新特光电
Sintec Optronics

16 mm lens with integrated EL-3-10

Test report of ELM-16-5.6-9-S

Summary

- Versatile, affordable focusing solution for sensors up to 1/1.7”
- High resolution for 2.4 um pixels:
  - Close to Nyquist resolution of 193-208 lp/mm in the center and edges over large working distance ranges
  - Great Polychromatic performance: no difference between blue and white light
  - Field Curvature appears only slightly at the corners, but can easily be corrected by re-focusing
- Angular Field of View [°]

AFOV Type \ WD	800 mm	500 mm	300 mm	150 mm
Width	25.9	26.8	25.2	27.9
Height	17.5	18.0	16.9	18.8
Diagonal	31.0	31.9	30.1	33.2

WD [mm]	HFOV [mm]
800	369
500	238
300	134
150	74

- Works for S-mount cameras & C-mount cameras with adapter

Optimized performance based on your application

- Depending on the desired application, the zero-current working distance can be optimized by changing the flange focal distance (by screwing/unscrewing the C-to-S-Mount adapter)
- This way, field curvature effects can be greatly reduced so that performance is good and uniform from center to corner (with only minimal refocus needed at the corners)

Examples

- «**Macro-like**» case: set the zero-current WD to 225 mm (middle of 150-300 mm range)

WD	Resolution (lp/mm)		
	Center	Edge	Corner
150 mm	203	203	161*
300 mm	203	193	175

- «**Long-range**» case: set the zero-current WD to 650 mm (middle of 500-800 mm range)

WD	Resolution (lp/mm)		
	Center	Edge	Corner
500 mm	208	208	208*
800 mm	203	203	203*

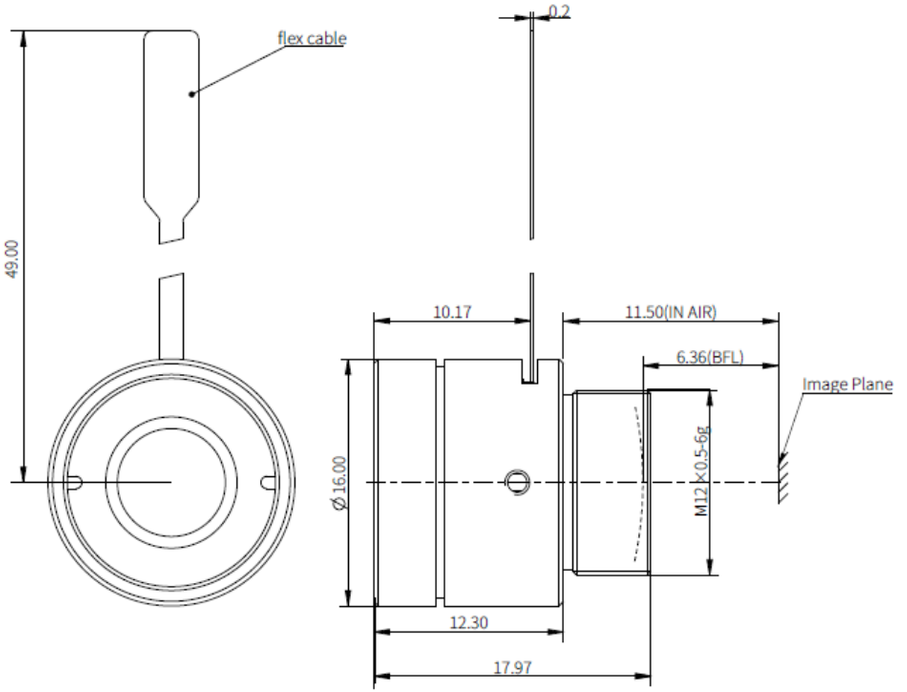
*Slight refocus needed to compensate for field curvature

ELM-16-5.6-9-S Datasheet

Specifications

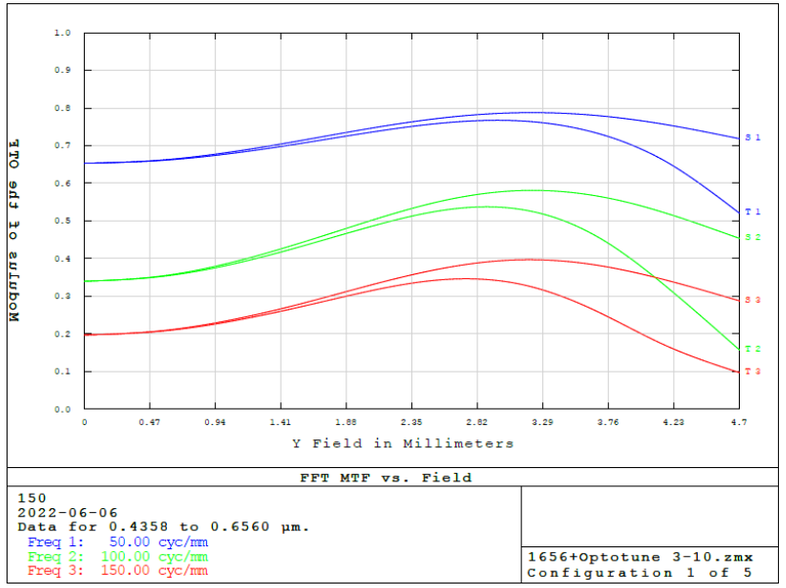
Effective focal length (mm)		16
Sensor ø(mm)		9.4(1/1.7")
F NO.		F5.6
FOV Angle	Diagonal (9.25 mm)	31.78°
	Horizontal (7.4 mm)	25.54°
	Vertical (5.5 mm)	19.06°
Wavelength range (nm)		435～656
Relative illumination		>83%
Working distance (mm)		150～∞
Working distance without current (mm)		300
Distortion (at WD 300)		<1.21%
Max chief ray angle		<5.5°
Flange focal distance (mm)		11.50
Back focal length (mm)		6.36
Mount		M12×0.5-6g
Connector type		FPC(2 pins)
Size (mm)		ø16×12.3
Total track length (Liquid Lens included) (mm)		23.8
Focus tunable lens specifications		EL-3-10-VIS-26D-FPC
Focal power range at 20°C (dpt)		-13～+13
Wavefront error at 525 nm (vertical/horizontal) (λRMS)		<0.2 / <0.2
Working temperature		-20℃～+65℃
Storage temperature		-50℃～+85℃
Temperature compensation		No

Mechanical drawings

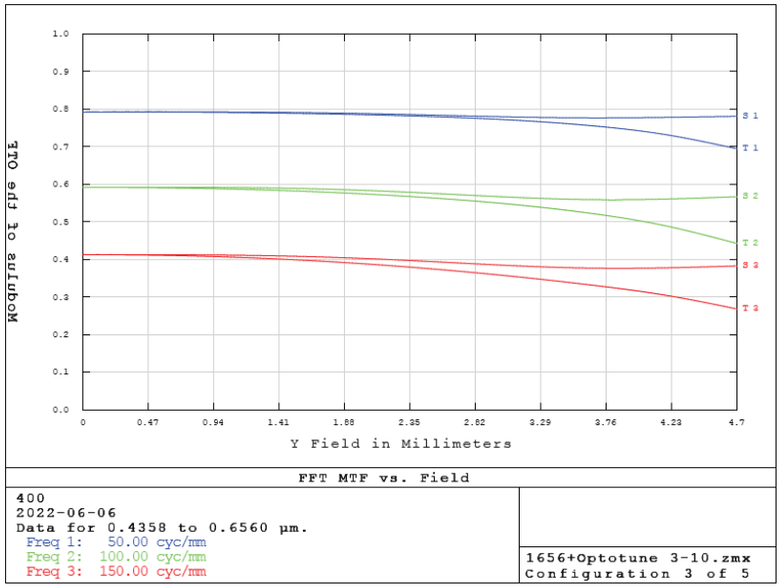


Good nominal MTF values at different working distances

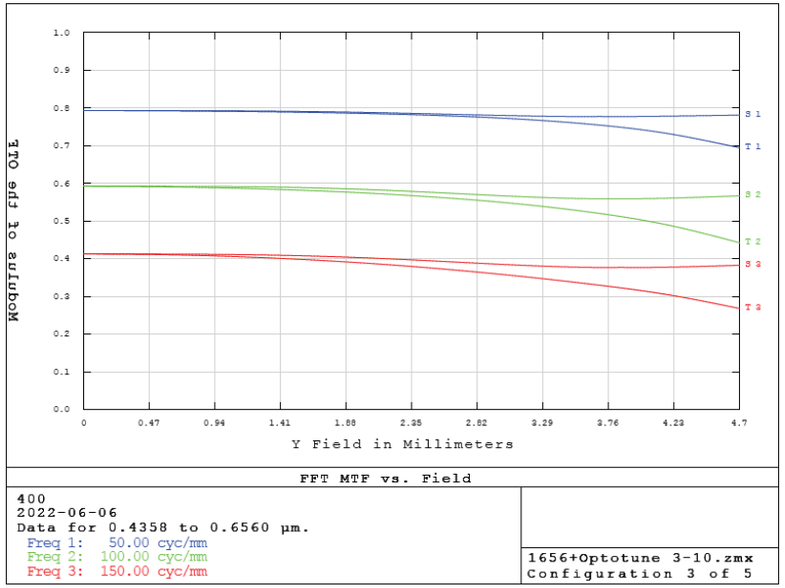
180mm



300mm
(WD with best nominal performance)



500mm



Field of view with 1/1.8” sensor

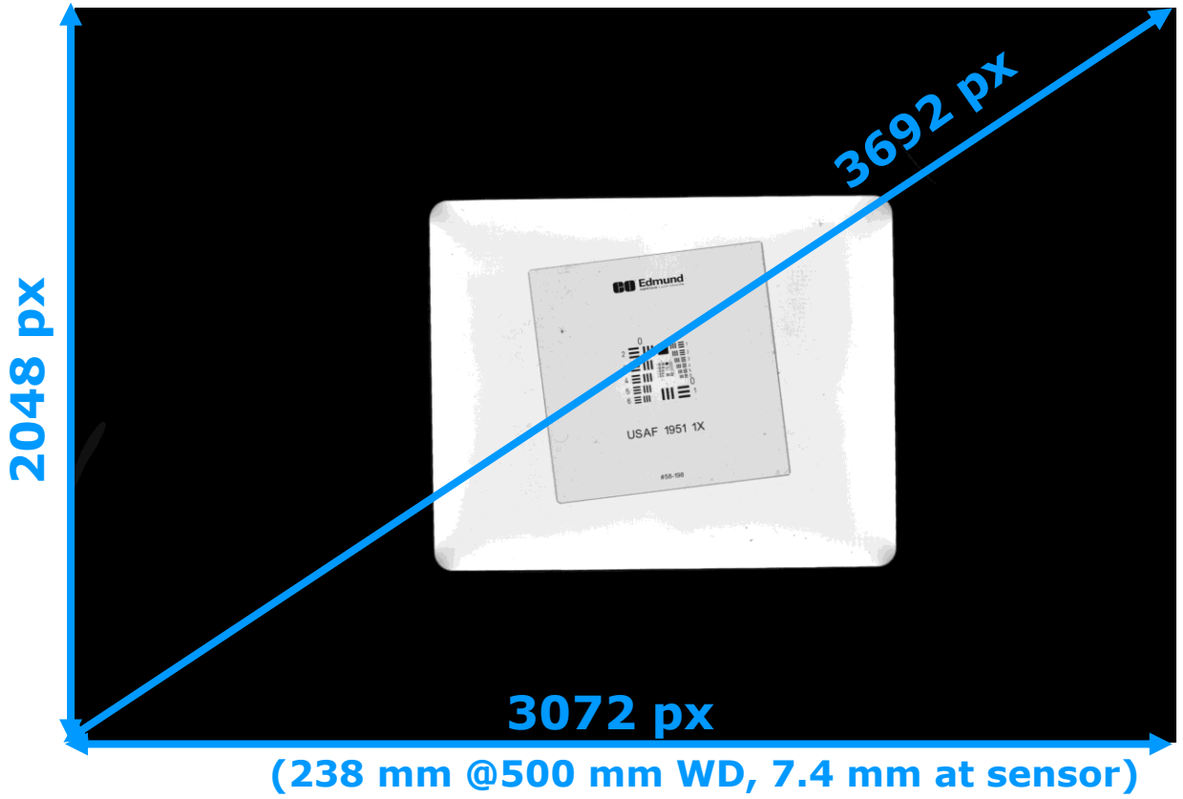
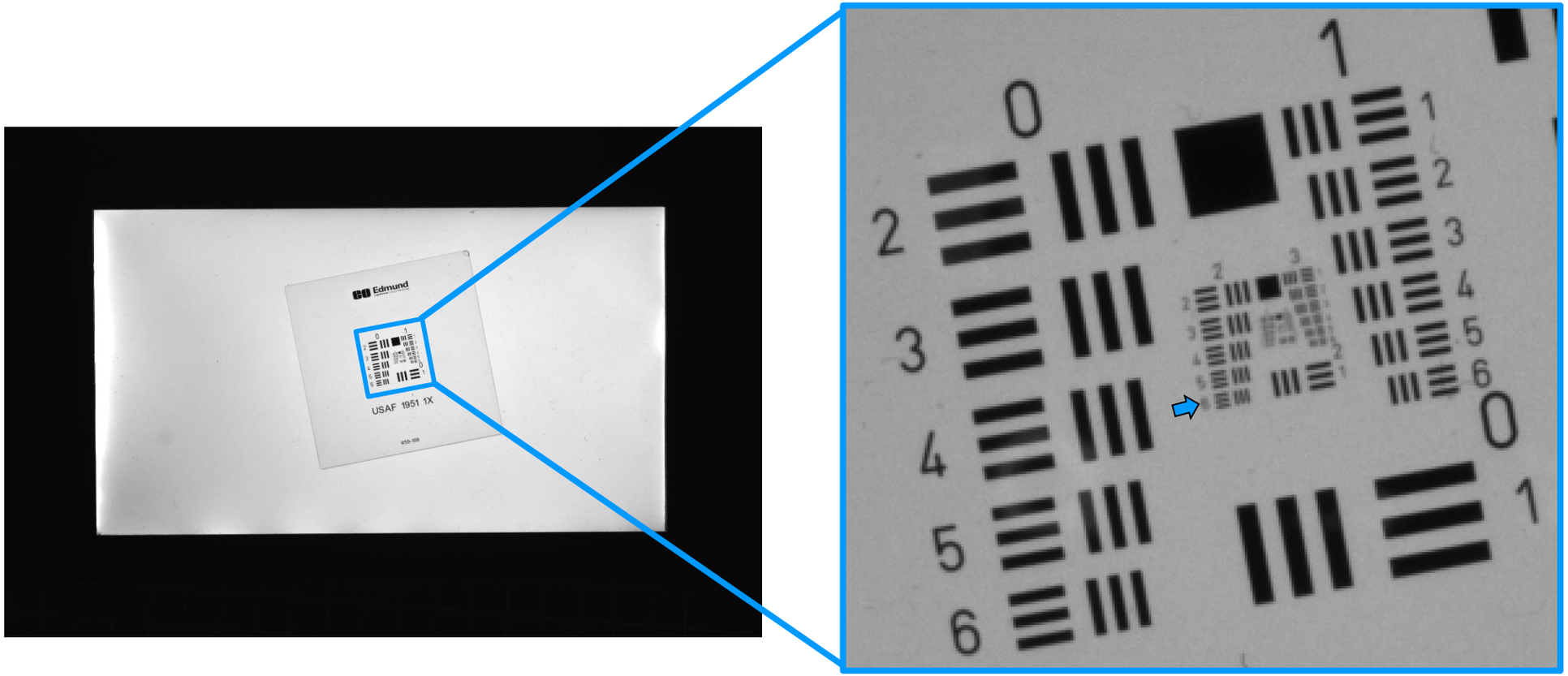


Image size (2.4 um px):

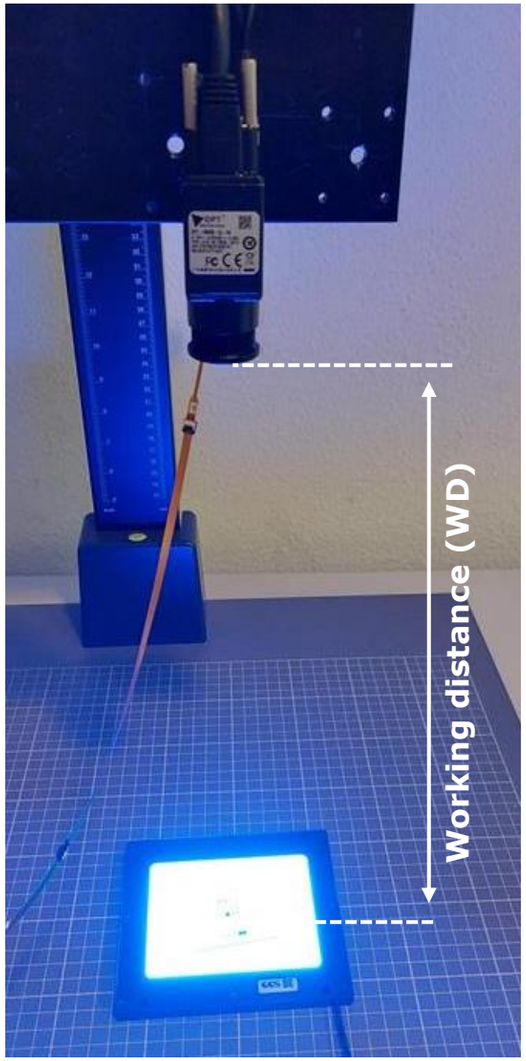
- Width = 7.37 mm
- Height = 4.9 mm
- Diagonal = 8.86 mm

Method for image evaluation

- After acquisition, images are zoomed in to show resolution limited element



Test setup



Camera:	OPT-CM600-GL-0402 1/1.8“, 3072 x 2048 px Pixel size = 2.4 um S to C-mount adapter
Lens:	ELM-16-5.6-9 with EL-3-10-VIS-26D-FPC embedded
Orientation:	Vertical Optical Axis
Driver:	Optotune ICC-4C
Target:	USAF chrome target, transparent
Light:	Blue backlight (LFL-100BL2, 470 nm)

WD 150 mm “Macro”
Performance is close to Nyquist in the center

Camera

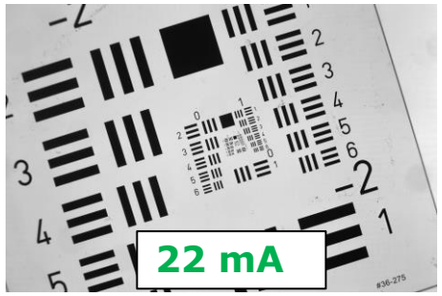
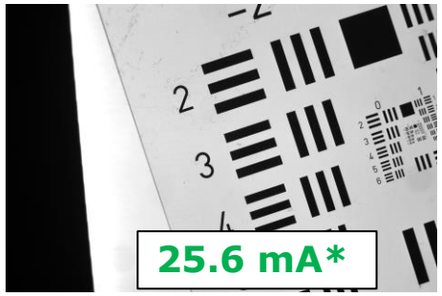
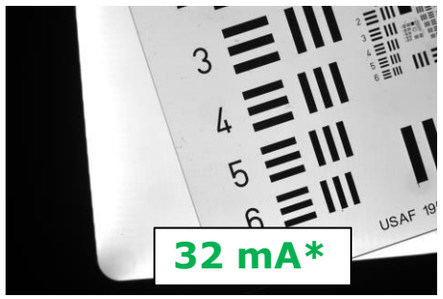
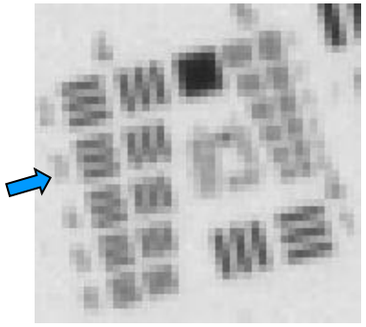
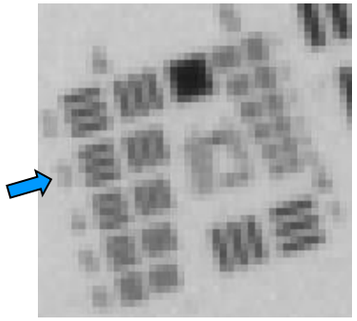
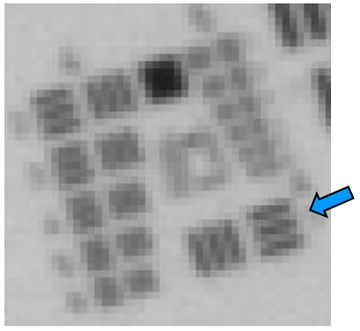
Sensor size = 3072 x 2048 px

Nyquist limit = 208 lp/mm

Pixel size = 2.4 um

Light

Blue background illumination

	Center	Edge	Corner
			
			
USAF element:	4/3	4/3	4/1
Line width (um):	24.8	24.8	31.25
Lp/mm (object):	20	20	16
Magnification:	0.099	0.099	0.099
Lp/mm (image):	**203**	**203**	**161**

Note: Module was initially focused manually at 225mm WD @0mA

*Current was changed to compensate for field curvature

WD 300 mm “Macro”

Performance is close to Nyquist in center and edge without refocusing

Camera

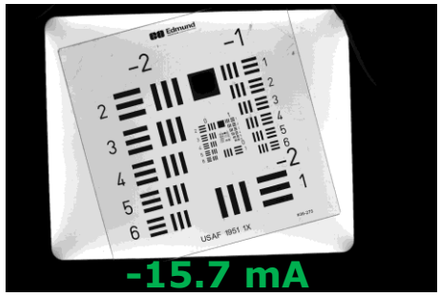
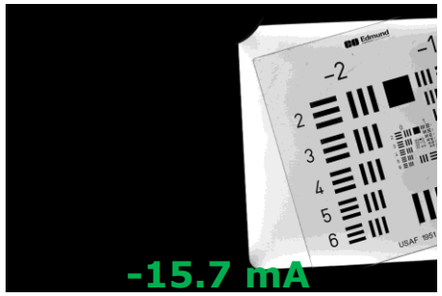
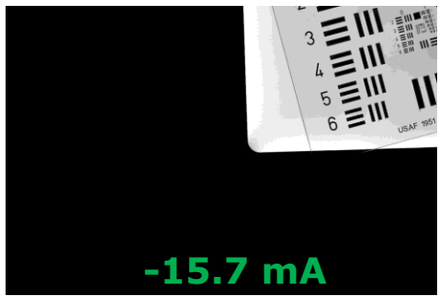
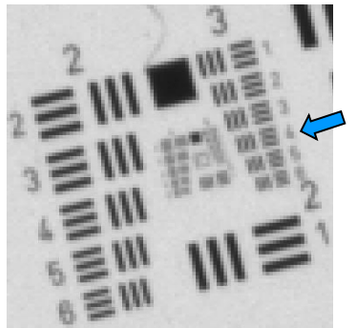
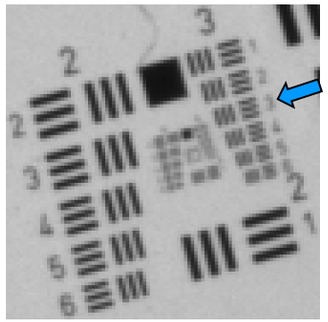
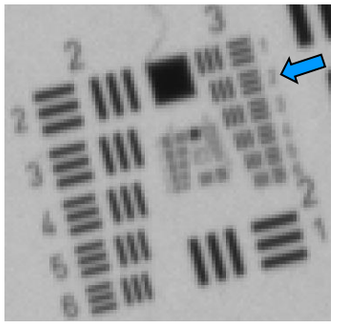
Sensor size = 3072 x 2048 px

Nyquist limit = 208 lp/mm

Pixel size = 2.4 um

Light

Blue background illumination

	Center	Edge	Corner
			
			
USAF element:	3/4	3/3	3/2
Line width (um):	44.19	49.61	55.68
Lp/mm (object):	11	10	9
Magnification:	0.055	0.052	0.051
Lp/mm (image):	**206**	**193**	**175**

Note: Module was initially focused manually at 225mm WD @0mA

WD 500 mm “long-range”

Performance is Nyquist-resolved in center and edge without refocusing

Camera

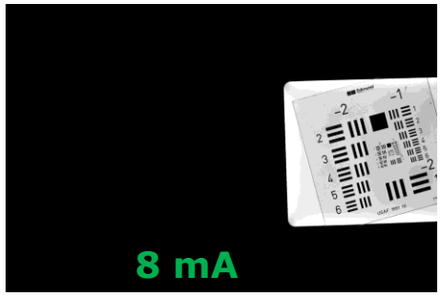
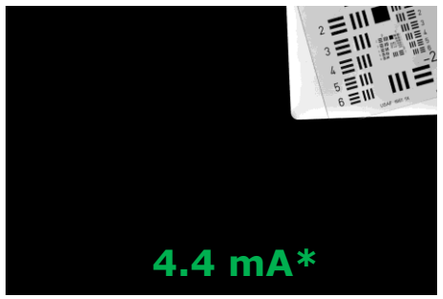
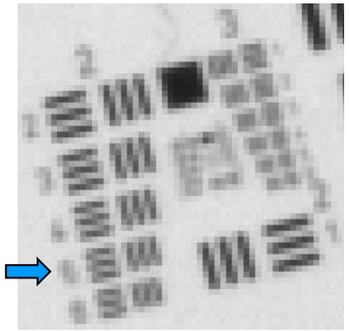
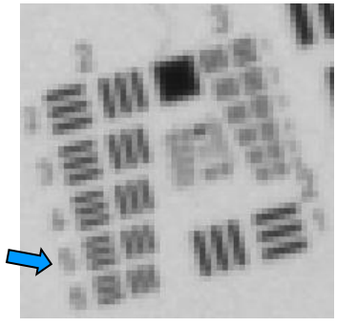
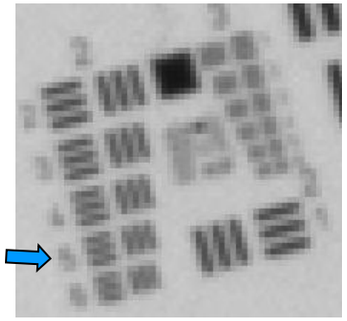
Sensor size = 3072 x 2048 px

Nyquist limit = 208 lp/mm

Pixel size = 2.4 um

Light

Blue background illumination

	Center	Edge	Corner
			
			
USAF element:	2/5	2/5	2/5
Line width (um):	78.75	78.75	78.75
Lp/mm (object):	6	6	6
Magnification:	0.031	0.031	0.031
Lp/mm (image):	**208**	**208**	**208**

Note: Module was initially focused manually at 650mm WD @0mA

*Current was changed to compensate for field curvature

WD 800 mm “long-range”

Performance is Nyquist-resolved in center and edge without refocusing

Camera

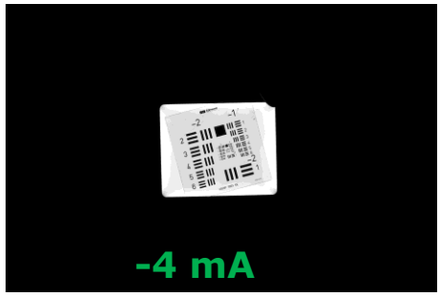
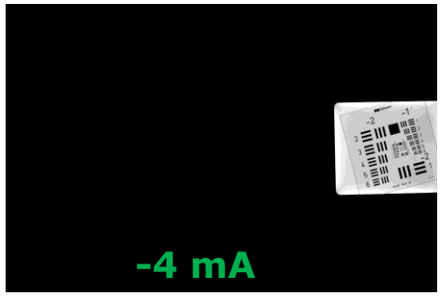
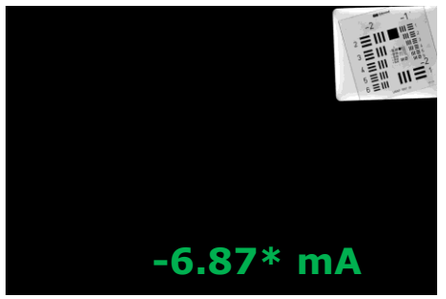
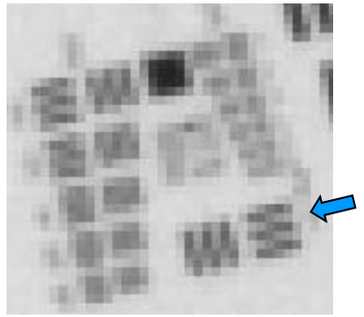
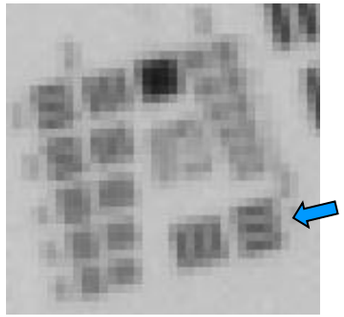
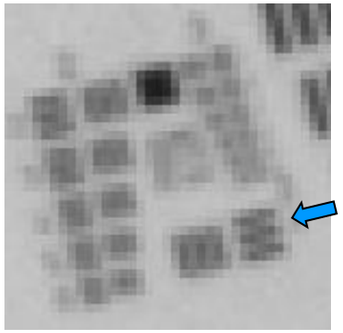
Sensor size = 3072 x 2048 px

Nyquist limit = 208 lp/mm

Pixel size = 2.4 um

Light

Blue background illumination

	Center	Edge	Corner
			
			
USAF element:	2/1	2/1	2/1
Line width (um):	125	125	125
Lp/mm (object):	4	4	4
Magnification:	0.020	0.020	0.020
Lp/mm (image):	**203**	**203**	**203**

Note: Module was initially focused manually at 650mm WD @0mA

*Current was changed to compensate for field curvature

Great polychromatic performance
No difference between blue and white light @ 800 mm WD