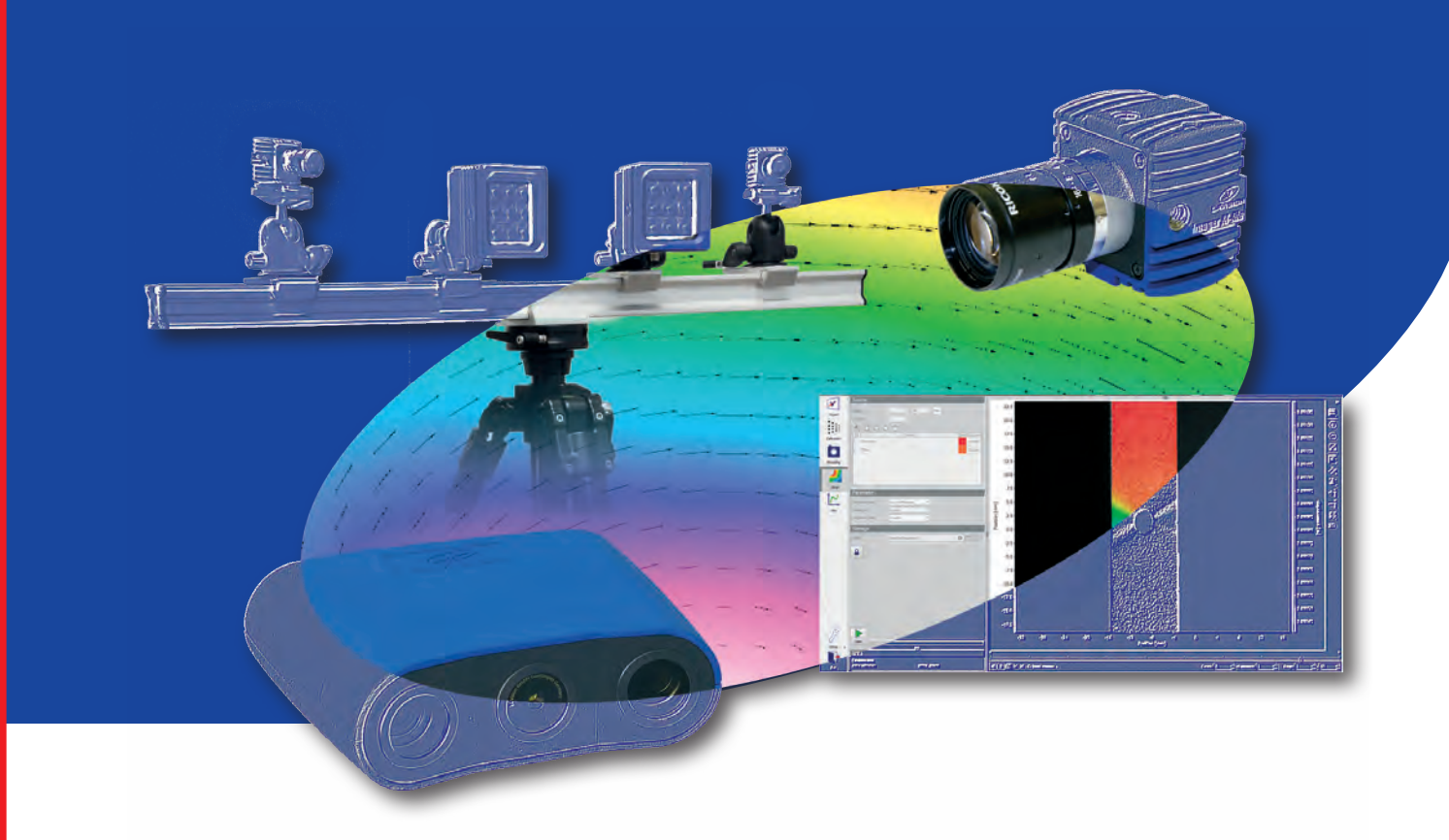


StrainMaster

System Components and Accessories

LaVision

FOCUS ON IMAGING

Contents

1 Cameras 4

2 Camera Lenses 9

3 Lens Filters 15

4 Adapter Rings 16

5 Light Sources 17

6 Calibration Plates 26

7 Mechanics 38

8 Cable Extensions 44

9 Sample Preparation 45

10 A/D-Converters for PC and DCU 11/PTU X 48

11 Laptop / PC 54

Introduction

StrainMaster systems from LaVision have a modular design and can be configured according to the user needs. If the measurement conditions change, additional accessories can be added at any time.

On the following pages we introduce you to the individual components and accessories that LaVision offers for deformation measurement. Our program is continuously expanded. If you should not find the desired component or tool in this brochure, please contact us. We also have the option of using components from the product portfolio of our other application areas or of sourcing them from external suppliers.

You can individually configure your DIC system or change the set-up of our **StrainMaster** Portable system according to your requirements. However, the basic configuration of a functional system must always consist of:

- one camera for a 2D system or two (identical) cameras for a stereo system
- suitable camera lenses
- an external controller unit or one installed in a PC
- a Windows 10 PC (not required when using a DCU 11 controller)

Optional

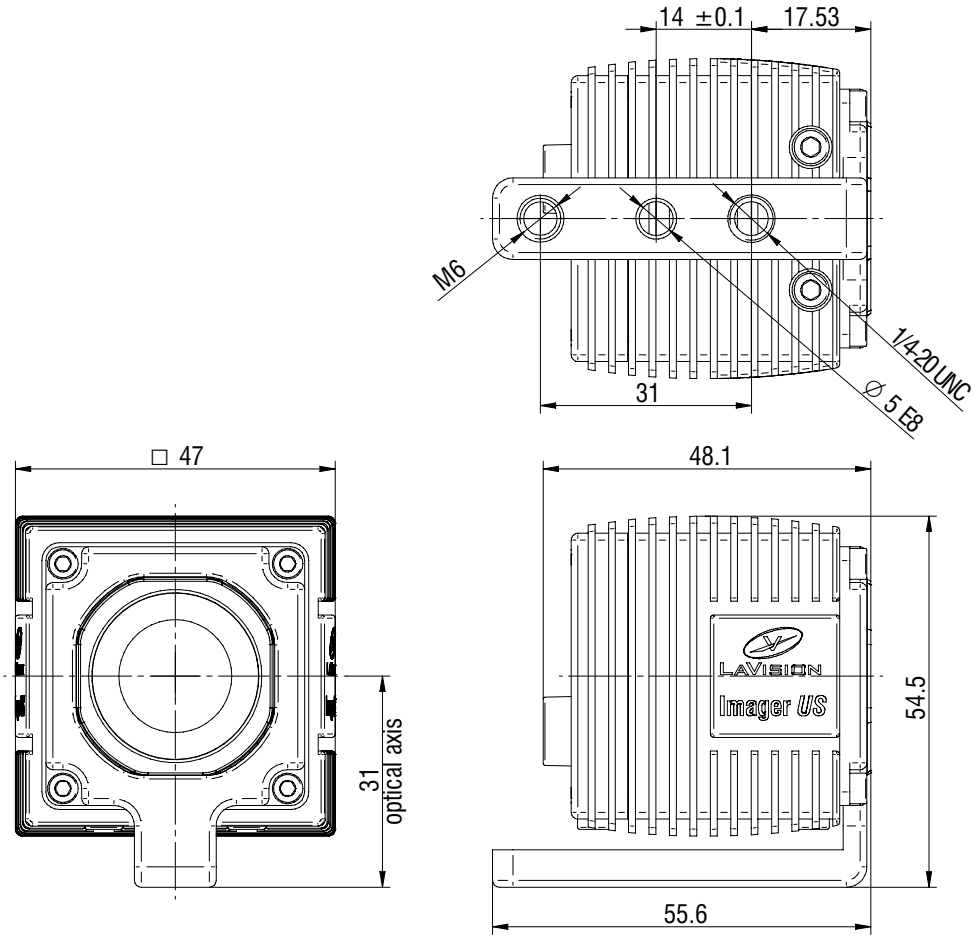
- one or more calibration plates (required for a stereo systems)
- an analog/digital-converter
- mechanisms for mounting cameras, illumination devices and the control unit

Imager *US*

Model	Resolution	Frame rate@ digital output	Lens mount	Interface	Part number
Imager *US*-5	2440 x 2040	72 Hz@8bit	C-mount, adapter to F-mount included	USB 3.0	1101761
Imager *US*-12	4080 x 2984	29 Hz@8bit			1101762
Imager *US*-16	5312 x 3024	22 Hz@8bit			1101763
Imager *US*-25	5296 x 4584	14 Hz@8 bit			1101764

Dimensions





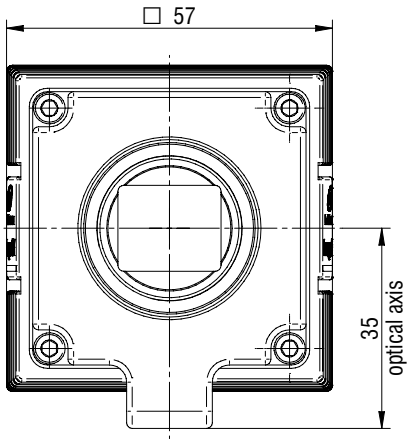
all dimensions shown in mm

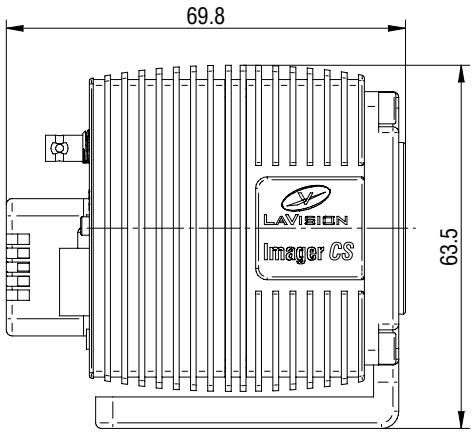
Imager *CS*

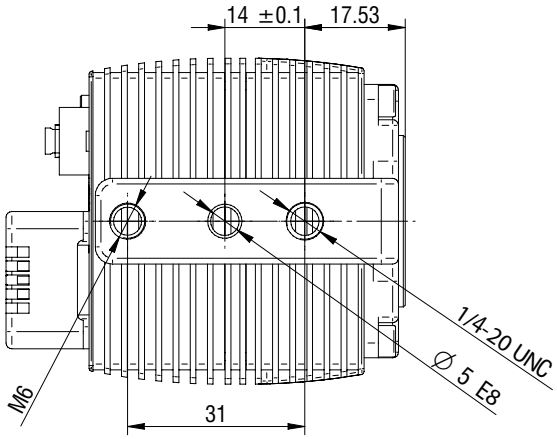
Model	Resolution	Frame rate@ digital output	Lens mount	Interface	Part number
CS-5	2440 x 2040	123 Hz@8 bit 83 Hz@12 bit	C-mount, adapter to F-mount included	CoaXPress-12	1101741
CS-16	5312 x 3024	45 Hz@8 bit 30 Hz@12 bit			1101743

Dimensions









all dimensions shown in mm

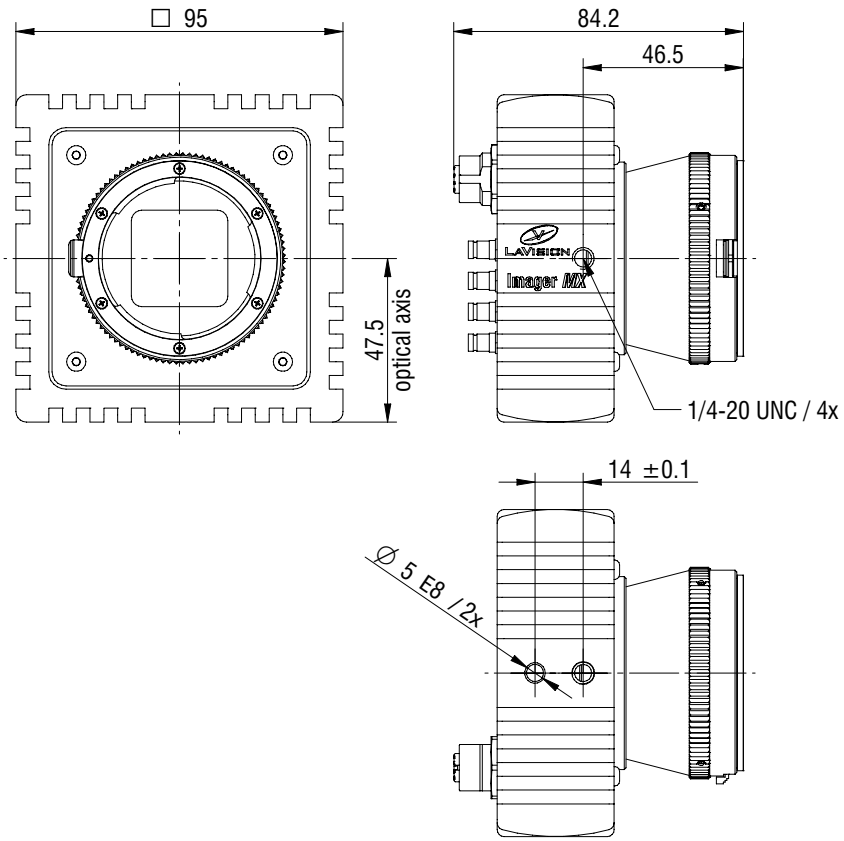
Imager MX 50M

Model	Resolution	Frame rate@ digital output	Lens mount	Interface	Part number
MX 50M	7920 x 6004	30 Hz	M48x1, adapter to F-mount included	CoaxPress PCIe interface card	1101448

*not for use in combination with DCU X

Dimensions





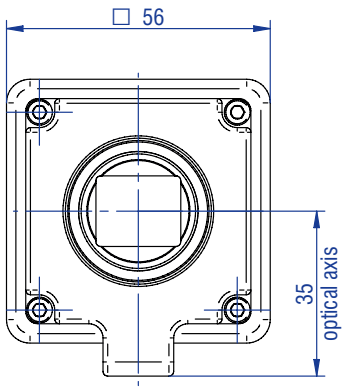
all dimensions shown in mm

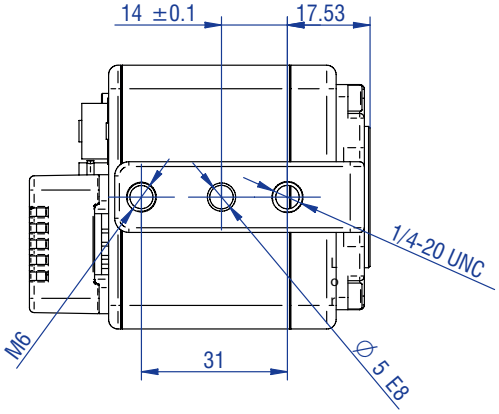
Imager *CS3*

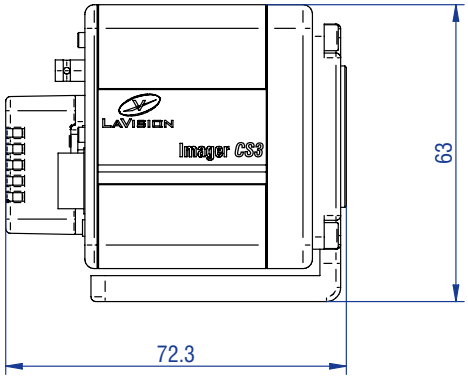
Model	Resolution	Frame rate@ digital output	Lens mount	Interface	Part number
Imager *CS3*-5	2440 x 2040	260 Hz@8 bit 172 Hz@ 12 bit	C-mount	2x CoaX-Press-12, 2x 10 meter HD BNC cable included	1101751
Imager *CS2*-12	4080 x 2984	181 Hz@ 8 bit 120 Hz@12 bit			1101752
Imager *CS3*-16	5312 x 3024	142 Hz@8 bit 95 Hz@12 bit			1101753
Imager *CS3*-25	5312 x 4608	96 Hz@8 bit 63 Hz@12 bit			1101754

Dimensions









all dimensions shown in mm

High-Speed Cameras



Phantom T1340



Phantom VEO4k



FASTCAM NOVA

Model	Resolution	Frame rate	Lens mount	Interface	Part number
Phantom vxx12 series	1280 x 800	12600 Hz 25600 Hz	F/M42	GigE / 10 GigE	1102301/02/03 1102306/07/08 1102311/12/13 1102316/17/18
FASTCAM Mini AX series	1024 x 1024	4000 Hz 6400 Hz	F/C/M42		1101482/83/84 1101487/88/89
Phantom v1840	2048 x 1952 (HS) 1024 x 976 (HS binned)	4510 Hz 17240 Hz	F/C/M42	GigE / 10 GigE	1102410/11/12
Phantom v2640	2048 x 1952 (HS) 1024 x 976 (HS binned)	6600 Hz 25030 Hz			1102400/01/02
Phantom VEO series	1280 x 800 2560 x 1600	7400 Hz 1400 Hz			1102350/52/54 1102420/22/24 1102380/82/84
Phantom VEO-E series	1280 x 800 2560 x 1600	3200 Hz 800 Hz		GigE	1102426/28 1102430/32
Phantom VEO4k series	4096 x 2304	540 Hz 938 Hz	F	GigE / 10 GigE	1102390/85 1102391/92
Phantom VEO xx10 series	1280 x 960 (HS) 640 x 480 (HS binned)	5610 Hz 40300 Hz	F/C/M42		1102510/12/14 1102470/72/74 1102450/52/54
FASTCAM NOVA series	1024 x 1024	6400 Hz 12800 Hz	F/C	GigE	1101601/02/03/04 1101605/06/07/08 1101609/10/11/12
Phantom T1340	2048 x 1952 (HS) 1024 x 976 (HS binned)	3270 Hz _	F/C/M42	GigE / 10 GigE	1102460/62/64
Phantom TMX series	1280 x 800 (HS) 640 x 384 (HS binned)	50725 Hz 205880 Hz			1102500/02/04 1102480/82/84 1102490/92/94

other models available on request

Optional Features

- up to 288 GB onboard CamRAM
- dual rate recording

Camera Lenses

C-Mount Lenses





Part number	1014067	1012532	1013995	1013993
Mount	C-Mount	C-mount	C-mount	C-mount
Format	1.1"	1"	1.1"	1.1"
Focal length [mm]	12	16	16	25
F# range	2.0 - 16.0	1.4 - 16.0	2.0 - 16	2.0 - 22
Min. object distance [mm]	100	300	100	100
Filter thread	M46	M30.5	M37	M37.5
Dimension [mm]	Ø 48 x 61.5	Ø 38 x 45.0	Ø 40.5 x 61.3	Ø 45 x 75.41

additional camera lenses available on request







Part number	1013994	1014068	1017272
Mount	C-mount	C-mount	C-mount
Format	1.1"	1.1"	1.1“
Focal length [mm]	35	50	75
F# range	2.0 - 22	2.2 - 22	2.6 - 32
Min. object distance [mm]	200	250	300
Filter thread	M37.5	M37.5	M34
Dimension [mm]	Ø 46 x 77.1	Ø 49 x 102.6	Ø 50 x 95.4

additional camera lenses available on request

Macro Lenses



Part number	1011546	1013374	1012074
Mount	C-Mount	C-Mount	C-Mount
Format	2/3”	2/3“	2/3”
Focal length [mm]	50	50	26.0
Magnification	1	1	2
F# range	4	5.6	4.4
Fixed object distance [mm]	90	90	75
Field of view (FOV) [mm]	8.3 x 6.2	8.3 x 6.2	4.2 x 3.1
Front diameter [mm]	28	28	16
Filter thread	M22.5 x 0.5	M22.5 x 0.5	no
Weight [g]	70	70	40
Dimension [mm]	29 x 96.6	29 x 96.6	29 x 76.8

additional camera lenses available on request

F-Mount Lenses



Part number	1014455	1014454	1000865	1014383	1108672
Mount	F-Mount	F-Mount	F-Mount	F-Mount	F-Mount
Image size	Ø 43 mm	Ø 43 mm	Ø 43 mm	Ø 43 mm	Ø 43 mm
Focal length [mm]	24	35	35	50	100
F# range	1.4 - 22	1.4 - 22	2.0	1.4 - 22	2.8 - 32
Min. object distance [mm]	250 - infinity	300 - infinity	250 - infinity	450 - infinity	300 - infinity
Filter thread	77	77	52	77	55
Weight [g]	565	690	250	520	540
Dimension [mm]	95 x 83	109 x 83	64.5 x 43.5	81 x 72	73 x 95

additional camera lenses available on request

12x Zoom Lens System



The **Zoom Lens System** with 12x magnification range consists of a main lens body and a variety of attachments to get application-specific working distances and fields of view.

Developed for measurement tasks the **Zoom Lens System** design has an advantage over conventional photographic lenses due to its universality in variations of working distances and magnifications.

Features

- high 12x magnification (0.58 - 7X) lens system
- zoom lens with wide field coverage
- increased resolution with 0.018 - 0.1 N.A.
- variable working distance from 37 to 341 mm
- field of view from 0.29 mm to 75.9 mm with attachments
- unmatched edge flatness and clarity
- works with any current format cameras

The 12X **Zoom Lens System** is designed on a modular basis, offering optical quality and mechanical flexibility. This interchangeable design, combined with a wide range of lens adapters and attachments, allows you to easily choose the magnification, field of view and working distance that suits your viewing needs best.

This 12X **Zoom Lens System** delivers unbeatable accuracy and repeatability for even the toughest applications. Superb optics deliver remarkably high contrast, high resolution video images. The 12:1 zoom ratio provides an incredible magnification range which allows both, high magnification for precision measurement and inspection, as well as low magnification for a wider field of view.

Applications

- Spray analysis
- Strain & stress measurements
- Materials testing
- Particle sizing

The **Zoom Lens System**'s modularity enables a huge amount of combinations of components so that the following tables give details about the most typical data only.
In case you require different magnifications and/or working distances please contact us.

The standard set of this lens system consists of :

Zoom Lens System 12x with 12 mm fine adjustment range	
C-mount coupler for connecting a camera	
2 types of adapters :	A 1x
	A 2x
Standard lens attachment:	L 2 x
Optional additional lens attachments:	L 0.25 x
	L 0.5 x
	L 1.5x

Combinations of the **Zoom Lens** with these components give this performance

Lens attachment	Working distance/ mm	Camera models	Sensor format	1x tube field of view (hor. x vert.)/ mm²		2x tube field of view (hor. x vert.)/ mm²		Resolution/ µm (min - max)	Depth of field/mm (min - max)
				min.	max.	min.	max.		
Lens 0.25x optional 1001895	341		Magnification	1.75	0.145	3.5	0.29	33.3 - 6.7	20 - 0.8
		Imager CX/CS/CX2/ CS2 - 5	1/2“	3.76 x 3.15	45.43 x 37.99	1.88 x 1.57	22.72 x 18.99		
		Imager M-lite 5M v2	2/3“	4.83 x 4.04	58.25 x 48.73	2.41 x 2.02	29.12 x 24.36		
		Imager CX/CS/CX2/ CS2 -12	1/1.2“	6.29 x 4.60	75.97 x 55.56	3.15 x 2.30	37.99 x 27.78		
Lens 0.5x optional 1001896	165		Magnification	3.5	0.29	7	0.58	18.5 - 3.3	6.2 - 0.2
		Imager CX/CS/CX2/ CS2 - 5	1/2“	1.88 x 1.57	22.72 x 18.99	0.94 x 0.79	11.36 x 9.50		
		Imager M-lite 5M v2	2/3“	2.41 x 2.02	29.12 x 24.36	1.21 x 1.01	14.56 x 12.18		
		Imager CX/CS/CX2/ CS2 -12	1/1.2“	3.15 x 2.30	37.99 x 27.78	1.57 x 1.15	18.99 x 13.89		
No lens -	86		Magnification	7	0.58	14	1.16	9.3 - 1.7	1.4 - 0.05
		Imager CX/CS/CX2/ CS2 - 5	1/2“	0.94 x 0.79	11.36 x 9,50	0.47 x 0.39	5.68 x 4.75		
		Imager M-lite 5M v2	2/3“	1.21 x 1.01	14.56 x 12.18	0.60 x 0.50	7.28 x 6.09		
		Imager CX/CS/CX2/ CS2 -12	1/1.2“	1.57 x 1.15	18.99 x 13.89	0.79 x 0.58	9,.50 x 6..95		
Lens 1.5x optional 1002211	62		Magnification	10.5	0.87	21	1.74	6.7 - 1.2	0.8 - 0.03
		Imager CX/CS/CX2/ CS2 - 5	1/2“	0.63 x 0.52	7.57 x 6.33	0.31 x 0.26	3.79 x 3.17		
		Imager M-lite 5M v2	2/3“	0.80 x 0.67	9.71 x 8.12	0.40 x 0.34	4.85 x 4.06		
		Imager CX/CS/CX2/ CS2 -12	1/1.2“	4.85 x 4.06	12.66 x 9.26	0.52 x 0.38	6.33 x 4.63		

Lens attachment	Working distance/ mm	Camera models	Sensor format	1x tube field of view (hor. x vert.)/ mm²		2x tube field of view (hor. x vert.)/ mm²		Resolution/ µm (min - max)	Depth of field/mm (min - max)
				min.	max.	min.	max.		
Lens 2x included as standard	37		Magnification	14	1.16	28	2.32	4.5 - 0.8	0.3 - 0.01
		Imager CX/CS/CX2/ CS2 - 5	1/2“	0.47 x 0.39	5.68 x 4.75	0.,24 x 0.20	2.84 x 2.37		
		Imager M-lite 5M v2	2/3“	0.60 x 0.50	7.28 x 6.09	0.30 x 0.25	3.64 x 3.05		
		Imager CX/CS/CX2/ CS2 -12	1/1.2“	0.79 x 0.58	9.50 x 6.95	0.39 x 0.29	4.75 x 3.47		



Zoom lens with M-lite camera mounted onto an X48 rail

One can use the ball-head compact 496RC2 plus a fitting slider for the rail plus a grub screw for mounting the lens with M-lite cameras.

Part number	Description
1108548	Zoom lens system
1001895	Additional lens attachment L 0.25 x
1001896	Additional lens attachment L 0.5 x
1001897	Standard lens attachment L 2 x
1008252	Ball-head compact 496RC2
1109925	Mount for zoom lens and camera, incl. 500 mm rail

Filters

Lens filter attachments for various applications:

- the use of polarization filters reduces reflections on the sample surface
- in combination with blue light, a blue filter allows a view of hot/glowing surfaces
- UV filters remove unwanted light from disturbing light sources, e.g. from the sun or neon tubes



Polarization

Type	Lens type	Filter thread	Part number
Linear polarization	C-Mount	M27 x 0.5	1010468
Linear polarization	C-Mount	M52 & adapter ring M34	1103344
Linear polarization	C-Mount	M37.5	1014369
Linear polarization	F-Mount	M62 & adapter rings M58/ M55/ M52	1103343
Circular polarization	F-Mount	M52	1009717

For use with white LED device 1103520, 1103530 and clip-on frame with polarization filter 1103354



Visible Blue

Type	Wavelength	Lens type	Filter thread	Part number
Bandpass	450 / 40	F-Mount	M52	1108600

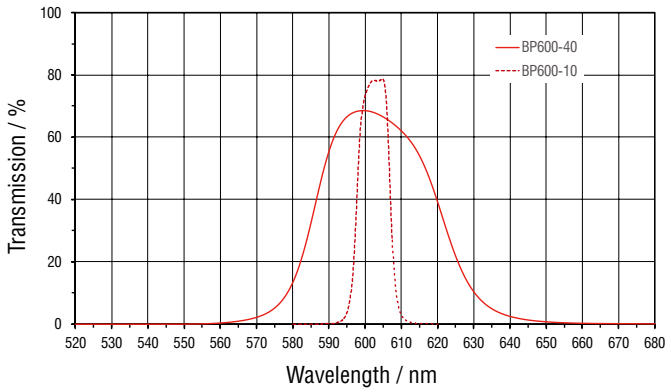
For use with blue LED device 1103521 and 1103531

Filters for Use with Fluorescent Paint

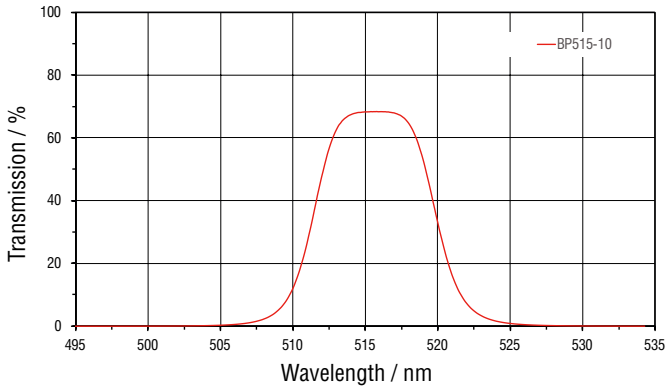
Type	Wavelength	Lens type	Filter thread	Part number
Bandpass orange	600 / 40	C-Mount	M27	1109056
Bandpass orange	600 / 10		M27	1109066
Bandpass green	515 / 10		M27	1109058
Bandpass orange	600 / 40	F-Mount	M52	1109057
Bandpass orange	600 / 10		M52	1109055
Bandpass green	515 / 10		M52	1109059

for use with UV or blue light for fluorescent excitation

Filter Transmission



for part numbers # 1109055, # 1109056, # 1109057 and # 1109066



for part numbers # 1109058 and # 1109059

Adapter Rings

Type	Lens type	Filter thread	Part number
Filter adapter ring		M27 to M37	1009398
Filter adapter ring		M37 to M52	1007031
Filter adapter ring		M34 to M52	1010712
Filter adapter ring		M46 to M52	1003499
Filter adapter ring		M37.5 to M52	1014101
Filter adapter ring	for use with 1013994	M37.5 to M52	1014875
Filter adapter ring		M30.5 to M52	1008878
Filter adapter ring		M27 to M22.5	1013345
Lens adapter	C-mount to F-mount	M27	1009961
Lens adapter rings	C-mount extension, 5 / 8 / 10 mm	M27	1002101

LED Illumination Units

A wide range of imaging applications do not require the unique illumination capabilities of a laser but still demand for more precise control than a constant halogen illumination can offer.
This is where LED illumination can have clear advantages over all alternatives.
Known spectral characteristics together with low heat dissipation and the ability to work in pulsed mode come in a cost-efficient package for various fields of applications.

Applications

- non-destructive testing
- strain and deformation analysis
- background suppression in bright or hot environments
- thermal mechanical fatigue (MFT) testing
- multi-phase flow
- bubble research

LaVision has developed different solutions for different purposes. The LED 35 can be used in a „quasi-CW“ operating mode (light pulses are perceived by the human eye as flicker-free light) or synchronized to other devices and events by DaVis software. The LED units come with individual power supplies and are triggered or modulated by TTL signals up to 5 kHz.



White LED illumination unit

Standard colors are white and blue and others are available on request. The **LED Illumination Units** contain 9 high power LEDs each and are focused for efficient usage of the light. White illumination is highly efficient and matches any camera‘s sensitivity curve well so that it is optimal even for short exposure times or pulse durations.
Blue illumination is advantageous when high temperatures or flames give a strong background radiation of visible or infrared wavelengths. This can be best suppressed by using a shorter wavelength (blue) for illumination and use a pulsed synchronized mode (matching camera filter required).
Simultaneous measurements of different techniques benefit from wavelength separation.
A good example is the measurement of bubble size and shape (Shadowgraphy) with simultaneous liquid flow around them (PIV). The blue backlight for Shadowgraphy from an LED unit does not interfere with the green lightsheet for PIV and different cameras with different filters separate the signals well.

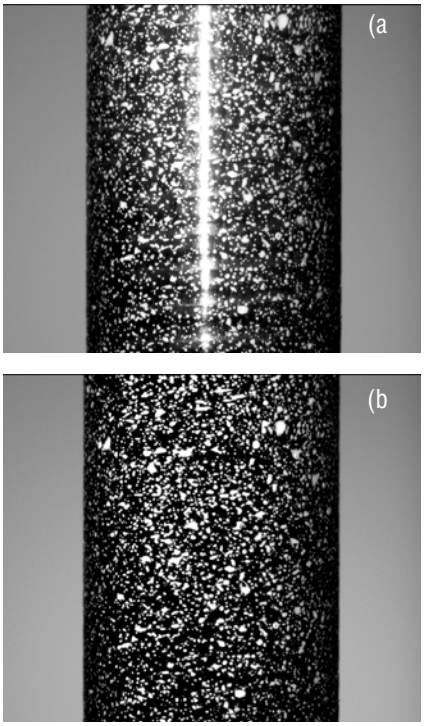
Specifications

Size	100 x 100 x 70 mm
Weight	0.85 kg (LED module)
	0.85 kg (power supply)
LED array	3 x 3 LED´s
White color	400 - 700 nm, 6500 K
Blue color	445 nm
Light power	
White	8000 lux
Blue	1000 lux at 500 mm working distance in quasi-cw mode
Opening angle	12°
Illuminated area	200 x 200 mm at 500 mm working distance FWHM
Working distance	300 - 1000 mm
Exposure time	min. 200 µs
Max. duty cycle	50%



Blue LED illumination unit

Polarized Light



Speckled carbon fiber tube without (a) and with (b) polarized light



Clip-on frame with polarizing filters

Sometimes it is not possible to guarantee an optimal sample illumination over the entire measurement process. Light reflections on metallic or glossy surfaces that may arise due to movement or deformation of the sample, complicate the subsequent image analysis or make recordings even unusable. As a variant the LED illumination units can be equipped with a filter for producing polarized light, whereby these reflections are reduced significantly.

When using polarization filtered LEDs it must be considered that there is up to 60% less light available as compared to the operation of the same LED with un-polarized light. Please note that the required polarization attachment of the camera lens effects an additional light intensity reduction of 1 to 2 aperture stops. The measurement process should therefore allow for sufficiently long camera exposure times. In case of using two polarized light sources it is important that these are aligned in parallel to each other. An angular deviation of more than 60° between two light sources leads to the loss of all advantages of the polarization.

The clip-on frame with polarizing filter 1103354 includes 1 frame for use with LED 35 illumination devices 1103520, 1103530, 1103532. For use of a stereo-light setup 2 x 1103354 is required.



Part number	Description
1103520	2 pieces of LED 35, pulsed or constant illumination, overpulse function, for StrainMaster Portable; color: white*
1103521	2 pieces of LED 35, pulsed or constant illumination, overpulse function, for StrainMaster Portable; color: blue*
1103530	1 piece of LED 35, pulsed or constant illumination, overpulse function, with external power supply for stand-alone use, for StrainMaster Portable; color: white**
1103532	1 piece of LED 35, pulsed or constant illumination, overpulse function, to extend 1103530; color: white
1103531	1 piece of LED 35, pulsed or constant illumination, overpulse function, with external power supply for stand-alone use, for StrainMaster Portable; color: blue**
1103533	1 piece of LED 35, pulsed or constant illumination, overpulse function, to extend 1103531; color: blue
1108600	Filter, central wavelength 450 nm; bandwidth 40 nm for high temperature imaging in combination with blue light source
1103343	Polarization filter for F-mount camera lens; diameter 62 mm; includes a set of 3 adapter rings 58, 55 and 52 mm for lenses with smaller filter threads
1010468	Polarization filter for C-mount camera lens with M27 thread
1014369	Polarization filter for C-mount camera lens with M37.5 thread
1103344	Polarization filter kit for C-mount camera lens with M34 thread
1103320	2 pieces (one pair) cable extension for trigger for LED 35, length: 200 cm
1103354	1 piece clip-on frame with polarizing filter, for use with 1103520, 1103530, 1103532

* For use with DCU X with part no. 1104340, 1104341, 1104342, 1104343, only.

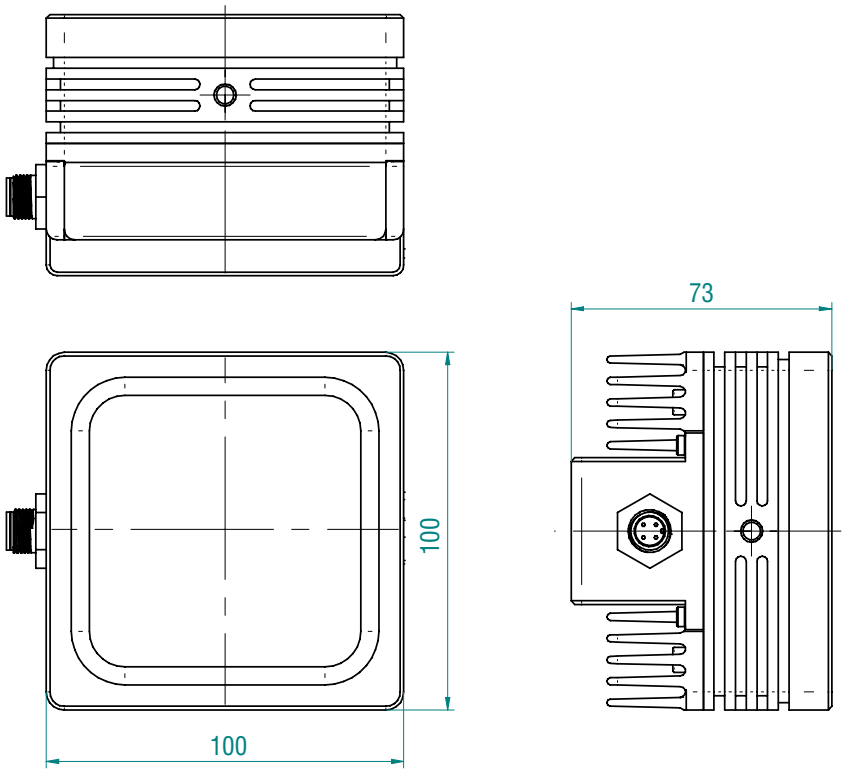
** For use with DCU X with part no. 1104215, 1104216, 1104217 or 1104218 or with PTU X.

Overpulsed Light

For camera recordings of moving objects short exposure times are required and they need a stronger light source when compared to quasi-static tests. The LED 35 is equipped with an overpulse function which allows up to 150% light yield of the nominal power for a short time period < 3 ms.

This function is not suitable for use of constant light and also does not replace the lighting units that are designed specifically for high-speed applications.

Dimensions



The **LED Illumination Units** are available in sets of 2 devices for **StrainMaster** Portable (#1103520, #1103521). The power is supplied by a **Device Control Unit**.

Single units (#1103530, #1103531, #1103532, #1103533) have standard threads on the back (M4, M6 or ¼“-20 UNC) so that mounting on tripods, magic arms or flat rails is easy. For stand-alone use the device is equipped with an external power supply.

LED Illumination Spot

The **LED Illumination Spot** consists of a controller that can drive up to two LED spots with a diameter of 1 inch. The high energy LED spots are available with white and blue (455 nm) light.



Applications

It is designed as a light source to illuminate small fields of view with incoherent light, like imaging with high magnification lenses or µstrain applications.

Operation mode

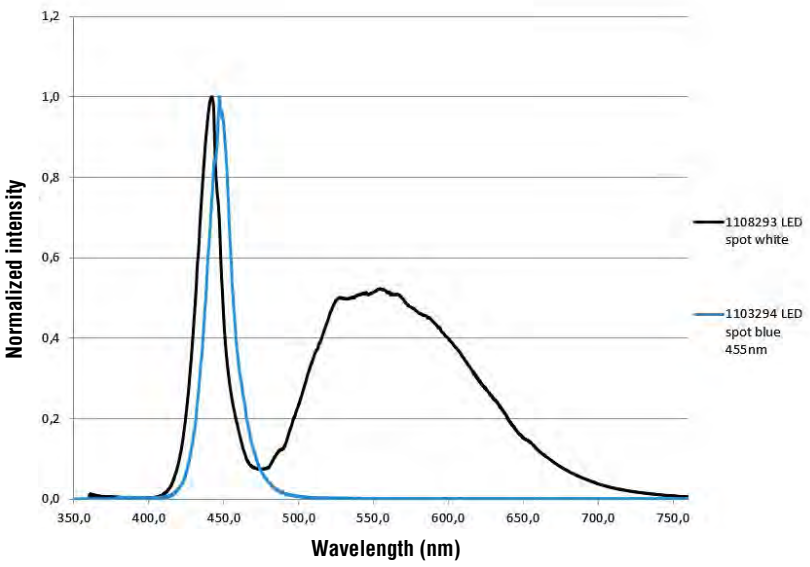
The **LED Illumination Spot** can be operated as a gated light source controlled by DaVis or as a continuous light source. The controller has a knob to control the energy output of the LED spot.

Light colors

The spots are available in following configurations:

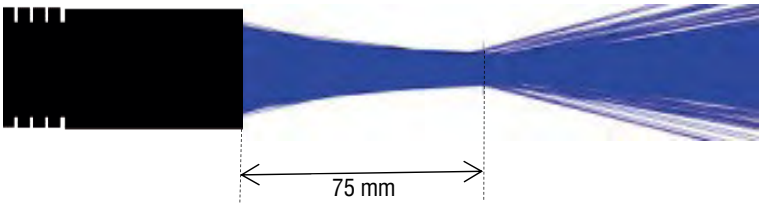
- white light with 990 mW
- blue light (455 nm) with 1.1 W

LED spot emission spectrum



Beam characteristics

The beam diameter at the exit of the spot is ca. 18 mm. The focal point is 75 mm from the front surface of the tube of the spot.



Beam diameter in focus ca. 5 mm

Spot diameter: ca. 18 mm ca. 5 mm

Mounting options



The **LED Illumination Spot** comes with a mounting ring with M6 threads.

Mini articulated arm

A mini articulated arm is available. It has internal M6 tread, external M6 or M8 thread and allows a flexible mount of the **LED Illumination Spot** to a rail slider or to a stereo microscope.





Ordering information

Part number	Description
1103292	LED spot controller for one or two LED spots, 90-250 V AC
1103293	LED spot, white, 990 mW
1103294	LED spot, blue, 455 nm, 1.1 W
1008963	Mini articulated arm

UV LED Panel

The correct illumination of an experiment is of crucial importance for optical measurement methods such as digital image correlation (DIC). A continuous (CW) or pulsed white light is often used for this purpose. However, if the specimen has a reflective surface, complex geometry, or undergoes large deformation during the experiment, shadows or reflections may occur on the specimen surface. This can make image evaluation difficult.



An alternative approach to white light illumination is Ultra-Violet (UV) light. When UV light is combined with a matching filter for the camera it is possible to avoid the potential issues described above. In order to use UV light the specimen surface must be prepared with a suitable speckle pattern: this can be achieved with fluorescent paint matched to the light characteristics. UV speckle is robust and stable over time irrespective of the specimen's movement, and through the use of a matched filter, changes in ambient lighting do not affect the image quality.



Bicycle helmet speckled with green fluorescent paint

LaVision's **UV LED Panel** offers a compact light capable of illuminating small or large areas together with matched camera filters and speckle application kit.

Length	356 mm
Width	248 mm
Height	2.2 kg
Input voltage	100 to 240 VAC, 50/60 Hz
Power	48 W
Watt per LED	0.25 W
LED quantity	192
Wavelength	405 nm
Illumination	constant (CW)
Working distance to sample	30 cm – 400 cm
Illuminated area	up to 5 m^2

Part number	Description
1103447	UV LED illumination device
1108560	Light filter 532 nm,10 nm
1011149	Green fluorescent paint to apply artificial speckle pattern
1012056	Orange fluorescent paint to apply artificial speckle pattern
1109055	Bandpass filter, 600, 10 nm, M52
1109056	Bandpass filter, 600, 40 nm, M27
1109057	Bandpass filter, 600, 40 nm, M52
1109058	Bandpass filter, 515, 10 nm, M27
1109059	Bandpass filter, 515, 10 nm, M52
1109066	Bandpass filter, 600, 10 nm, M27

LED-Flashlight 300

For high-speed deformation analysis the usual laser illumination can often be replaced by high power LED illumination. The **LED-Flashlight 300** provides an array of 72 white or blue high-power LEDs in an area of 300 x 100 mm². The small divergence angle of +/- 5° allows the illumination of measurement volumes with a cross section of about 300 x 100 mm² at 1 m working distance. Optional Fresnel lenses can be used for smaller or larger cross sections.



LED-Flashlight 300 blue



LED-Flashlight 300 white

Compared to low- and especially high-repetition-rate, **LED-Flashlight 300** has important advantages:

Specifications

- It is much more compact, made up only by the LED module itself and a small power supply, allowing easy transportation and mounting, without potential laser misalignment. No maintenance efforts are needed.
- It is safe to operate, requiring no particular laser safety infrastructure and training.
- The incoherent light ensures high image quality with constant homogeneous particle brightness in time and space without laser speckle effects. Laser illumination often exhibits darker regions due to fringes in the laser beam profile causing less reliable particle tracking.
- The amount of light output is similar to high-repetition-rate lasers at a fraction of the cost.

Applications

The field of application for the **LED-Flashlight 300** is very wide. It is particularly suitable for illuminating high-speed tensile and fracture tests. Due to its luminosity, it enables sufficient illumination of an area of up to 1 x 1 m for low-speed applications. As a variant with blue LEDs it can be used for high-temperature tests. In combination with corresponding camera filters, disturbing red light can be filtered out. For applications at room temperature in combination of fluorescent paint and suitable camera filters, high-contrast speckle patterns can be obtained even under the influence of disturbing neon light or sunlight.

Operating Modes

The **LED-Flashlight 300** supports two operating modes: the pulsed-overdrive mode and the free-trigger mode.

Pulsed-Overdrive Mode

The pulsed-overdrive mode is specifically designed for particle based velocity measurements. The LEDs are operated above the nominal LED current to generate short pulses at very high light intensities. Compared to nanosecond laser pulse durations, the lengths of LED pulses need to be much longer to gather enough light. To protect the LEDs at such high current, the duty cycle is limited to a maximum of 10 %. Consequently, for a maximal particle shift of e.g. 10 pixel, a particle image is smeared by 1 pixel at most. 1 pixel smearing has been found to be acceptable for Tomographic PIV and Shake-the-Box analysis.

Free-Trigger Mode

In the free-trigger mode at lower peak power, the **LED-Flashlight 300** can either be used for constant illumination (100 % duty cycle), e.g. for experimental adjustment, or can be triggered with an arbitrary pulse sequence, e.g. for dual-pulse or multi-pulse illumination.

Multiple **LED-Flashlight 300** modules are seamlessly combined to obtain larger cross sections with different aspect ratios, e.g. with four modules a cross section of 600 x 200 mm² or 400 x 300 mm² can be readily obtained.





Specifications

Size	337 x 117 x 153 mm³
Weight	5.3 kg (LED module) 1.6 kg (power supply)
LEDs	72 blue or white high power, high efficiency LEDs
Opening angle	10° (+/- 5°)
Working distance	typ. 500 mm – 2000 mm
Electrical power	avg. 300 W
Efficiency	20 % (free-trigger), 10 % (pulsed-overdrive)
Light pulse trigger	0 – 20 kHz, TTL-level
Jitter	< 15 ns
Mode selection	manual switch or remote (TTL)
Safety features	temperature control, LED trigger protection

Mode	Power emitted light	Duty cycle	Max. pulse energy	Pulse length
Pulsed-overdrive	290 W	0 - 10 %	145 mJ @ 200 Hz 29 mJ @ 1 kHz 2.9 mJ @ 10 kHz	2.5 µs – 335 µs
Free-trigger (white)	60 W	0 - 100 %	60 W x Δt	2.5 µs – ∞(cw)

Part number	Description
1103445	LED-Flashlight 300 white
1103446	LED-Flashlight 300 blue

High Energy LED Spotlight

The requirements for illumination in technical imaging applications are dictated by the application and must be met by a suitable light source.
This **High Energy LED Spotlight** combines the advantages of an LED with the capability of short pulses which allow synchronization to high frame rate cameras or stroboscopic illumination of cyclic events. Different from lasers which are typically used for such applications the LED can also be operated in constant illumination mode and gives a spectral appearance close to daylight.

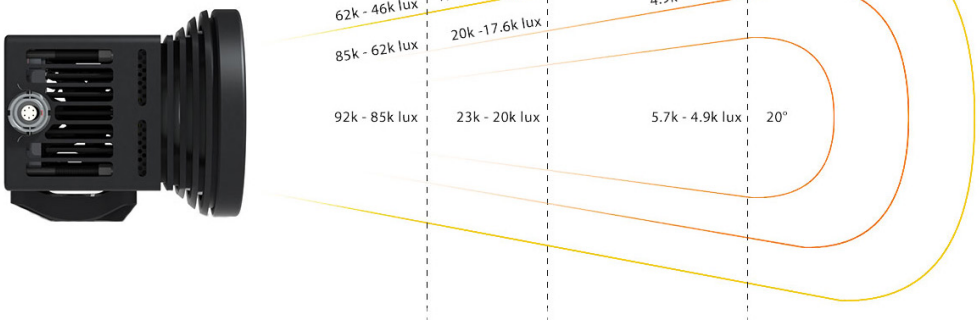
Applications

- phase-locked imaging
- high-speed synchronization
- dynamic strain measurements (DIC)
- analysis of bubbles or sprays
- particle size measurements (Shadowgraphy)



Specifications

- LED cluster with 12000 lumens continuous and 24000 lumens pulsed
- power input 120 W
- compact size 60 x 58 x 72 mm (LED head)
- pulsed (up to 100 kHz) or continuous
- timing control by DaVis software
- color temperature 5000 K
- beam angle 28°



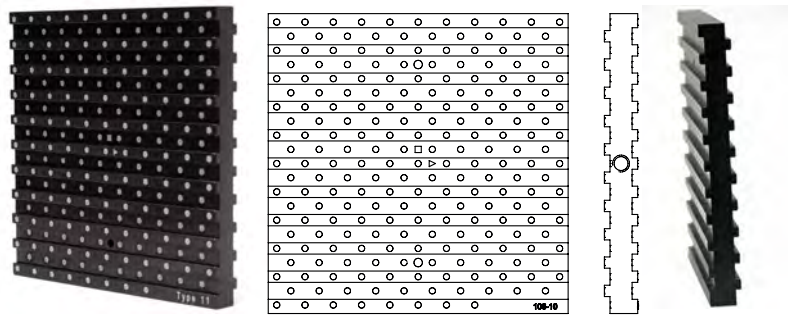
Part number	Description
1103421	High energy stroboscopic LED head with controller (single)
1103336	Quick-lock flexible mounting arm
1110025	Lens kit, diameter 152 mm including holder

3D Calibration Plate

The **two-level double-sided** **3D Calibration Plate** allows calibration of a stereo (Stereo-PIV, Stereo-DIC) or volume (Tomo-PIV) setup with only a single view calibration. Taking a single image from one target position is sufficient to calibrate the entire volume.
In contrast to widely used flat calibration targets, physically scanning the volume or taking several views is not required. The **3D Calibration Plate** are active on both sides, so that camera views from any side of the measurement region are possible. This feature is extremely convenient, when the measurement plane is difficult to access, like in a basin or heat chamber.

DaVis finds the marks on a calibration plate by automated mark detection. It can distinguish between both sides of a calibration plate and recognizes its orientation by detecting additional position marks.

Each **Calibration Plate** is measured at a dedicated test bench to quantify the geometrical deviations from its technical specifications. This is done to monitor the quality of the manufacturing process within LaVision's quality management system. Furthermore, this measurement is also performed with the aim of creating an individual **Validated Calibration Plate** file containing the true geometrical properties of the actual plate.
Since each manufactured **Calibration Plate** has its unique ID, DaVis can identify the corresponding validated calibration plate file and will correct the camera calibration from all quantified systematic errors.



Type	Dot distance	Dot diameter	Level separation
058-5	5 mm	1.2 mm	1 mm
106-10	10 mm	2.2 mm	2 mm
204-15	15 mm	3.2 mm	3 mm
309-15	15 mm	3 mm	3 mm

Applications

- Stereo-PIV
- Tomographic PIV
- 3D PTV
- 3D Strain

Features

- high precision dot pattern
- two-level double-sided pattern suitable for simultaneous calibration from opposite sides
- fiducials for automatic mark search identifying front and back side automatically
- screw thread on border for easy mounting

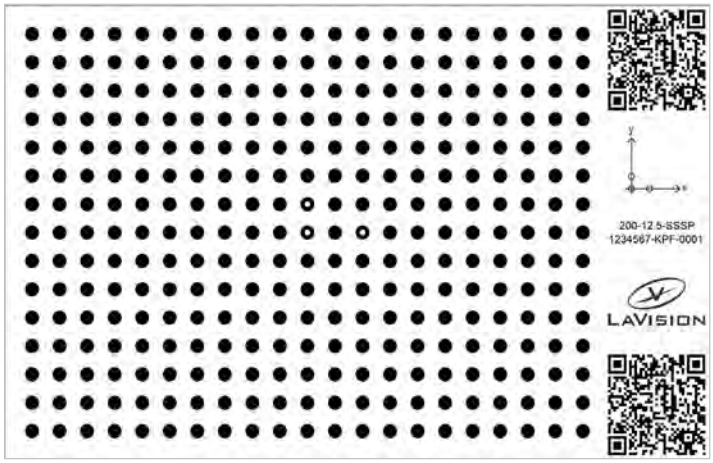
Ambient conditions

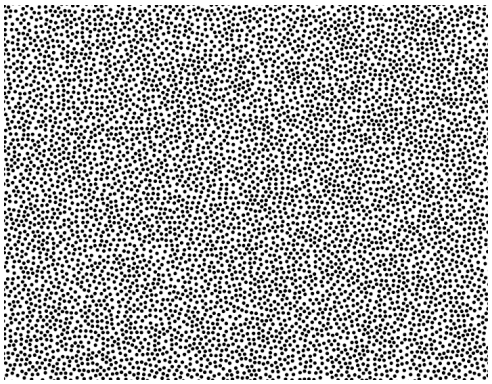
- temperature range: 0°C – 40°C
- humidity: 0% - 90%, non-condensing
- store in a dry environment
- handle with care and avoid shock

Part number	Description
1108961	Type 058-5, dimensions: 58 mm x 58 mm
1108962	Type 106-10, dimensions: 106 mm x 106 mm
1108963	Type 204-15, dimensions: 204 mm x 204 mm
1108964	Type 309-15, dimensions: 309 mm x 309 mm

White Single-sided QR-Code Calibration Plate

The **White Single-sided QR-Code Calibration Plate** is a widely used tool for calibrating 2D and 3D DIC setups.





Speckled rear side for 0 strain test

The calibration procedure when using this type of plate utilizes several views of the plate at different positions and orientations within the depth of focus of the system. Marks are automatically detected, and all detected marks provide information which is used in the bundle adjustment calibration algorithm. The QR-code identifies the calibration plate used in the calibration process (starting with DaVis 10.2). Information about the plate like number of marks, mark sizes, mark distance and fiducials are extracted automatically. This allows a fully automated calibration process. During this live calibration procedure, the intrinsic and extrinsic camera parameters are calculated.

An additional feature of the plates are printed speckle patterns on the rear side, allowing the user to perform rigid body shift (0% strain) tests to quantify the uncertainty within the system.

Each **Calibration Plate** is measured at a dedicated test bench to quantify the geometrical deviations from its technical specifications. This is done to monitor the quality of the manufacturing process within LaVision's quality management system. Furthermore, this measurement is also performed with the aim of creating an individual **Validated Calibration Plate** file containing the true geometrical properties of the actual plate.
Since each manufactured **Calibration Plate** has its unique ID, DaVis can identify the corresponding validated calibration plate file and will correct the camera calibration from all quantified systematic errors.

Features

- suitable for calibration of 2D and 3D DIC systems
- high precision dot pattern with three fiducials for orientation detection
- lightweight and easy to handle
- plates are provided with printed speckle pattern on the back side for 0 strain test according to VDI standard 2626

Ambient conditions

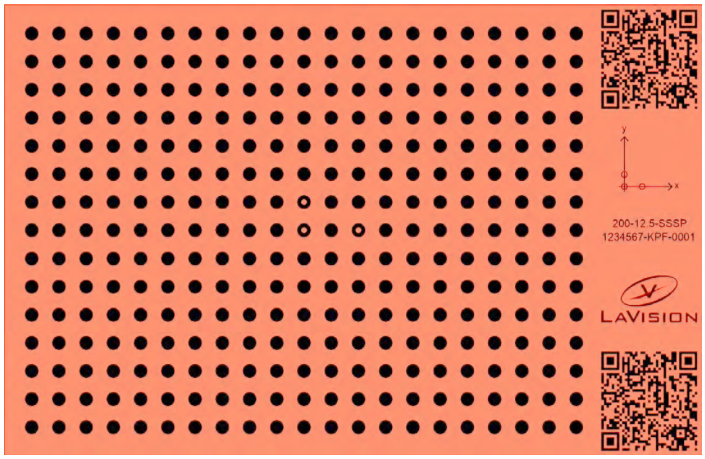
- temperature range: 0°C – 40°C
- humidity: 0% - 90%, non-condensing
- store in a dry environment
- handle with care and avoid shock

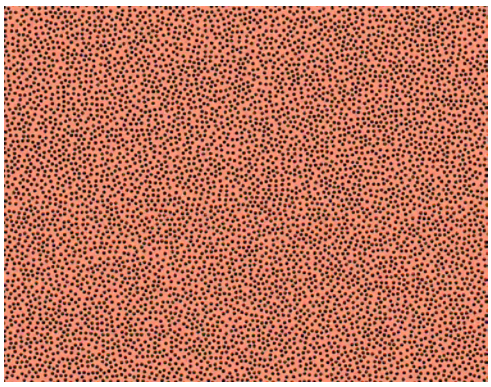
LaVision offers sets of calibration plates suitable for different sized FoV´s (Field of View) for use with white illumination.

Part number	Description
1107200	Set of five validated single plane calibration plates for use with white light; consists of type: 1 x QR1-102-3.5; 102 x 60 mm 1 x QR2-130-4.7; 130 x 80 mm 1 x QR3-169-6.4; 169 x 109 mm 1 x QR4-227-8.5; 227 x 146 mm 1 x QR5-306-11.6; 306 x 197 mm
1107202	Set of three validated single plane calibration plates for use with white light; consists of type: 1 x QR6-414-15.7; 414 x 267 mm 1 x QR7-560-21.2; 560 x 360 mm 1 x QR8-792-30.0; 792 x 510 mm
1107204	1 x QR9-1188-45.0; 1188 x 765 mm, validated
1108943	1 x 1000-75 SSSP, 1000 x 1000 mm

Fluorescent Single-sided QR-Code Calibration Plate

The **Fluorescent Single-sided QR-Code Calibration Plate** is a widely used tool for calibrating 2D and 3D DIC setups.





Speckled rear side for 0 strain test

The calibration procedure when using this type of plate utilizes several views of the plate at different positions and orientations within the depth of focus of the system. Marks are automatically detected, and all detected marks provide information which is used in the bundle adjustment calibration algorithm. The QR-code identifies the calibration plate used in the calibration process (starting with DaVis 10.2). Information about the plate like number of marks, mark sizes, mark distance and fiducials are extracted automatically. This allows a fully automated calibration process. During this live calibration procedure, the intrinsic and extrinsic camera parameters are calculated.

An additional feature of the plates are printed speckle patterns on the rear side, allowing the user to perform rigid body shift (0% strain) tests to quantify the uncertainty within the system.

Each **Calibration Plate** is measured at a dedicated test bench to quantify the geometrical deviations from its technical specifications. This is done to monitor the quality of the manufacturing process within LaVision's quality management system. Furthermore, this measurement is also performed with the aim of creating an individual **Validated Calibration Plate** file containing the true geometrical properties of the actual plate.
Since each manufactured **Calibration Plate** has its unique ID, DaVis can identify the corresponding validated calibration plate file and will correct the camera calibration from all quantified systematic errors.

Features

- suitable for calibration of 2D and 3D DIC systems
- high precision dot pattern with three fiducials for orientation detection
- lightweight and easy to handle
- plates are provided with printed speckle pattern on the back side for 0 strain test according to VDI standard 2626

Ambient conditions

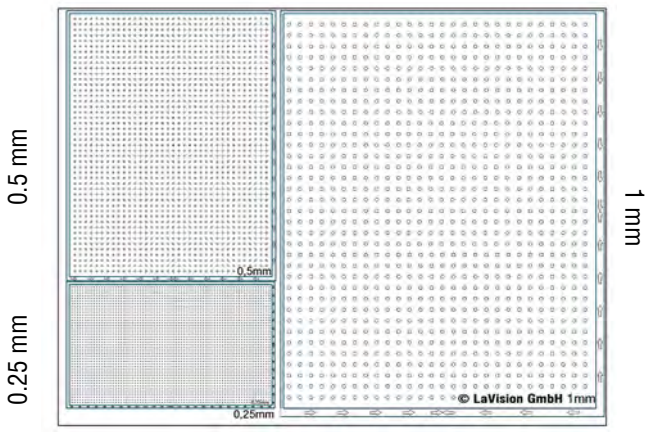
- temperature range: 0°C – 40°C
- humidity: 0% - 90%, non-condensing
- store in a dry environment
- handle with care and avoid shock

LaVision offers sets of fluorescent calibration plates suitable for different sized FoV´s (Field of View) for use in combination with blue illumination and orange bandpass filter.

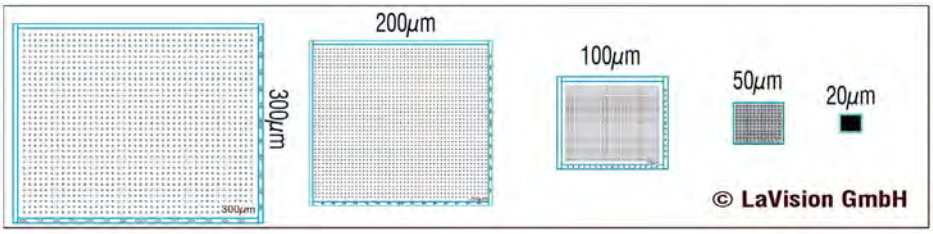
Part number	Description
1107201	Set of validated five single plane calibration plates for use in combination with blue illumination and orange bandpass filter; consists of type: 1 x QR1-102-3.5F; 102 x 60 mm, fluorescent 1 x QR2-130-4.7F; 130 x 80 mm, fluorescent 1 x QR3-169-6.4F; 169 x 109 mm, fluorescent 1 x QR4-227-8.5F; 227 x 146 mm, fluorescent 1 x QR5-306-11.6F; 306 x 197 mm, fluorescent
1107203	Set of three validated single plane calibration plates for use in combination with blue illumination and orange bandpass filter; consists of type: 1 x QR6-414-15.7F; 414 x 267 mm, fluorescent 1 x QR7-560-21.2F; 560 x 360 mm, fluorescent 1 x QR8-792-30.0F; 792 x 510 mm, fluorescent
1107205	1 x QR9-1188-45.0; 1188 x 765 mm, fluorescent, validated

Micro Calibration Plate

Micro Calibration Plates are used for calibration purposes for **FlowMaster** and **StrainMaster** systems with small scale fields of view, especially for µPIV applications. Two different plates are available with several targets of different dot diameters and distances and with automatic mark detection in **DaVis** versions >8.3.



Dot distance	Dot diameter	Type of calibration plate in DaVis calibration dialog
1 mm +/- 0.001mm	0.333 mm +/- 0.001mm	MP 50 x 38 1 mm
0.5 mm +/- 0.001mm	0.167 mm +/- 0.001mm	MP 50 x 38 0.5 mm
0.25 mm +/- 0.001mm	0.083 mm +/- 0.001mm	MP 50 x 38 0.25 mm



Dot distance	Dot diameter	Type of calibration plate in DaVis calibration dialog
300 µm +/- 1 µm	100 µm +/- 1 µm	MP 50 x 12 300 µm
200 µm +/- 1 µm	66.7µm +/- 1 µm	MP 50 x 12 200 µm
100 µm +/- 1 µm	33.3µm +/- 1 µm	MP 50 x 12 100 µm
50 µm +/- 1 µm	16.7 +/- 1 µm	MP 50 x 12 50 µm
20 µm +/- 1 µm	6.7µm +/- 1 µm	MP 50 x 12 20 µm

Material: clear glass substrate- protective coating, guide marks to locate the center of the grid, automatic detection of marks in DaVis versions >8.3.

Applications

- calibration for **FlowMaster** µPIV and **StrainMaster** µDIC systems
- calibration for small scale imaging

Holder for micro calibration plates

Micro calibration plate holder type 1: solid holder for incident light applications:
They are made of white plastics. The calibration plate is clamped between two jaws. The tension of the clamp can be adjusted to securely hold the calibration plate. A 80 mm long post with 14 mm diameter is included to mount it in a post holder.



*Solid micro calibration holder type 1 **with** calibration plate*

Micro calibration plate holder type 2: open frame holder for backlight applications:
These holders consist of a 2 piece frame that accomodate the micro calibration plate. A post adapter can be attached in different locations to provide flexible mounting options. A 80 mm long post with 14 mm diameter is included to mount it in a post holder.



*Open frame holder type 2 for backlight applications **with** calibration plate*

Inserting the micro calibration plate:



- open the screw of the post adapter
- take off the post adapter
- loosen the screws holding the two frame parts together



- slide the calibration plate into the groove
- the side of the calibration plate with the print should point to the frame with the grooves and marks
- make sure the micro calibration plate sits in the groove
- carefully tighten the screws hand tight



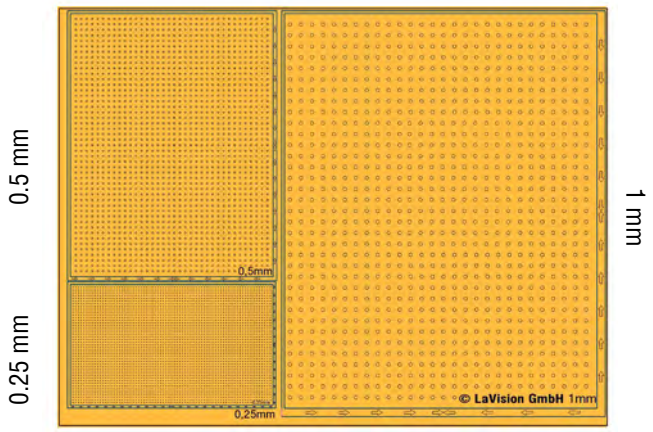
- reattach the post with the post adapter to the position of your choice and tighten the screw of the post adapter
- note that the marks do indicate the center of the fields of dots

Ordering information

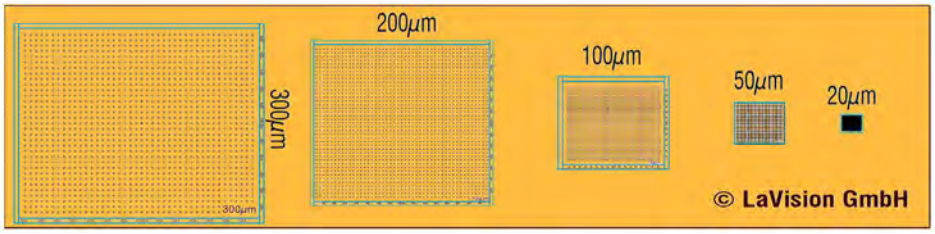
Part number	Description
1108936	12 mm x 50 mm x 1.5 mm target overall dimensions 300 µm, 200 µm, 100 µm, 50 µm and 20 µm dot distances
1108937	38 mm x 50 mm x 1.5 mm target overall dimensions 0.25 mm, 0.5 mm and 1 mm dot distances
1010884	Solid mechanical holder type 1 for micro calibration plate 12 mm x 50 mm including 80 mm post
1011481	Solid mechanical holder type 1 for micro calibration plate 38 mm x 50 mm including 80 mm post
1108978	Open frame mechanical holder type 2 for micro calibration plate 12 mm x 50 mm including 80 mm post
1108979	Open frame mechanical holder type 2 for micro calibration plate 38 mm x 50 mm including 80 mm post

Fluorescent Micro Calibration Plate

Fluorescent Micro Calibration Plates are used for calibration purposes for **FlowMaster** and **StrainMaster** systems with small scale fields of view, especially for µPIV applications. Two different plates are available with several targets of different dot diameters and distances and with automatic mark detection in **DaVis** versions >8.3.



Dot distance	Dot diameter	Type of calibration plate in DaVis calibration dialog
1 mm +/- 0.001mm	0.333 mm +/- 0.001mm	MP 50 x 38 1 mm
0.5 mm +/- 0.001mm	0.167 mm +/- 0.001mm	MP 50 x 38 0.5 mm
0.25 mm +/- 0.001mm	0.083 mm +/- 0.001mm	MP 50 x 38 0.25 mm



Dot distance	Dot diameter	Type of calibration plate in DaVis calibration dialog
300 µm +/- 1 µm	100 µm +/- 1 µm	MP 50 x 12 300 µm
200 µm +/- 1 µm	66.7µm +/- 1 µm	MP 50 x 12 200 µm
100 µm +/- 1 µm	33.3µm +/- 1 µm	MP 50 x 12 100 µm
50 µm +/- 1 µm	16.7 +/- 1 µm	MP 50 x 12 50 µm
20 µm +/- 1 µm	6.7µm +/- 1 µm	MP 50 x 12 20 µm

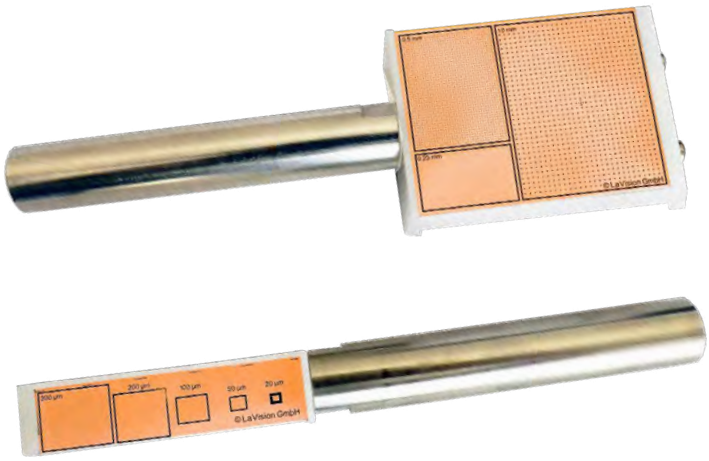
Material: clear glass substrate- protective coating, guide marks to locate the center of the grid, automatic detection of marks in DaVis versions >8.3.

Applications

- calibration for **FlowMaster** µPIV and **StrainMaster** µDIC systems
- calibration for small scale imaging

Holder for micro calibration plates

Micro calibration plate holder type 1: solid holder for incident light applications:
They are made of white plastics. The calibration plate is clamped between two jaws. The tension of the clamp can be adjusted to securely hold the calibration plate. A 80 mm long post with 14 mm diameter is included to mount it in a post holder.



Solid micro calibration holder type 1 ***with*** *calibration plate*

Micro calibration plate holder type 2: open frame holder for backlight applications:
These holders consist of a 2 piece frame that accomodate the micro calibration plate. A post adapter can be attached in different locations to provide flexible mounting options. A 80 mm long post with 14 mm diameter is included to mount it in a post holder.

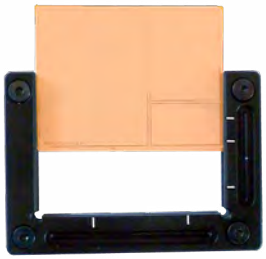


Open frame holder type 2 for backlight applications ***with*** *calibration plate*

Inserting the micro calibration plate:



- open the screw of the post adapter
- take off the post adapter
- loosen the screws holding the two frame parts together



- slide the calibration plate into the groove
- the side of the calibration plate with the print should point to the frame with the grooves and marks
- make sure the micro calibration plate sits in the groove
- carefully tighten the screws hand tight



- reattach the post with the post adapter to the position of your choice and tighten the screw of the post adapter
- note that the marks do indicate the center of the fields of dots

Ordering information

Part number	Description
1108971	12 mm x 50 mm x 1.5 mm target overall dimensions 300 µm, 200 µm, 100 µm, 50 µm and 20 µm dot distances
1108972	38 mm x 50 mm x 1.5 mm target overall dimensions 0.25 mm, 0.5 mm and 1 mm dot distances
1010884	Solid mechanical holder type 1 for micro calibration plate 12 mm x 50 mm including 80 mm post
1011481	Solid mechanical holder type 1 for micro calibration plate 38 mm x 50 mm including 80 mm post
1108978	Open frame mechanical holder type 2 for micro calibration plate 12 mm x 50 mm including 80 mm post
1108979	Open frame mechanical holder type 2 for micro calibration plate 38 mm x 50 mm including 80 mm post

Magic Arm

For optimum illumination in technical imaging applications it is often necessary, to attach an illumination device off the camera stand.

The **Magic Arm** with magnetic holder allows an individual positioning of light illumination devices or also lightweight cameras on all magnetic surfaces without any additional mounting materials or tools. The fully movable arm can be fixed in any position and allows an illumination or a camera recording from any angle to the test object. The strong permanent magnet can be (de)activated by a switch and detached from the subsoil without effort, e.g. to change the position.



Quick mounting plate for cameras





Features

- holds on all magnetic surfaces
- the arm can be fixed in any position
- easy removal of the magnetic base without effort

Load-capacity	up to 3 kg
Arm length	53 cm
Weight	2200 g
Material	Aluminum
Pipe diameter	20 mm
Mount	permanent magnet with 800 N retention force



Super clamp

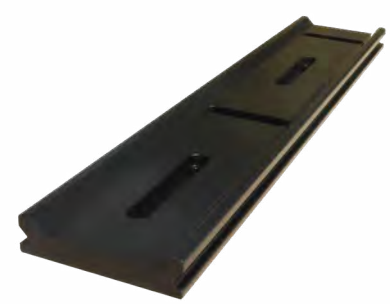
- SuperClamp for alternative attachment to a table edge

Part number	Description
1103330	Magic arm with magnetic holder and super clamp
1001906	Magic arm with quick mounting plate
1009106	Magic arm with mounting rail for camera and lights
1103336	Magic arm with quick connection plate and super clamp
1008263	Slider for X48 rail to mount 101906 & 109106
1005378	Screw 3/8“ 16 UNCx3/4“ to lock slider with the magic arm

Rails & Mounts

For the use of a **StrainMaster** system you can choose between a portable construction, mounted on a tripod or a fixed installation. The following table provides an overview of mounting elements and expansion options. Further mounting material and customer-specific lengths of the rails on request are possible!

We would also be happy to configure an individual mounting device for your needs.



X95 flat rail



X95 X-shaped rail



X95 slider



Gearhead (10 kg) on flat rail

Part number	Description
1009447	Mounting plate for X95 flat rail or X95 slider backside down on a tripod
1001474	X95 slider for use with 1009447
1001516	X95 slider, 50 mm width
1001517	X95 slider, 80 mm width
1001456	X95 flat rail, 750 mm length
1001457	X95 flat rail, 1000 mm length
1001468	X95 X-shaped rail, 1000 mm length
1001470	X95 X-shaped rail, 2000 mm length
1108251	Gearhead, 10 kg
1003955	Thread adapter 1/4“ IG - 3/8“ to mount a StrainMaster Compact head onto a gearhead
1108193	Heavy mount & rail for cameras up to 10 kg weight
1108221	Mount & rail for heavy high-speed cameras like FASTCAM or Phantom
1011833	Mounting plate to mount a Device Control Unit onto a X95 slider

additional mechanical components available on request

StrainMaster Portable Mechanics

The current **StrainMaster Portable** hardware for our full field strain and deformation measurement systems offers unparalleled flexibility and excellent stability in an extremely compact package.



Improvements

Improvements over existing DIC mounting concepts include:

- easily switch between standard test configurations and challenging locations
- lightweight frame system contained in one carry case
- suitable for low-speed and high-speed cameras
- modular design allowing modifications and upgrades





Advantages

The custom designed system addresses common problems encountered with DIC setups:
supports for camera cables to avoid cable damage, and cable weight
causing small (but critical) camera movement deviations
quick and easy to setup and reconfigure (vertical, long reach, large separation)
frame is mountable on a tripod or direct onto a test machine (with the suitable adaptors)
the controller is located on the rail, reducing cable lengths, increasing ease of movement
and meaning minimal cabling between system location and PC
the new controller is ultra-compact and includes all power supplies and synchronizer

Standard 2D StrainMaster

Standard 2D StrainMaster mounting system includes:

- heavy duty tripod for maximum stability
- 1m lightweight horizontal rail
- 1x camera gearhead on sliding mount
- 1x LED gearhead on sliding mount

Upgrade to standard 3D StrainMaster

Standard 3D StrainMaster mounting system includes 2D system as above plus:

- additional 1x camera gearhead on sliding mount
- additional 1x LED gearhead on sliding mount

Optional mounting kit

- additional rails for long reach applications
- longer rails for larger camera separation
- test machine mounting systems
- adaptor for vertical orientation

The standard system will be suitable for most applications, but LaVision is equally happy to adapt this and design the most complex systems for challenging or unusual environments.

Part number	Description
1103317	Tripod, 1 m rail, mounts for 1 camera & 2 LED devices
1103318	Tripod, 1 m rail, mounts for 2 cameras & 2 LED devices
1103319	1 extra camera mount with slider for X48 rail
1103331	1 gearhead on slider for heavy cameras for X48 rail
1103325	X48 x shaped rail, 1000 mm length, with slider, for “T-shape” extension of 1103317/ 1103318
1103335	X48 x shaped rail, 2000 mm length, without weight reductional core drilling
1008263	X48 slider, 50 mm width, center drill for ball-head
1007721	X48 slider, 80 mm width
1002298	Tripod without rail-holder or camera gearhead

High-Speed Camera Stand

Digital Image Correlation (DIC) utilizing high-speed cameras requires a suitably rigid and stable mechanical setup. With their typically large size and weight, standard tripod-rail arrangements are not sufficient, and therefore a different solution is required to avoid unnecessary movement and vibration. For static configurations, or situations where the system is mainly located in one lab, LaVision normally recommends a mounting frame configured to your needs. However in cases where the system has to move around frequently, a more easily transportable camera stand is desirable. For this reason LaVision has designed the **StrainMaster High-Speed Stand**.





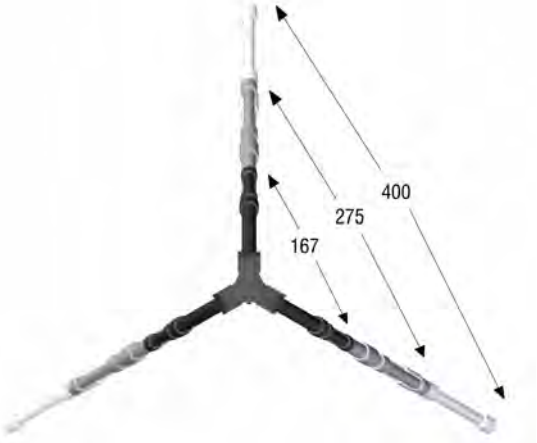
Slider to mount an X95 profile onto a tripod

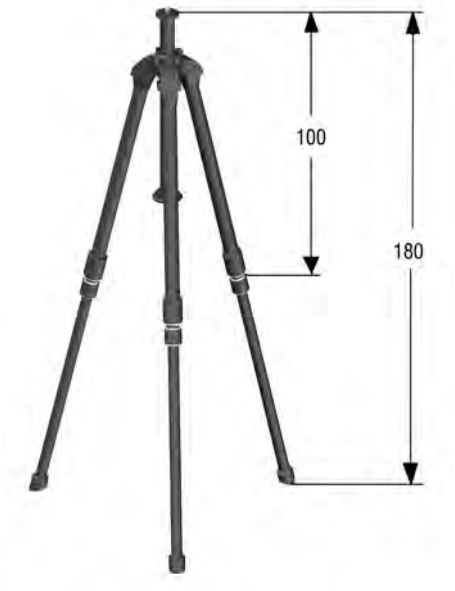
The stand consists of two heavy duty tripods connected via a substantial rail. This connection ensures that the cameras remain rigidly fixed relative to each other. This is an important condition in order to utilize the DIC technique. The camera stand is designed to carry two of our largest and heaviest high-speed cameras. In addition, other components such as lighting units can also be attached to the rail. For optimum alignment, the cameras are mounted on 3D heavy duty gearheads with three built-in level indicators for horizontal and vertical positioning. The set-up of the camera stand happens in a few minutes and does not require any tools.



Dimensions







all dimensions shown in cm

The tripod legs can be extended and spread to a wide angle if required. This allows a working practical height between min. 45 cm up to 180 cm (although the tripod can be extended to a working height of 230 cm, LaVision advises against this for stability reasons).

Specifications

Rail length	250 cm
Total weight	33 kg
Maximum load	40 kg
Working height	45 – 180 cm

Max. foot distance with extended telescopic tube [cm]	Min. height [cm]	Typical foot distance with extended telescopic tube [cm]	Max. height [cm]
167	45	85	100
275	70	130	180
400	95	185	230

☐ Not recommended to use the max. possible extension



Part number	Description
1103349	Mounting system for two high-speed cameras with 2 tripods, 2 heavy gearheads, 1 rail with length of 2500 mm

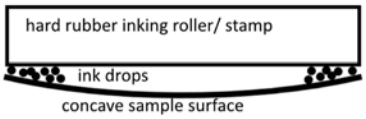
Cable Extensions & Adapters

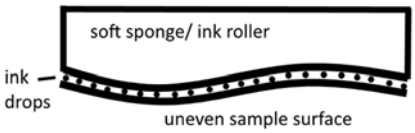
Do you need a cable extension to install a camera or lighting device at a greater distance from the control unit / control PC? The table below shows the cable required. Other lengths or connectors are available on request!

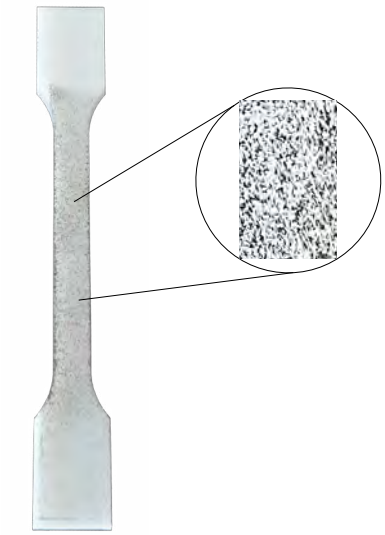
Cable extension for Imager M-lite, Imager CS, Imager X-lite & Imager MX 4M cameras, A/D-converter and LED devices

Part number	Description
1009008	USB3.0 power & data cable for M-lite, MicroB screwlock/A, 3 m
1009886	USB3.0 power & data cable for M-lite, MicroB screwlock/A, 5 m
1011749	Camera trigger (only) cable for DCU X to Imager M-lite, 5 m
1010025	Camera trigger (only) cable BNC (PTU X side) to Imager M-lite, 5 m
1008903	Camera trigger (only) adapter plug Hirose (DCU X side) to BNC, 0.2 m
1103321	Camera trigger & power cable DCU X to Imager X-lite, 3 m
1008693	Camera trigger & power extension cable for Imager X-lite, 3 m
1008820	Camera trigger & power cable DCU X to Imager MX 4M, 1.2 m
1008935	Camera trigger & power cable DCU X to Imager MX 4M, 5 m
1108089	A/D-converter cable adapter NI, 3 CH IN, 2 digital CH OUT for use with DCU X and 1.25 MHz PCIe ADC
1006656	A/D-converter cable adapter, NI PCIE 6320, 8 channel for use with PTU X
1008933	LED trigger & power adapter plug M12 (DCU X side) to BNC, 0.25 m
1103320	LED trigger & power extension cable M12, 2 pieces, for use with LED device 1103333/34/40/48, 3 m
1008820	Trigger cable for Imager MX 4M camera, 1.2 m
1008935	Trigger cable Imager MX 4M camera, 5 m
1009859	Trigger cable Imager M-lite camera, 1.2 m, for DCU X, not for 1101507 M-lite 5M version 2
1103351	Cable set for 1 M-lite camera + 2 LED lights, 5 m, for DCU X, not for 1101507 M-lite 5M version 2
1103352	Cable set for 2 M-lite cameras + 2 LED lights, 5 m, for DCU X, not for 1101507 M-lite 5M version 2
1005281	Hand trigger with BNC port, 9 V batterie driven
1101455	CoaxPress framegrabber for use with max. 4 Imager CS cameras
1104405	DCU 11 high-speed upgrade
1015060	Cable adapter to double camera ports, 1 x Hirose to 2 x BNC
1014767	Adapter high-speed camera DCU 11, set of 2 cable
1014766	High-speed camera extension cable for DCU 11, 1 cable, 5m
1015072	Trigger cable all Imager M-lite cameras, 5m, for DCU X and DCU 11
1014946	Cable adapter for use with external A/D-converter
1013928	Trigger cable Imager CS, 1 cable, 10m

Speckle Pattern Toolkit









Digital Image Correlation matches the surface pattern on specimens subjected to deformation processes between successive acquired images. If there is no sufficiently identifiable natural pattern on the surface of the specimen, an artificial pattern must be applied. Spray paints are often used in such cases, but a disadvantage these is the solvents present which can degrade the specimen surface. Additionally, a fume cupboard may be required to extract the odours, or one may have to apply the speckle pattern outdoors. Utilizing stamps or rollers are other methods use, however classic stamp paints do not adhere to plastic or metal surfaces. Also, on uneven surfaces, hard rubber stamps are difficult to use because they do not conform to the surface shapes.

The **StrainMaster Speckle Pattern Toolkit** is an easy-to-use alternative to spray cans and conventional stamps.



A special foam roller allows the application of a particularly fine speckle pattern similar to that provided by aerosol paints. On larger areas patterns can be produced with the porous, soft rubber sponge. Multiple applications of the sponge to the specimen surface increases the density of the speckle pattern.

The paint used for the **StrainMaster Speckle Pattern Toolkit** is water-based with additives that ensure it adheres to plastic and metal surfaces. The paint is completely non-toxic and easily cleaned from the surface with soap and water!

The tool kit includes the foam roller for fine patterns, a hand roller, the porous sponge for coarse patterns and an extra-large stamp pad. The paint can be ordered separately depending on the application. We currently offer white, black and green-fluorescent paint, but others may be available upon request. The roller and sponge can be cleaned with water and soap for re-use.

Part number	Description
1103350	Speckle pattern toolkit; includes 1 x handle, 2 x foam roller 1 x sponge, 1 x extra-large ink pad, all stored in a case; paint to be ordered separately depending on the application
1010933	White paint to apply speckle pattern; bottle with 150 ml
1010934	Black paint to apply speckle pattern; bottle with 150 ml
1011149	Green-fluorescent paint to apply speckle pattern; bottle with 150 ml
1010932	Porous sponge for creating coarse speckle patterns (spare part); 10 cm x 5 cm x 15 cm
1010936	Super fine foam roller for creating fine speckle pattern (spare part); 3.3 cm x 5 cm
1010935	Extra-large ink pad (spare part); 240 mm x 120 mm
1012056	Orange-fluorescent paint to apply speckle pattern, bottle with 150 ml

StrainMaster Airbrush Kit

Surface patterns on the specimen are essential for digital image correlation (DIC). If there are no sufficiently recognizable natural patterns on the specimen surface or if the surface is highly reflective, it is recommended to use artificial patterns, e.g. by spraying paint. One way to apply artificial patterns to the sample is to use an airbrush system. The **Airbrush Kit** that LaVision offers consists of a powerful compressor, two airbrush guns for the application of fine to medium patterns and a wide range of accessories.



Specifications

Nozzle size	0.2, 0.3, 0.35, 0.5 mm
Paint reservoir	7/ 10 ml, gravity feed cup
	5/ 22 ml inflow via suction
Trigger action	double action
Trigger tension	adjustable
Operating pressure	1 bis 3.4 bar



The **Airbrush Kit** uses a powerful, quiet and oil-free working compressor with a 3 liter air pressure tank. The compressor runs according to the demand of the air tank based on the automatic pressure control of the air tank.

Flow rate	20 - 23 l/m
Max. pressure	6 bar
Motor performance	150 Watt
Operating noise	47 dB (A)
Outlet (male)	1 x 1/8“
Braided hose (included)	3.0 m, 1/8“
Weight	5.4 kg
Dimensions (W x D x H)	130 x 310 x 310 mm



Attention!
The **Airbrush Kit** does not contain any paints, as these depends on your DIC application!

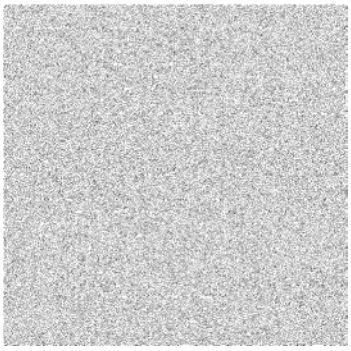
The paints recommended by LaVision are water-based with additives that ensure adhesion to plastic and metal surfaces. The paints are non-toxic. Non-permanent paints can be easily removed from the surface with soap and water.

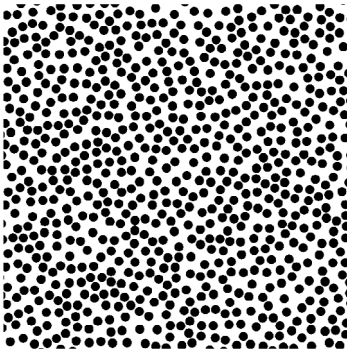
Ordering information

Part number	Description
1103353*	Airbrush kit with 2 airbrush guns, 230 V
1014518	Permanent orange fluorescent airbrush paint, water based, bottle with 60 ml
1014500	Non-permanent black airbrush paint, water based, bottle with 100 ml
1014501	Non-permanent white airbrush-paint, water based, bottle with 100 ml
1014745	Permanent black airbrush paint, water based, bottle with 60 ml
1014746	Permanent white airbrush-paint, water based, bottle with 60 ml

* Factory setting: gun type 116 equipped with 0.3 mm nozzle, gun type 128 equipped with 0.35 mm nozzle

Digital Speckle Pattern Generator





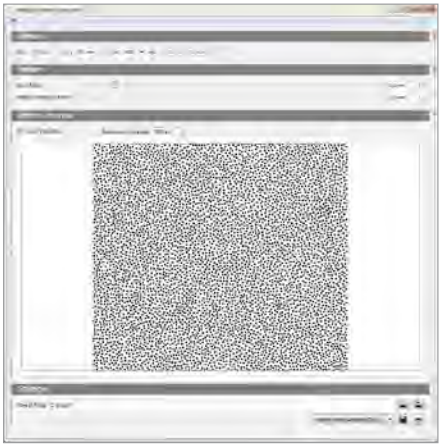
LaVision recognizes the importance of providing high quality data, and therefore strives to provide tools which allow users to check the quality of their data. Various environmental factors can influence the quality of a digital image correlation (DIC) setup such as varying lighting conditions, motion blur, air currents, or simply a dirty camera lens. Knowing the influence of such external factors on the quality of the evaluation is extremely important.

One method to assess the quality of the setup is via a rigid-body (0-strain) test, as described e.g. In the German VDI standard 2626. In this test, a flat plate with a speckle pattern is moved through the focal depth of the measurement volume. The recorded images are then evaluated using digital image correlation (DIC).

Since the plate remains rigid during this test, the resultant calculated strain should theoretically be zero. In reality, the influences described above will introduce small uncertainties. It is the responsibility of the user to determine whether the system uncertainties are acceptable for their particular requirements, or whether their setup needs to be modified to reduce the uncertainty level.

The **Random Pattern Generator** from LaVision allows you to easily generate artificial speckle patterns for a rigid body (0-strain) test.





1. In the program, specify the size of the graphic you wish to generate.
2. Use the sliders to set the dot size and spacing of the pattern. You will immediately see the results in a preview.
3. Print the pattern directly from the application or save as a PDF, bitmap, or vector graphic.

The **Random Pattern Generator** is available free of charge in the download area on the LaVision homepage: www.lavision.com.

Analog Data Recording

LaVision's DaVis software supports a selection of National Instruments® **A/D-Converters**, which are well known to give outstanding performance. The USB version allows using an **A/D-Converter** also with mobile equipment, such as the **StrainMaster** Portable or other laptop PC based imaging systems. All **A/D-Converters** are synchronized to the measurement by timing control through LaVision's unique trigger devices PTU or HSC.

Specifications



ADC-1250-PCIe

The ADC-1250-PCIe is the ideal solution for fast sampling tasks (like engine applications) with up to 1.25 MHz sampling rate at 16 bit resolution. With the PCI express (PCIe) form factor it fits into all modern PCs.

PC connector	PCIe
No. of analog input channels	8 differential
Max sampling rate	1.25 MHz (single channel) and 1MHz (multi channel, shared over the channels used)
Resolution	16 bit
Input ranges	±10 V down to ±0.2 V
Connectors	BNC, 3 x IN/2 x OUT and 8 x IN optional: NI connector block and NI cable

Specifications



ADC-1250-USB

The ADC-1250-USB is connected through a USB port and therefore the best choice for mobile applications. A sampling rate up to 1.25 MHz and 16 bit resolution opens a wide range of applications, especially in the field of engine measurements.

PC connector	USB 2.0
No. of analog input channels	8 differential
Max sampling rate	1.25 MHz (single channel) and 1 MHz (multi channel, shared over the channels used)
Resolution	16 bit
Input ranges	±10 V down to ±0.2 V
Connectors	threaded terminals, shipped with 3 x BNC connectors

Specifications



ADC-250-PCIe

The ADC-250-PCIe is the cost effective choice for all standard applications where 250 kHz total sampling rate is sufficient. With the PCI express (PCIe) form factor it fits into all modern PCs. For use of the optional Live Extensometervoltage output, you have to use the article #1107320.

PC connector	PCIe
No. of analog input channels	8 differential
Max sampling rate	250 kHz (shared over the channels used)
Resolution	16 bit
Input ranges	±10 V down to ±0.2 V
Connectors	BNC, 3 x IN/2 x OUT and 8 x IN optional: NI connector block and NI cable

Specifications



ADC-250-USB

The ADC-250-USB is connected through a USB port and therefore the best choice for mobile applications. With 250 kHz total sampling rate and 16 bit resolution it meets most standard requirements. Note that it is not possible to upgrade the 250 kHz ADCs with the optional Live Extensometer voltage output. Should you require this you must choose either the DCU 11 with 250 Hz ADC #1107320 or one of the 1.25 MHz ADCs.

PC connector	USB 2.0
No. of analog input channels	8 single-ended
Max sampling rate	250 kHz (shared over the channels used)
Resolution	16 bit
Input ranges	±10 V down to ±0.2 V
Connectors	BNC, 3 x IN and 8 x IN optional: NI connector block and NI cable

Part number	Description
1107320	ADC-250-PCIe, 8 channel ADC, 250 kHz, 16 bit PCIe with BNC-connectors BNC, 3 x IN/2 x OUT and 8 x IN
1108084	ADC-250-USB, 8 channel ADC, 250 kHz 16 bit, USB with BNC-connectors BNC, 3 x IN and 8 x IN
1108086	ADC-1250-USB, 8 channel ADC, 1.25 MHz, 16 bit, USB, threaded terminals, shipped with BNC-connectors BNC, 3 x IN/2 x OUT and 8 x IN
1108087	ADC-1250-PCIe, 8 channel ADC, 1.25 MHz, 16 bit, PCIe with BNC-connectors BNC, 3 x IN/2 x OUT and 8 x IN

DCU 11

The **Device Control Unit** (**DCU**) **11** is the central controller for every **StrainMaster** system from LaVision. It is responsible for the camera synchronization and takes over the communication with the other peripherals. For this purpose, it is equipped with all the connections necessary for the operation of a 2D or stereo camera system, including three channels for the acquisition of analog data from a connected test device and the voltage supply for two **StrainMaster LED 35** lights.



Features

- multiple device control
- fully synchronized recording
- supports low-speed recording
- power support for **StrainMaster LED 35** lights #1103520, #1103521
- camera recording frequency changeable with external trigger during image acquisition
- trigger-output for external devices (e.g. cameras, lights)
- external start triggers for recording sequence or individual image acquisition
- **DaVis** software on-board (option)
- in-system firmware update
- three AD/C channels to collect analog data from test devices (with optional A/D-converter)

Part number	Description
1104401	DCU 11; basic device for use with 2 cameras, English OS
1104400	DCU 11; basic device for use with 2 cameras, German OS
1101455	CoaxPress framegrabber for use with max. 4 Imager CS cameras
1107320	A/D converter 250 kHz, PCIe
1108084	A/D converter 250 kHz, USB
1108087	ADC-1250-PCIe, 8 channel ADC, 1.25 MHz, 16 bit, PCIe with BNC-connectors BNC, 3 x IN/2 x OUT and 8 x IN
1108089	D/A external output for DCU X
1104405	DCU 11 high-speed upgrade
1104212	Remote laptop **e**; instead of use monitor/ keyboard, mouse
1104213	Remote laptop **d**; instead of use monitor/ keyboard, mouse
1104407	Mon., keyboard **e**, mouse; instead of using a remote laptop
1104406	Mon., keyboard **d**, mouse; instead of using a remote laptop
1006656	Adapter for A/D converter, 8 channel in
1010710	GigE Card with 4 ports
1014946	Cable adapter for use with external A/D-converter
1015060	Cable adapter to double camera ports, 1 x Hirose to 2 x BNC
1014766	Hirose extention cable 1:1 for DCU 11, 5 m
1015215	Travel case for DCU 11

Specifications

Connection ports	4 x USB3 1 x GigE 3 x analog input (with optional A/D-converter) 1 x trigger-in 1 x manual trigger-in 1x start 1 x trigger-out 2 x camera trigger 1 x HDMI output 2 x LED trigger &power
Internal clock	100 MHz
Output drivers	50 Ω
Time resolution	10 ns
Storage	1 x 500 GB SSD, 1 x 2 TB SSD M.2
RAM	16 GB
Operating system	Windows 10
Power	110 – 230 VAC
Compliance	CE
Dimensions	267 x 426 x 210.5 mm (W x D x H)
Weight	8 kg

Specifications

Electrical characteristics of DCU 11 lines

Output drivers

- 3 software controlled I/O lines
- impedance 50 Ohm drivers
- max. output current 100 mA
- output voltage TTL level typically 0-5 V, (low < 0.4 V, high >2.4 V)
- protection short circuit safe

Inputs

- number of 3 analog channels (with optional A/D-converter; 8 channels optional)
- input range -10-10 V
- trigger level TLL, low=0-0.8 V, high=2.0-5.0 V
- compliance electrostatic discharge (ESD) protection

Analog Out

- output calculated values to an analog voltage out (with optional A/D-converter)
- this can be used to monitor values like strain gauge extension in testing machines
- 2 analog out channels (with optional A/D-converter)
- output range 0-10 V
- output impedance 200 Ω
- resolution 12 bit
- settle time 10 µs
- noise 2.5 mV

PTU X

Its very successful predecessor PTU 9/HighSpeed Controllers (HSC) marked a milestone in managing complex trigger schemes with multiple devices under challenging conditions, like unevenly running engines or shock tubes.
With **PTU X** LaVision takes the next leap in comprehensive triggering. The new concept integrates the advances of the former PTU 9 with HighSpeed Controllers (HSC) in a single device.
Modern PC interfaces like PCIe and USB improve connectivity to state of the art levels.
Improved input and output drivers simplify the use under harsh electrical environments such as engine test beds and turbines with large dynamometers. Software selectable input impedance switches (50 Ohm, High-Z) and low pass filters (1MHz) improve noise resistance without changing the cabeling.



Features

- fully synchronized recording
- multiple device control
- phase locked trigger
- user defined triggers
- device delay control
- Graphical Connector Interface (GCI)
- in-system firmware updates
- different frequency strategies
- multi exposure
- engine synchronization (upgrade)
- flexible independent reference times (upgrade)

Part number	Description
1108090	PTU X basic, internal
1108091	PTU X basic, USB external
1108092	PTU X standard, internal
1108093	PTU X standard, USB external

PTU X High-Speed

The **PTU X High-Speed**, an upgrade of the **PTU X**, is programmed according to the requirements of all connected devices. This guarantees that all devices like lasers and cameras are prepared and ready to start at the time of the experiment triggers.

Features

- Programmable Parameter Recording (PPR) (upgrade)
- fully synchronized recording
- multiple device control
- phase locked trigger
- user defined triggers
- device delay control
- Graphical Connector Interface (GCI)
- in-system firmware updates
- free choice of image rates
- easy cabeling
- dedicated status outputs
- engine synchronization (upgrade)
- Hypersampling (upgrade)

Specifications

PTU X High-Speed version	Basic	Standard
Output drivers	TTL, 50 Ohm	
Time resolution	10 ns	
Typical jitter between all outputs	< 1 ns	
Trigger source	internal generator, external TTL input, phase locked rec. start	internal generator, external TTL input, phase locked rec. start
Device	1 HS camera + 1 HS IRO, 1 gated, triggered or continuous light source, 1 HS user trigger	multiple HS cameras, A/D-converter, IRO, E-Monitor, laser, PPR upgrade (optional), Rotary decoder upgrade (optional), Hypersampling upgrade (optional)
Version	USB/ PCIe	
Jitter to asynchronous external signals	+/- 5 ns	

depending on the camera model, additional devices might be required.

Part number	Description
1108262	Rotary decoder upgrade
1108098	Reference time upgrade 1 to 8
1108100	High-speed upgrade
1108261	Programmable Parameter Recording upgrade
1108260	Hypersampling upgrade, requires ADC (1108086 or 1108087)
1015318	Extension cable for laser or camera port, 5 m
1015319	Extension cable for laser or camera port, 20 m

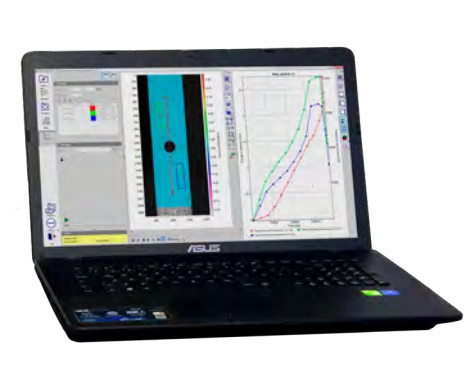
Laptop for Remote Control

In mobile operation, the Device Control Unit 11 (DCU 11) can be controlled via a remote-coupled laptop. This is particularly convenient if the user cannot work directly next to the **StrainMaster** system for space or safety reasons and must operate the system from a distance.

The laptop takes the function of monitor and keyboard.

The laptop is not suitable for controlling the **StrainMaster** system or for performing evaluations with the **DaVis** software. These tasks are performed by the DCU 11.

Specifications



The **StrainMaster** Portable laptop consists of:

- Terra NB Mobile 1515
- Intel© Core i5-7200U processor (3M cache, up to 10 GHz)
- Microsoft© Windows 10 Pro x64
- 39.6 cm (15.6“) 1920 x 1080 display full HD
- 4 GB DDR4 RAM (1 socket free)
- 240 GB SSD SATA
- DVD-RW
- Intel© HD Graphics 620
- bluetooth, WLAN, LAN, HDMI, VGA
- 1 x USB 3.0 Type C, 1 x USB 3.0, 2 x USB 2.0
- 24 months warranty



Part number	Description
1104212	Remote-laptop for DCU 11, U.K. English
1104213	Remote-laptop for DCU 11, German

Desktop-PC for Stationary Use

A desktop PC individually configured to the user's requirements offers an alternative to using a Device Control Unit X.

Especially for very demanding applications, such as high-speed tests with very large amounts of image data, it is recommended to use a powerful PC.

All necessary components, such as:

- (high-speed) Programmable Timing Unit X
- analog to digital-converter
- fast camera connections, e.g. USB3 vision or CamLink

are installed as plug-in cards.

The PC working memory and the required storage media for the recorded data are configured according to customer requirements.

Specifications



The basic configuration consists of:

- Tower-Silentmaxx ST-360, 43.1cm (H) x 52cm (D) x 22.5cm (W)
- power supply FSP AURUM PT SERIES PT-850FM
- mainboard C7X99-OCE
- 1 x Intel© Xeon E5-1620V4 3,5GHZ LGA2011 10 MB Cache
- 1 x Heat Sink active
- 4 x 16 GB (64 GB) 2400 MHz DDR4 CL17
- graphic card 2 GB NVIDIA Quadro K420
- SAMSUNG© 850 Pro Series 512GB SSD SATA3 (6Gb/s) as boot-device
- hard disc 2TB 7200 rpm SATA 6 GB/s NCQ 64 MB
- 5 1/4" SATA DVD RW LG
- LOGITECH© RX250 optical mouse USB
- USB 3.0 card, PCIe, 4x, Fresco FL1100
- CHERRY Strait keyboard JK-0340 black
- Microsoft© Windows 10 professional 64 bit DVD

Note: supports up to 64 GB RAM



Slots

6x PCI-E slots total:

1 PCI-E 3.0 x16
3 PCI-E 3.0 x8 (in x16),
2 PCI-E 2.0 x1 (in x4)

Part number	Description
1104270	Desktop PC, German, 64 GB RAM, 1TB SSD, 2 TB HDD, with monitor
1104271	Desktop PC, English, 64 GB RAM, 1TB SSD, 2 TB HDD with monitor
1104272	Desktop PC, German, 64 GB RAM, 1TB SSD, 2 TB HDD without monitor
1104273	Desktop PC, English, 64 GB RAM, 1TB SSD, 2 TB HDD without monitor
1009823	4 x USB 3 card, PCIe for use with USB cameras, like Imager M-lite
1108215	GigE card
1011599	PC-card for SMC trigger and power connection
1009823	FL 1100 USB 3.0 card, 4 ports

LaVision

FOCUS ON IMAGING

LaVisionUK Ltd
2 Minton Place / Victoria Road
Bicester, Oxon, OX26 6QB / UK
www.lavisionuk.com
Email: sales@lavision.com
Tel.: +44-(0)-870-997-6532
Fax: +44-(0)-870-762-6252

LaVision GmbH
Anna-Vandenhoeck-Ring 19
D-37081 Göttingen, Germany
www.lavision.com
Email: sales@lavision.com
Tel.: +49(0)551-9004-0
Fax: +49(0)551-9004-100

LaVision, Inc.
211 W. Michigan Ave., Suite 100
Ypsilanti, MI 48197, USA
www.lavisioninc.com
Email: sales@lavisioninc.com
Phone: +1(0)734-485-0913
Fax: +1(0)240-465-4306

10/25