Schneider Sales Manual
Digitar Lenses

It all starts with the glass
and an upgrade!

Why upgrade to digitar lenses when purchasing or using a digital back.

Digitar lenses are developed to be used with digital chips and are matched to the requirements of this medium.

1. Higher Resolving Power

Digitar Lenses have much higher resolving power than medium format or large format lenses which is needed to project the same image content onto the much smaller area of a digital chip.

2. Better Apochromatic Correction

Apochromatic correction of Digitar lenses is optimized for digital chips, which record all colors in one focal plain compared to film, which has virtually 3 focal plains due to its layered design.

3. Shorter Focal Length For Wide Angle Capabilities

Digitar lenses are available with much shorter focal length. Because of the lens magnification factor that applies for the use of all 4 x 5 lenses with the much smaller chips, wide-angle photography is only possible with Digitar lenses.

4. Use of full perspective control with view cameras and digital backs

Digitars with their large image circle are designed to work with view cameras for full perspective control which cannot be achieved with any other system.

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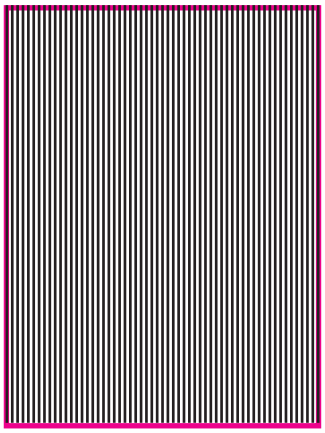
Line Resolving power and requirements depending on medium

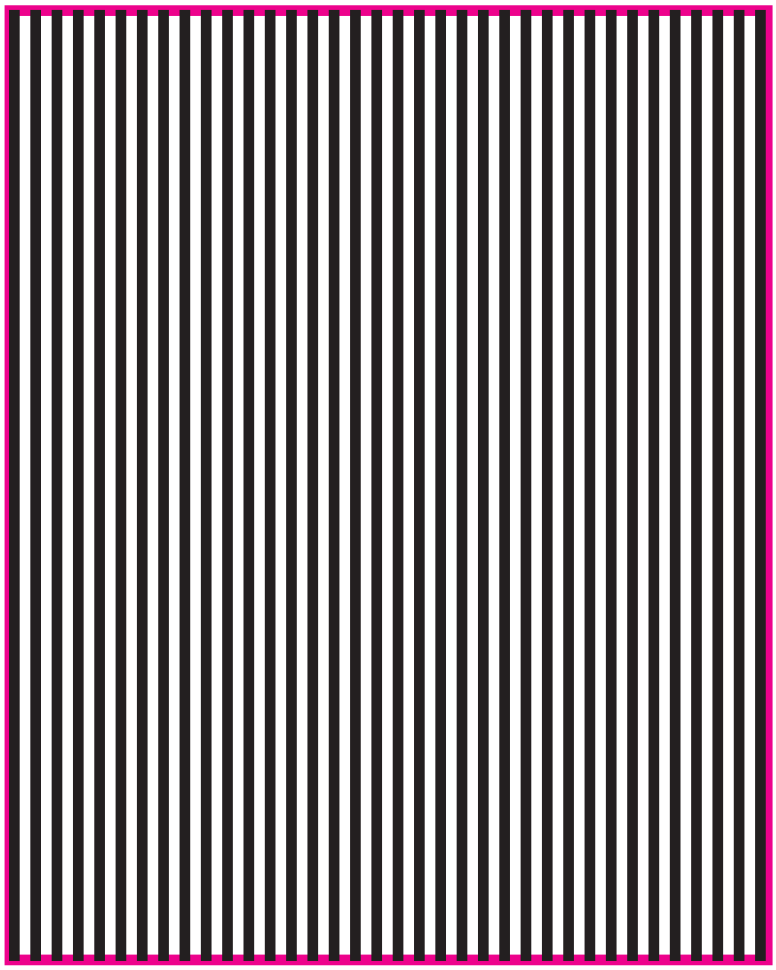
Challenge: A carpet with 48 straight lines of black and white has to be photographed on a 36 x 48 mm chip and a piece of 4 x 5 inch film filling the entire format.

36 x 48 mm Chip



36 x 48 mm
48 line pairs
each line pair has 0.75 mm
space on the chip

4 x 5 inch Film



101.6 x 127.0 mm
48 line pairs - each line pair has 2.3 mm space on the film

Resolving power of a Digitar lens has to be much higher - because it has to project the same amount of information on a much smaller space

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What is line resolution and how does it compare

Line Resolving Power

Resolution is measured by how many lines a lens can project side by side into 1 millimeter of space with the lines still clearly distinguishable from each other. One black and one white line make one line pair.

Capture Area and Resolving Power

The lens used with the small digital chip has to be able to project x times the lines onto the same space then the large format lens! The higher the resolving power of the chip the more crucial is the performance of the lens.

Chip Resolution

Sensors on chips are aligned in straight lines. The new chips with 6.8 micron sensor size have approximately 148 ccd sensors per millimeter which equals apprx. 70 line pairs per millimeter.

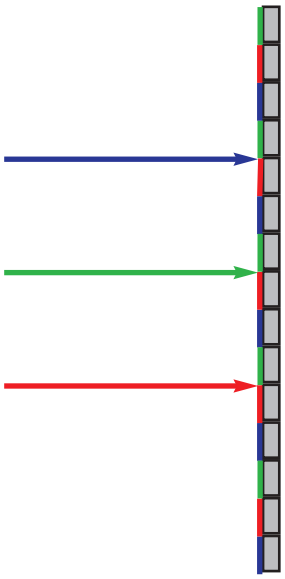
Resolving Power in Comparison

Medium Format	**apprx. 40 to 60 line pairs per millimeter**
Large Format	**apprx. 30 to 50 line pairs per millimeter**
Digitar Lenses	**apprx. 90 to 200 line pairs per millimeter**

Existing large format lenses are not a good choice for digital work in terms of their resolving power because they have not been designed with the small area of the chip in mind.

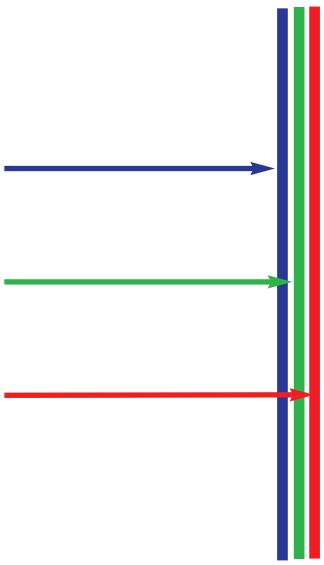
Why are requirements on apochromatic corrections different between film and chip.

Apochromatic correction of Digitar lenses is optimized for digital chips, which record all colors in one focal plain compared to film, which has virtually 3 focal plains due to its layered design.



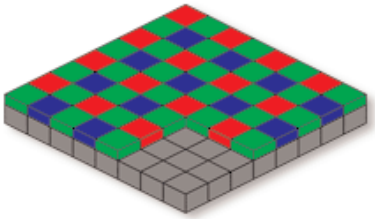
Chip

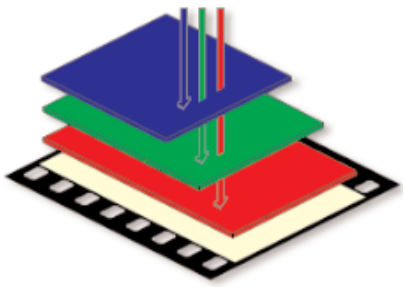
all colors are in the same focal plane



Film

3 layers for the different colors

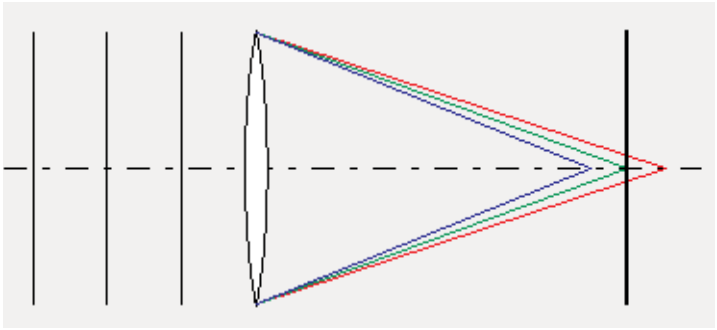


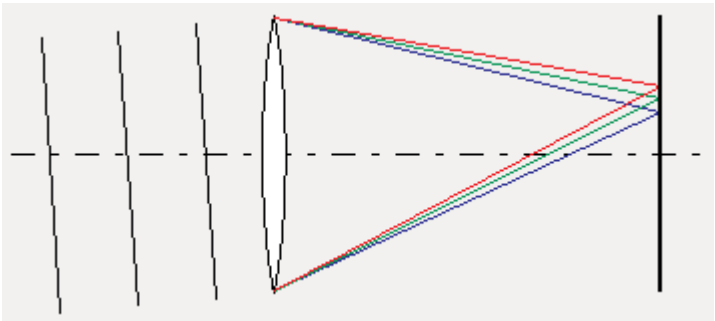


What does a lens which is not perfectly corrected used with a chip do to the image.

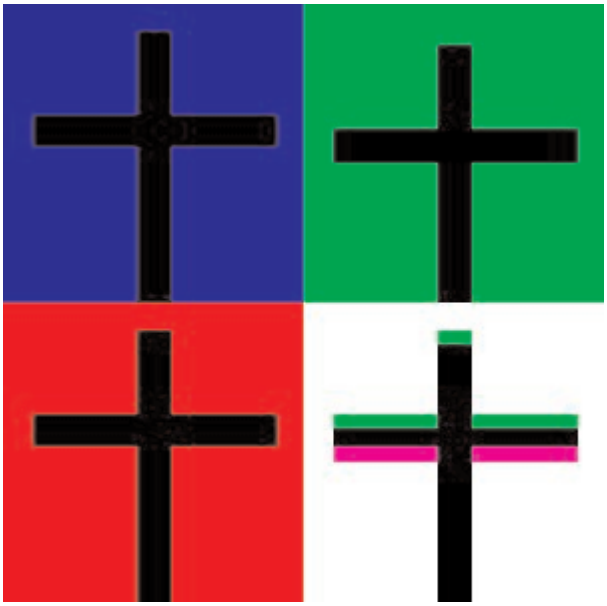
A lens used with a digital chip has to focus all colors in exactly the same focal plain. Otherwise unwanted effects like color fringing can occur. This color fringing is caused by the fact, that images, which are focused in different focal plains, have different sizes. The blue image for example is larger then the green which results in the blue image shining through underneath the green.

Cause





Effect



Lenses used with digital backs have to have perfect apochromatic correction to avoid color fringing especially towards the outer areas of the image

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3. Lens Magnification

Because of the smaller size of the chip compared to 4 x 5 inch a lens magnification factor applies and wide angle capabilities are lost with existing lenses.

A 65 mm super wide angle lens on a 4 x 5 will become a standard focal length used with a medium format chip. To get the same wide angle perspective with a 36 x 48 mm digital chip as with the 65 mm on the 4 x 5, a 24 mm lens has to be used with the chip!

If you use this lens on your 4 x 5 inch camera	To get the same perspective with a full frame (37 x 49 mm) medium format chip you have to use:
65 mm	24 mm
72 mm	28 mm
90 mm	35 mm
120 mm	47 mm
150 mm	60 mm
180 mm	72 mm
210 mm	80 mm
240 mm	90 mm
360 mm	150 mm
480 mm	180 mm
550 mm	210 mm

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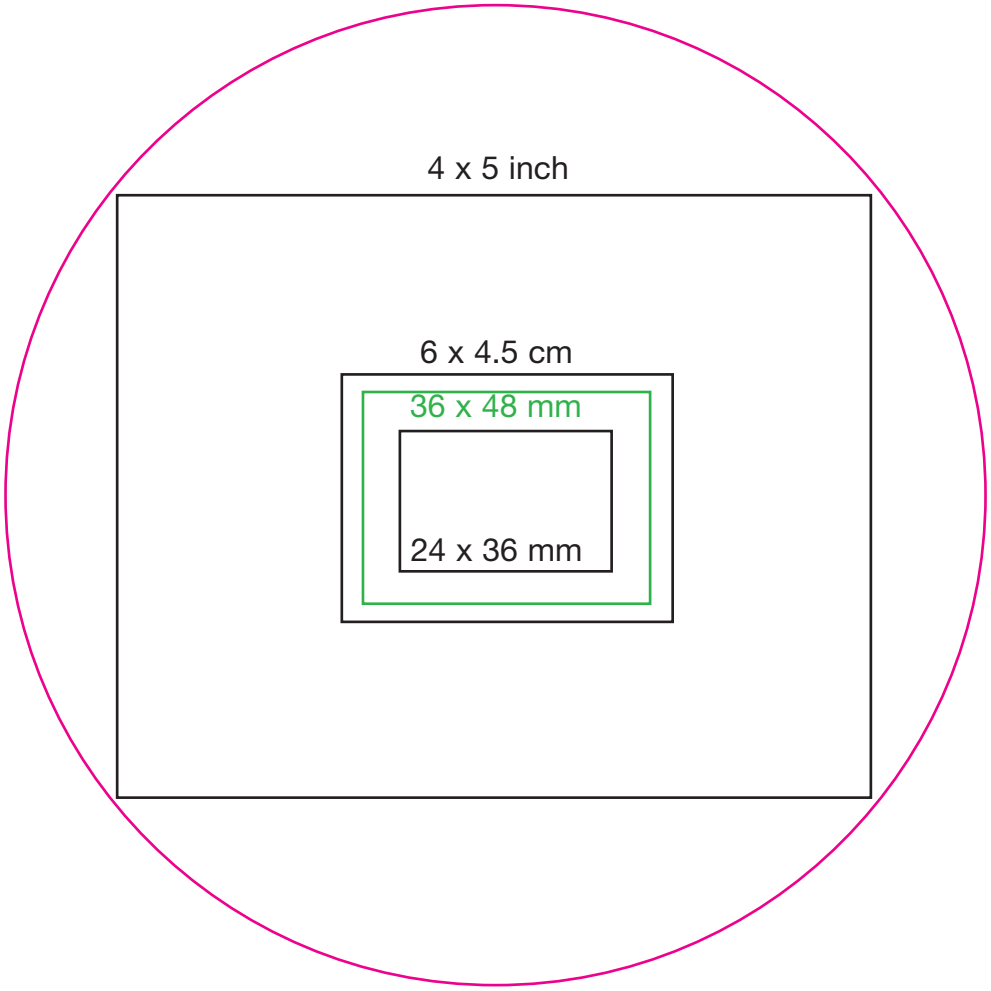
Magnification Factor with change of format.

The full frame chips are smaller then the 4 x 5 inch sheet film format. A lens magnification factor applies with the use of lenses designed for 4 x 5. This lens magnification factor is sometimes also called the crop factor. The small capture area of the chip crops out only a small portion of the image circle which results in a very narrow field of view.



Digitar lenses are available with much shorter focal length. The shortest large format lens is 65 mm compared to the shortest Digitar, which is 24 mm, reinstating wide angle capabilities with digital backs!

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Shutter Systems for Digitar Lenses

Mechanical Shutters - Copal 0

- Can be used for all digital backs in one shot mode.
- Connect with strobe synchronization to the back.
- **Cannot** be used for backs with mulit shot capabilities.

Electronic Shutters - Schneider, Rollei

- Are **required** for the use with multi shot backs, have also advantages with one shot backs.
- More precise then mechanical shutters with aperture settings in increments of 1/10 f-stop.
- On some backs controls can be integrated in camera software which gives full control on one screen.
- Do not need to be accessible for control and cocking and for this reason can be mounted on the back of the lens board into the bellows to accommodate shorter lenses.
- Need external power supply or controller.

	SCHNEIDER ELECTR	ROLLEI ELECTR.
Exp. Time	B, 30 sec - 1/60 Sec	B, 30 sec -1/500
Precision	1/10 f-stop	1/10 f-stop
Sizes	0	0 and 1
Required Accessories	Can be used without external controller with Imacon/Hasselblad and Eyelike Backs	Always has to be used with external controller (additional purchase)
Software integration	Imacon, Eyelike	Imacon, Eyelike
Battery operated	Yes, with controller	Yes, with controller
Power Source	Rechargeable AA and Standart AA Batteries	Propietary Rechargeable Battery

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Set up of Shutter, Digital Back and View Camera

Mounting on view camera (all shutters)

To mount a shutter lens combination to a view camera first a lens board size 0 (or 1 for ROLLEI shutters size 1) is required, which can be purchased from the view camera manufacturer.

Lens boards are not part of delivery scope of lenses and shutters, except for the pre mounted mini view camera assemblies of lenses, shutter and special recessed lens board.

Mechanical Shutters

Mechanical shutters are electronically connected with the backs using a trigger cable which connects the strobe synch. of the shutter with the back.

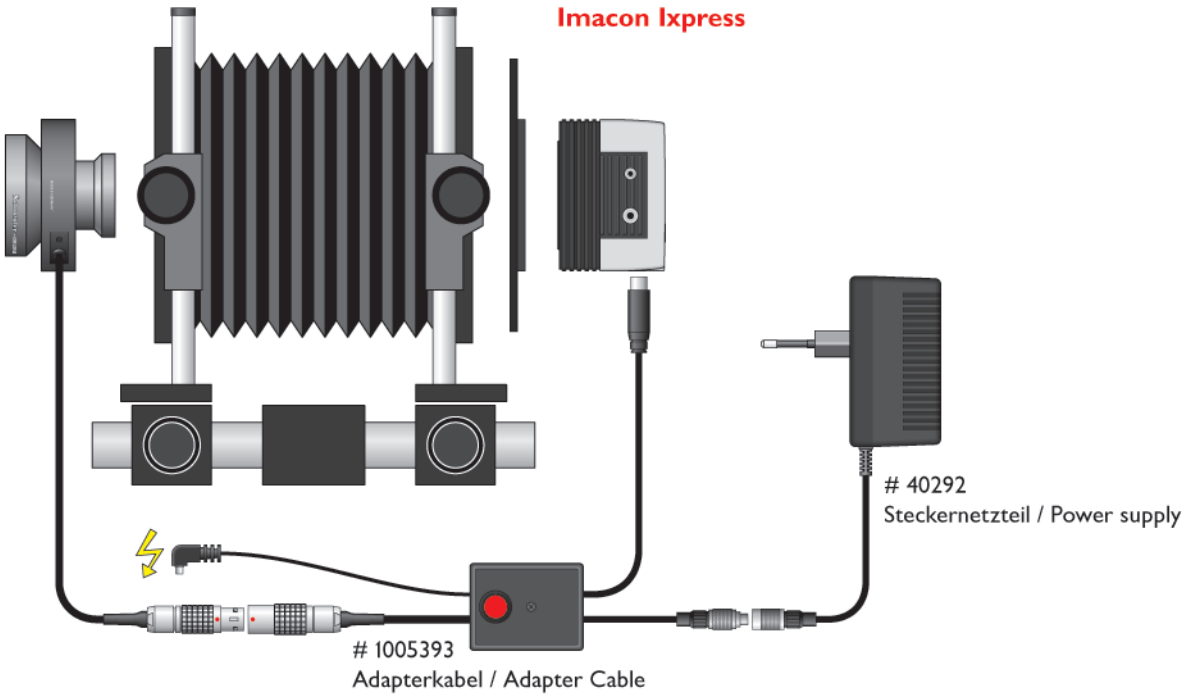
Cables for this connection have to be purchased from the back manufacturers and are not part of the delivery scope of the mechanical shutter - lens combination.

Schneider Electronic Shutters

Shutters are connected to the backs with connection kits, which contain all cables for the interface between shutter and back as well as depending on the connection kit, the contoller box.

Interfaces for each back are different!

Connection to Imacon-Hasselblad IXpress Studio



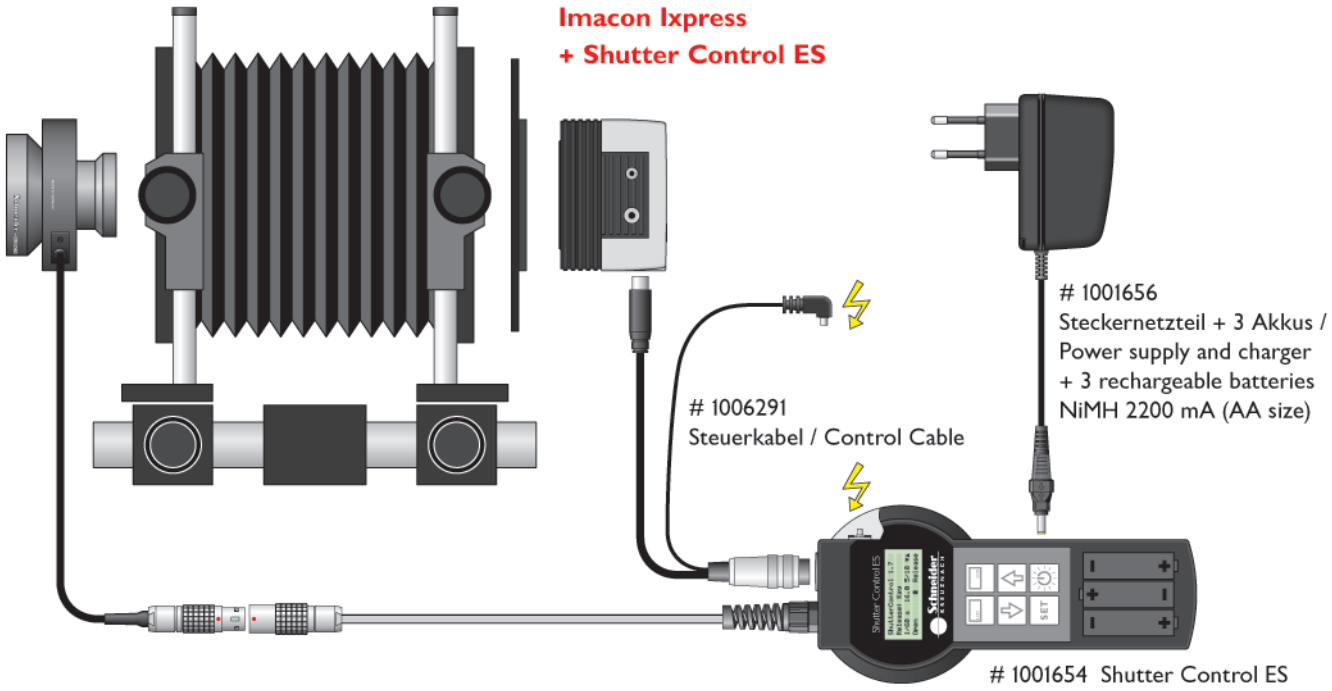
Functionality:

Apert. and Exp. Time control through camera software. Automatic full open for video online image. Working aperture preview. Multi shot enabled. AC operated

03-8001040	Connection Kit imacon Ixpress Backs Studio only	
1	03-1005393	Cable from shutter to Imacon IXpress back
1	03-040292	AC/DC Power Supply for shutter

Schneider OPTICS

Connection to Imacon/Hasselblad IXpress Studio and Location



Functionality:

Apert. and Exp Time control through camera software or hand controller.
Automatic full open for video online image. Working aperture pre view.
Multi shot enabled. Battery operated

03-8001050	Connection Kit Imacon IXpress Field and Studio	
1	03-1006291	Imacon Cable to Remote - for Field Use
1	03-1001656	Power Supply, Charger and 3 rech Batteries
1	03-1001654	Remote Shutter Control ES

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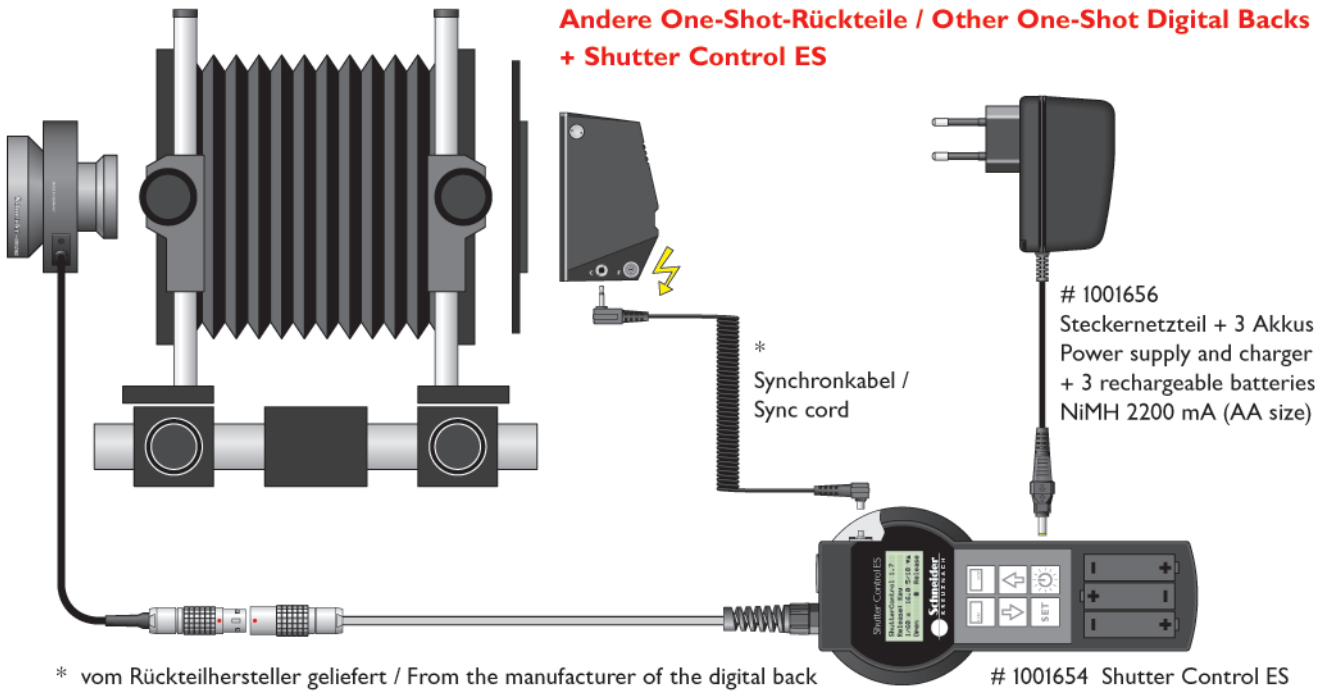
Connection to one shot back without software interface (Phase One, Leaf, Megavision, Imacon CF and CFH current)



Functionality:

Apert. and Exp Time control through Hand Controller ONLY. Battery operated

03-8001060	Connection Kit Universal for one-shot digital Backs (Phase One, Megavision, Leaf)	
1	03-1001656	Power Supply, Charger and 3 rech Batteries
1	03-1001654	Remote Shutter Control ES

IMPORTANT

Requires Synch Cable supplied by back manufacturer!

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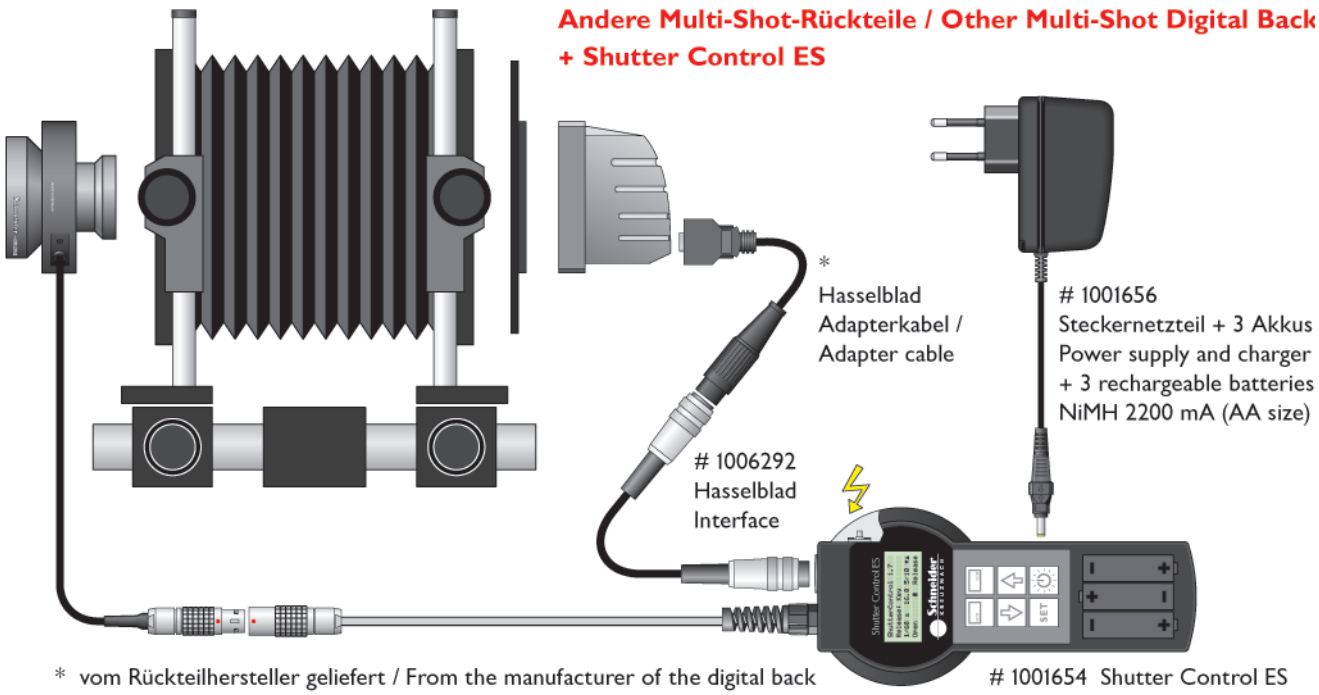
Connection to Multi Shot backs with Hasselblad EL compatible interface. (Sinar, Megavision, Leaf Cantare)



Functionality:

Apert. and Exp. Time control through Hand Controller ONLY Multi shot enabled Battery operated.

03-8001070	Connection Kit Universal for Hasselblad EL compatible mulit-shot digital Backs	
1	03-1001656	Power Supply, Charger and 3 rech Batteries
1	03-1001654	Remote Shutter Control ES
1	03-1006292	Hasselblad Adapter Cable for Control ES

IMPORTANT

Requires Hasselblad interface cable supplied by Back manufacturer!

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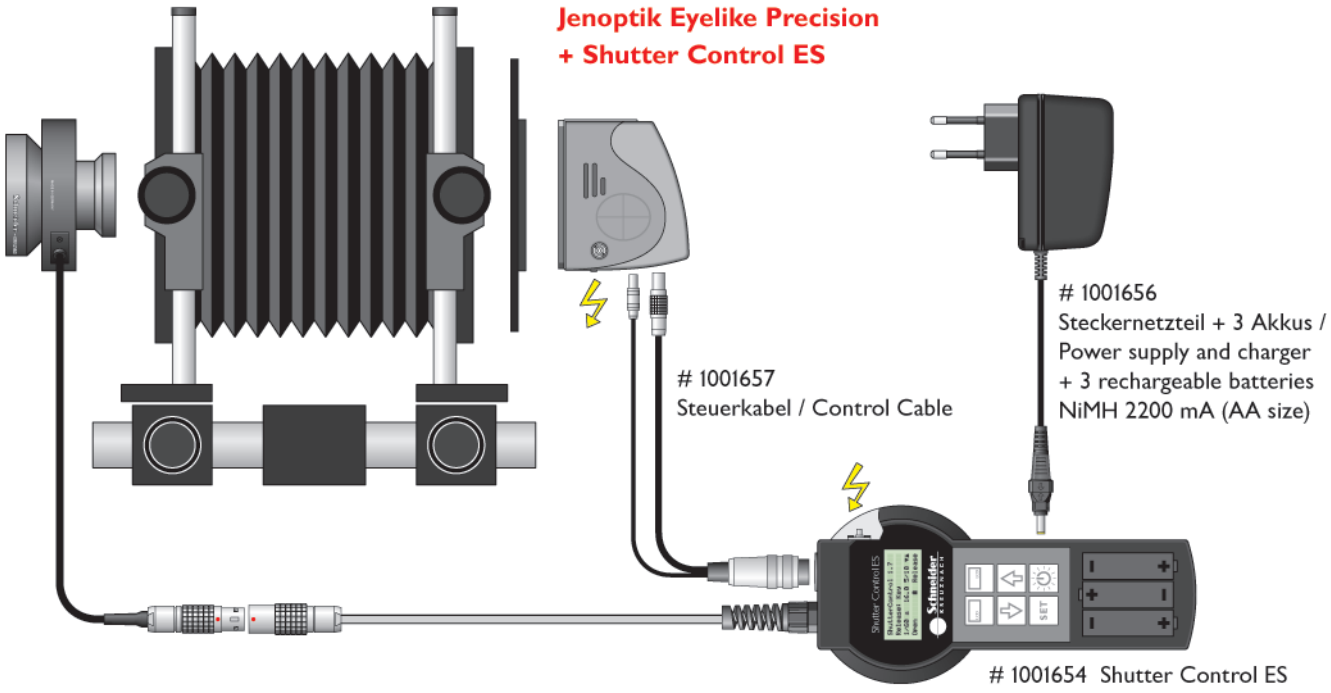
Connection to Eyelike Precision Studio and Location



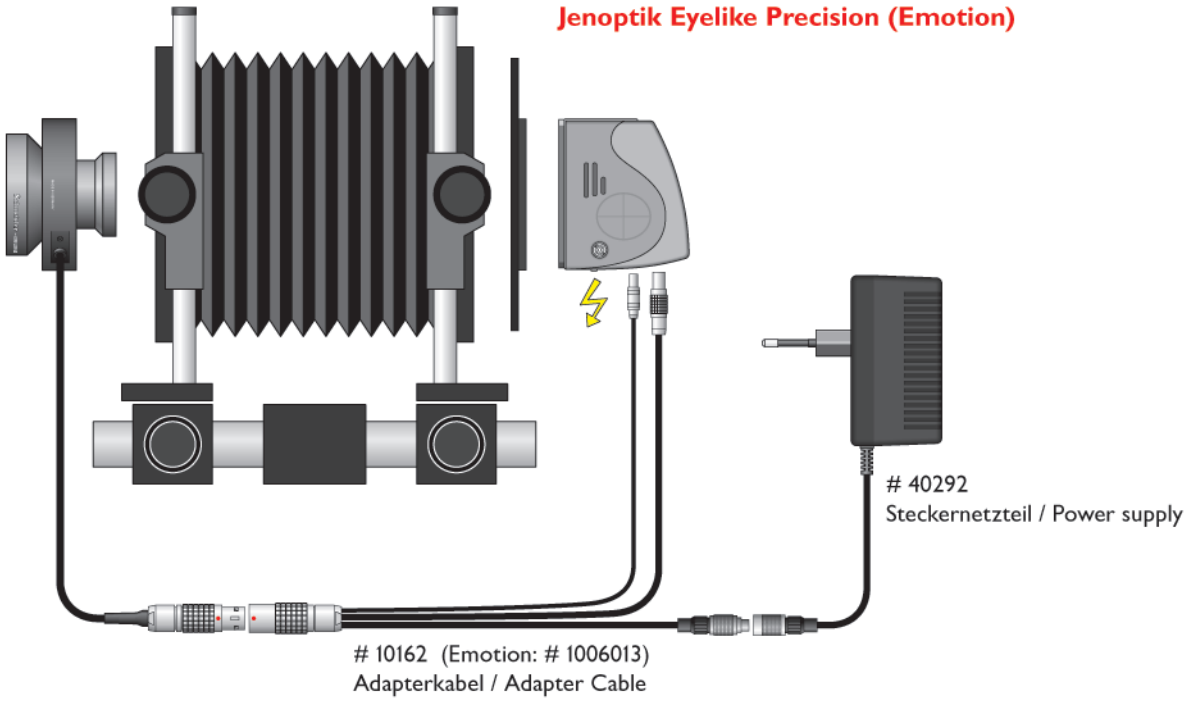
Functionality:

Apert. and Exp Time control through camera software or Hand Controller.
Automatic full open for video image. Battery operated

03-8001020	Connection Kit Eyelike Precision Field and Studio	
1	03-1001657	Eyelike Cable to Remote - for Field Use
1	03-1001656	Power Supply, Charger and 3 rech Batteries
1	03-1001654	Remote Shutter Control ES

Schneider OPTICS

Connection to Eyelike Precision Studio



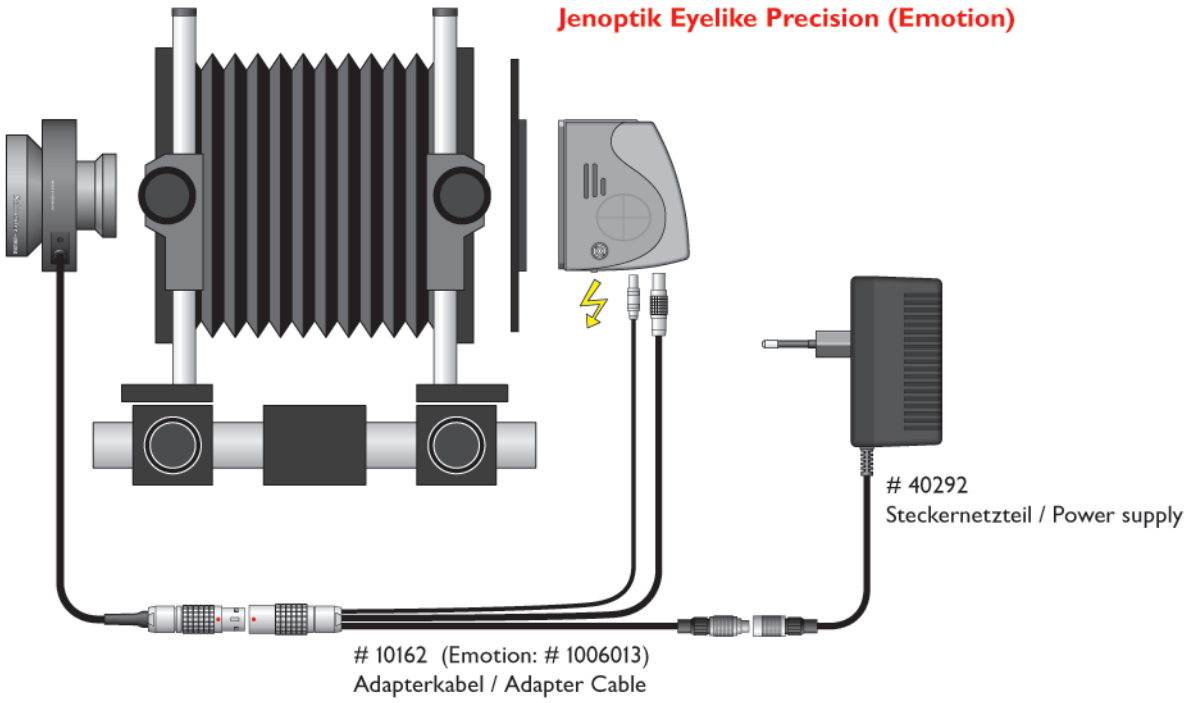
Functionality:

Apert. and Exp. Time control through camera software. Automatic full open for video online image. Working aperture pre view. AC operated

03-8001010	**Connection Kit Eyelike Precision Backs Studio only**	
consists of		
1	03-010162	Cable from shutter to Eyelike precision back
1	03-040292	AC/DC Power Supply for shutter

Schneider OPTICS

Connection to Eyelike/Sinar emotion studio use



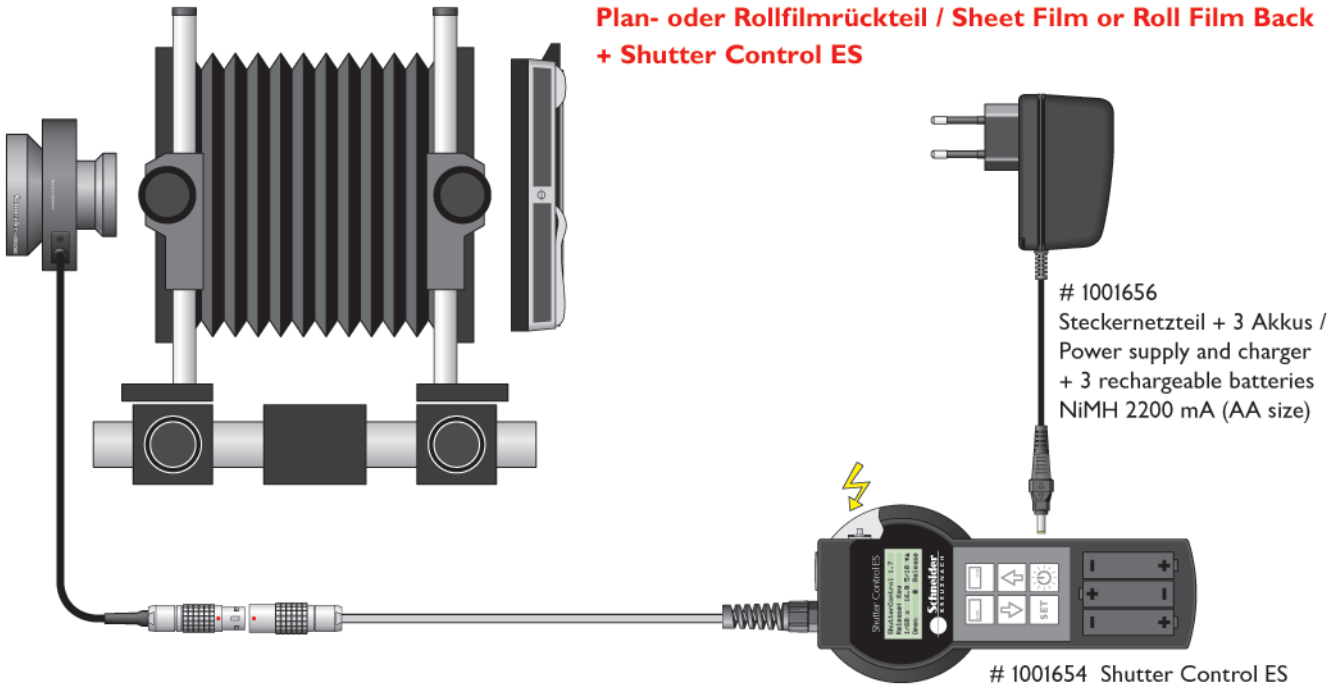
Functionality:

Apert. and Exp. Time control through camera software. Automatic full open for video online image. Working aperture pre view. AC operated

03-8001030	Connection Kit Eyelike emotion Backs Studio only	
1	03-010163	Cable from shutter to Eyelike emotion back
1	03-040292	AC/DC Power Supply for shutter

Schneider OPTICS

Connection for use with film.
(same as use with one-shot digital backs)



Functionality:

Apert. and Exp. Time control through hand controller. Full open and working aperture pre view. Battery operated

03-8001060	Connection Kit Universal for one-shot digital Backs (Phase One, Megavision, Leaf)	
1	03-1001656	Power Supply, Charger and 3 rech Batteries
1	03-1001654	Remote Shutter Control ES

Schneider OPTICS

Compatibility Imacon/Hasselblad Digital Backs

Back Type	**Ixpress 96C/V96 C**	**Ixpress 132C**	**Ixpress 384C**	**Ixpress 528C**
Chip	Kodak	Kodak	Kodak	Kodak
Chip Size	37 x 37 mm	37 x 49 mm	37 x 37 mm	37 x 49 mm
Pixel	16 MP	22 MP	16 MP	22 MP
Application	Studio Semi Port	Studio Semi Port	Studio Semi Port	Studio Semi Port
Mulit Shot	NO	NO	YES	YES
Interface	Intell	Intell	Intell	Intell
View Cam	Y	Y	Y	Y
Support SEC in Software	YES	YES	YES	YES
Electr. shutter required	NO	NO	YES	YES
Connection Kit to use	03-8001040 / 50	03-8001040 / 50	03-8001040 / 50	03-8001040 / 50
Lens exceptions	None	24 / 60	None	24 / 60
Back Type	**Ixpress CF132**	**Ixpress CF528**		
Chip	Kodak	Kodak		
Chip Size	37 x 49 mm	37 x 49 mm		
Pixel	22 MP	22 MP		
Application	Full Portable	Full Portable		
Mulit Shot	NO	YES		
Interface	Intell	Intell		
View Cam	Y	Y		
Support SES	Planned	Planned		
Electr. shutter required	NO	YES		
Connection Kit to use	03-8001060	03-8001060		
Lens exceptions	24 / 60	24 / 60		
Back Type	**CFH**	**CF 39**	**CFH 39**	
Chip	Kodak	Kodak	Kodak	
Chip Size	37 x 49 mm	42 x 50 mm	42 x 50 mm	
Pixel	22 MP	39 MP	39 MP	
Application	Full Portable	Full Portable	Full Portable	
Mulit Shot	NO	NO	NO	
Interface	Intell	Intell	Intell	
View Cam	only w H Adapter	Y	only w H Adapter	
Support SES	NO	Planned	NO	
Electr. shutter required	NO	NO	NO	
Connection Kit to use	03-8001060	03-8001060	03-8001060	
Lens exceptions	24 / 60	24 / 60	24 / 60	

Interface: Intell = can support automatic trigger from camera software for multi shot
Support SES YES = control of shutter functions from within the camera software is possible
Lens exception Lenses which are listed cannot be used with sufficient adjustments because of image circle restrictions
Electr. shutter required YES = for multi shot use. For one-shot only with the same back mechanical shutters can be used

Schneider OPTICS

Compatibility Phase One Digital Backs

Back Type	Light Phase	Phase One H10	Phase One H 20	Phase One H 25
Chip	Dalsa	Dalsa	Kodak	Kodak
Chip Size	24 x 36 mm	24 x 36 mm	37 x 37 mm	37 x 49 mm
Pixel	6 MP	11 MP	16 MP	22 MP
Application	Theathered FW	Theathered FW	Theathered FW	Theathered FW
Mulit Shot	NO	NO	NO	NO
Ext. Interface	None	None	None	None
View Cam	Y w Hasselblad Adapter	Y w Hasselblad Adapter	Y w Hasselblad Adapter	Y w Hasselblad Adapter
Support SEC	NO	NO	NO	NO
Electr. shutter required	NO	NO	NO	NO
Connection Kit to use	03-8001060	03-8001060	03-8001060	Item ID
Lens exceptions	None	None	None	24 / 60
Back Type	**Phase One P 20**	**Phase One P 21**	**Phase One P 25**	**Phase One P 30**
Chip	Kodak	Dalsa	Kodak	Kodak
Chip Size	37 x 37 mm	31 x 43 mm	37 x 49 mm	35 x 46 mm
Pixel	16 MP	17 MP	22 MP	31 MP
Application	Full Portable	Full Portable	Full Portable	Full Portable
Mulit Shot	NO	NO	NO	NO
Ext. Interface	None	None	None	None
View Cam	Y w Hasselblad Adapter	Y w Hasselblad Adapter	Y w Hasselblad Adapter	Y w Hasselblad Adapter
Support SES	NO	NO	NO	NO
Electr. shutter required	NO	NO	NO	NO
Connection Kit to use	03-8001060	03-8001060	03-8001060	Item ID
Lens exceptions	None	24 / 60	24 / 60	24 / 60
Back Type	**Phase One P 45**			
Chip	Kodak			
Chip Size	39 x 50 mm			
Pixel	39 MP			
Application	Full Portable			
Mulit Shot	NO			
Ext. Interface	None			
View Cam	Y w Hasselblad Ad.			
Support SES	NO			
Electr. shutter required	NO			

Interface: Intell = can support automatic trigger from camera software for multi shot
Support SES YES = control of shutter functions from within the camera software is possible
Lens exception Lenses which are listed cannot be used with sufficient adjustments because of image circle restrictions
Electr. shutter required YES = for multi shot use. For one-shot only with the same back mechanical shutters can be used

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Compatibility Leaf Digital Backs

Back Type	**Volare**	**Cantare**	
Chip	Dalsa	Dalsa	
Chip Size	24 x 36 mm	24 x 36 mm	
Pixel	6 MP	6 MP	
Application	Theathered Scsi	Theathered Scsi	
Mulit Shot	YES	NO	
Ext. Interface	YES	YES	
View Cam	YES	YES	
Softw. Support SEC	NO	NO	
Electr. shutter required	YES	NO	
Connection Kit to use	03-8001070	03-8001060	
Lens exceptions	None	None	
Back Type	**Valeo 17 Wi**	**Valeo 22 Wi**	
Chip	Dalsa	Dalsa	
Chip Size	33 x 44 mm	36 x 48 mm	
Pixel	17 MP	17 MP	
Application	Studio Semi Port	Studio Semi Port	
Mulit Shot	NO	NO	
Ext. Interface	None	None	
View Cam	Y w Hasselblad Ad.	Y w Hasselblad Ad.	
Support SES	NO	NO	
Electr. shutter required	NO	NO	
Connection Kit to use	03-8001060	03-8001060	
Lens exceptions	None	**24 / 60**	
Back Type	**Aptus 17**	**Aptus 22**	**Aptus 75**
Chip	Dalsa	Dalsa	Dalsa
Chip Size	33 x 44 mm	36 x 48 mm	
Pixel	17 MP	22 MP	33.3 MP
Application	Full Portable	Full Portable	Full Portable
Mulit Shot	NO	NO	NO
Ext. Interface	NO	NO	NO
View Cam	Y w Hasselblad Ad.	Y w Hasselblad Ad.	Y w Hasselblad Ad.
Support SES	NO	NO	NO
Electr. shutter required	NO	NO	NO
Connection Kit to use	03-8001060	03-8001060	03-8001060
Lens exceptions	None	**24 / 60**	**24 / 60**

Interface:	Intell = can support automatic trigger from camera software for multi shot
Support SES	YES = control of shutter functions from within the camera software is possible
Lens exception	Lenses which are listed cannot be used with sufficient adjustments because of image circle restrictions
Electr. shutter required	YES = for multi shot use. For one-shot only with the same back mechanical shutters can be used

Schneider OPTICS

Compatibility Sinar Digital Backs

Back Type	**Sinar 54M**	**Sinarback 43S**	**Sinarback 43H**	**Sinarback 54H**
Chip	Kodak	Dalsa	Dalsa	Kodak
Chip Size	37 x 49 mm	24 X 36 mm	24 X 36 mm	37 x 49 mm
Pixel	22 MP	11 MP	11 MP	22 MP
Application	Theathered FW	Theathered FW	Theathered FW	Theathered FW
Mulit Shot	NO	NO	YES	YES
Interface	Intell	Intell	Intell	Intell
View Cam	Y	Y	Y	Y
Support SEC in Software	NO	NO	NO	NO
Electr. shutter required	NO	NO	YES	YES
Connection Kit to use	03-8001060	03-8001060	03-8001070	03-8001070
Lens exceptions	**24 / 60**	None	None	**24 / 60**
Back Type	**Sinar Emotion**			
Chip	Dalsa			
Chip Size	36 x 48 mm			
Pixel	22 MP			
Application	Full Portable			
Mulit Shot	NO			
Interface	Intell			
View Cam	Y			
Support SES	Y			
Electr. shutter required	NO			
Connection Kit to use	03-8001030			
Lens exceptions	**24 / 60**			

Interface:	Intell = can support automatic trigger from camera software for multi shot
Support SES	YES = control of shutter functions from within the camera software is possible
Lens exception	Lenses which are listed cannot be used with sufficient adjustments because of image circle restrictions
Electr. shutter required	YES = for multi shot use. For one-shot only with the same back mechanical shutters can be used

Schneider OPTICS

Compatibility eyelike Digital Backs

Back Type	Precision M11	Precision M16	Precision M22
Chip	Dalsa	Kodak	Dalsa
Chip Size	24 X 36 mm	37 X 37 mm	36 x 48 mm
Pixel	11 MP	16 MP	22 MP
Application	Theathered FW	Theathered FW	Theathered FW
Mulit Shot	YES	YES	YES
Interface	Intell	Intell	Intell
View Cam	Y	Y	Y
Support SEC in Software	YES	YES	YES
Electr. shutter required	YES	YES	YES
Connection Kit to use	03-8001010 / 20	03-8001010 / 20	03-8001010 / 20
Lens exceptions	None	None	**24 / 60**
Back Type	**Emotion 22**	**Emotion 75**	
Chip	Dalsa	Dalsa	
Chip Size	36 x 48 mm	36 x 48 mm	
Pixel	22 MP	33 MP	
Application	Full Portable	Full Portable	
Mulit Shot	NO	NO	
Interface	Intell	Intell	
View Cam	Y	Y	
Support SES	Y	Y	
Electr. shutter required	NO	NO	
Connection Kit to use	03-8001030	03-8001030	
Lens exceptions	**24 / 60**	**24 / 60**	

Interface:	Intell = can support automatic trigger from camera software for multi shot
Support SES	YES = control of shutter functions from within the camera software is possible
Lens exception	Lenses which are listed cannot be used with sufficient adjustments because of image circle restrictions
Electr. shutter required	YES = for multi shot use. For one-shot only with the same back mechanical shutters can be used

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Limitations of view cameras used with wide angle lenses.

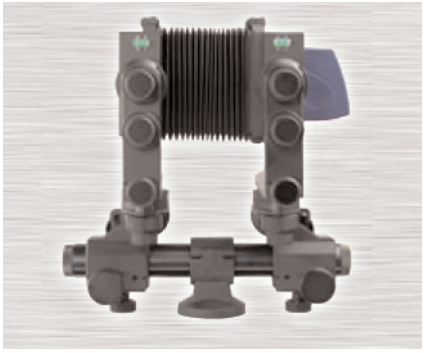
In general: At infinity the bellows extension has to equal the focal length of the camera to be in focus. To focus on objects closer to the camera (macro), the bellows has to be extended.

For wide angle lenses this means, that view cameras have to be very short to focus at infinity with a wide angle lenses.

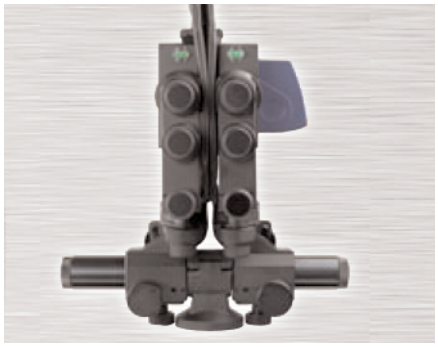
Example:

The bellows extension to focus a 35 mm Digitar at infinity is 35 mm or about 1.5 inches

Many 4 x 5 inch cameras have not been designed for use with lenses as short as the wide angle Digitars. In case 4 x 5 inch cameras are used with ultra short lenses, at least wide angle bellows as well as recessed lens boards are required.



Focus at infinity with 120 mm lens



Focus at infinity with 35 mm lens

Following a list of the view cameras and the shortest focal length which can be focused with the camera.

View cameras and shortest focal Length

	Min Focal Lenght	Accessories Required	Lens Exception
Toyo			
45CX	67.5 mm	with recessed lens board and wide angle bellows	24, 28, 35, 47, 60
45GX	47 mm	with recessed lens board and wide angle bellows	24, 28, 35
45II	47 mm	with recessed lens board and wide angle bellows	24, 28, 35
45 C	45 mm	with recessed lens board and wide angle bellows	24, 28, 35
VX125	45 mm	with recessed lens board and wide angle bellows	24, 28, 35
VX125b	45 mm	with recessed lens board and wide angle bellows	24, 28, 35
Linhof			
Tecnikardan 6 x 9	48 mm	with recessed lens board and wide angle bellows	24, 28, 35, 47
Kardan E 45	75 mm	with recessed lens board and wide angle bellows	24, 28, 35, 47, 60
Horseman			
LE 45	20 mm	with wide-angle bellows, 40mm recessed lensboard	
LX 45	28 mm	with wide-angle bellows, 40mm recessed lensboard	24
LD	28 mm	with wide-angle bellows, 40mm recessed lensboard	24
Arca Swiss			
4x5 Discovery	55 mm	with recessed lens board and wide angle bellows	24, 28, 35, 47
4x5 M-Line Monolith C	55 mm	with recessed lens board and wide angle bellows	24, 28, 35, 47
Cambo			
Ultima D 45	47 mm		24, 28, 35
Legend 2			
SC 2			
SCN			
Sinar			
P2 4x5	34 mm	with recessed lens board and wide angle bellows	24, 28
x	32 mm	with recessed lens board and wide angle bellows	24, 28
F1/F2	40 mm	with recessed lens board and wide angle bellows	24, 28, 35

IMPORTANT! Although some cameras can be focused with short lenses, the movements of the camera will be very limited. Especially rise and fall as well as shifts and tilts are restricted and might not be sufficient for some applications. Lens Exceptions are the DIGITAR lenses which can NOT be used with the camera.
All data from camera manufacturers claims.

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Macro Lenses and their Applications

Macro lenses are optimized for their application. The performance of a Macro lens is significantly higher used for enlargement and 1 to 1 up to 1 to 8 ratios compared to regular lenses.

Macro lenses are highly recommended for

shooting Objects smaller then 11 3/8" x 15 1/8" filling the frame of a 36 x 48 mm chip

or

when the object is closer then 25 2/8" using an 80 mm lens
when the object is closer then 37 6/8" using an 120 mm lens

The following chart shows the coherence between object size, object distance in the range of limited conditions between regular lenses and macro lenses.

Factor	Object Height	Object Width	Dist w 80 mm	Dist w 120 mm	Recommended
1 to 4	5 5/8	7 4/8	12 5/8	18 7/8	Macro !!!!!
1 to 6	8 4/8	11 3/8	18 7/8	28 3/8	Macro !!!
1 to 8	11 3/8	15 1/8	25 2/8	37 6/8	Macro / Normal

Use of Digitar Lenses with Copy Stands.

Due to the high resolving power Scheider Digitar lenses are excellent for use on copy stands.

Depending on the focal length and the size of the original, a minimum distance between the lens and the original is required to be able to capture the entire object.

Following a chart with the distance required for a specified size of original and a specific lens as well as the resulting distance for this set up. With this data the right copy stand can be chosen.

Required distance from object for full frame image with 36 x 48 mm chip and different lenses

Focal Length / max Object Size	35 mm	47 mm	60 mm	80 mm Macro	80 mm	90 mm	120 mm Macro	120 mm
8 x 10	7 6/8	10 4/8	13 3/8	**17 6/8**	17 6/8	20	**26 5/8**	26 5/8
8.5 x 11	8 2/8	11 1/8	14 1/8	**18 7/8**	18 7/8	21 2/8	**28 3/8**	28 3/8
9 x 12	8 6/8	11 6/8	15	**20**	20	22 4/8	**30**	30
11 x 14	10 6/8	14 3/8	18 3/8	**24 4/8**	24 4/8	27 4/8	**36 5/8**	36 5/8
16 x 20	15 4/8	20 7/8	26 5/8	35 4/8	35 4/8	40	53 3/8	53 3/8
18 x 24	17 4/8	23 4/8	30	40	40	45	60	60
24 x 30	23 3/8	31 3/8	40	53 3/8	53 3/8	60	80	80
30 x 36	29 1/8	39 1/8	50	66 5/8	66 5/8	75	100	100
36 x 48	35	47	60	80	80	90	120	120
48 x 60	46 5/8	62 5/8	80	106 5/8	106 5/8	120	160	160

Recommended
Not Recommended
and **Bold** Highly Recommended
with limitations

Although wide angle lenses are listed, they should only be the last resort if space is restricted. In general they are not suitable for copy work. (see color coding for recommendations)

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