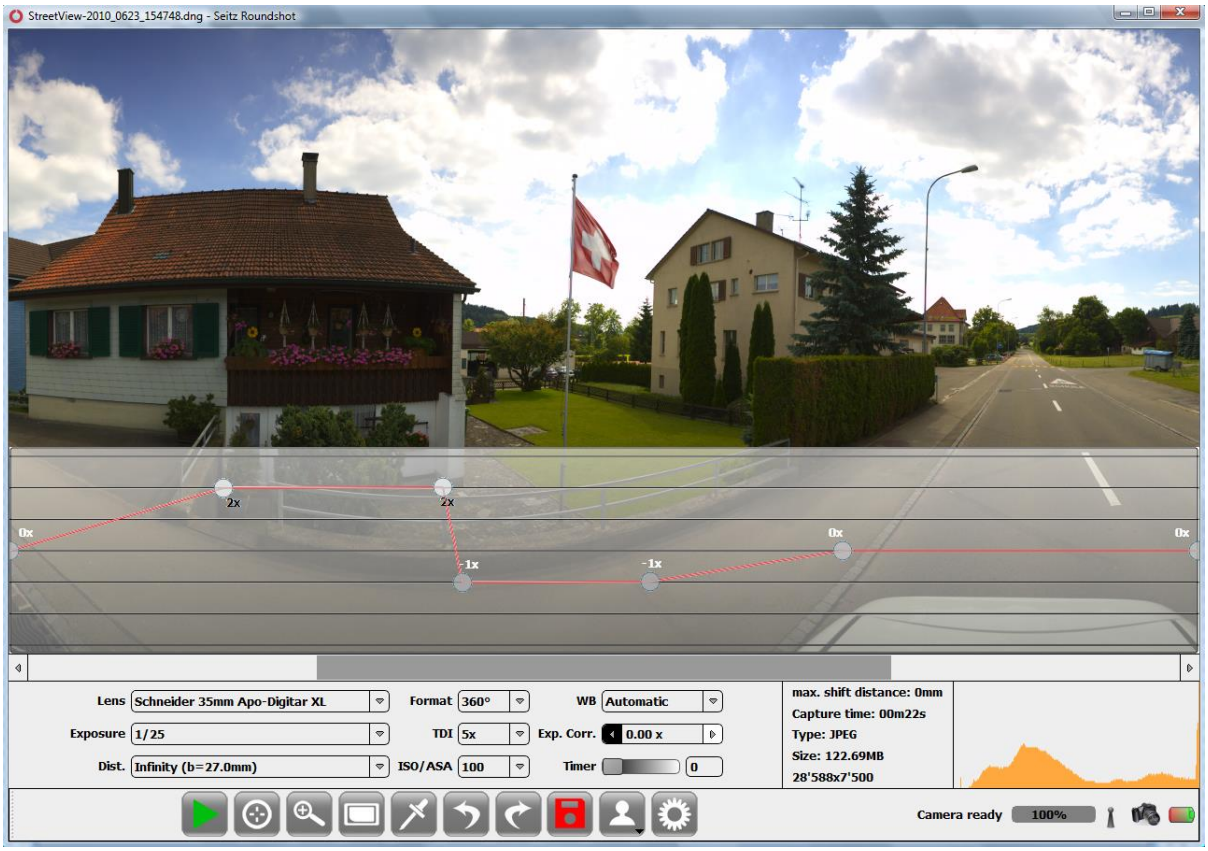


It is recommended to choose an exposure time corresponding to the average light condition of the panorama. This will help to design the exposure correction curve more accurately.

When using the "variation with manual exposure tool" the 3 fastest exposure times are not available. This is due to the limitation of the motor acceleration. Furthermore, this limit prevents sharp light transition to be visible on the images.

4.4 … use variation with manual exposure (continued)

Step 4: The exposure correction curve is designed according to the image content. Add as many intermediate point as necessary by just clicking on the corresponding location on the curve.



In this example, the exposure correction curve is defined as follows:
- section 1: smooth transition from the initial exposure time to 2 f-stops brighter
- section 2: stable exposure time at +2 f-stops
- section 3: sharp transition From +2 to -1 f-stop the resulting image will be darker

Step 5: When the exposure correction curve is designed, create a new scan to see the results. If the image is not perfect, fine tune the curve by moving every point separately.

When changing the image angle, the lens or any other parameter affecting the image format, the correction curve will be reset to flat. It is then necessary to design a new correction curve.

4.5 … select the image format

In rotational 360° panoramic photography the image format is defined by three factors:
• the **image height** (sensor resolution in pixels vertically)
• the **image length** (degrees of rotation horizontally)
• the **effective focal length** of the lens used

The **image height** for the Seitz D3 Digital Scan Back is 7‘500 pixels. This vertical resolution does not change regardless the lens used*. The vertical resolution of the final image can be further increased by scanning the scene twice while shifting the back up/down (for static scenes only). With this 50mm shift a maximum vertical resolution of 13‘750 (7‘500 + 6‘250) pixels can be achieved.

The **image length** can be defined in the software in degrees, from 1° to 999°. With a given image length and a given effective focal length, the software calculates the number of steps required to complete the image:

$$\textbf{Image length} = \frac{f^* 2 * \pi * deg}{360 * pitch}$$

where:	f =	effective focal length
	π =	3.14159265
	deg =	degrees of rotation (image length)
	pitch =	size of one pixel; for D3 = 8 µ or 0.008mm

For example:

The image length for a 360° panorama taken with the Roundshot D3 and a 35mm lens is:

35 x 2 x 3.14159265 x 360 / 360 / 0.008 = **27‘489 pixels**

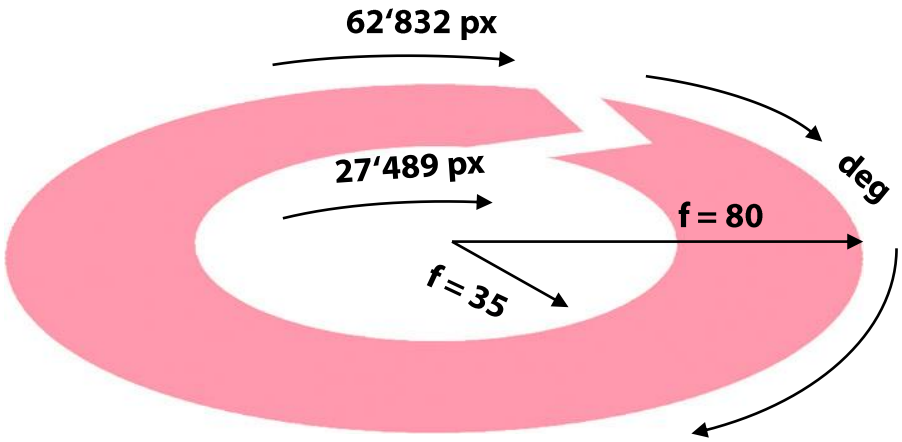
… and with an 80mm lens:

80 x 2 x 3.14159265 x 360 / 360 / 0.008 = **62‘832 pixels**

* For medium format lenses; small format lenses have less vertical resolution

4.5 … select the image format (continued)

We can also illustrate this graphically:



The larger the focal length, the longer the resulting panorama. At a vertical resolution of 7,500 pixels the panorama becomes flatter and flatter when increasing the focal length.

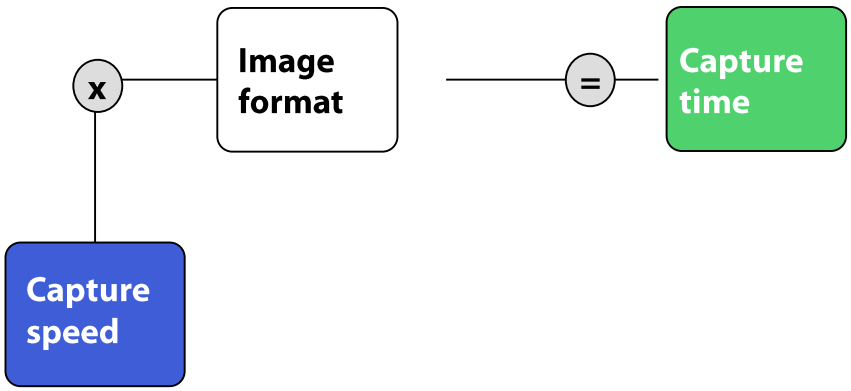
At 360° and TDI 20x, the resulting resolution, capture time and file sizes in function of the focal length are:

Focal length	Image length (pixels) at 360°	Image height (pixels)	Resolution (mio. pixels)	Capture time	File size raw, MB	File size tiff, MB	File size jpg, MB
28	21'991	7'500	165	1.1	318	954.3	94.4
35	27'489	7'500	206	1.4	398	1'192.9	118.0
38	29'845	7'500	224	1.5	432	1'295.2	128.1
45	35'343	7'500	265	1.8	511	1'533.7	151.7
50	39'270	7'500	295	2.0	568	1'704.2	168.5
55	43'197	7'500	324	2.2	625	1'874.6	185.4
60	47'124	7'500	353	2.4	682	2'045.0	202.2
70	54'978	7'500	412	2.7	795	2'385.8	235.9
80	62'832	7'500	471	3.1	909	2'726.7	269.6
100	78'540	7'500	589	3.9	1'136	3'408.3	337.1
120	94'248	7'500	707	4.7	1'363	4'090.0	404.5
150	117'810	7'500	884	5.9	1'704	5'112.5	505.6
180	141'372	7'500	1'060	7.1	2'045	6'135.0	606.7
210	164'934	7'500	1'237	8.2	2'386	7'157.5	707.8

This means that for example a 360° panorama taken with a 50mm medium format lens has a resolution of 295 million pixels, takes 2 seconds at image capture (at full exposure speed) and has a resulting file size of 568 MB in dng, 1.7 GB in tiff and 169 MB in jpg (uncompressed).

4.6 … compute the capture time

Capture time is the amount of time required to complete the scan for a given image format and capture speed (set by the exposure speed). It is calculated by multiplying the read-out speed per pixel by the number of horizontal pixels in the image:



To take the example of the 35mm and 80mm focal lengths again:

35mm: 1.4 seconds

80mm: 3.1 seconds

These are minimum capture times (under daylight lighting conditions).

4.7 … minimise noise at image capture

To minimise noise it is recommendable to use a faster exposure. A faster exposure allows faster integration times (TDI sensor) which minimises the creation of noise.

ISO/ASA (gain) amplifies the output signal and multiplies the noise in the image. Therefore it is recommendable to select a low ISO/ASA setting.

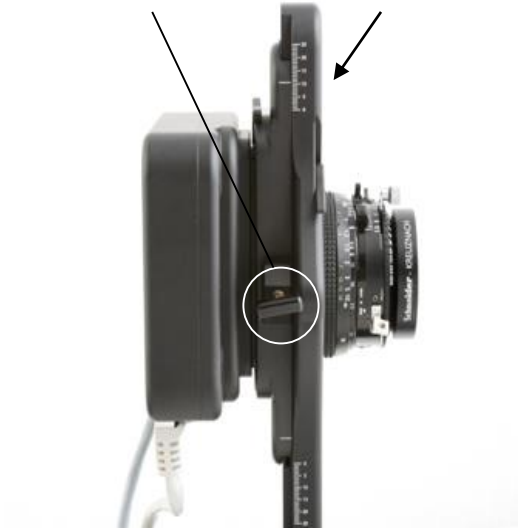
4.8 … shift

The digital scan back of the Roundshot D3 can be shifted up or down by +/- 25mm.

Shifting the back can be beneficial to:
- Select a different vertical image aspect without having to change the camera's position
- Create two consecutive scans, one at the lower border (-25mm) and one at the top border (+25mm), and merge the two images into one panorama with higher vertical resolution (60mm + 50mm = 110mm or 7,500 + 6,250 = 13,750 pixels)

To shift open the shift break and slide the back plate of the camera body up or down.

Open shift break



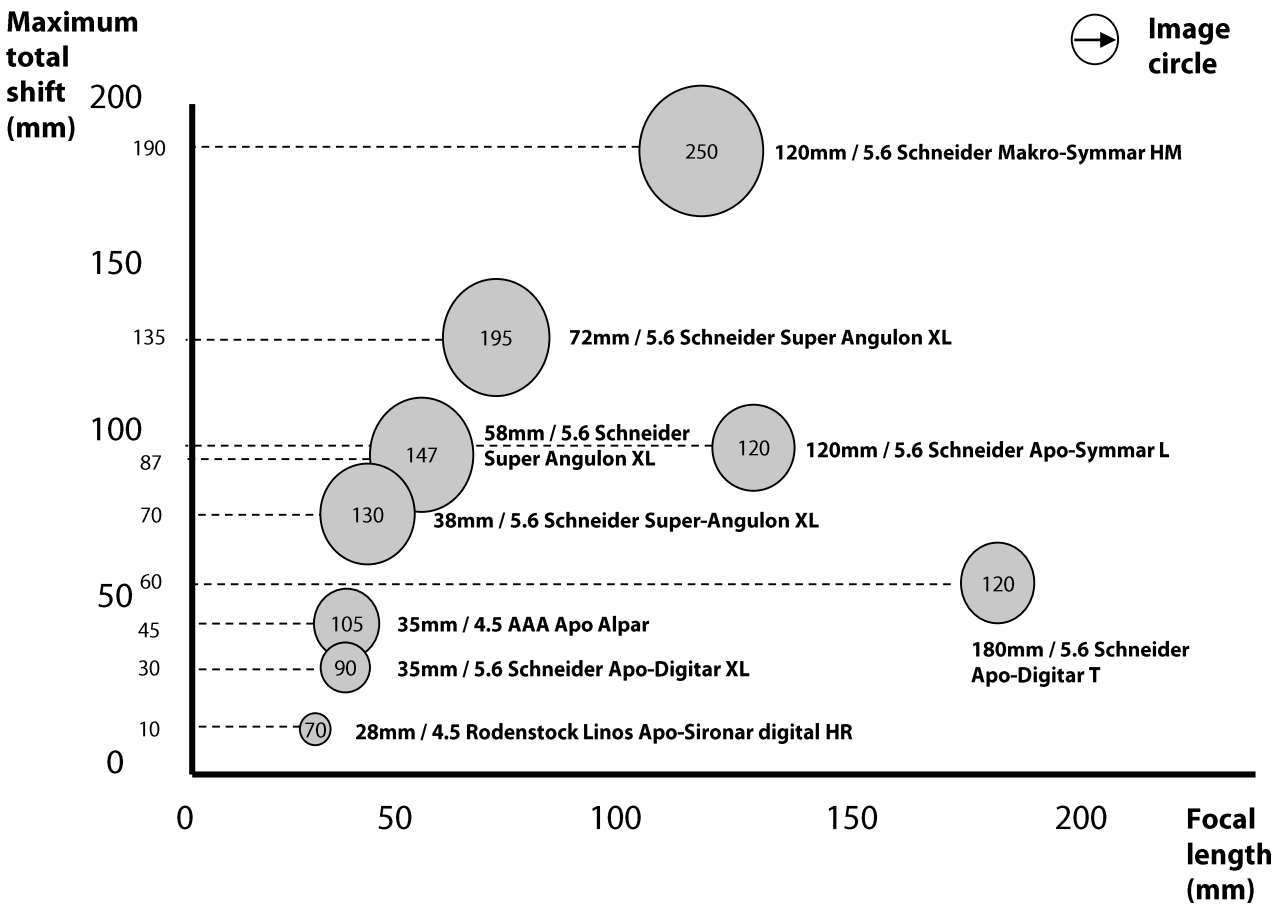
Example: Shift up by 10.5mm

4.8 … shift (continued)

Please note that when shifting the back plate of the camera body up more of the lower part and when down more of the upper part of the image will be visible.

As the digital back and not the lens is shifted the two files can be merged easily and without any distortion (for example in Photoshop).

The precondition for shift is that the image circle of the lens is sufficient and that optional lens shades are removed. In general: the longer the focal length, the bigger the image circle. Here are some examples of image circles and maximum shift:

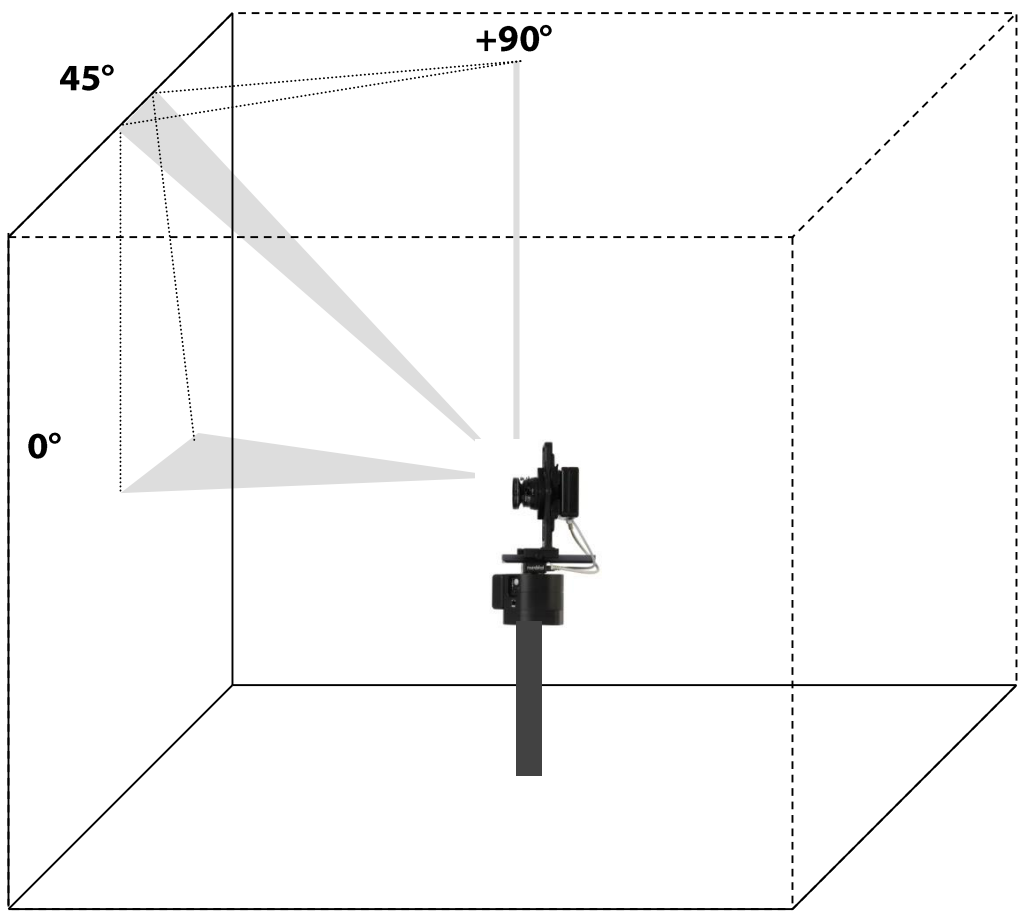


4.9 … create spherical QTVR panoramas

This section explains how to use calibrated equipment for spherical panoramas as well as blending the beginning and end of a 360° panorama manually. Please note that for software versions 3.2 and higher, the blending of the 360° panorama can also be done automatically at image capture.

The Roundshot D3 equipped with a calibrated fisheye lens allows to create a spherical 180° x 360° panorama by a single scan.

With increasing vertical angle, the horizontal field of view becomes smaller and smaller. In the extreme points (+90° - top and -90° - bottom) it becomes very small and converges to one single pixel.



4.9 … create spherical QTVR panoramas (continued)

Currently there are three fisheye lenses which are suitable for spherical QTVR panoramas and which can be calibrated at the Seitz factory for this purpose:

		With Seitz D3 digital scan back		
Lens	**Image circle at f=11** (and focusing at infinity)	**Vertical resolution (pixels)**	**Resolution after calibration (pixels)**	**Approximate field of view**
8mm Sigma fisheye f/3.5	22mm	2,750	3,063 x 6,126	180° x 360°
16mm Nikkor fisheye f/2.8	43mm	5,400	6.216 x 12,432	180° x 360°
24mm Mamiya 645 fisheye f/4.0	70,5mm	7,450	7,800 x 18,770*	150° x 360°

* For the 24mm Mamiya fisheye lens the software automatically adds a black border at the lower edge of the image to create the 180x360° format. With this black border the image dimensions are: 9,385 x 18,770 pixels

To capture the extreme points (+/- 90°) the fisheye lens is distorted, ie it has a non-linear behaviour for the last few degrees.

The purpose of the lens calibration is to correct this non-linearity and to optimise the camera hardware to minimise any potential error.

The calibration is done on a special calibration bench at the Seitz factory and includes:

- measuring of the lens and computation of a **lens-specific mapping function** (calibration file/software); the **calibration file** is added to the camera software
- **digital back blocker**: new pressure bolts to lock the digital back and to avoid any lateral or vertical play
- **shift blocker** (to fix the vertical shift)
- **focus ring blocker** (fixed distances 2m, 7m**)
- **lens mount blocker** (the lens cannot be detached from lens mount)
- **nodal bench blocker** (to always have the exact position on the nodal bench); 2 blockers are available for 2 standard distances: 2m, 7m**
- **digital shift:** correction of vertical position of sensor (to compensate any mounting differences of the sensors); this is included in the lens calibration file

** Corresponds to 7m on focal mount of the lens – this focusing allows optimum depth of field up to infinity (hyperfocal)

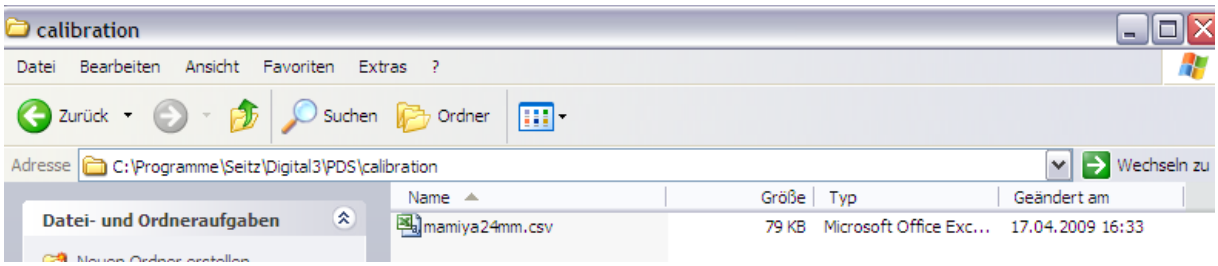
The calibration blockers can also be removed from the camera and the Roundshot D3 can be used freely with different lenses to create a variety of image formats.

4.9 … create spherical QTVR panoramas (continued)

To obtain the best possible results a number of software and hardware adjustments are required.

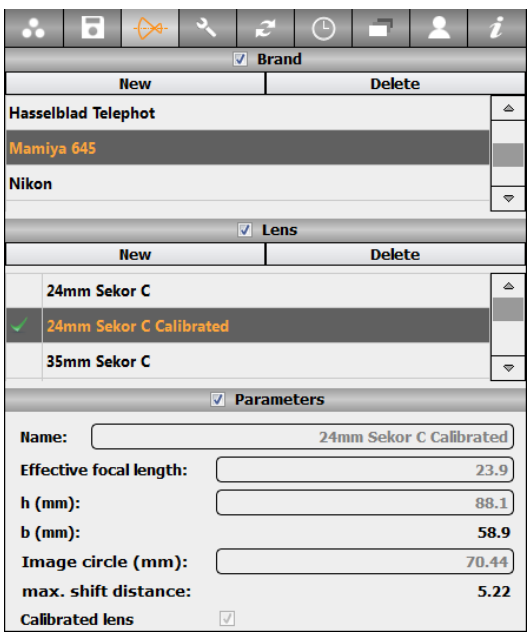
4.9.1 Software adjustments

Load the lens calibration file into your Seitz Roundshot D3 software. Please note that you will need to reload your lens-specific calibration file if you overwrite your program folder (ie through software update) or when installing the software on another computer.



C:\Program Files\Seitz\Digital3\PDS\calibration

Add the **calibrated fisheye lens** to your **favourite lens list** and **select the lens** in the software (shoot settings):



Please note that for all lenses that can be calibrated there are two versions, for example for the 24mm Mamiya 645 fisheye lens:

- 24mm Sekor C Calibrated
- 24mm Sekor C

Select the calibrated lens in the "shoot settings" box in the "shoot" menu.

The focusing distance will now automatically be set to 7m and can be changed only to 2m. This is necessary for optimum sharpness results.

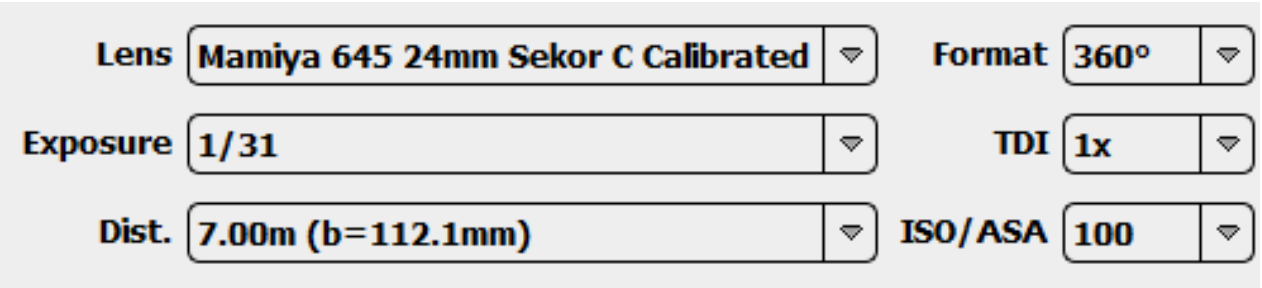
When selecting the calibrated lens the lens-specific mapping function is loaded and applied when converting the dng file into RGB*.

* The spherical QTVR panoramas must be converted from dng into RGB (TIFF, JPEG) in the Seitz Roundshot D3 software or in the Seitz raw converter.

4.9 … create spherical QTVR panoramas (continued)

4.9.1 Software adjustments (continued)

For best sharpness results **select a TDI Stage of 1x or 2.5x**. It is possible to use higher TDI Stages, however, for scenes which require a large depth of field the sharpness at the top and bottom will not be optimal. The sharpness in the centre of the image will be the same for all TDI Stages.

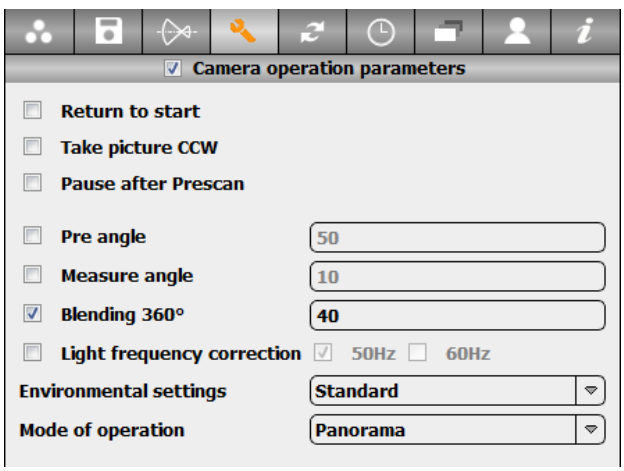


The image sensor is centred in the camera for TDI Stages 1x.

Choosing the best TDI Stages depends also on the scene. For spherical panoramas with fine detail in the top/bottom of the sphere, select TDI 1x or 2.5x. For scenes without detail in the top/bottom, you may also select higher TDI Stages, for example, when photographing outdoors (sky).

Activate blending to avoid any change in the light conditions between the start and the end of the picture to generate a sharp transition line in the viewer.

Open the camera parameter tab and activate **"Blending 360°".** It is also possible to define the size of the blending area (in this example 40°)



The blending option is active only when 360° images are taken. Choosing a smaller or bigger angle will deactivate this option

4.9 … create spherical QTVR panoramas (continued)

4.9.2 Hardware adjustments

Choose the nodal bench blocker according to the desired focusing distance (2m, 7m) and **fix it to the nodal bench** to fix the position of the camera body using a screw driver or by hand.

Adjust & lock

Attach the Seitz D3 digital scan back to the Roundshot D3 camera body by closing the upper brackets half, the lower brackets half, and then all brackets fully. This allows an even distribution of pressure laterally and vertically.

Close half

Close fully

Add the shift blocker, push the camera body downwards to the shift blocker position and close the shift bracket firmly. The dimension of the shift blocker is lens-specific and can vary between -5.2 and -5.8mm. Make sure that the **camera body is fully locked in this shift position**. Small differences in image circle are compensated by digital shifting (included in the lens calibration file).

4.9.2 Hardware adjustments (continued)

Attach the lens to the Roundshot D3 camera body **and lock it firmly by closing the two lens brackets.**

Set the aperture and the focusing distance on the lens. The focusing distance needs to correspond with the nodal bench blocker.

For the 24mm Mamiya 645 fisheye lens there are two click-stops available on the lens: 2m and 7m. Please note that the infinity position is not recommendable as it allows less sharpness and depth of field than the 7m position.

4.9 … create spherical QTVR panoramas (continued)

4.9.3 Post production on spherical QTVR panoramas

Raw conversion

Please note that the lens-specific mapping function and image correction is only applied in the Seitz Roundshot D3 software. These parameters are saved with the DNG file metadata and are then reloaded when converting the raw file into RGB in the Seitz Roundshot D3 software or the Seitz raw converter. For more information on post production please refer to chapter 5 "Post production".

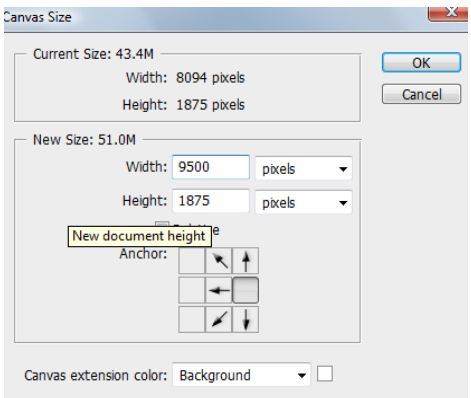
The spherical QTVR panoramas must be converted from dng into RGB (TIFF, JPEG) in the Seitz Roundshot D3 software or in the Seitz raw converter. Converting them in another raw converter (camera raw, Lightroom) will not allow calibrated results.

Blending of 360° QTVR panoramas

Please note that for software versions 3.2 and higher the blending of a 360° panorama can be done automatically in tab "Camera parameters/blending 360°". This section explains how to do the blending manually.

In certain situations QTVRs will not match at the beginning and the end of the panorama, or in other words, there will be a seam. This is due to changing light conditions at the beginning and the end of the scan (for example a cloud passing in front of the sun). To overcome this issue we recommend retouching the image in Photoshop according to the following procedure:

1. Capture the panorama at 400°
For a smooth blending the original image should be more than 360°. Typically 400° will give good results.



2. Open the panorama in Photoshop and extend its canvas
Increase the canvas size to obtain a white background to the left of the image. The extension size should exceed area above 360° (in this example > 40°).

4.9 … create spherical QTVR panoramas (continued)

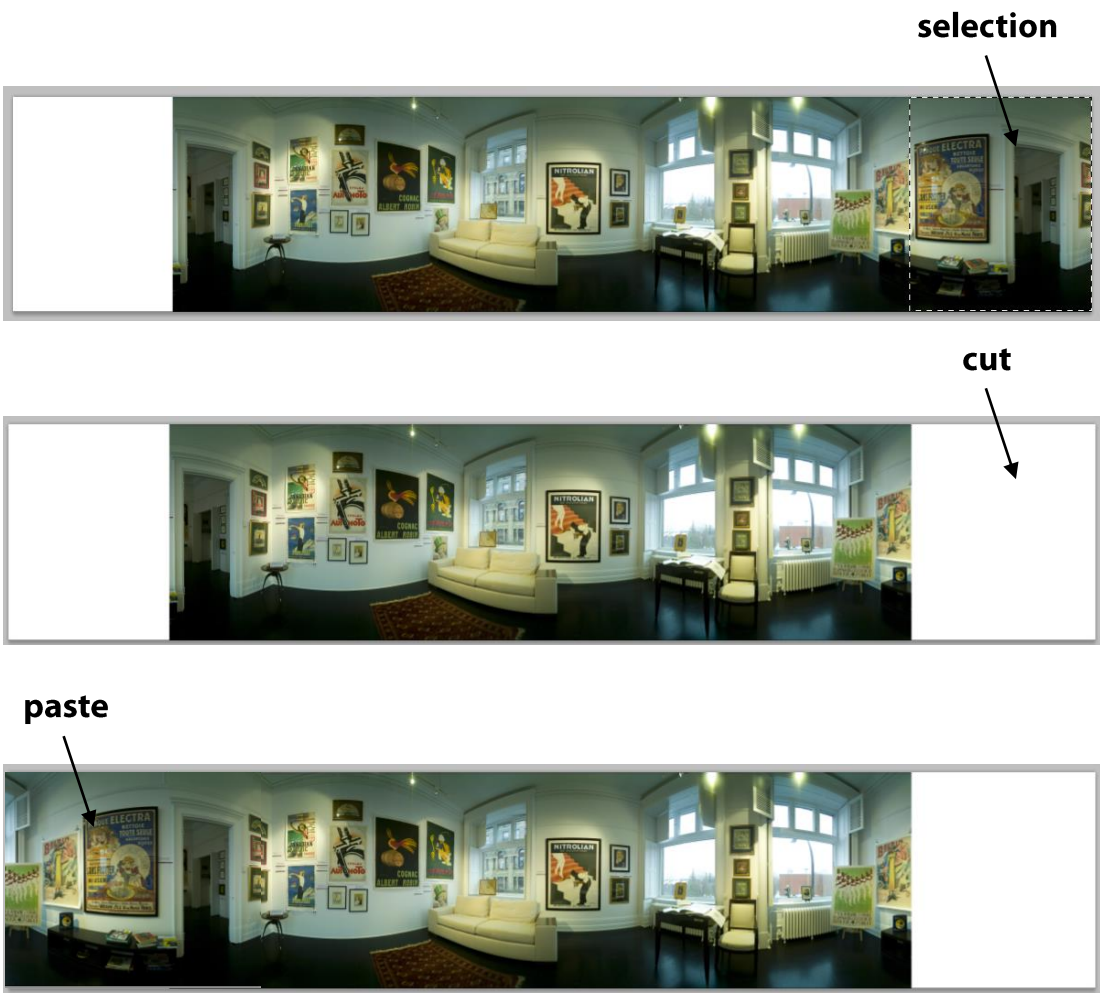
4.9.3 Post production on spherical QTVR panoramas

Blending of 360° QTVR panoramas (continued)

As a result, the panorama has an additional white background to the left:

3. Prepare the blending area

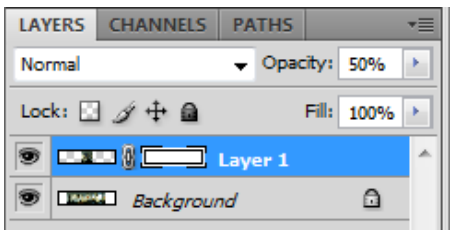
On the right part of the image select an area including more than the part above 360° (>40° in this example). Cut the selection and paste it on the left of the image.



Blending of 360° QTVR panoramas (continued)

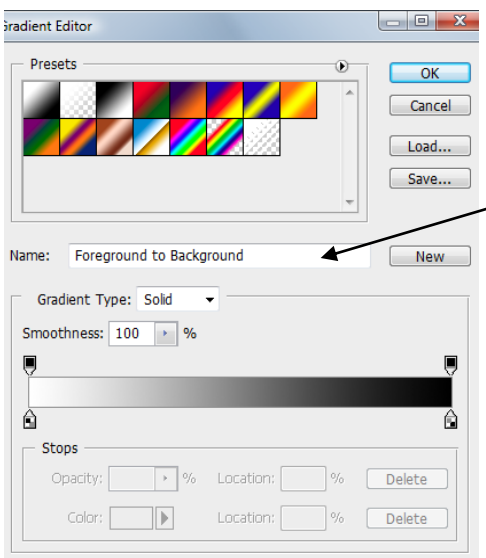
4. Blend the layers

Select layer 1, set its opacity to 50% and add a layer mask.



Using the left arrow on the keyboard, move layer 1 until it matches perfectly the background image. Zoom to more than 100% to check.

Select the layer mask and activate the gradient tool with the "Foreground to background" preset.



"Foreground to Background"

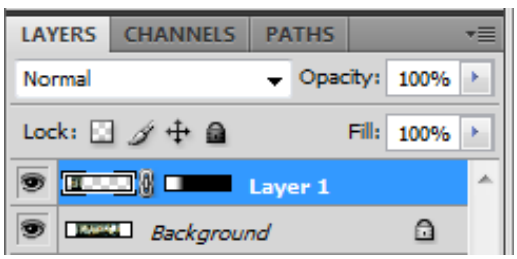
4.9 … create spherical QTVR panoramas (continued)

4.9.3 Post production on spherical QTVR panoramas (continued)

Blending of 360° QTVR panoramas (continued)

Press the shift key and draw the gradient line from left to right with the gradient tool on the area where the 2 layers are overlapping.

Finally set the opacity of the layer 1 to 100%:



The exposure at the beginning and end of the panorama is now perfectly equal:

5. Crop the panorama to 360° and load it in a viewer

Merge all layers using the tool "flatten image" in the "Layer" menu. Then crop the image to remove the white areas on both sides of the image. Zoom to more than 100% to be sure that not even a line of 1 pixel width from these white areas remains.

Resize the image and load the final 360° panorama in a viewer of your choice.

4.10 … create turntable scans

This section explains how to use the Roundshot D3 camera in turntable mode. Please note that it is necessary to have the turntable bench together with the camera to be consistent with the capture software parameters and to obtain optimal image quality.

Different types of macro tubes are available. These macro tubes are used to obtain the desired zoom ratio and to capture more or less resolution and detail of the object surface.

The combination of the Roundshot D3 camera, the turntable bench and a set of macro tubes/lenses, allow to scan the surface of round objects with diameters ranging from 5mm to 1m. The shift capability of the turntable bench can be used to combine different high resolution scans (up/down) of high dimension objects.

4.10 … create turntable scans (continued)

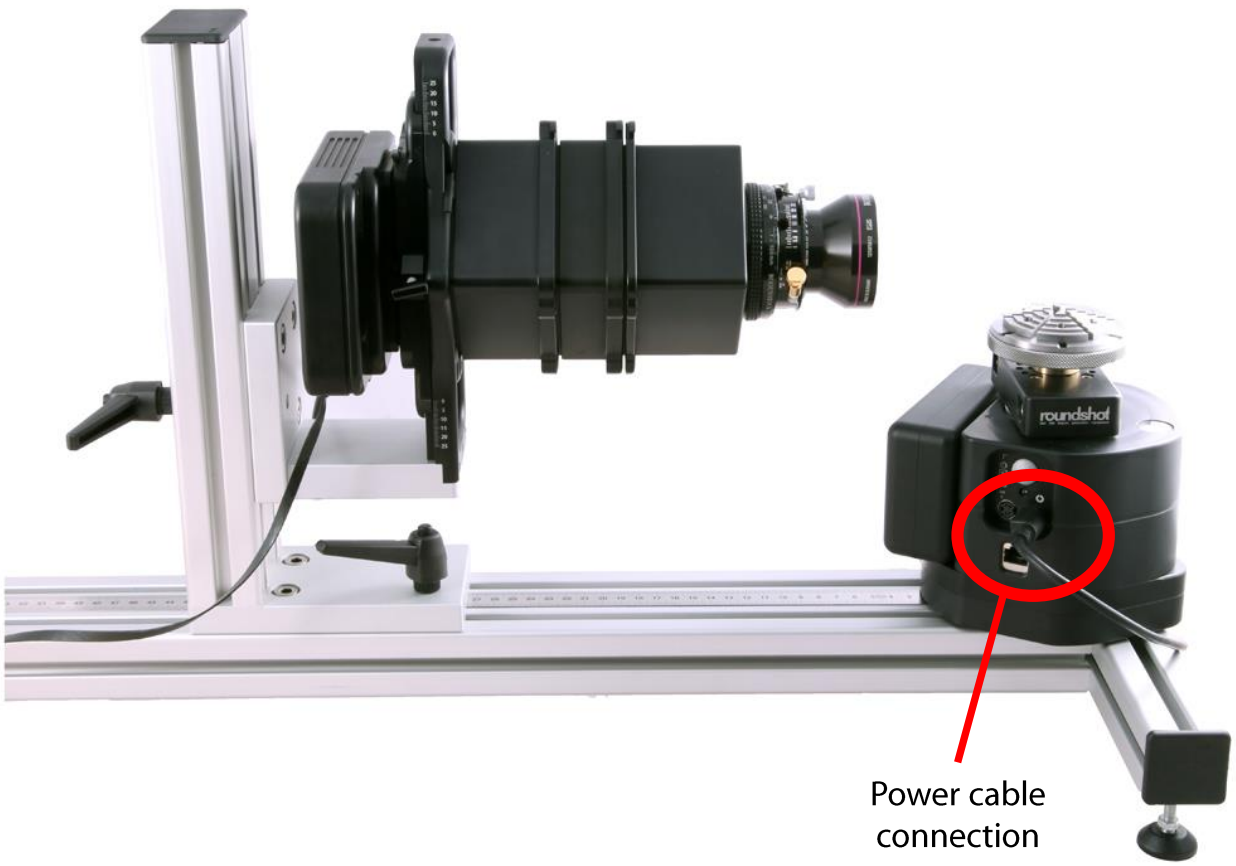
4.10.1 Hardware set-up

The turntable hardware set-up is slightly different from using a regular Roundshot D3. the motor is attached on one side of the bench and the camera body on the other.

Connect the power cable from the power socket on the digital back **to the socket for external power cable on the static part of the motor** as shown below. This way the cable will not be twisted when scanning the objects.

Connect the ethernet cable from the ethernet socket on the digital back **directly to the corresponding socket on the computer.** No ethernet connection to the motor is necessary.

Switch on the camera from the motor part as usual, and establish a connection with the computer.



4.10 … create turntable scans (continued)

4.10.1 Hardware set-up (continued)

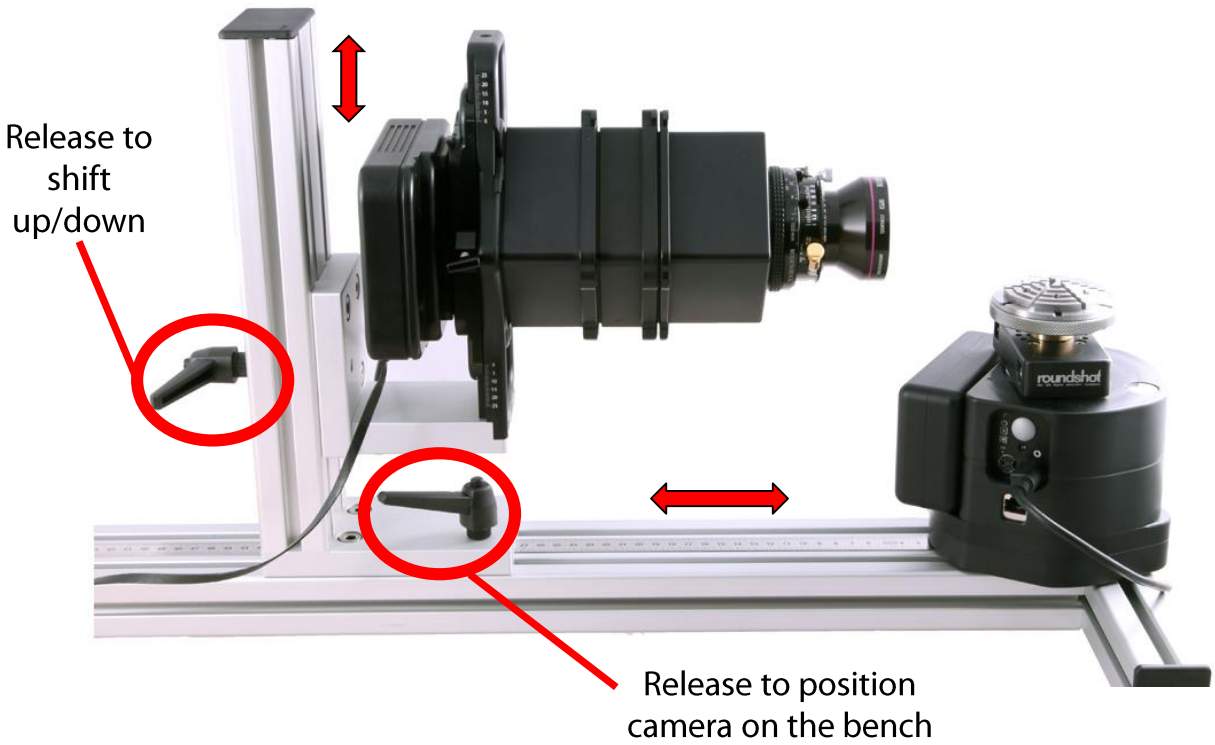
Depending on the object to be scanned it is possible to place on the motor a flat turntable, ideal for wide diameter objects, or an object holder more useful for small diameter objects

Flat turntable

Object holder

Depending on the object size and the software outputs (explained in the next section) some more hardware adjustment can be done :

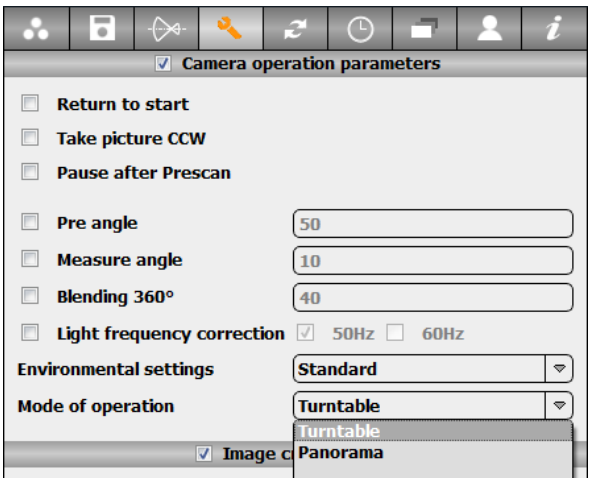
- Attach the correct number of **macro tubes** to the lens to obtain the desires zoom ratio on the object
- **Position the camera precisely on the bench** by reading its position on the **embedded scale. A correct camera positioning will insure an optimal image sharpness**
- **Shift the camera body up or down** to align the lens with the object to be scanned



4.10 … create turntable scans (continued)

4.10.2 Software adjustments

Press  to navigate to the **“Parameter”** menu.

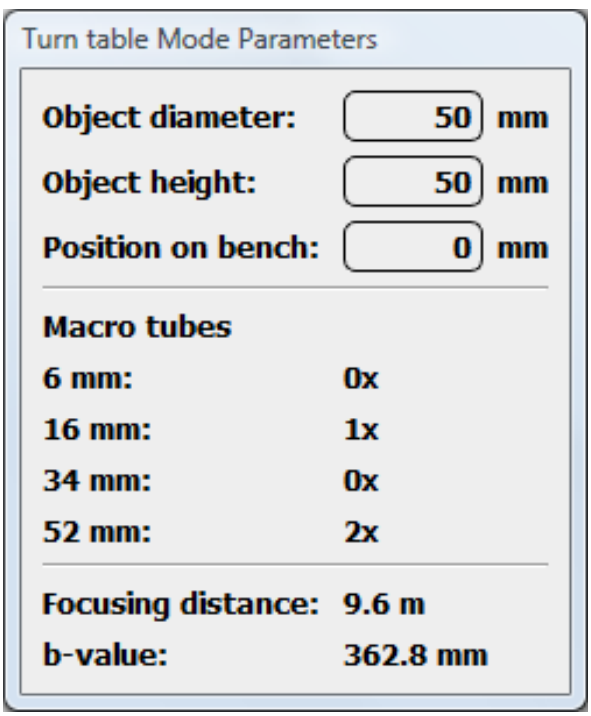


Open **„Camera parameters“** tab.

Choose **“Turntable”** as mode of operation.

This mode is only visible if a Roundshot D3 camera is already connected to the software.

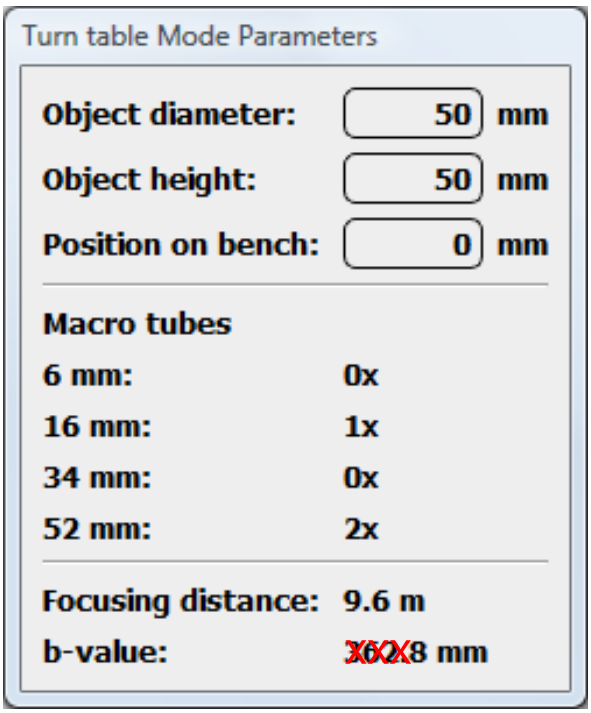
If the turntable mode is not in the list, please make sure the connection to the Roundshot D3 camera is established.



Once the turntable mode is active, a new window is displayed on the software. It contains all specific parameters used for turntable.

- **Object diameter:** enter the diameter of the object to be scanned.
- **Object height:** enter the height of the object to be scanned. This should correspond to the part of the object that will be captured by the sensor. It defines the zoom ratio of the object (60mm for a zoom ratio equal to 1).
- **Position on bench:** enter the turntable bench parameter defining the position of the 0 mark of the scale.
  By default keep this value to 0.

4.10.2 Software adjustments (continued)



- **Macro tubes:** defines the number and the size of macro tubes to be used. In this example one 16mm and two 52mm tubes should be attached to the lens to obtain the desired zoom ratio.
- **Focusing distance:** defines the focusing distance that needs to be set on the lens. Please note that the distance setting in "shoot settings" is now removed. In turntable mode the focusing distance is defined by the software according to the zoom ratio.
- **b-value:** this indication is not relevant for the turntable application – please disregard

In turntable mode the sharpness of the image is not defined by the focussing on the lens but rather by the accurate position of the camera on the bench. If the image is slightly blurred it is possible to move the camera on the bench slightly during a scan to optimise the sharpness.

The object height corresponds to the size of the area to be projected on the entire sensor i.e. 60mm. This means that if the entered value is 60mm the zoom ratio will be 1. if the value entered is lower the zoom ratio will increase and more details will be visible on the surface.

This means that the object height should be used to specify the desired zoom ratio on the object rather than the effective object size.

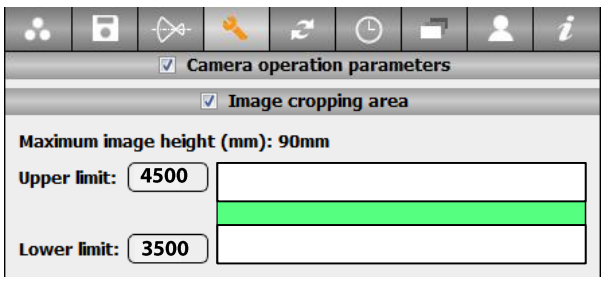
Setting the focussing distance on the lens has an influence only on the zoom ratio and not on the image sharpness. It is therefore not necessary to have a high precision is setting this value on the lens.

4.10 … create turntable scans (continued)

4.10.2 Software adjustments (continued)

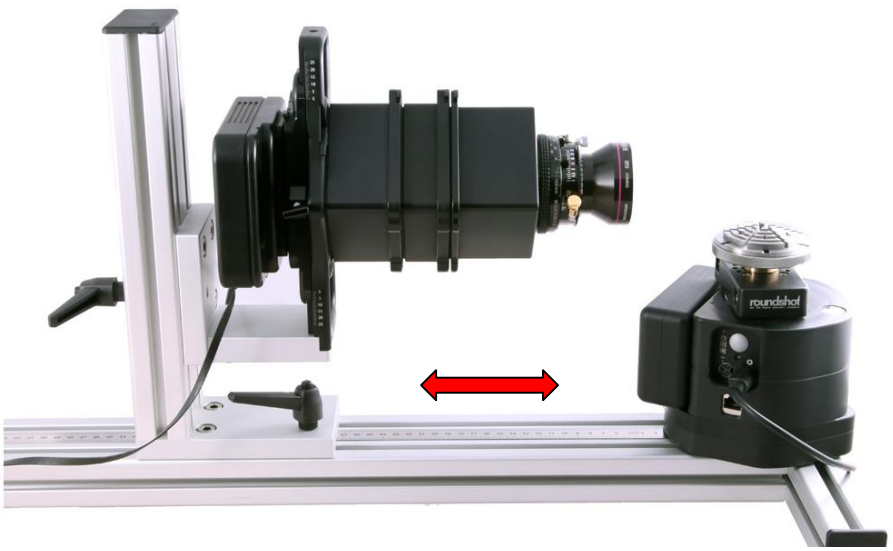
As a next step, switch to the tab "camera operation parameters / image cropping area" and define as upper and lower limit an area of approximately 1,000 pixels (according to screen resolution), for example:

- Upper limit: 4,500
- Lower limit: 3,500



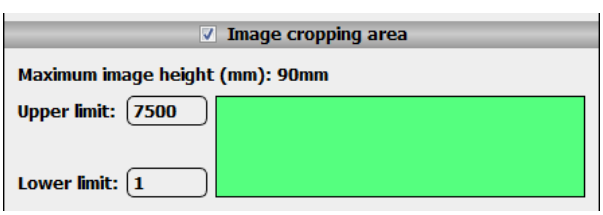
Now chose an image angle of 999°.
Open the aperture of the lens to f=5.6.

Press start to begin a scan



While scanning adjust the position of the bench until the image becomes sharp. Fine-tune the sharpness using the focusing on the lens.

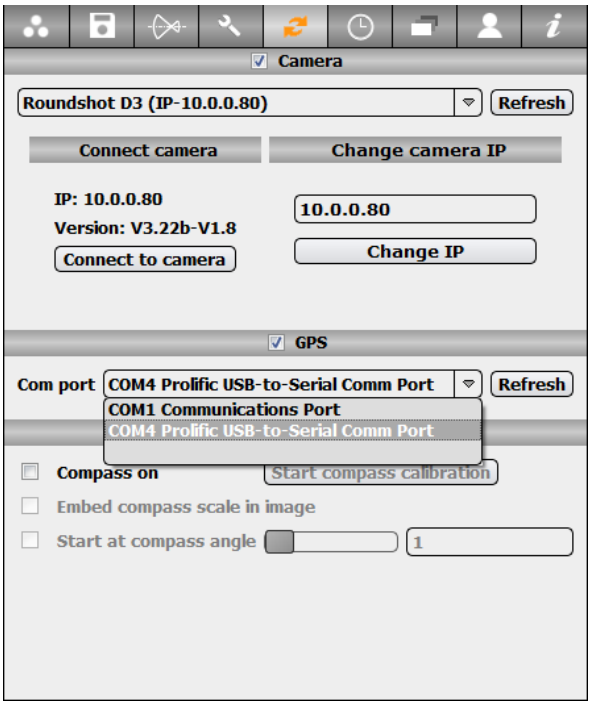
Once the image is sharp, reset the upper/lower limits of the "image cropping area" :



Press start to begin a scan

4.11 … use a USB GPS device

Press  to navigate to the **"Parameter"** menu.



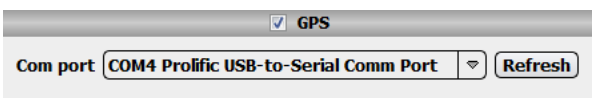
Open **„External device"** tab.

The comport box contains a list of all activated com port on your computer

When no GPS device is connected, the **„Com port list"** window remains empty.

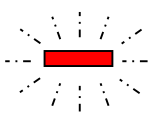
Install the USB driver for your GPS device (for example: *GlobalSat BU-353*) on your computer first. Then connect it via the USB port. The detection of the GPS device may take 3-4 minutes.

In this situation the GPS status symbol which is indicated on the lower right of the computer screen appears in grey (no connection) and the LED of the GPS device is off.

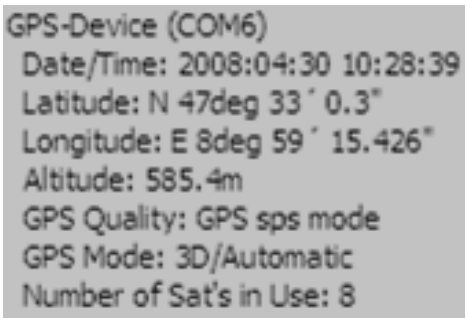


Once the USB GPS device is recognised by the computer and the USB driver loaded, the Com port list will be updated and will show the GPS device (in this example COM4). Click on **"Refresh"** to update the GPS device list

The GPS status symbol and the LED of the GPS device will change to red. As soon as a satellite signal is received, the GPS status symbol will turn to green and the LED of the GPS device will be red and blinking.

GPS status symbol (located on lower right of computer screen)	**LED of GPS device** (GlobalSat BU-353)	
		No connection to GPS USB device
		GPS device connected to computer, searching for satellite signal
		GPS device connected to computer and satellite signal received

4.11 … use a USB GPS device (continued)



Example: GPS data for Lustdorf / Switzerland

When the GPS device is connected to the computer and the satellite signal is received, a **GPS information tag** is displayed next to the green GPS status symbol.

Once the GPS device is connected it automatically feeds the latitude and longitude of the current camera position into the software. This data is then written to the metadata / EXIF when saving a new image.

Make sure when unplugging and replugging the USB GPS device to always use the same USB port. If not reload the USB driver for the new port.

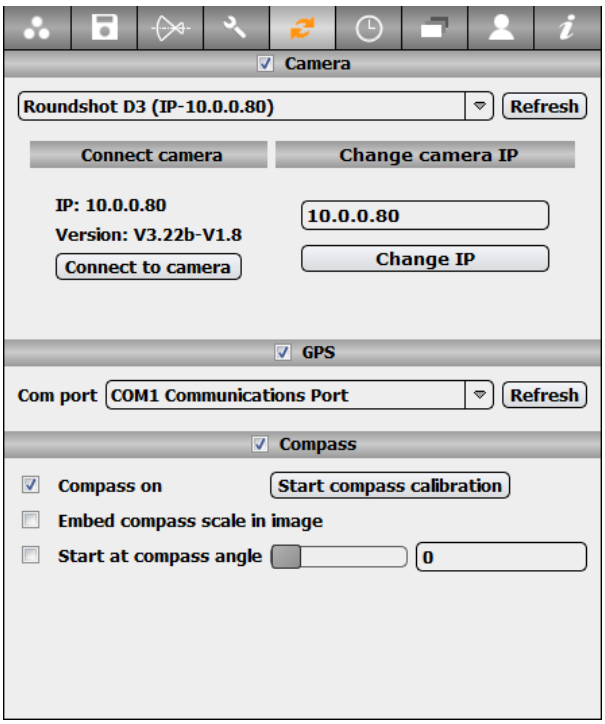
GPS devices use a uniform date/time standard which is always Greenwich time (GMT) regardless of the time zone of the actual position. Therefore the date/time of the GPS device may differ from the actual date/time.

GPS data (latitude, longitude...) are saved with the image and can be accessed by viewing the metadata.

The GPS position is written in the image metadata only if the GPS status symbol is green. It is possible that even if the GPS device is connected the GPS status symbol remains red. In this case the GPS device is not able to fix a location and no GPS data will be saved in the image metadata.

4.12 … use a compass

Press  to navigate to the **"Parameter"** menu.

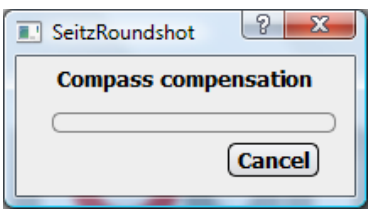


Open **„External device"** tab.

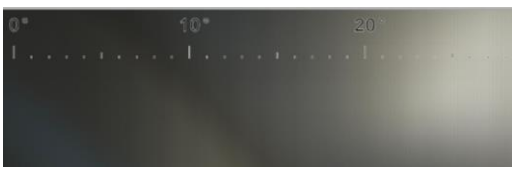
Click on the **"Compass on"** check box to activate the connected compass.

Several options related to compass are displayed:

Start compass calibration: press on this button to allow the compass to be calibrated on the first use. The camera will rotate 360° and the compass output will be synchronized with the motor rotation. This function needs to be used only once. A calibration status popup will be displayed.



Embed compass scale in image: allows to embed the compass output angles in the image. These angles will be visible only on tiff or jpeg images. DNG files are not modified. Below and example of compass scale on a jpeg image



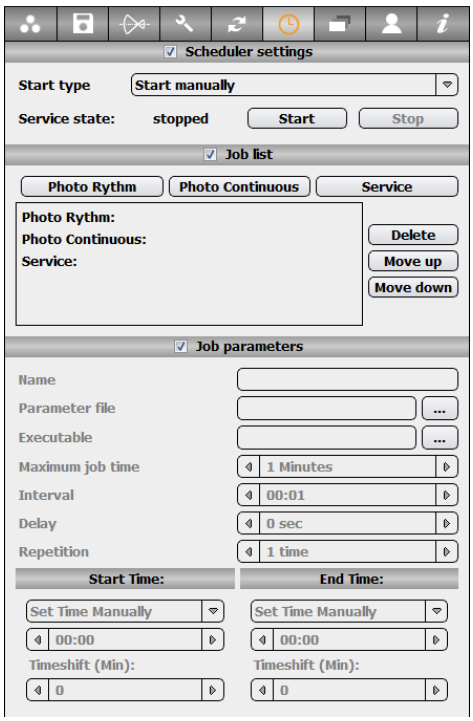
Start at compass angle: allows to always start taking the picture at the selected compass angle no matter the initial direction of the lens. For example setting this angle to **0° ensures that the images will always start direction north**

Please note that the compass scale will be visible only on tiff and jpeg images. When saving the images in DNG the compass data is lost and cannot be recovered in post processing.

4.13 … program the scheduler

The scheduler is often used to create a time-lapse over a defined period with the Roundshot D3.

Before programming the scheduler, make sure to create one or more **profiles** as presented in section 3.1.7. with the image parameters to be used for the time-lapse.



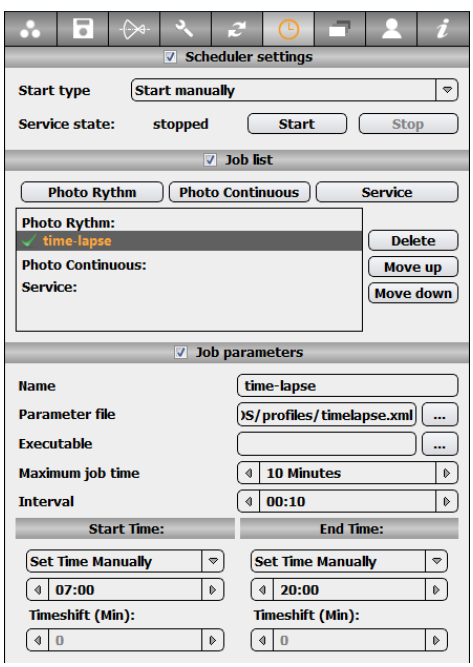
In the "Parameter" menu**.** Select the Scheduler tab

In the **"Job list"** section different jobs (or tasks) can be defined:

- Photo Rhythm Job
- Photo Continuous Job
- Service Job (not used for Roundshot D3 cameras)

In the **"Job parameters"** section the selected job parameters can be defined:

- Name
- Parameter file
- Executable
- Maximum job time
- Start / end time
- Interval
- Repetition (continuous job only)
- Delay (continuous job only)

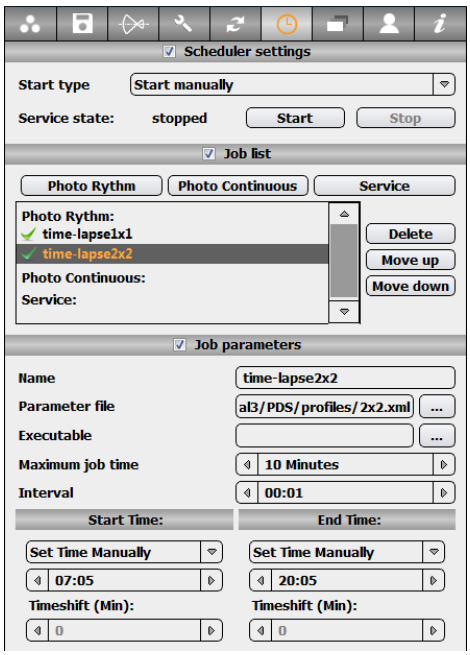


For example define a **"Photo Rhythm Job"** to take an image at constant time intervals.

Click on **"Photo Rhythm Job"** to define a new job.

- Change its **name**. (ex: time-lapse)
- Define the **profile** that will be used for image parameters. (ex: timelapse.xml)
- Define the **interval** of image taking (in hours : minutes). (ex: 10min)
- Define the **start time** and **end time**. In this example the images will be taken from 7:00 to 20:00

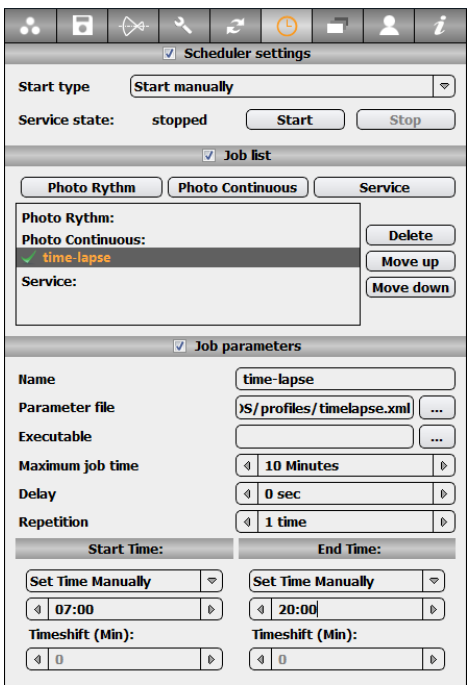
4.13 … program the scheduler (continued)



It is possible to **create as many jobs as necessary** if different parameters are to be used.

For example it is possible to create 2 sequences one in full resolution and one in 2x2 resolution.

In this example the start time of the second job is shifted by 5 minutes to avoid job conflicts. In case of conflict the job at the top of the list will be started



If the project has to contain as many images as possible, then the best choice is to create **"Photo Continuous Job"** as presented in this example.

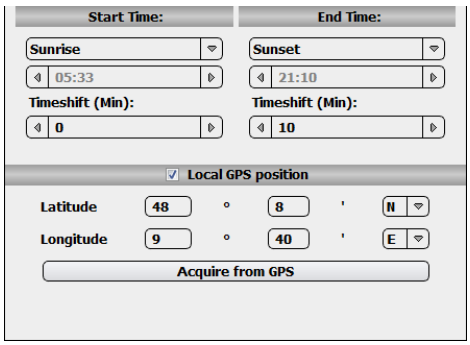
In this case, as soon as the previous image is saved, the next image will be launched without delay.

Click on **"Photo Continuous Job"**,edit the job name and select the profile.

Define the **start time** and **end time** (in hours : minutes). There is no interval because the image taking is continuous.

Enter **repetition** defining the number of times this job is to be repeated in case of multiple jobs. Finally define a **delay** between the jobs.

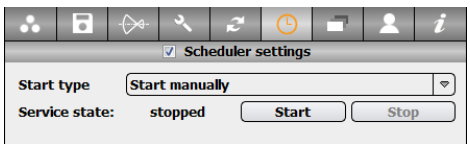
4.13 … program the scheduler (continued)

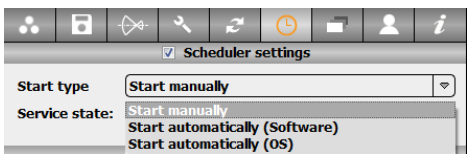


For all types of jobs, the **start/end times** can be generated **automatically** according to the **GPS location** of the camera.

Enter the local GPS coordinates and select sunrise/sunset for example. The effective start/end times will change automatically according to the location throughout the season. This is useful to create projects over a longer time frame (for example a year).

Once the Jobs are programmed correctly, it is necessary to start the scheduler.





In the **scheduler settings** section, the following **start-up options** can be selected:

- **Start Manually** (default): this option is recommended for testing when the Scheduler should not be launched automatically (for example when closing the software)
- **Start Automatically with software**: this option allows the scheduler to start as soon as the Roundshot software is started
- **Start Automatically with operating system**: this option allows the scheduler to start as soon as the computer is restarted. This is used for Livecam applications.

4.14 … read + edit metadata

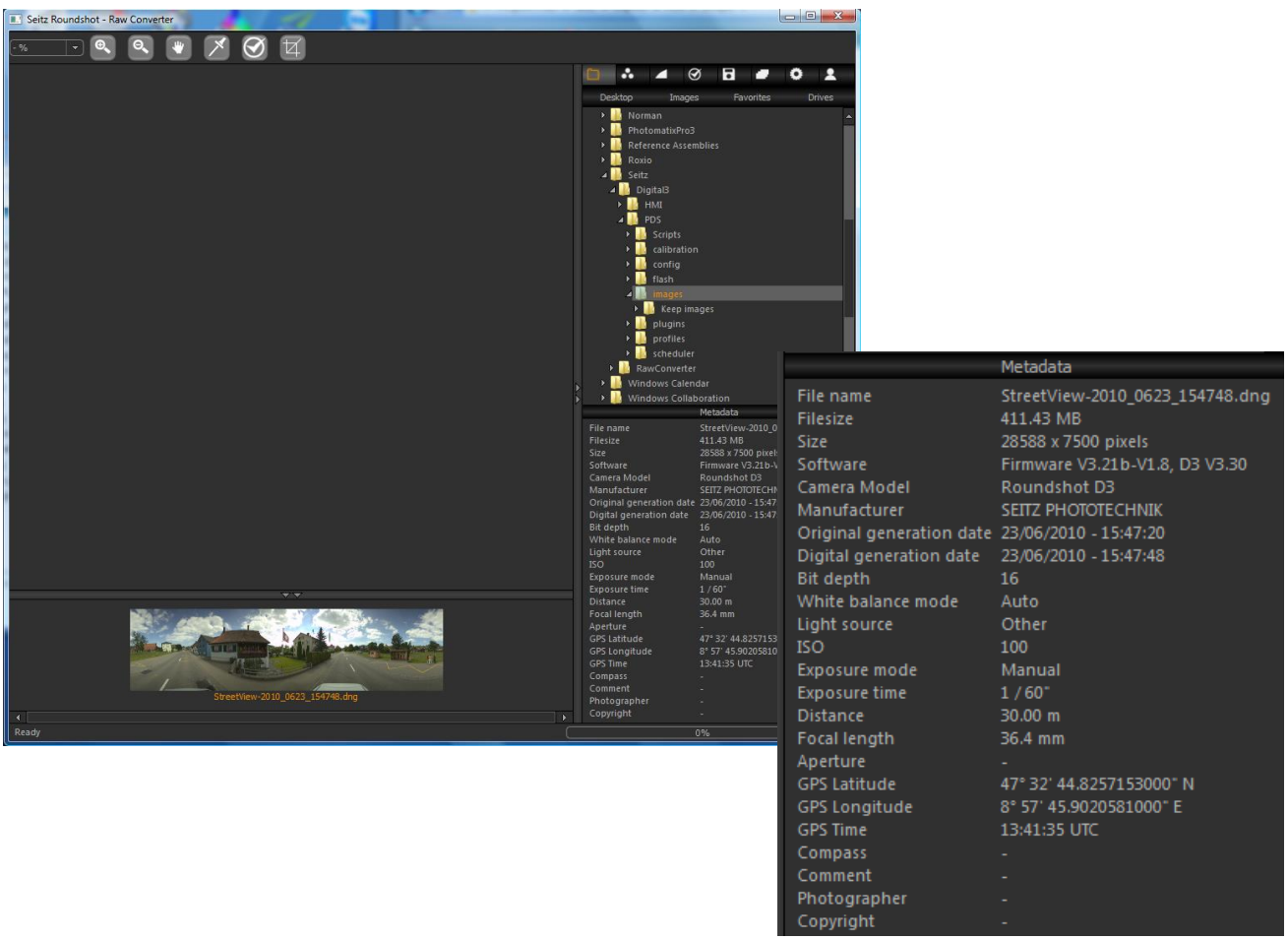
Metadata or **EXIF** are camera and image parameters which are embedded in the image. They help in the post-processing of the files and assist the photographer in retrieving essential image information later in the process (for example, lens, exposure speed, ISO/ASA).

The metadata can be loaded in the following software:

- Seitz Raw Converter
- PhotoMe
- Adobe Bridge + camera raw
- Adobe Lightroom
- Adobe Photoshop

4.14.1 Seitz Raw Converter

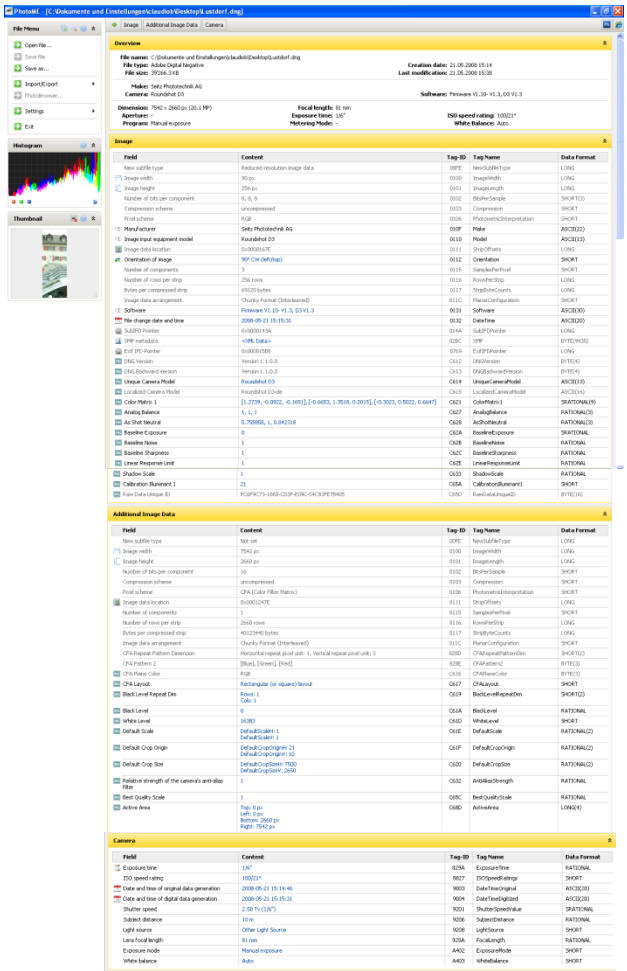
The Seitz raw converter is a software specially implemented for the DNG files generated by the Seitz D3 digital scan back. It is possible to browse these files and by a simple click see all necessary metadata in the lower right filed as show in the example below:



4.14 … read + edit metadata

4.14.2 PhotoMe

PhotoMe is a dedicated software to display, analyse and edit metadata. Load a DNG, TIFF or JPG file into the software to display image and camera data. It is also possible to edit most Metadata information, especially to add the lens aperture information. This is useful for HDR set of images generated by changing lens aperture manually.



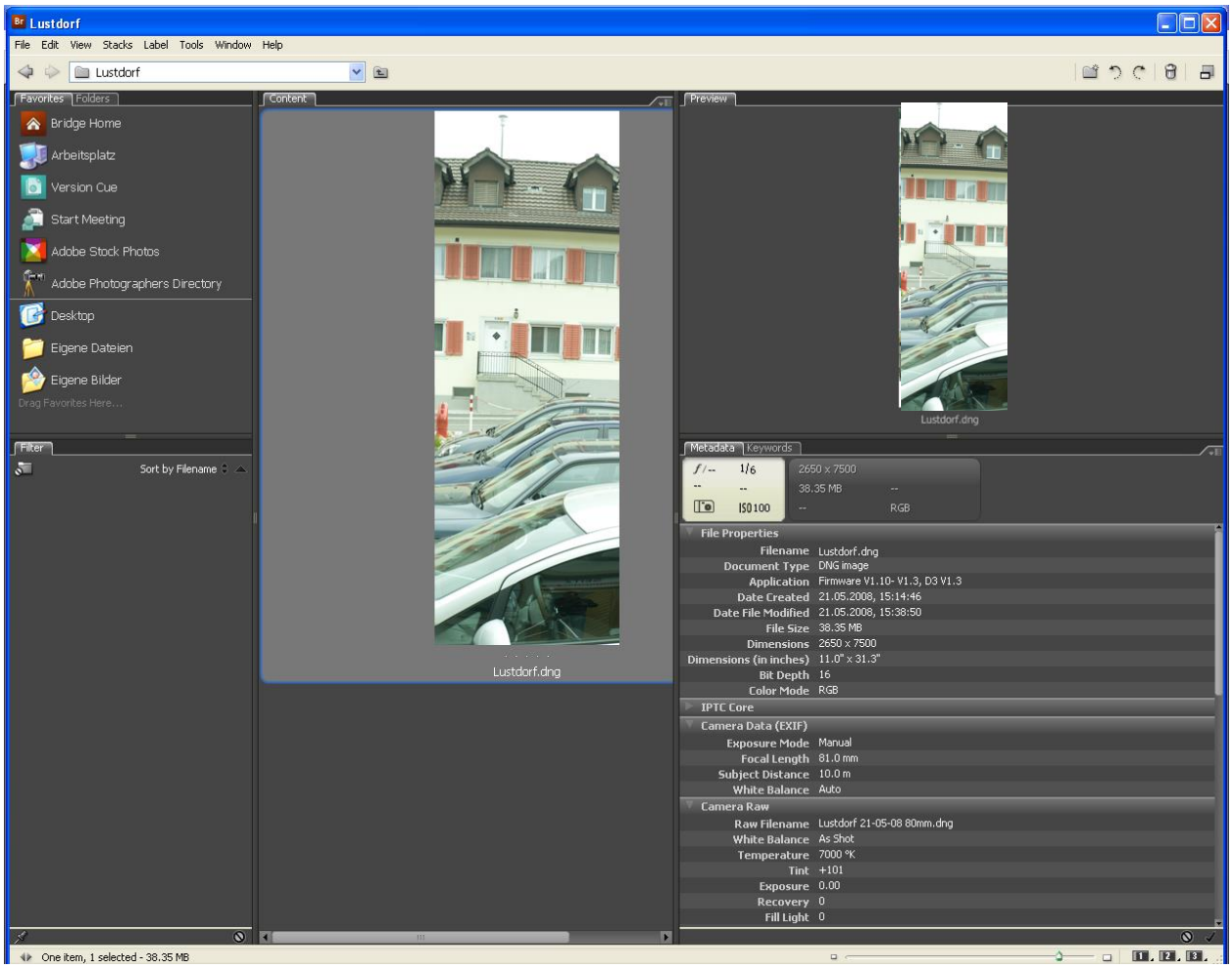
Camera

Field	Content
Exposure time	1/6"
ISO speed rating	100/21°
Date and time of original data generation	2008-05-21 15:14:46
Date and time of digital data generation	2008-05-21 15:15:31
Shutter speed	2.58 Tv (1/6")
Subject distance	10 m
Light source	Other Light Source
Lens focal length	81 mm
Exposure mode	Manual exposure
White balance	Auto

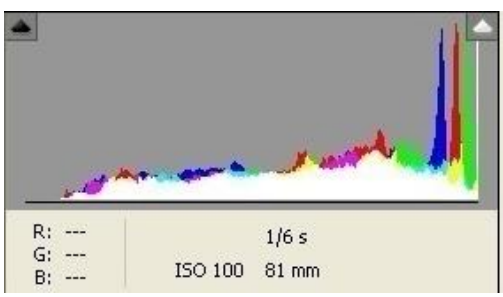
4.14 … read + edit metadata (continued)

4.14.3 Adobe Bridge + camera raw

Adobe Bridge displays all image files within a folder as thumbnails and is a seemless addition to post-processing software (camera raw). Click on the thumbnail image of the image file to display the metadata (file properties, camera data, settings for camera raw, etc.):



When double-clicking an image it is opened in camera raw.



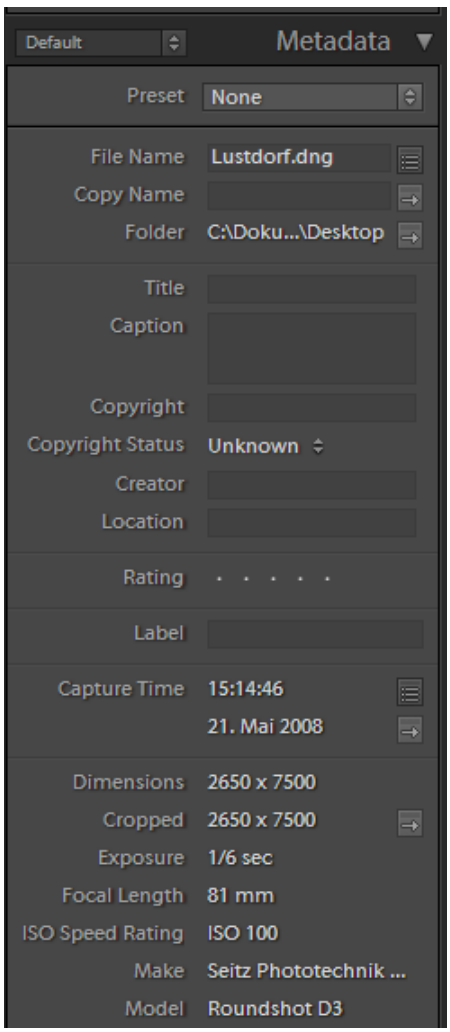
Camera raw shows only metadata for exposure speed, ISO/ASA and focal length.

For a complete list of metadata please refer to PhotoMe or Adobe Bridge.

4.14 … read + edit metadata (continued)

4.14.4 Adobe Lightroom

Contrary to camera raw where a full list of metadata is displayed in Bridge, Lightroom has all metadata integrated. Click on **„Metadata“** to display the full list:

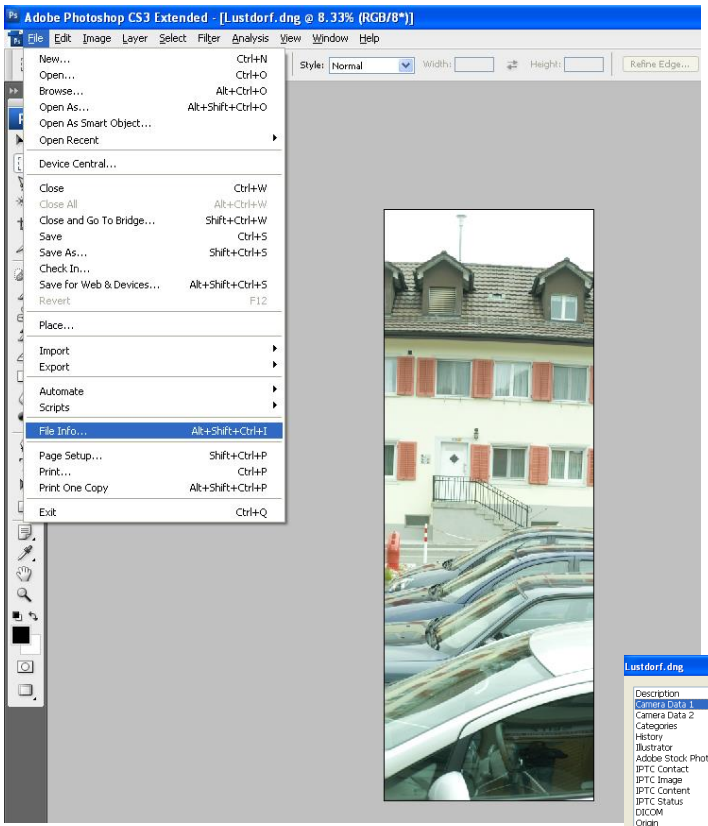


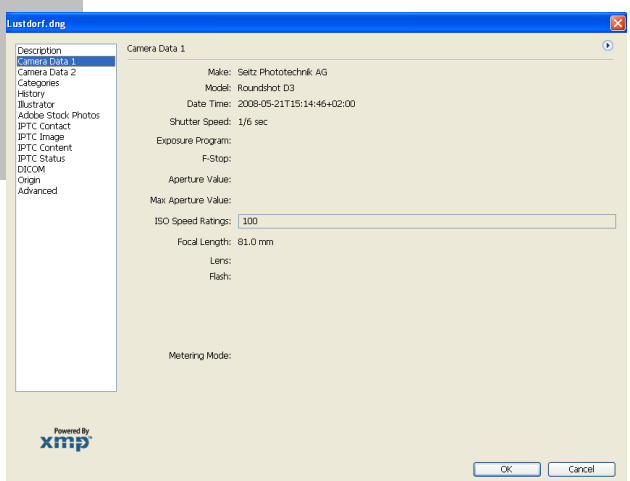
For a full list of metadata please refer to PhotoMe or Adobe Bridge.

4.14 … read + edit metadata (continued)

4.14.5 Photoshop

In Photoshop the metadata can be accessed by selecting **“File/File Info”** or by pressing **ALT+CTRL+SHIFT+I**:



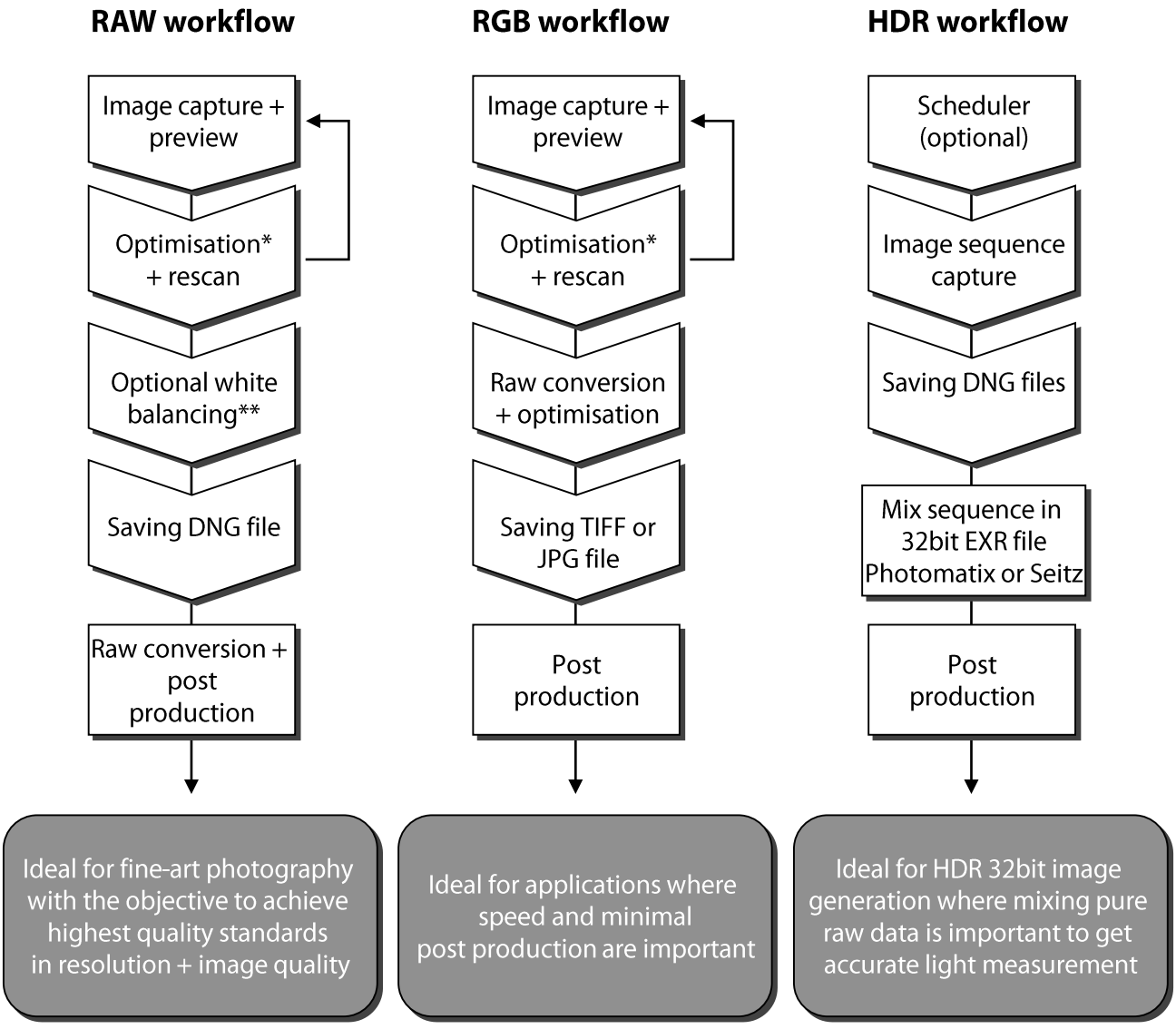


For a full list of metadata please refer to PhotoMe or Adobe Bridge.

5. Workflow

5.1 Introduction

The Roundshot D3 is a very versatile camera system and can be used for a large variety of different applications. For each of these applications different end products are created, which in turn influences the choice of workflow. Therefore we recommend thinking through the ideal workflow before starting to use the camera in the field. There are three main workflows:



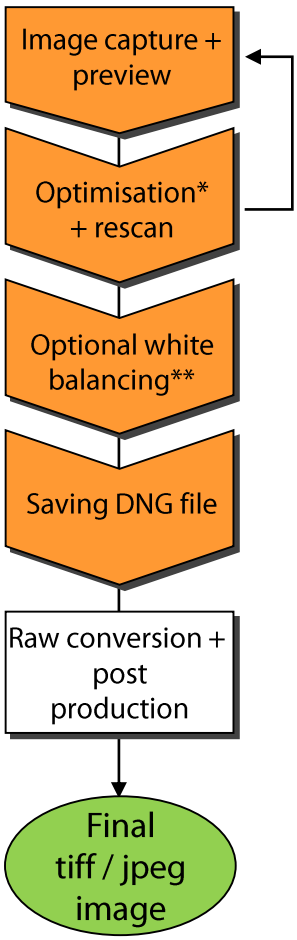
When working with large image files we recommend using 64-bit operating systems with 64-bit imaging software as this significantly increases processing speed.

* By changing setttings such as exposure speed, aperture, TDI Stages, focusing, ISO/ASA, etc.
** All other optimisations are not stored with the raw (dng) file (such as histogram stretching, tone-mapping, etc.)

5.2 RAW workflow: Seitz raw converter

Focus on the following points to obtain the highest possible image quality:

- **Framing:** it is recommended to capture an image containing slightly more angle than necessary to have higher flexibility in framing
- **Exposure:** make sure to obtain a perfect histogram. This ensures that the exposure is precise and no additional post-processing (and loss of quality) is required.
- **Sharpness:** work with focusing, aperture, rotation point and distance setting in the software to obtain the best possible definition. Of course sharpness can be enhanced in post-production, but the better the original image, the more natural the final image will be.



Raw saving: save the image in raw format DNG. Any other format will contain an already converted image with non-reversible operations reducing the adjustment possibilities. **All other parameters can be readjusted later during the raw conversion with no risk of data loss**, including white balance, tone mapping etc.

There are currently 3 software solutions for raw conversion + post production on the images:
- Seitz raw converter
- Adobe camera raw (+ Photoshop)
- Adobe Lightroom (+ Photoshop)

Both camera raw and Lightroom use the same base technology for their raw conversion (linear interpolation), while the Seitz Roundshot D3 software and Seitz raw converter uses conversion algorithms which are specifically designed for the Seitz D3 digital scan back sensor. This is why the **Seitz raw converter allows best image quality.**

Open the dng file with the desired application. The raw image will be converted automatically into an RGB image preview using a given demosaïcing method. All colour management options (such as white balance, HSL), tonemapping and filtering (for example to reduce colour noise) are applied simultaneously on the raw image. The image can then be further processed in Photoshop.

5.2 RAW workflow: Seitz raw converter (continued)

The **Seitz raw converter** gives best results for the raw conversion. **We therefore recommend to convert the dng raw file in the Seitz raw converter** (including white balance, tone mapping, colour noise removal). As a next step open the image in Adobe Photoshop for additional retouching (for example for sharpening).

Raw conversion in Seitz raw converter

Raw conversion in Other software

Diagonal lines are smooth (straight) lines after raw conversion in the Seitz software. When converting the image in other software it is possible that staircase artefacts appear.

* The Seitz D3 digital scan back has a non-Bayer pattern and the Seitz Roundshot D3 raw conversion applies a sensor-specific algorithm. Other raw converters apply a linear interpolation (no sensor-specific algorithm).

5.2 RAW workflow: Seitz raw converter (continued)

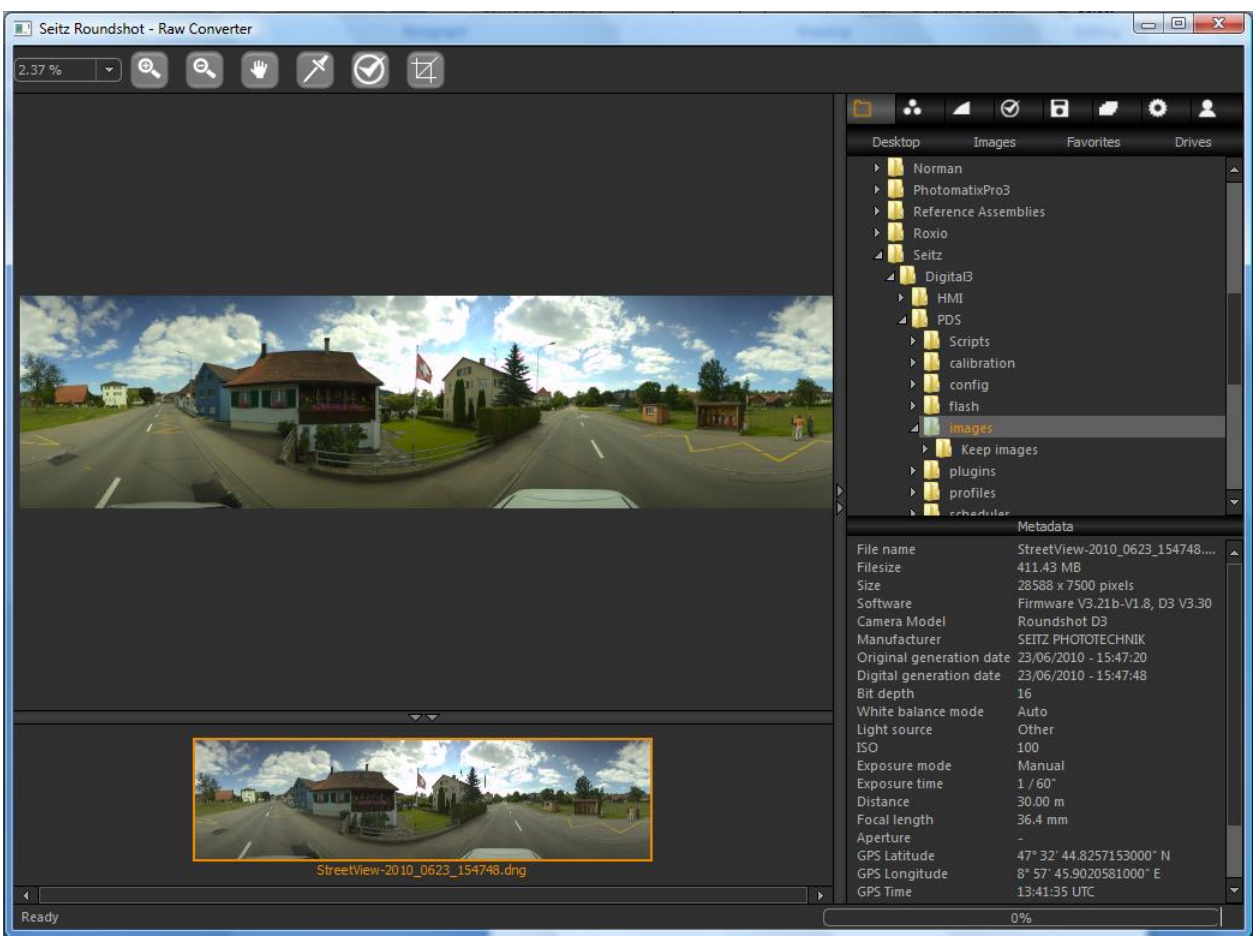
The Seitz Raw converter is divided into 4 fields for an optimised usability and image conversion workflow:

Tool bar: located on the top of the window, the tool bar is used for direct image editing and image navigation

Thumbnail: Located on the bottom part of the window, the thumbnail field displays the thumbnails of all DNG images located in the current folder. It is useful for image selection and loading. It is possible to minimise this field when the image is loaded.

Preview: located in the centre of the window. It is possible to navigate and zoom up to 200% in the image.

Parameter menu: located on the right side of the window, the parameter menu contains all the raw conversion parameters to be applied on the image. It is structured into 8 tabs following the logical raw conversion workflow (Image browsing, colour adjustment, tone mapping ...)



5.2 RAW workflow: Seitz raw converter (continued)

Browsing

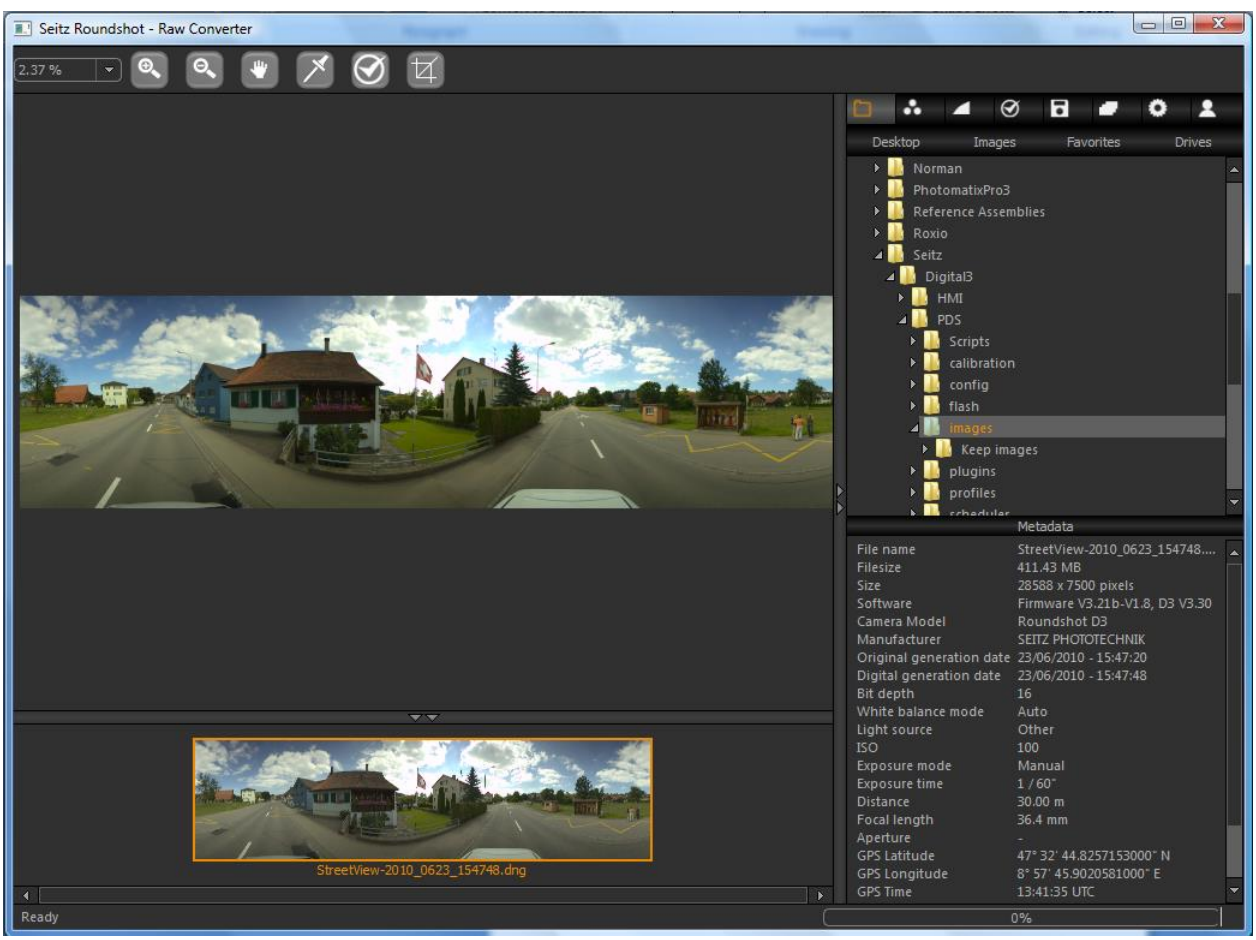
After Opening the Seitz raw conversion software the first step is to browse and open the desired file:

Open the correct folder: use the browsing tree on the right side of the window to open the folder containing the dng images.

Image selection: the thumbnails of all the dng images of the folder will be displayed. By clicking one time on every image, the corresponding metadata are displayed on the bottom right field.

Load image: when the image is selected, double click on the thumbnail and the image will be loaded.

Image preview: the image preview is displayed in the centre field and the colour tab is automatically opened in the parameter menu .



5.2 RAW workflow: Seitz raw converter (continued)

Image navigation and basic editing

Using the **"Tool bar"** it is possible to navigate in the image and to apply some basic editing commands:

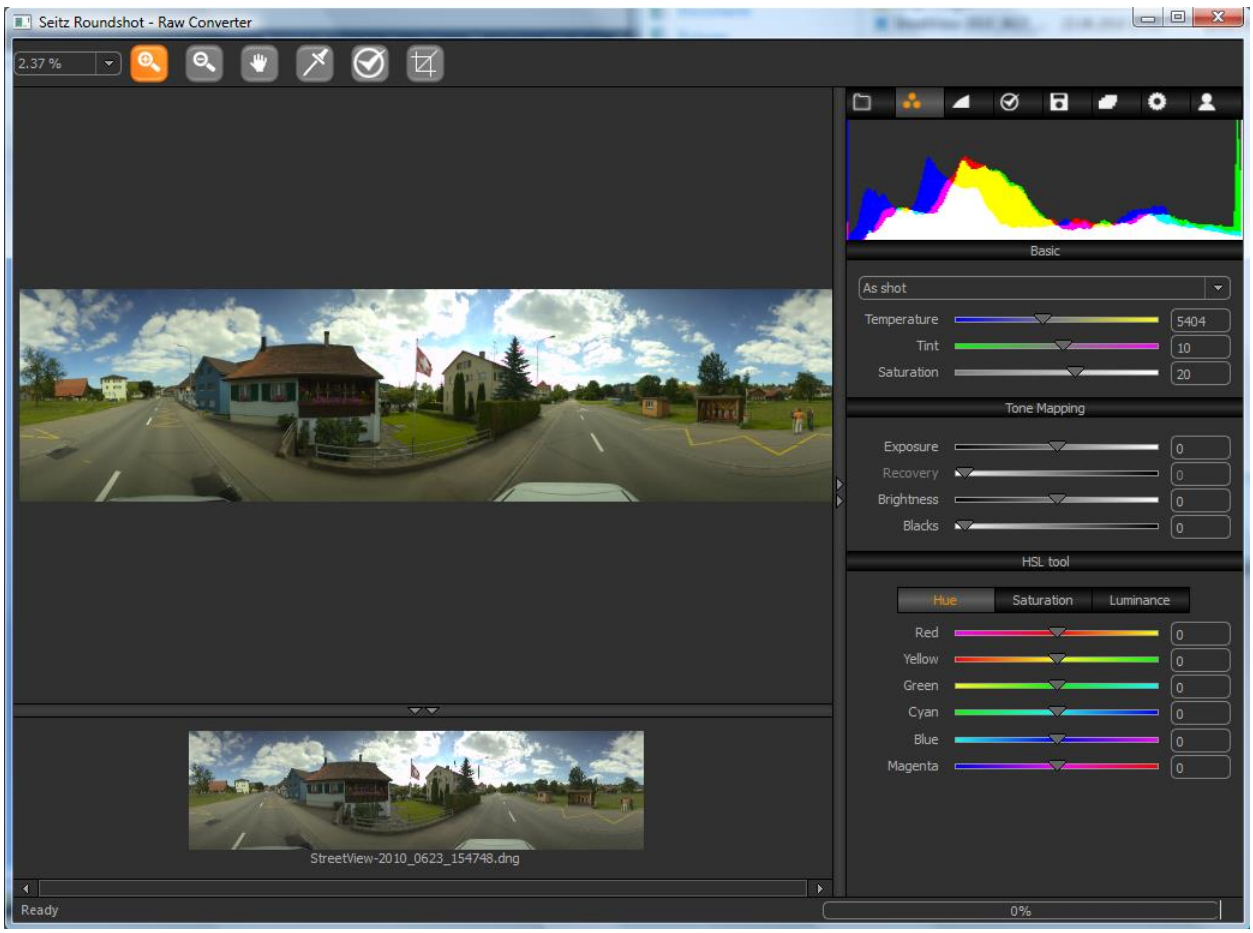
Zoom in/out: Also possible with "X + mouse click" for zoom in or "C + mouse click" for zoom out

Navigation hand: Slides the image in the viewer. Also possible with "Space + mouse slide"

Choose in picture white balance: Select a point within a grey region of the image for specific white balancing

Details window tool: Creates a preview of the image at 100% with all details filters applied (sharpening, noise removal ...)

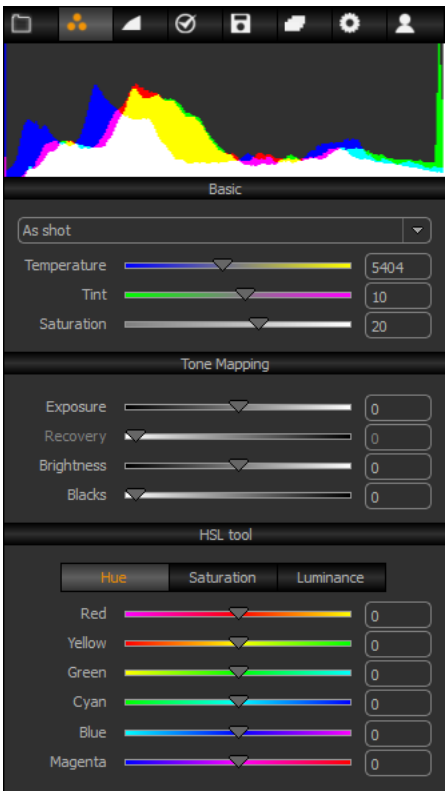
Cropping tool: Defines the part of the image to be exported. The raw image itself is never cropped



5.2 RAW workflow: Seitz raw converter (continued)

Colour

The **Colour adjustment** is the first step in the raw conversion workflow. It contains all the basic colour adjustment parameters and some basic tone mapping tools:



Basic: white balance

Select one of the white balancing options in the list. It is recommended to use either "**choose in picture**" and point on a grey area in the image, or "**Automatic**". This will give a starting point for the subsequent fine tuning of colours. The white balanced version of the image is displayed directly in the preview.

Use the other **"basic"** colour management tools to fine tune the image white balance:

- **Temperature:** makes the image appear warmer or cooler
- **Tint:** compensates a potential greenish or magenta colour cast
- **Saturation:** increases or decreases the overall colour saturation without reducing the dynamic range of the image

Tone mapping - for adjusting the image histogram:

- **Exposure:** applies a linear gain on the image. This tool can lead to dynamic range clipping if used heavily
- **Brightness:** applies a non linear tone mapping on the image. The image will be brighter or darker without any dynamic range clipping
- **Black:** crops the lower part of the image dynamic range. Can be useful if low light levels contain no useful information

HSL*: use the **"HSL"** tool to selectively adjust colours. It is possible to select and adjust each of the six proposed colours: Red, Yellow, Green, Cyan, Blue, Magenta. The adjustment can be done in three ways:

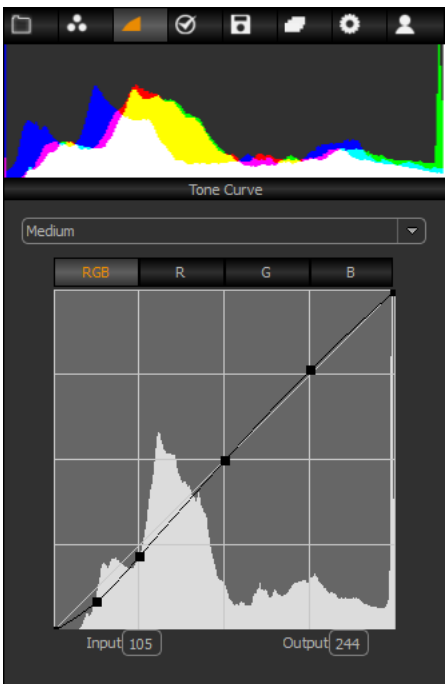
- **Hue:** Fades the colour toward neighbouring colours in the HSL colour space
- **Saturation:** increases or decreases the saturation of the selected colour only.
- **Luminance:** increases or decreases the luminance of the selected colour only

* Hue, saturation, luminance

5.2 RAW workflow: Seitz raw converter (continued)

Tone mapping

After colour adjustments the tone mapping tab offers some advanced tone mapping tools:

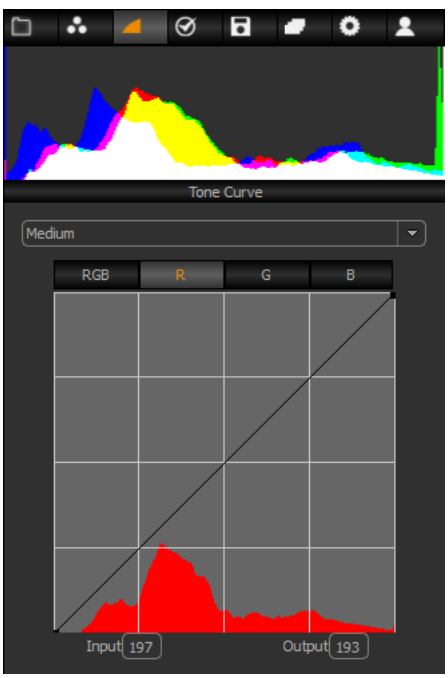


RGB tone mapping

With RGB tone mapping it is possible to apply a **global tone mapping** on the image without affecting the colour settings.

It is recommended to use first one of the **preset tone mapping** curves provided. These tone mapping curves are S-shaped and allow to control the global **image contrast**.

In a second step it is possible to fine tune the tone mapping by adjusting the **tone curve** directly on the graph. It is possible to move the existing reference points or to create some new ones (black squares on the curve)



Selective colour tone mapping

It is also possible to apply different tone mapping curves for each primary colour (red, green and blue)

The default curve is linear and can be adjusted by creating intermediate points in the graph.

Please note that this tool should not be used heavily. A major difference between the R, G and B tone mapping will affect the image white balancing.

5.2 RAW workflow: Seitz raw converter (continued)

Details enhancement

After Image global adjustments (colour, tone, histogram...) the details enhancement tab offers some tools to remove image artefacts or to increase image quality. These tools are only applied on the converted tiff or jpeg image and are visible in the dedicated preview located in this tab:

Click the "**details button"** in the toolbar and the details tab will open automatically

In the main image preview, select the area of interest by clicking directly on the image. A 100% zoom on the selected region is displayed in the details tab.

Important: Please note that all the detail tools are not applied on the main preview even when zooming at 100%. For optimisation and speed matters, their effect in only visible in the details tab preview.

Sharpening: this tool allows to enhance the image sharpness by applying an unsharp-mask filter on the image. It is possible to use presets (weak, medium, strong) or to adjust the following 2 parameters manually:

- **Strength:** defines the sharpening level applied on the detected edges
- **Sensitivity:** defines the sensitivity of the tool to detect edges. The higher sensitivity the more edges will be detected

Denoising: this tool applies a median filtering on the entire image. The degree of denoising can be selected by the changing the filter size. Avoid using too much denoising as this will reduce sharpness.

Colour denoising: this tool applies a specially designed algorithm for colour noise reduction. It is recommended to use presets first. In a second step it is possible to fine tune the parameters depending on the image content:

- **Filter size:** defines the size of the local area affected by this filter
- **Sensitivity:** defines how sensitive the tool will be to wrong colours. The higher the value the more wrong colours will be detected on the image
- **Strength:** defines how strongly the wrong colours will be affected by the filter

5.2 RAW workflow: Seitz raw converter (continued)

Details enhancement

For all the details enhancement tools it is strongly recommended to use the lowest presets (weak) for best results. When using high presets new artefacts might appear: heavy denoising can generate blurred images, strong sharpening may generate noise and high colour noise removal levels may desaturate colours.

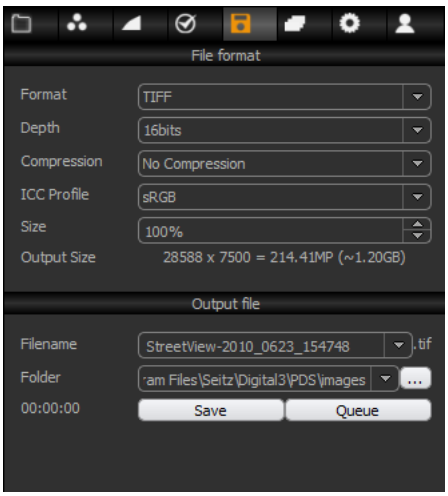
Colour noise occurs when fine details in the image cannot be resolved by the sensor or for high frequency areas (passage from dark to very bright) on a sharp edge.

Add some saturation (Master saturation) when using the colour noise filter as otherwise the image may lose some colour.

5.2 RAW workflow: Seitz raw converter (continued)

Save

Once the image is optimised and all image adjustment parameters are set, the next step is to export the image in Tiff or JPEG formats. Open the "**Save tab**" and select the image export parameters as described below:



File format: this menu contains all raw conversion parameters:

- **Format:** select between Tiff for highest image quality or JPEG for smaller file size
- **Depth:** when selecting Tiff it is possible to choose between 16bit or 8bit colour depth. JPEG is limited to 8bit
- **Compression:** for both formats it is possible to use compression to reduce the output file size. However, for JPEG this can lead to loss of quality

- **ICC profile:** select the output colour space of the final image. It is possible to choose between **sRGB**, optimized for web applications, or **AdobeRGB** and **ProPhotoRGB,** which allow higher colour precision for fine art work
- **Size:** depending on the final application the image is not needed in full resolution. It is therefore possible to reduce the output image size and processing time.
- **Output size:** depending on the selected reduction size, this field displays the expected output image number of pixels and file size on disk

Output file: This menu contains the file name and location options as described below:

- **File name :** by default the original file name is used with the new output file extension. It is possible to change this name by editing this field
- **Folder:** the default output file location is the location of the original DNG file. It is possible to change this by editing this field or browsing the new location using the button on the right side ...

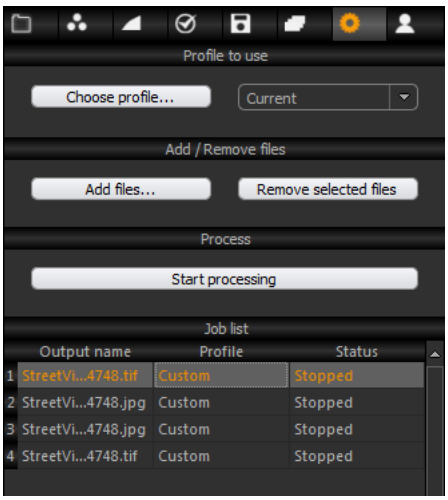
Press Save to Export the image directly. During the processing the Seitz raw converter will not be available for other tasks.

Press Queue to add the image export to a waiting list. The software is immediately available for the next image conversion. Once all images are ready, open the **"batch process tab"** and process all the images. Please refer to next section.

5.2 RAW workflow: Seitz raw converter (continued)

Batch process

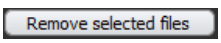
The **"Batch process tab"** allows setting up batch processing, i.e. applying raw conversion to several images one after the other using profiles. It is possible to add files to the waiting list from the Save tab or add the files directly using saved profiles:



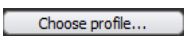
Job list: the job list contains all the files waiting to be processed and their corresponding profiles. The files sent to this list via the saving tab use a custom profile.

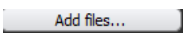
Start processing: press on start processing to process the job list. during this process the software will not allow any other operation

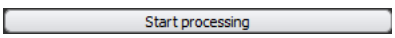
Remove files: it is also possible to remove some jobs from the list. Select the jobs and then click on



Add files: if some profiles are already saved, it is possible to apply them on images directly from this tab.

- **Choose Profile**: first it is necessary to select the profiles in the "Profile to use section". Browse the profile using the button 

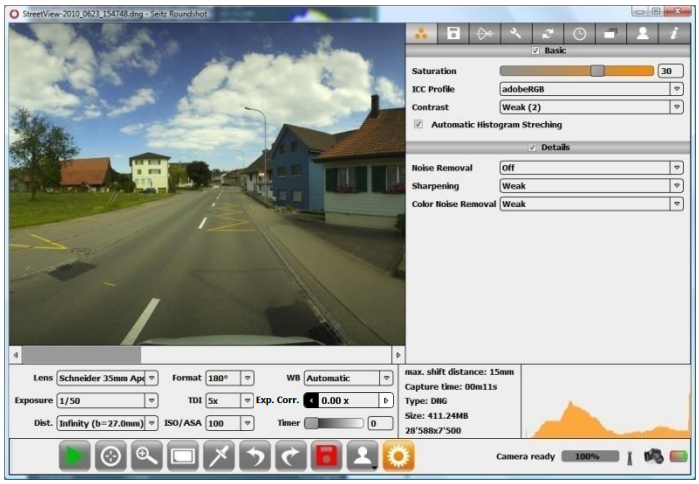
- **Add file:** press on the button 

and browse the image to be processed. A new job will be created in the job list and will be processed when clicking on 

5.3 RGB workflow

With the RGB workflow image capture and RGB conversion are done in one step in the Seitz Roundshot D3 capture software. This workflow is ideal for applications where speed and limited post production are important.

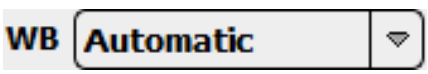
5.3.1 Full resolution RGB workflow



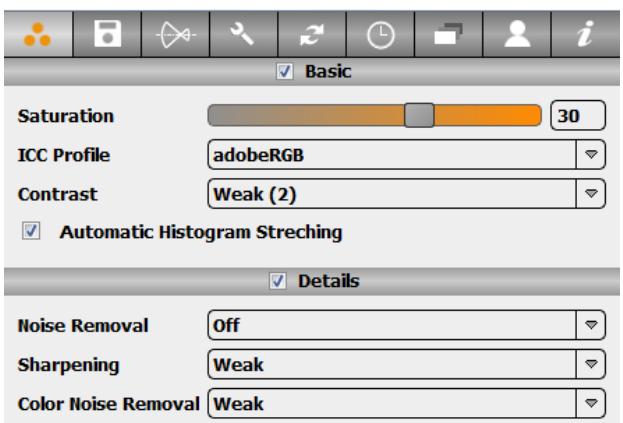
Once the image is captured and displayed in the preview window, complete the following post-production steps:

- **White balancing**
- **Saturation**
- **Tone mapping**
- **Optional: sharpening/noise removal**

Example:



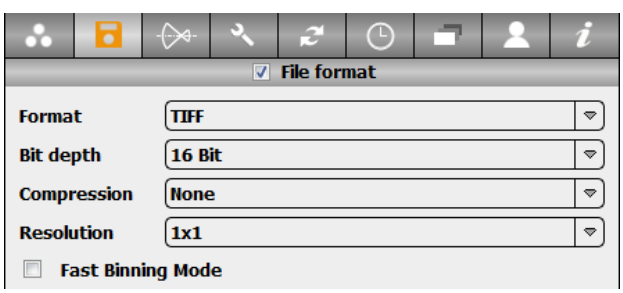
White balancing



Saturation

Tone mapping
(contrast + histogram stretching)

Optional details enhancement:
(noise removal + Sharpening + Colour noise removal



Output file format

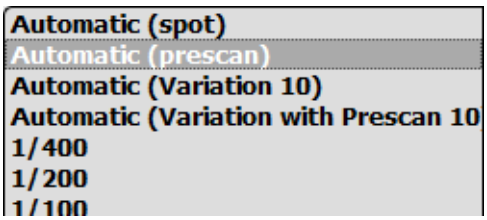
Resolution

Please note that details enhancing options (noise removal, sharpening, colour noise removal) increase saving time.

5.3 RGB workflow (continued)

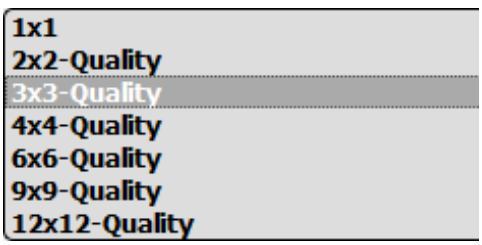
5.3.2 Reduced resolution RGB workflow (fast RGB workflow)

For projects which require a fast image taking/processing/saving rhythm at reduced resolution the **fast RGB workflow** is ideal. This is achieved by selecting an **automatic exposure** (spot, prescan or variation) a **reduced resolution** (option **"fast"**) and selecting **"auto save"**:

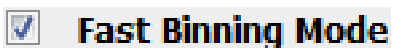


"Automatic (prescan)" is more accurate, but is more time-consuming than **"Automatic (spot)"**, as it requires a 360° turn of the camera head for light metering. **"Automatic (variation)"**change the exposure time within the image.

There are seven resolution options:



- **1x1:** 7'500 pixels vertical resolution)
- **2x2:** 3'750 pixels vertical resolution)
- **3x3:** 2'500 pixels vertical resolution)
- **4x4:** 1'875 pixels vertical resolution)
- **6x6:** 1'250 pixels vertical resolution)
- **9x9:** 833 pixels vertical resolution)
- **12 x 12:** 625 pixels vertical resolution)



„Fast" compresses the image already in the digital scan back, making the image transfer significantly faster. However, this fast compression method allows less quality than when compressing after image transfer (option "Quality").

Auto Save saves the image directly after image taking without pressing the „save" button. It names the file automatically.

Set all other parameters to the desired value (format, distance, TDI Stages, ISO/ASA, File type TIFF or JPG).

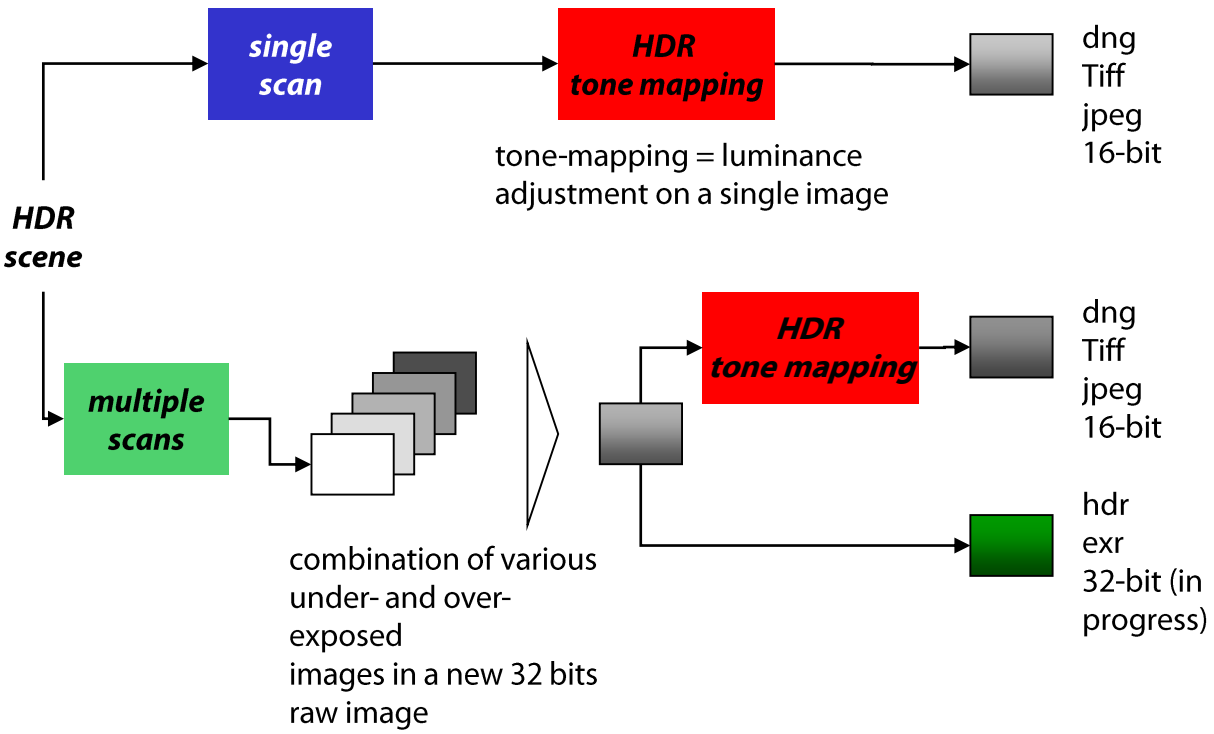
Selecting "automatic (spot)", "6x6/fast" and "Auto save" allows to scan, transfer and save a 1'250 x 5'000 pixel panorama in less than 10 sec.

The resulting TIFF or JPG files cannot be reopened by the Seitz Roundshot D3 software or other raw converters. Additional post-processing needs to be done entirely in Photoshop.

5.4 HDR workflow

5.4.1 HDR overview

The graph below contains an overview of the different possible HDR techniques. However, only the **multiple HDR** solution - mixing differently exposed images - can lead to a **32bit HDR** file with extreme dynamic range.



	Single HDR	Multiple HDR
Image capture	• One image	• Several images
Rendering process	• Tone-mapping of the raw image	• Combination of under-/over-exposed images into one HDR image (raw), tone-mapping of the raw image (optional)
Photography	• Action photography possible (moving scenes)	• Only still photography possible (no moving scenes)
Noise	• Amplification of noise	• No additional noise
Dynamic range	• 11 f-stops (1:2600)	• A multiple of 11 f-stops
Colour depth	• 16-bit	• 16-bit or 32-bit
File formats	• dng, tiff, or jpg	• dng, tiff, jpg, hdr or exr

5.4 HDR workflow

5.4.2 Image capture

There are two possible **workflows**:

	Resolution 1x1	Resolution 3x3
Quality	Exp	Exp
Speed	TDI/Exp	TDI/Exp

Quality: this workflow is designed for the highest image quality possible. From an image to the other **only the exposure time** is changed to adjust the image brightness.

Speed: This workflow is designed to minimise the overall time for capturing the images. It is possible to change **exposure time and TDI** from image to image. For fisheye lenses the top and bottom of the sphere will not be sharp.

	Bracketing	TDI	Exposure speed	Rotation time	
"Quality"	1	2.5x	1/800s	<1 s	46s*
	2	2.5x	1/100s	5 s	
	3	2.5x	1/13s	40 s	
"Speed"	1	2.5x	1/800s	<1 s	7s*
	2	20x	1/100s	<1 s	
	3	20x	1/13s	5 s	

Please note that in the "speed example" the 2 first images will be taken with the fastest rotation time. However as the TDI stages are different, the exposure time is changed.

In all cases it is very important to **save the images in DNG**. DNG files contains raw data allowing the mixing software to accurately mix the images and render a precise exposure for each pixel.

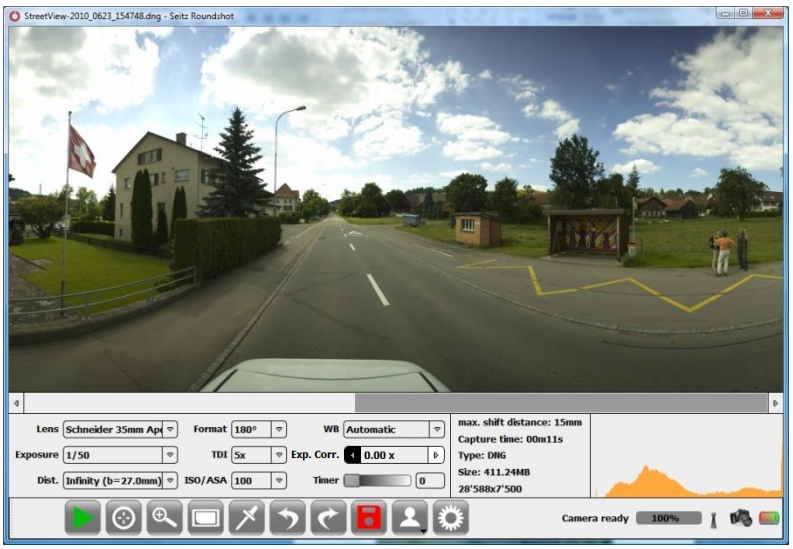
There are **two options** for **resolution**:

- **1x1** allows to get the highest image resolution. However, **Photomatix is not able to read these files**. Therefore it will be necessary to first convert them into tiff and then load them in Photomatix . The other option is to use the Seitz Raw Converter for mixing the images. However, there are no ghost removal and alignment tools in this software, yet.
- **3x3** uses images with reduced resolution. The files can be processed without modification with either **Photomatix (recommended) or the Seitz Roundshot** software.

* Capture time only (without transfer / saving time)

5.4 HDR workflow (continued)

5.4.2 Image capture (continued)



Step 1: Take a test image to determine exposure

Example:

Exp1=1/800s
Exp2=1/100
Exp3=1/13s

Either take an image with medium exposure and optimise the histogram or create a fast exposure and reduce the light source (sun) to the minimum. This will determine the base for bracketing.

Step 2: Set the white balance

There are 2 possible options for white balance:
- **"choose in picture"** – for point white balance
- **"presets"** (direct sunlight, shade, tungsten, fluorescent)

The above white balance options will keep the coefficient values exactly the same for every panorama. "Choose in picture" is the most visual or intuitive tool.

There is always the possibility to readjust the white balance afterwards. However, the fastest and most accurate workflow is to have a uniform white balance from the beginning.

Do not use "automatic white balance" as this will create different colour temperatures and hues for every image. As a consequence, the HDR mixing will lead to artefacts.

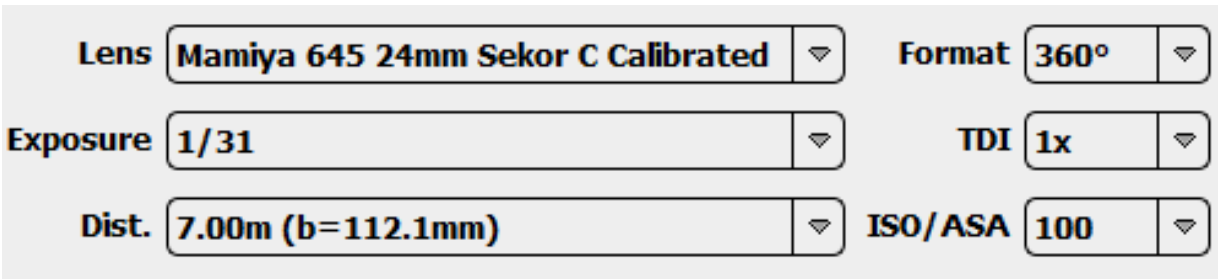
5.4 HDR workflow (continued)

5.4.2 Image capture (continued)

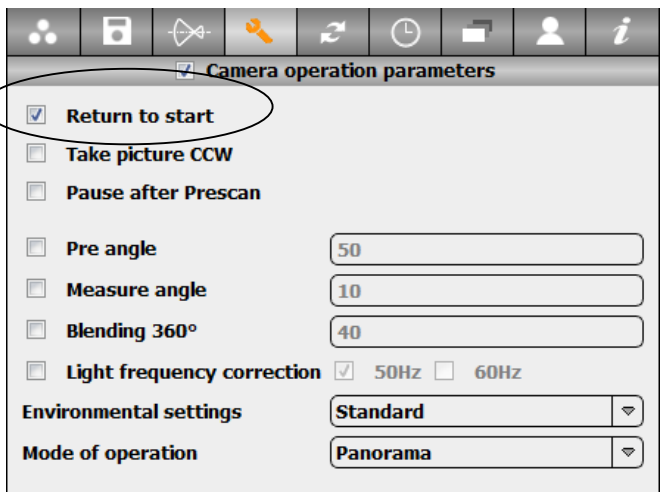
Step 3: Check the "shoot settings"

For example, with a **fisheye lens**:

- 24mm Mamiya 645 fisheye lens
- 360°
- Distance equal to focusing on lens
- Exposure speed and TDI according to bracketing table
- **ISO set to 100** as higher ISO does not allow better information for 32-bit
- **White balance: "choose in picture" or "presets"**
- Saturation, contrast, sharpening & noise removal will be set automatically to default when saving DNG
- **Auto histogram stretching: off**
- **File type: DNG**
- **Saving options: automatic**

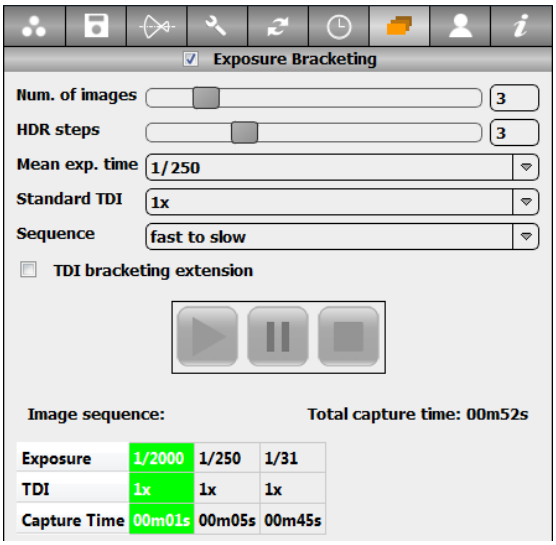


If the HDR sequence will be taken manually (not using the HDR bracketing tool), do not forget to activate **"return to start"** in **the "Camera parameters"** tab. This makes the camera return **anti-clockwise** to the starting position, thus ensuring a perfectly uniform pixel registration for every image.



5.4 HDR workflow (continued)

5.4.2 Image capture (continued)



Step 4: Program HDR Image sequence

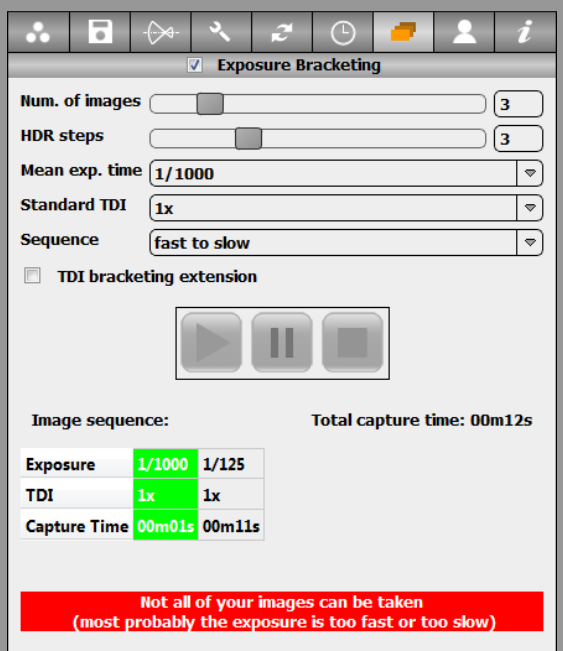
Open the HDR menu and set the desired **number of images** and **HDR steps**. In this example we take 3 images with each time 3 f-stops difference.

Define the **mean exposure time** and standard **TDI**. This results in the following sequence

Exp1=1/2000s; TDI=1x
Exp2=1/250s; TDI=1x
Exp3=1/31s; TDI=1x

Press the **„Start“** button to initiate the image sequence

If the scanning speed range is not sufficient to generate an image sequence corresponding to the defined parameters, the image sequence is cropped to the maximum possible and a warning will be displayed.



In this case it is possible to:

- Change the mean exposure time
- Activate the TDI Bracketing extension
- Reduce either the number of images or the HDR steps

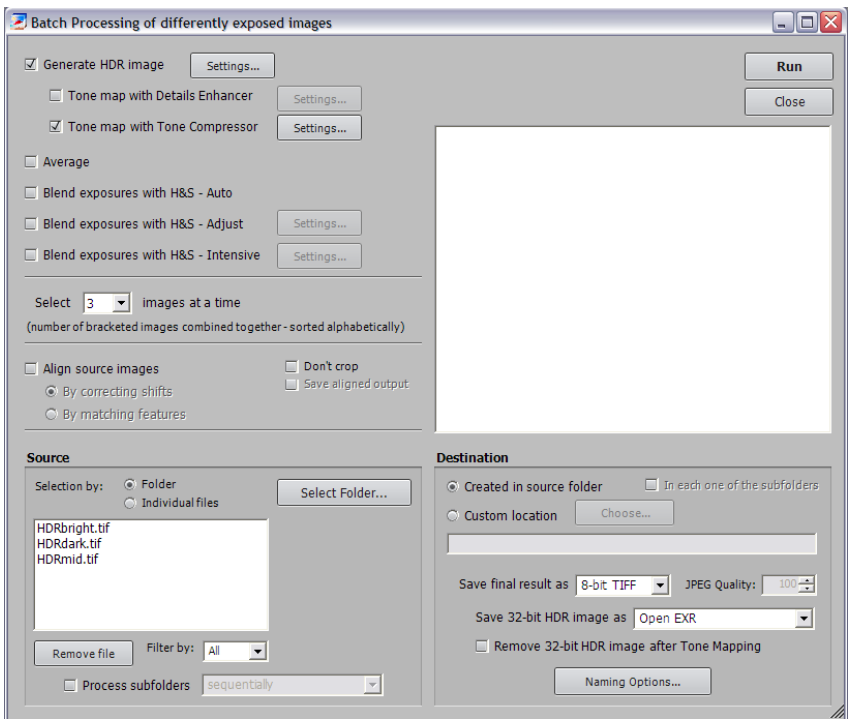
5.4 HDR workflow (continued)

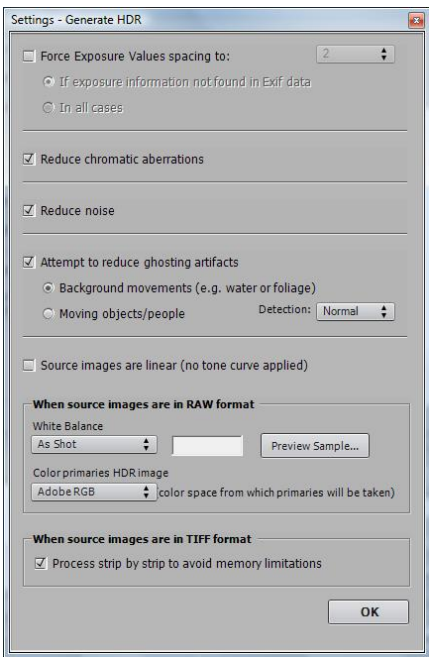
5.4.3 32bit HDR generation: image mixing

Photomatix

This software is recommended for 32bit EXR generation. It is able to read 3x3 dng files or unlimited size tiffs. It also contains very useful tools especially for outdoor images:

- **Align source images -** in case any external factor (wind, vibration on floor) moved the camera from its position during image capture
- **Reduce chromatic aberration** at the edge of objects or buildings
- **Attempt to remove ghosting artefacts -** in case of non static scenes either for background or object movement
- **Process images by stripe** allowing the processing of very big tiff files





When using 1x1 image resolution, it is not possible to load the raw files directly into Photomatix. In this case it is necessary to first process the images in the Seitz Roundshot software and then load the tiff files in Photomatix.

Please note that in this case, all conversion options must be turned off and the **S-curve needs to be set to 1.** The less processing the image contains, the higher 32bit image quality is generated.

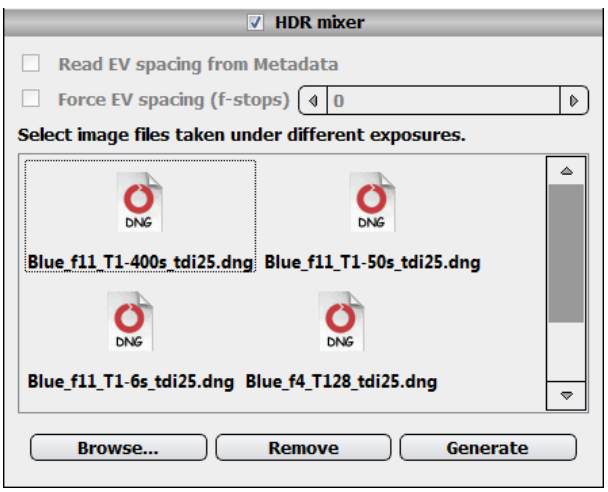
5.4 HDR workflow (continued)

5.4.3 32bit HDR generation: image mixing (continued)

Seitz Roundshot software

Press the „HDR“ button in the „Parameter“ menu to activate the **„HDR“** tab:

This menu allows to merge differently exposed images of the same scene into a single 32bit EXR file. The input files must be in DNG format.



Press **“Browse”** and select a set of differently exposed images of the same scene.

All the parameters necessary for the HDR generation are stored in the image metadata (except for aperture. see hint below).

Click **“Generate”.** The mixing of the 32-bit HDR image takes a few minutes, depending on image size and number of images. The progress of the mixing process is indicated by a percentage progress bar.

A **32bit EXR file** is saved according to the selected image saving path.

The Seitz Roundshot HDR mixing tool is able to process all dng file resolutions. However it does not contain any ghost removal or image alignment tools.

Therefore it is recommended to use this tool only for static scenes (mainly indoors). For the outdoor scenes please use Photomatix or other HDR mixing tools (Photoshop for example).

Avoid changing the lens aperture from one image to image because:
- The camera can move slightly creating a misalignment between images
- The depth of field changes between images
- The aperture information is not written in the metadata and has to be corrected manually. This can be done by readjusting the exposure time in a metadata editor like PhotoMe.

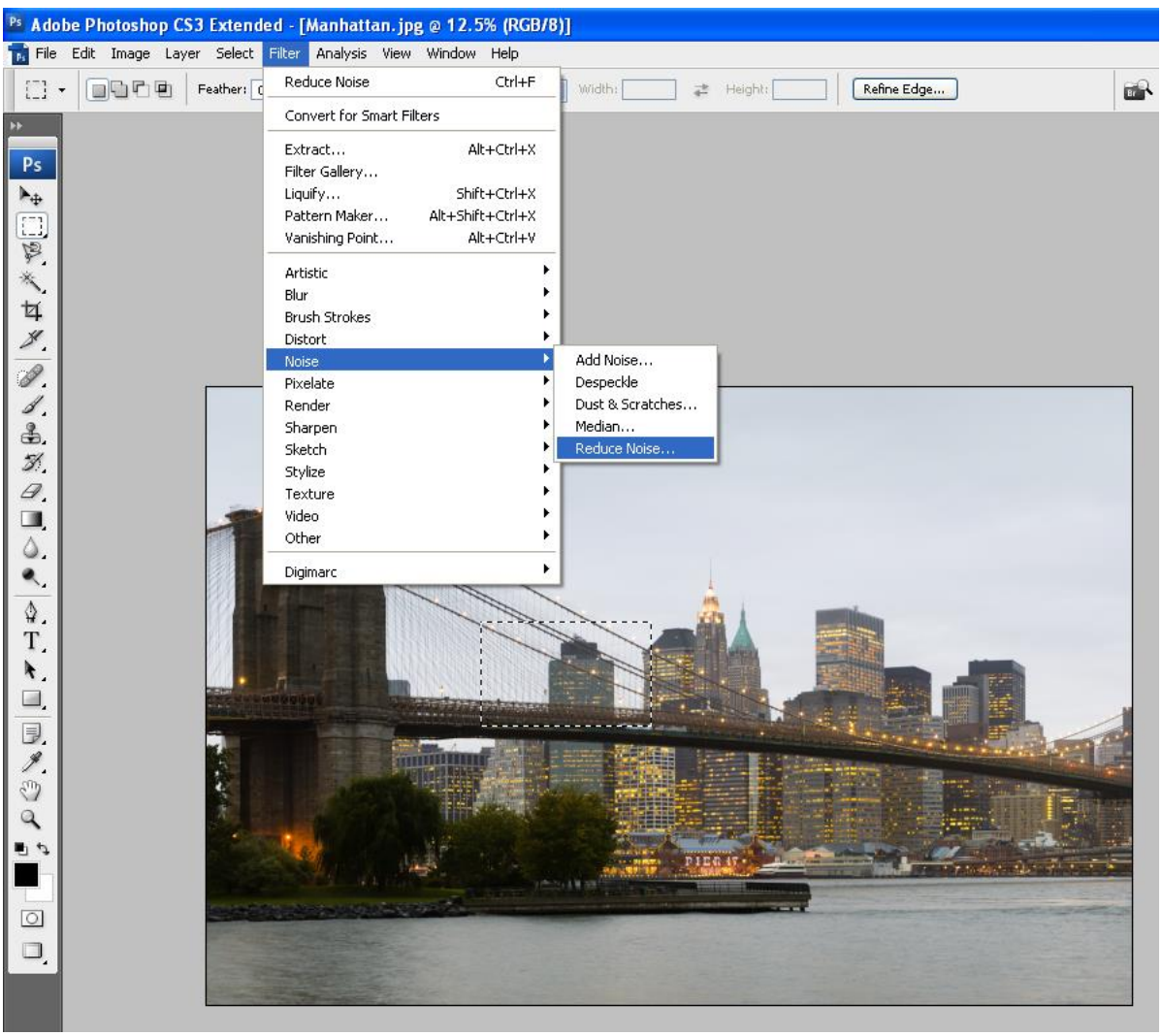
5.5 Additional post production in Photoshop

Colour noise

For details in the image that contain high frequency areas it is possible that colour artefacts occur. These artefacts are created because the resolution (frequency response) of the lens is higher than that of the digital scan back or when photographing fine structures (moiré). For example, Schneider and Rodenstock medium format lenses often have a resolution (in line pairs per mm) which is higher than that of the D3 sensor.

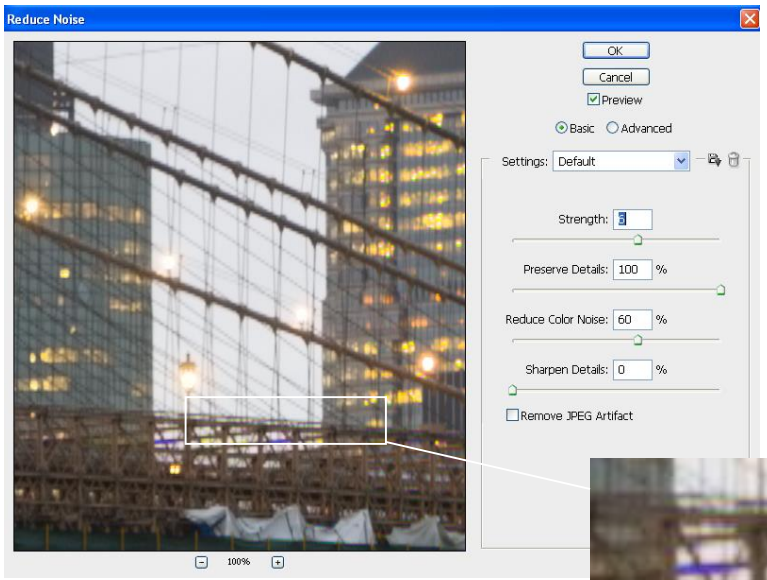
These colour artefacts can be eliminated in the Seitz Roundshot software using the "Colour noise reduction" tool. However some parts of the image might still suffer from this artefact. In the case it is possible to select only these areas and apply a stronger colour noise reduction in Photoshop using the filter **"Reduce noise".**

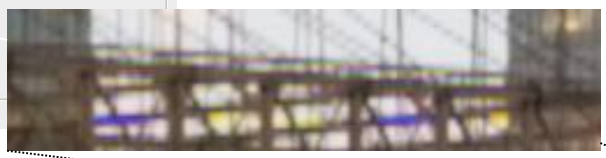
This method has two main advantages. It allows to get an image free from any colour noise artefact. Also, because of its selection possibilities, the parts non affected by the colour noise will remain unchanged.

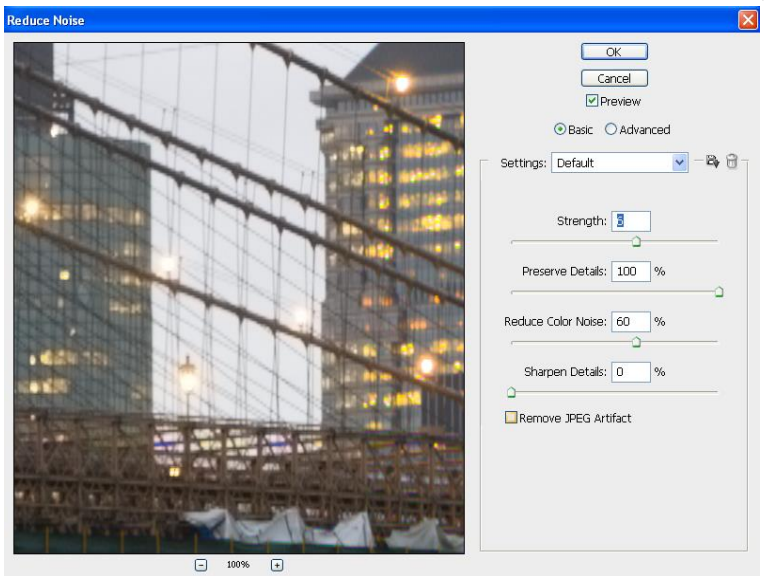


5.5 Additional post production in Photoshop (continued)

Colour noise







Colour artefacts (false colours/rainbow) on fine structures or high frequency areas.

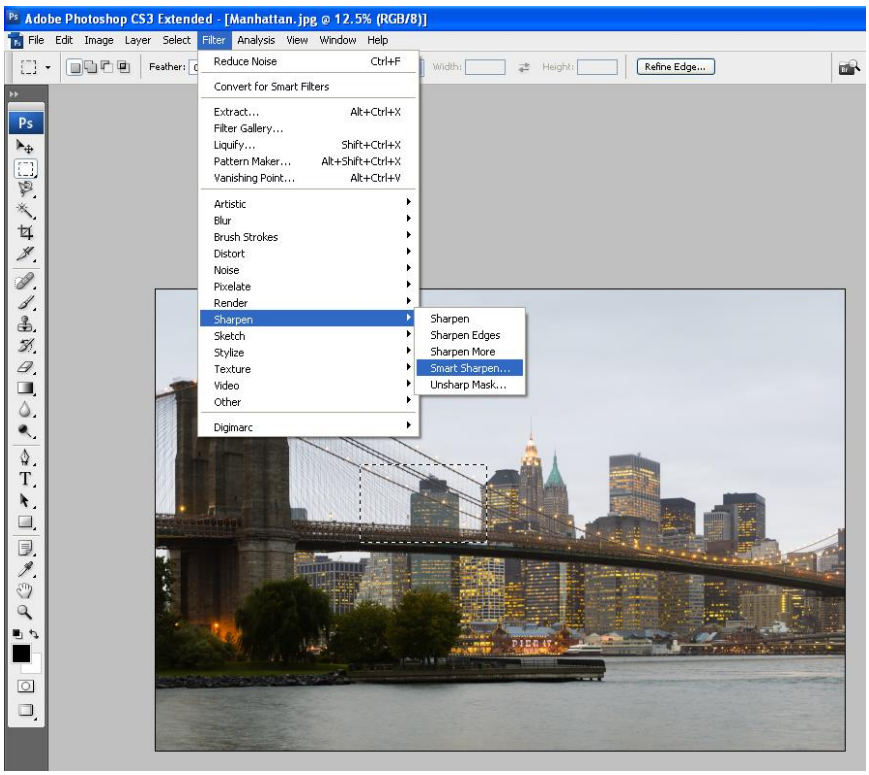
Select medium parameters (strength 6, reduce colour noise. 60%) to avoid "halo effect" / unsharpness.

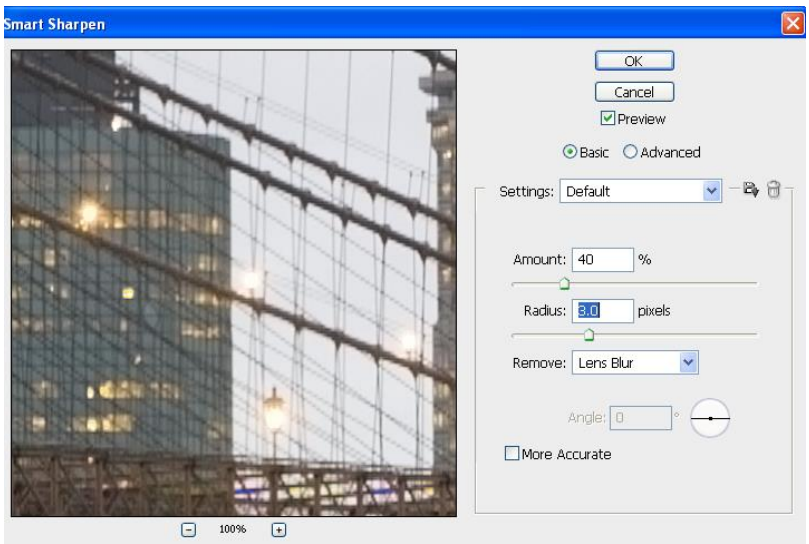
As this filter requires significant calculations work with a 64-bit machine/software or on selected areas of the image only.

5.5 Additional post production in Photoshop (continued)

Sharpening

When all filtering, tone-mapping and histogram adjustments are done it may be beneficial to sharpen the image. A sharpening algorithm which works well is **„Smart Sharpen“:**





6. Maintenance

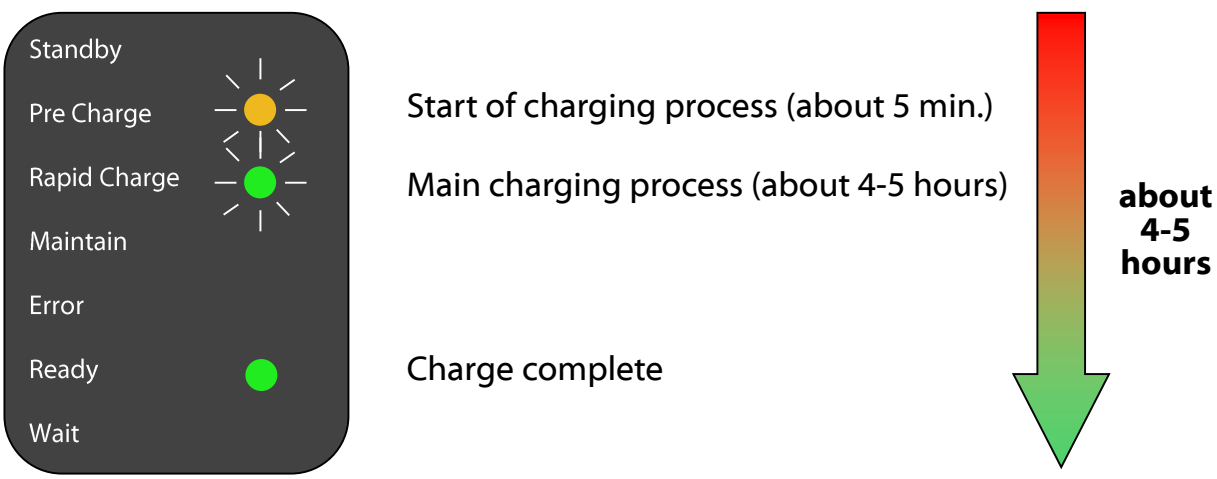
6.1 Power supply: AC power adaptor and battery charger

The Roundshot D3 camera can be operated either with the battery or by connecting the camera to a permanent power supply.

Important: make sure that the power supply is not plugged into the battery socket as a malfunction may occur.

A single charge of the NiMh 12V 4.5A battery usually last for **5-6 hours of operation**. The camera has a built-in power save feature and shuts down all non essential camera functions when idle.

Charging the 12V 4.5A battery



6.2 Reset of Seitz D3 digital scan back

In case of a malfunction the Seitz D3 digital scan back can be reset. This may be required if the software (flash file) within the Seitz D3 digital scan back is no longer working properly. It is done in the following way:

Push with a pen or with a screwdriver into the reset pin on the back side of the Seitz D3 digital scan back. Keep it pressed for a few seconds.

This initiates a reset of the software, i.e. the flash file is reset to the original factory file.

After the reset it may be required to flash the camera with the latest flash file. Please follow the instructions in section 3.2.9.

6.3 Camera maintenance

The Roundshot D3 contains high-tech electronic components. Therefore it is important to handle the camera with care, in particular:

- Make sure that all brackets (for example: lens brackets) and releases (for example optical bench release, rotation point release) are securely fastened, especially for image taking
- Do not use the camera in rain or snow without any special weatherproof case
- Keep the camera in a cool and dry place for storage (ideally in the original case supplied with the camera)
- Do not expose the camera to excessive heat or cold for extended periods of time
- Prevent exposure to dust, as an accumulation of dust particles on the digital sensor may impair image quality
- Make sure not to drop the equipment
- When unplugging cables pull at the plug not at the cable

Very important:

Do not store the camera below -5° or above 40° C as the ultra-thin optical filters of the camera may be damaged.

This means, for example, not to leave the equipment in the car when temperatures are below 0° C or above 30° C as the temperature swings inside a car may be larger than on the outside.

6.3 Camera maintenance (continued)

Digital sensor and optics

Make sure that no dust accumulates on the digital sensor and that the lenses remain dust and scratch free. The outside protection glass (IR cut filter) can be cleaned using some window cleaner and a soft cotton swab:

Computer

Handle the tablet PC with care. Wipe the screen from time to time with a wet microfibre cleaning cloth. Be sure to download and install regular updates (operating system, Seitz Roundshot D3 capture software, Seitz raw converter).

6.4 „Club D3“

6.4.1 International warranty & product registration

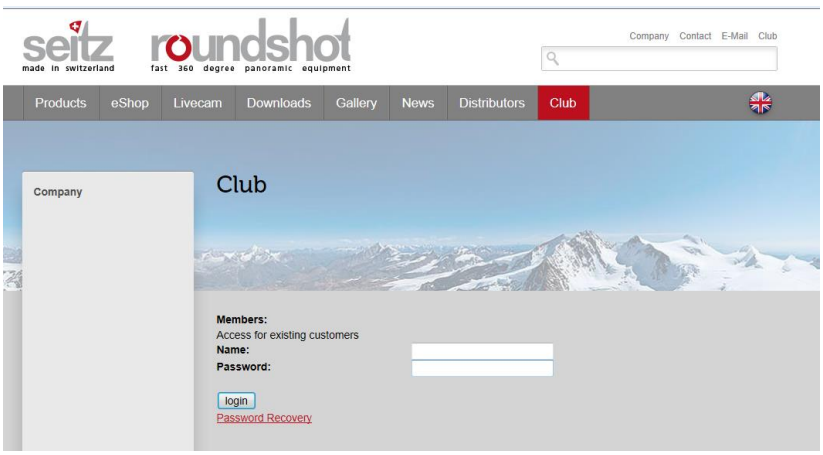
Your Roundshot D3 camera is covered by the international 2-year Seitz warranty. The warranty is linked to the serial number of the camera directly and is stored in our database.

If there is any malfunction or defect of the equipment we will repair the camera at no cost. The warranty extends to technical defaults that are not caused by inproper use, damage by transportation or other defaults not related to the manufacturing of the camera.

The warranty is void if the camera has not been handled with care (has been dropped) or if it has been stored at below -5° C or above 40° C. Delivered components for which separate warranty agreements are issued (for example for computers) bear the warranty of the manufacturer.

We invite you to register your product with us. Registering your product has several advantages:

- Free access to the latest software downloads and instruction manuals
- Email software update alerts + release notes
- Direct technical assistance in case of a problem



Registering your product is a simple 2-step process:

1. Send us an email to info@roundshot.com indicating the serial numbers of your Seitz D3 digital scan back and camera as well as where you bought the equipment.

2. We will activate your membership and confirm your registration by email.

Then go to the „Club D3“ section at www.roundshot.com, log in with your member ID and password and download new software or instruction manuals.

6.4 „Club D3 “ (continued)

6.4.2 Software & firmware updates

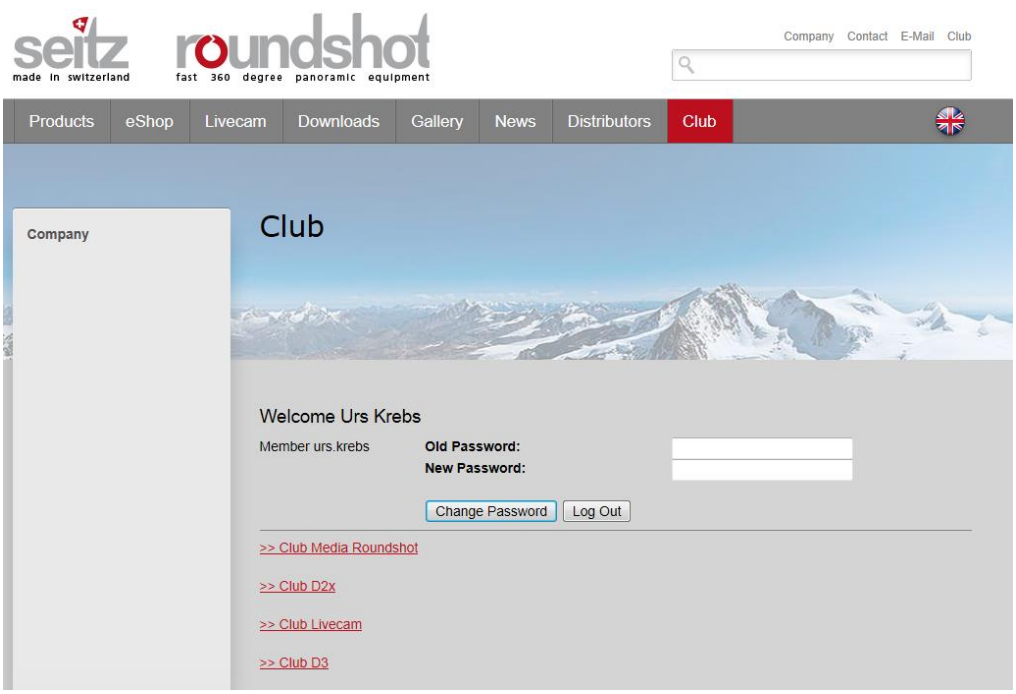
Sometimes copying programs or flash files on USB sticks can damage them. Therefore we recommend downloading the software directly to your computer from our website.

The Seitz Roundshot D3 software runs on Windows PCs (XP, VISTA, 7) as well as on Mac computers (OS 10.5 and 10.6) with 32-bit or 64-bit Intel processors.

To update the firmware (within Seitz D3 digital scan back) and Seitz Roundshot D3 software proceed as follows:

- Set the LAN connection properties to: detect IP and DNS server address automatically
- Connect to the www.roundshot.ch website and enter „Club“
- Download the latest software directly to your computer
- Make sure that the active account has Administrator rights (otherwise restart the computer and log on)
- Unzip the new installation exe file to your desktop, launch the installation file
- Choose your favorite language and follow the instructions
- Set the LAN connection properties again to: 10.0.0.20, 255.0.0.0 (or your personal settings)
- Connect to the camera

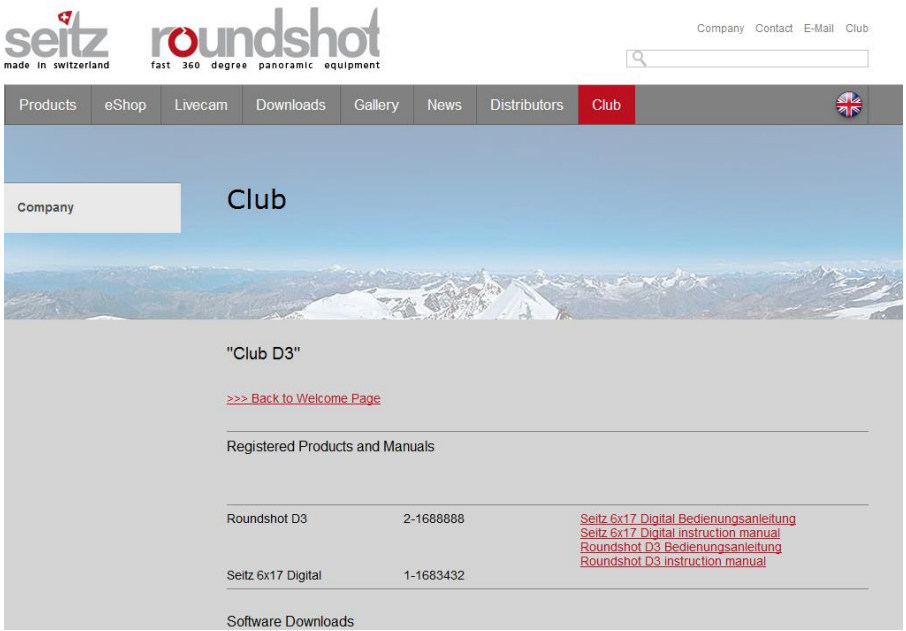
Connect to the “Club” website at www.roundshot.com
Please change your password on your first visit.



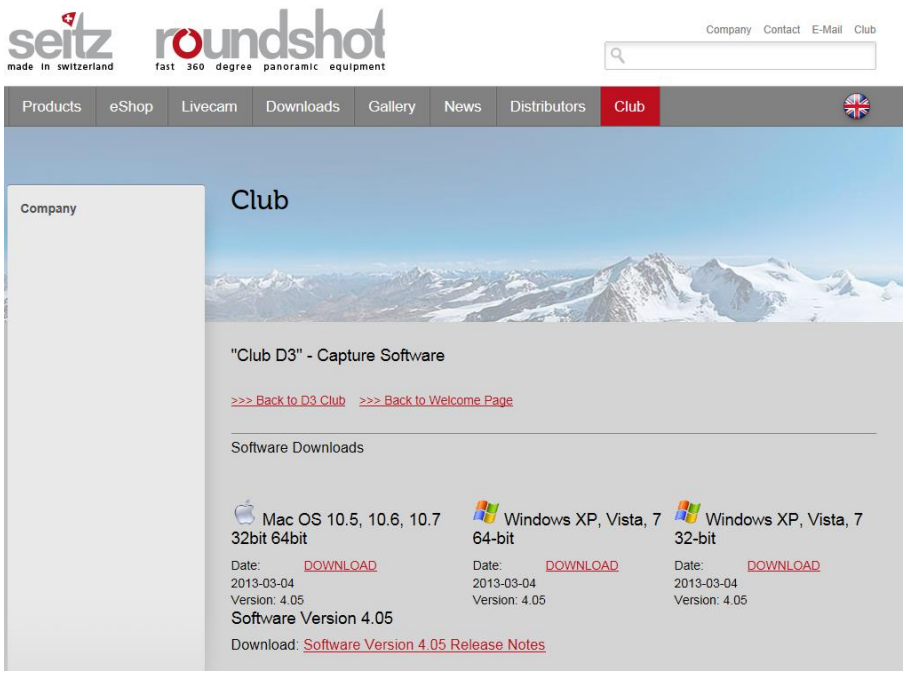
6.4 „Club D3 “ (continued)

6.4.2 Software & firmware updates (continued)

In the **“Club D3”** your registered products are displayed and the latest **instruction manuals** are available for download.



In **“Software Downloads”** both the most up-to-date version of the **Seitz raw converter software** and the **Seitz Roundshot D3 capture software** are available for download.



6.5 Return of equipment / recycling

Your Roundshot product and the accessories are produced from highest quality materials and parts and will provide you continued pleasure. Should you nevertheless want to dispose of your Roundshot equipment one day, it should not be placed in normal waste. The correct disposal of your old equipment is a contribution to preventing possible negative causes for the environment.

swico Recycling-Garantie
Garantie de recyclage

For optimum recycling we kindly ask you to return us your camera (with accessories) to the following address:

Seitz Phototechnik AG
Environment & Recycling Department
Frauenfelderstrasse 26
8512 Lustdorf / Switzerland

This return shipment to the manufacturer is **free of charge**. The service is available **worldwide**.

Please contact us to arrange the return shipment and prepare the materials for the delivery. Your camera and accessories will be picked up by our courier service and will be recycled in our factory.

We wish you continued success and fun with your Roundshot D3!

7. Technical data

Seitz D3 digital scan back

Manufacturer	DALSA Corporation exclusive for Seitz
Type	TDI
Stages	Multiple for sensitivity control
Vertical resolution **- Seitz D3** **- Seitz D3-2500**	 7,500 pixels (60mm) 2,500 pixels (60mm)
Pixel size	8 x 8 µ
Dynamic range	11 f-stops
Anti-Blooming	> 1,000x

Technical changes reserved

7. Technical data (continued)

Roundshot D3

Manufacturer	Seitz Phototechnik AG
Lenses	Medium or large format lenses by Schneider, Linos Rodenstock, Hasselblad and Mamiya 645; small format lenses by Nikon; selection of aperture directly on lens
Focal lengths	from 16mm fisheye to 250mm
Shift	+/- 25mm shift of scan back - depending on image circle of lens
Horizontal resolution	Depending on lens and degree of panorama: focal length (mm) * 2 * 3.1415 / 360 * degrees / 0.008
Total resolution at 360° **- Roundshot D3** **- Roundshot D3-2500**	 from 65 million pixels (16mm lens) to 1,471 million pixels (250mm lens) from 7 million pixels (16mm lens) to 165 million pixels (250mm lens)
File sizes at 360° with 80mm lens **- Roundshot D3** **- Roundshot D3-2500**	 raw (16-bit): 909 MB, tiff (48-bit): 2.7 GB raw (16-bit): 303 MB, tiff (48-bit): 0.9 GB
Time for 360° scan	example with 80mm lens: about 3 seconds at full resolution
Exposure range	from 1/2000 sec. to 10 seconds
Exposure control	automatic or manual exposure
Sensitivity control	by selection of TDI stages (1x, 2.5x, 5x, 10x, 20x) or by ISO/ASA (100, 200, 400, 800)
File formats	raw (dng), tiff, jpeg
Camera body* **- dimensions** **- weight**	 width: 150mm, height: 280mm, depth: 200mm 4.6 kg (camera 3.0 kg, Seitz D3 digital scan back: 0.6 kg, battery 0.8 kg)
Capture software	Seitz Roundshot D3 capture software installed on 64-bit Mac or Windows computer
Ideal capture computer	Motion J3500 tablet PC with gigabit ethernet, fast SSD disks, back-lit LED screen for outdoor viewability - dimensions: 323 x 231 x 23mm (13 x 9" x 1") - weight: 1.8 kg
Raw conversion software	Seitz Roundshot raw converter, Adobe camera raw/Photoshop, Lightroom, installed on 64-bit Mac or Windows computer
Image transfer	gigabit ethernet
Power supply (camera)	12V 4.5A NiMh battery
Battery charger	110-220V universal charger - plugs provided for EU, North America, UK, Australia, Asia
Modes	panorama, turntable, QTVR
Language support	English, German, French, Italian, Spanish, Chinese, Japanese

Technical changes reserved

Appendix 1: lens (focal length) and image angle combinations for jpg files

The **maximum amount of horizontal pixels** is limited to **65‘500 for jpg images**. The following table gives an overview of possible lens and image angle combinations (marked in green):

Image angle, °

f	20	40	60	80	100	120	140	160	180
28	1'222	2'443	3'665	4'887	6'109	7'330	8'552	9'774	10'996
35	1'527	3'054	4'581	6'109	7'636	9'163	10'690	12'217	13'744
38	1'658	3'316	4'974	6'632	8'290	9'948	11'606	13'265	14'923
45	1'963	3'927	5'890	7'854	9'817	11'781	13'744	15'708	17'671
50	2'182	4'363	6'545	8'727	10'908	13'090	15'272	17'453	19'635
55	2'400	4'800	7'199	9'599	11'999	14'399	16'799	19'199	21'598
60	2'618	5'236	7'854	10'472	13'090	15'708	18'326	20'944	23'562
70	3'054	6'109	9'163	12'217	15'272	18'326	21'380	24'435	27'489
80	3'491	6'981	10'472	13'963	17'453	20'944	24'435	27'925	31'416
100	4'363	8'727	13'090	17'453	21'817	26'180	30'543	34'907	39'270
120	5'236	10'472	15'708	20'944	26'180	31'416	36'652	41'888	47'124
150	6'545	13'090	19'635	26'180	32'725	39'270	45'815	52'360	58'905
180	7'854	15'708	23'562	31'416	39'270	47'124	54'978	62'832	70'686
210	9'163	18'326	27'489	36'652	45'815	54'978	64'141	73'304	82'467

f	200	220	240	260	280	300	320	340	360	**Limit**
28	12'217	13'439	14'661	15'882	17'104	18'326	19'548	20'769	21'991	1'072
35	15'272	16'799	18'326	19'853	21'380	22'907	24'435	25'962	27'489	858
38	16'581	18'239	19'897	21'555	23'213	24'871	26'529	28'187	29'845	790
45	19'635	21'598	23'562	25'525	27'489	29'452	31'416	33'379	35'343	667
50	21'817	23'998	26'180	28'362	30'543	32'725	34'907	37'088	39'270	600
55	23'998	26'398	28'798	31'198	33'598	35'997	38'397	40'797	43'197	546
60	26'180	28'798	31'416	34'034	36'652	39'270	41'888	44'506	47'124	500
70	30'543	33'598	36'652	39'706	42'761	45'815	48'869	51'924	54'978	429
80	34'907	38'397	41'888	45'379	48'869	52'360	55'851	59'341	62'832	375
100	43'633	47'997	52'360	56'723	61'087	65'450	69'813	74'176	78'540	300
120	52'360	57'596	62'832	68'068	73'304	78'540	83'776	89'012	94'248	250
150	65'450	71'995	78'540	85'085	91'630	98'175	104'720	111'265	117'810	200
180	78'540	86'394	94'248	102'102	109'956	117'810	125'664	133'518	141'372	167
210	91'630	100'793	109'956	119'119	128'282	137'445	146'608	155'771	164'934	143

For example, for a 360° panorama the longest focal length that can be used for jpg is a 75mm lens. Or with a 100mm medium format lens the maximum image angle that can be achieved for jpg is 275° (see column „Limit“).

Appendix 2: lens lists

Schneider

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length infinity	h-value	b-value infinity
28mm	Apo Helvetar	5.6	91.8	90	30	29.2	-11.2	18.0
35mm	Apo-Digitar XL	5.6	79.2	90	30	36.4	-9.4	27.1
36mm	ALPA Apo Switar	5.6	81.1	105	45	36.4	-9.4	27.1
38mm	Super-Angulon XL	5.6	74.8	130	70	39.4	0.3	39.7
43mm	Apo-Helvetar XL	5.6	68.0	110	50	44.7	-7.3	37.3
47mm	Apo-Digitar XL	5.6	64.7	115	55	47.6	-4.3	43.3
47mm	Super-Angulon XL	5.6	64.3	138	78	48.0	-6.4	41.6
48mm	Apo Helvetar	5.6	64.7	115	55	47.6	-4.3	43.3
58mm	Super-Angulon XL	5.6	54.8	147	87	58.1	2.3	60.4
60mm	Apo-Digitar N	4.0	53.4	60	-	59.9	-26.8	33.1
60mm	Apo-Helvetar	5.6	52.6	110	50	60.9	-1.2	59.7
72mm	Apo-Digitar L	5.6	43.8	90	30	74.9	-25.8	49.1
72mm	Super-Angulon XL	5.6	45.2	195	135	72.0	5.7	77.7
75mm	Apo-Helvetar	5.6	43.8	90	30	74.9	-25.8	49.1
80mm	Apo-Digitar L	4.0	41.1	90	30	80.3	-22.9	57.5
80mm	Super-Symmar XL	4.5	40.8	176	116	81	-8.5	72.5
90mm	Apo-Digitar N	4.5	36.7	90	30	90.72	-25.4	65.3
100mm	Apo-Digitar N	5.6	33.2	100	40	100.95	-28.0	72.9
120mm	Apo-Digitar N	5.6	27.1	110	50	124.89	-27.8	97.1
120mm	Apo-Digitar M (macro)	5.6	28.2	110	50	119.9	-25.0	94.9
120mm	Apo-Symmar L	5.6	27.5	160	100	120.68	-23.9	96.8
120mm	Apo-Helvetar	5.6	27.1	120	60	123.62	-26.4	97.2
150mm	Apo-Digitar N	5.6	22.4	110	50	151.3	-24.1	127.2
180mm	Apo-Digitar T	5.6	19.1	80	20	179.5	-29.6	150.0
210mm	Apo-Digitar T	6.8	16.3	120	60	210.14	-31.4	178.8
250mm	Tele Xenar	5.6	13.7	180	120	250.3	-96.4	153.9

Please note that Schneider and Rodenstock Linos lenses are mounted on Alpa lens boards and come with a helical mount. For these lenses no separate lens mount is required (they are attached directly to the camera body).

Appendix 2: lens lists

Rodenstock Linos

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length infinity	h-value	b-value infinity
23mm	HR Digaron-S	5.6	112.4	70	10	23.8	35.9	59.7
28mm	HR Digaron-S	4.5	92.6	70	10	28.8	42.1	70.9
32mm	HR Alpagon	4.0	84.6	90	30	33.1	50.1	83.2
35mm	HR Digaron-S	4.5	79.2	90	30	35.2	20.6	55.8
35mm	AAA Apo Alpar	4.5	79.7	105	45	36.1	-3.1	33.0
40mm	HR Digaron-W	5.6	71.4	90	30	41.9	29.8	71.7
45mm	AAA Apo Alpar	4.5	66.4	115	55	46.0	1.8	47.8
50mm	HR Digaron-W	4.5	60.5	90	30	51.7	25.1	76.8
55mm	AAA Apo Alpar	4.5	55.7	105	45	55.7	4.7	60.4
60mm	HR Digaron-S	4.0	52.9	70	10	60.6	-13.6	47.0
70mm	HR Alpagon (Apo Sironar digital)	5.6	46.6	100	40	70.0	-1.9	68.1
70mm	HR Digaron-W	4.0	46.6	90	30	70.0	-1.9	68.1
90mm	HR Digaron-SW / Alpagon	5.6	37.0	120	60	90.0	2.8	92.8
100mm	HR Digaron-S	4.0	33.5	70	10	100.0	-20.6	79.4
180mm	HR Digaron-S	5.6	19.1	80	20	179.5	-28.2	151.3

Please note that Schneider and Rodenstock Linos lenses are mounted on Alpa lens boards and come with a helical mount. For these lenses no separate lens mount is required (they are attached directly to the camera body).

Mamiya 645

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length infinity	h-value	b-value infinity
24mm	Sekor C fisheye	4.0	180.0			23.9	15.5	39.4
35mm	Sekor C	3.5	80.7			35.5	6.7	42.2
45mm	Sekor N	2.8	67.1			45.5	24.0	69.5
50mm	Sekor C Shift	4.0	61.8			50.3	54.0	104.3
50mm	Carl Zeiss Jena Flektagon / Mamiya 645	4.0	60.4			51.8	47.5	99.3
55mm	Sekor C	2.8	57.7			54.7	37.5	92.2
80mm	Sekor C	1.9	42.0			78.4	(3.0)	75.4
80mm	Sekor C	2.8	42.0			78.5	(12.1)	66.4
80mm	N/L Seiko	2.8	41.8			78.9	(7.5)	71.4
80mm	Sekor C Macro	4.0	41.2			80.1	(80.1)	-
120mm	Sekor A Macro	4.0	28.9			117.0	(117.0)	-
150mm	Sekor A	2.8	23.1			147.3	(147.3)	-
150mm	Sekor C	3.5	22.4			152.2	(63.5)	88.7
200mm	Sekor A	2.8	17.5			195.3	(195.3)	-
210mm	Sekor C	4.0	16.8			204.2	(75.8)	128.4

Appendix 2: lens lists

Zeiss Hasselblad CFi/CFE

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length (∞)	h-value	b-value (∞)
38mm	Biogon CFi	4.5	75.9	84	24	38.6	11.6	50.2
30mm	F-Distagon CFi	3.5	89.1	84	24	30.6	102.0	132.6
40mm	Distagon CFE	4.0	72.6	86	26	41.0	69.2	110.2
40mm	Distagon IF CFE	4.0	72.9	86	26	40.8	95.7	136.5
50mm	Distagon CFi	4.0	60.3	96	36	51.9	54.2	106.1
60mm	Distagon CFi	3.5	53.2	98	38	60.2	30.8	91.0
80mm	Planar CFE	2.8	40.7	104	44	81.2	-14.9	66.3
100mm	Planar CFi	3.5	33.1	105	45	101.3	-28.8	72.5
120mm	Makro Planar CFE	4.0	28.0	106	46	120.9	-20.0	100.9
120mm	Makro Planar CFi	4.0	28.0	106	46	120.9	-20.0	100.9
150mm	Sonnar CFi	4.0	22.5	110	50	151.5	-78.2	73.3
180mm	Sonnar CFE	4.0	19.1	119	59	179.4	-107.7	71.7
250mm	Sonnar CFi	5.6	14.1	130	70	243.4	-166.6	76.8
250mm	Sonnar Superachromat CFE	5.6	13.8	143	83	249.2	-188.3	60.9
350mm	Tele-Superachromat CFE	5.6	10.0	158	98	343.1	-366.8	-23.7

Zeiss Hasselblad FE

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length (∞)	h-value	b-value (∞)
50mm	Distagon FE	2.8	60.5	96	36	51.7	61.0	112.7
110mm	Planar FE	2.0	30.4	105	45	110.8	-36.4	74.4
150mm	Sonnar FE	2.8	22.5	110	50	151.3	-79.8	71.5
250mm	Tele-Tessar	4.0	14.0	130	70	245.6	-194.5	51.1
350mm	Tele-Tessar	4.0	9.8	158	98	349.9	-341.5	8.4

Appendix 2: lens lists

Zeiss Hasselblad Telephoto Power Pack

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length (∞)	h-value	b-value (∞)
300mm	Tele-Superachromat	2.8	11.5	145	85	299.9	-368.7	-68.8
503.5mm	Tele-Superachromat	4.8	6.8	170	110	503.5	-546.8	-43.3

Zeiss Hasselblad C

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length (∞)	h-value	b-value (∞)
30mm	F-Distagon	3.5	89.1	79	19	30.6	102.0	132.6
38mm	Biogon	4.5	75.9	85	25	38.6	11.6	50.2
40mm	Distagon	4.0	72.8	86	26	40.9	82.2	123.1
50mm	Distagon	4.0	60.9	96	36	51.3	54.9	106.2
60mm	Biogon	5.6	52.5	98	38	61.1	31.8	92.9
60mm	Distagon	3.5	53.2	98	38	60.2	30.8	91.0
80mm	Planar	2.8	41.0	104	44	80.5	-14.2	66.3
100mm	Planar	3.5	33.4	105	45	100.3	-28.8	71.5
105mm	UV-Sonnar	4.3	31.4	106	46	107.2	-28.9	78.3
150mm	Sonnar	4.0	22.5	110	50	151.2	-78.2	73.0
250mm	Sonnar Superachromat	5.6	13.8	135	75	249.6	-188.7	60.9
250mm	Sonnar	5.6	13.8	135	75	248.4	-171.6	76.8
350mm	Tele-Tessar	5.6	10.1	145	85	341.2	-396.9	-55.7
500mm	Tele-Tessar	8.0	6.9	170	110	500.1	-625.3	-125.2

Appendix 2: lens lists

Zeiss Hasselblad CF

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length (∞)	h-value	b-value (∞)
30mm	F Distagon	3.5	89.1	79	19	30.6	102.2	132.8
38mm	Biogon	4.5	75.9	85	25	38.6	11.5	50.1
40mm	Distagon	4.0	72.8	86	26	40.9	69.3	110.2
50mm	Distagon	4.0	60.9	96	36	51.3	54.9	106.2
50mm	Distagon (2 Einstellringe)	4.0	60.2	96	36	52.0	53.8	105.8
60mm	Distagon	3.5	53.2	98	38	60.2	30.8	91.0
80mm	Planar	2.8	40.7	104	44	81.2	-14.7	66.5
100mm	Planar	3.5	33.4	106	46	100.3	-26.0	74.3
105mm	UV-Sonnar	4.3	31.3	106	46	107.5	-24.6	82.9
120mm	Makro-Planar	4.0	28.0	107	47	120.9	-19.9	101.0
135mm	Makro-Planar	5.6	24.8	108	48	137.1	-14.2	122.9
150mm	Sonnar	4.0	22.5	110	50	151.2	-76.0	75.2
180mm	Sonnar	4.0	19.1	120	60	179.4	-107.9	71.5
250mm	Sonnar	5.6	13.8	135	75	248.4	-171.6	76.8
350mm	Tele-Apotessar	5.6	10.1	145	85	341.2	-396.2	-55.0
500mm	Tele-Apotessar	8.0	6.9	170	110	499.3	-624.5	-125.2

Zeiss Hasselblad CB

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length (∞)	h-value	b-value (∞)
60mm	Distagon	3.5	53.2	98	38	60.2	30.8	91.0
80mm	Planar	2.8	40.6	104	44	81.5	-16.7	64.8
160mm	Tessar	4.8	21.2	112	52	161.1	-65.4	95.7

Appendix 2: lens lists

Zeiss Hasselblad F-FE

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length (∞)	h-value	b-value (∞)
50mm	Distagon	2.8	60.5	96	36	51.7	61.5	113.2
80mm	Planar	2.8	41.0	104	44	80.5	-14.0	66.5
110mm	Planar	2.0	30.4	106	46	110.8	-37.4	73.4
150mm	Sonnar	2.8	22.5	110	50	151.3	-81.8	69.5
250mm	Tele-Tessar	4.0	14.0	135	75	245.6	-197.5	48.1
350mm	Tele-Tessar	4.0	9.8	145	85	349.9	-345.5	4.4

Nikon

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length (∞)	h-value	b-value (∞)
20mm	Nikkor	2.8				20.6	25.7	46.3
24mm	Nikkor	2.8				24.3	24.0	48.3
24mm	Nikkor PC-E	3.5				24.7	78.6	103.3
28mm	Nikkor	2.0				28.6	22.7	51.3
35mm	Nikkor	1.4				35.9	24.4	60.3
50mm	Nikkor	1.4				51.4	-8.1	43.3
85mm	Nikkor PC	2.8				86	-22.7	63.3
105mm	Nikkor	2.5				106.3	-78.0	28.3
135mm	Nikkor	2.8				139.2	-110.9	28.3
180mm	Nikkor ED	2.8				195	-207.7	-12.7

Appendix 2: lens lists

Rollei Zeiss

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length (∞)	h-value	b-value (∞)
30mm	F-Distagon	3.5	89.1	82	22	30.6	102.0	132.6
38mm	Biogon	4.5	75.9	85	25	38.6	11.6	50.2
40mm	Distagon HFT	4.0	72.6	86	26	41.0	69.2	110.2
50mm	Distagon	4.0	60.9	96	36	51.3	54.9	106.2
60mm	Biogon	5.6	52.5	97	37	61.1	31.8	92.9
60mm	Distagon	3.5	53.2	97	37	60.2	30.8	91.0
80mm	Planar HFT	2.8	40.7	104	44	81.2	-14.7	66.5
100mm	Planar	3.5	33.4	106	46	100.3	-28.8	71.5
105mm	UV-Sonnar	4.3	31.4	106	46	107.2	-28.9	78.3
120mm	Planar HFT PQS	4.0	28.0	107	47	120.9	-18.9	102.0
150mm	Sonnar HFT	4.0	22.5	110	50	151.2	-78.2	73.0
150mm	Sonnar HFT PQS	4.0	22.5	110	50	151.2	-75.5	75.7
180mm	Sonnar	4.0	19.1	120	60	179.4	-107.0	72.4
250mm	Sonnar Superachromat	5.6	13.8	135	75	249.6	-188.7	60.9
250mm	Sonnar	5.6	13.8	135	75	248.4	-171.6	76.8
350mm	Tele-Tessar	5.6	10.0	145	85	343.1	-398.1	-55.0
500mm	Tele-Tessar	8.0	6.9	170	110	500.1	-624.9	-124.8
500mm	APO-Tele-Tessar	8.0	6.9	170	110	500.0	-401.1	98.9

Rollei Schneider

focal length	lens type	min. aperture	Image angle, °	Image circle, mm	Maximum shift, mm	Effective focal length (∞)	h-value	b-value (∞)
50mm	AF Super-Angulon	2.8	60.4			51.8	48.0	99.8
55mm	PC-Super-Angulon	4.5	56.1	96	36	56.5	178.9	235.4
180mm	Tele-Xenar HFT	2.8	19.0	120	60	180.5		72.3
300mm	APO-Tele-Xenar HFT	4.0	11.8	140	80	292.0		27.5

Impressum

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