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Telecentric inspection with tunable optics

Achieving large z-range without significant magnification change

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Summary

- Large z-range of more than **15mm**
- **No** added vignetting
- **No** distortion
- **No** loss of resolution
- **Very small** magnification change – easy software compensation

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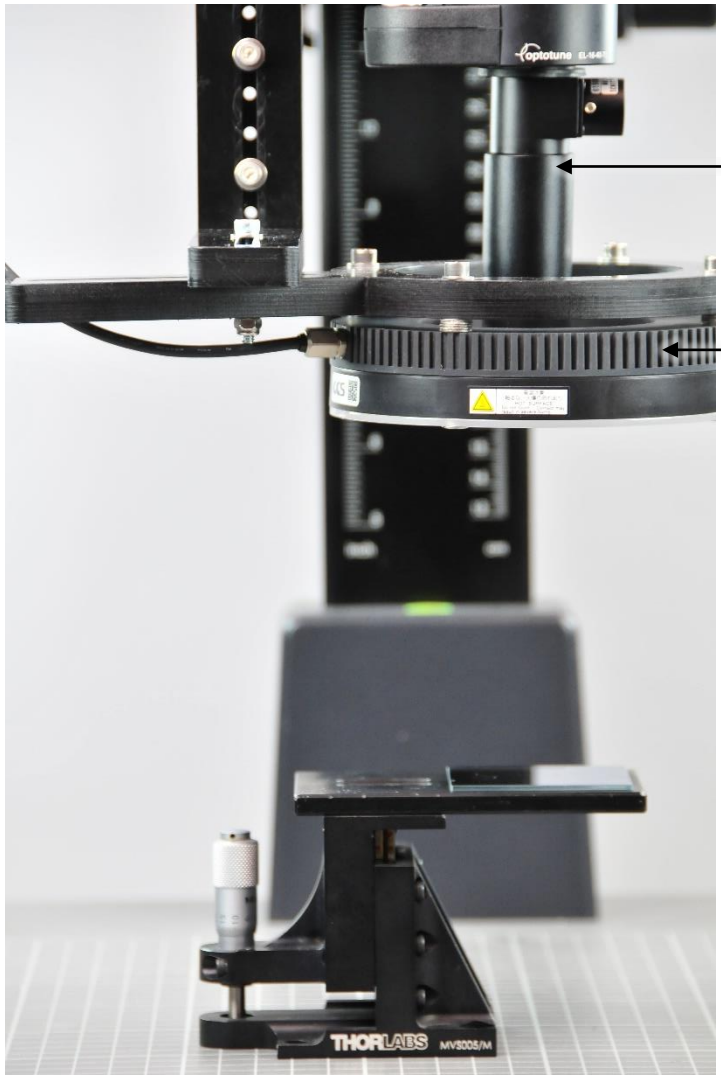
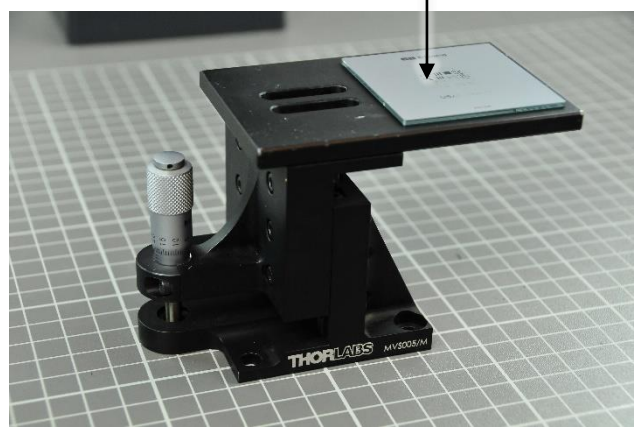
Measurement setup



Optical assembly

Ring light for target illumination
(distortion, magnification change, range)

USAF target and micrometer
adjustable mount



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Optical solution

Solution can be built using standard components.

C-Mount adapter can be ordered at Optotune.

30mm C-Mount spacer

Optotune EL-16-40-TC

C-Mount to Moritex adapter

Moritex MML1-ST150D

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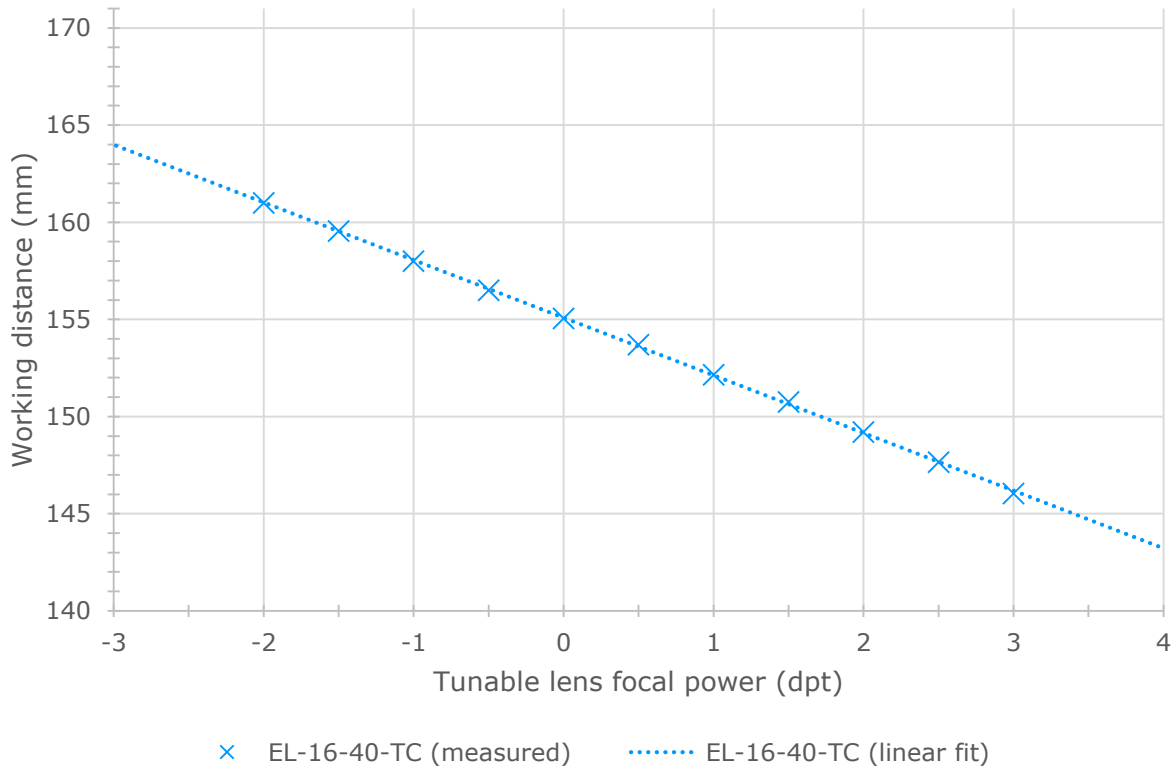
Large Z-range. Linear Operation.

15mm WD change over specified tuning range

0.3mm reproducible step size, well within 1.05mm DOF



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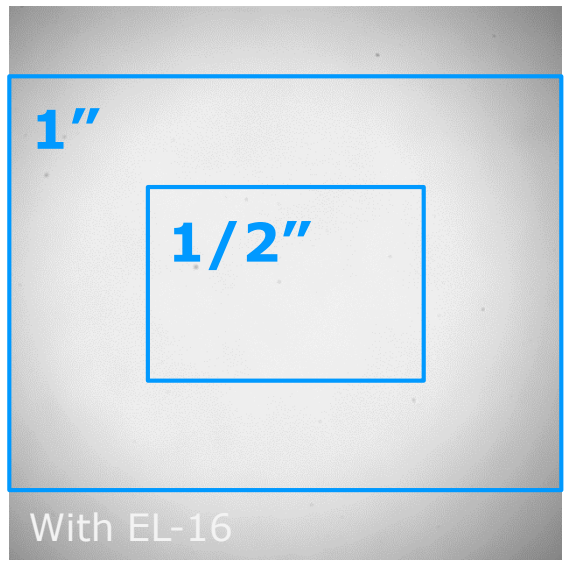
No vignetting issues on rated sensor sizes

Moritex MML1-ST150D is rated for sensor sizes up to 1/2”.

As visible in the picture on the right, such small sensors are illuminated homogeneously with the EL-16 added.

The EL-16 also *does not increase vignetting* when using larger sensors.



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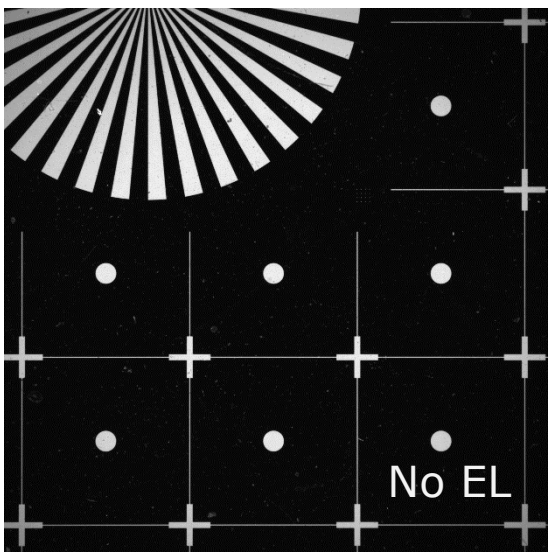
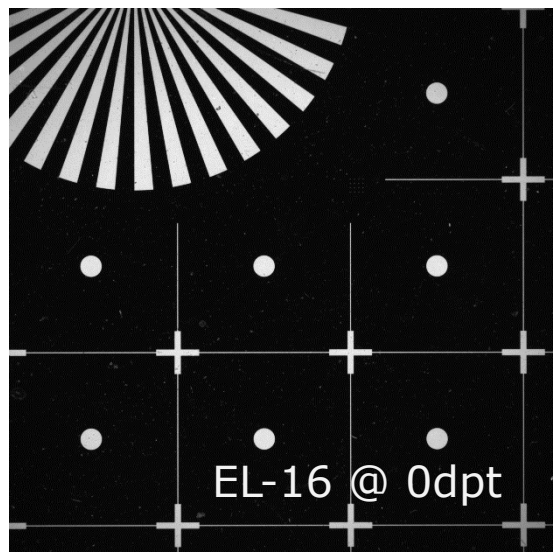
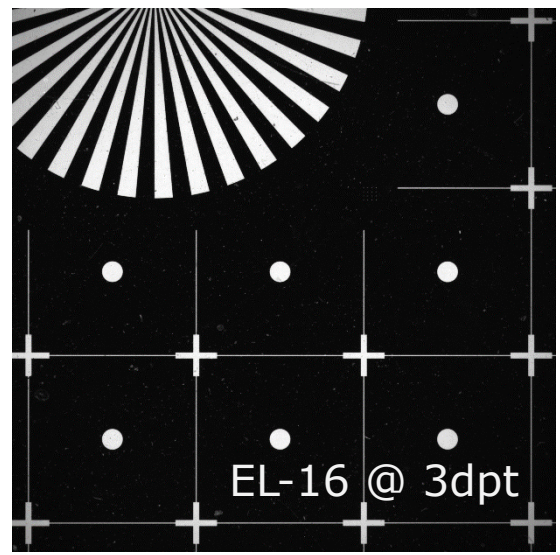
No change of distortion

Inserting the EL-16 does not change image distortion compared to the original picture without a tuneable lens (bottom left)

[These pictures show the full image of a 12.8 x 12.8mm sensor (larger than 1”)]







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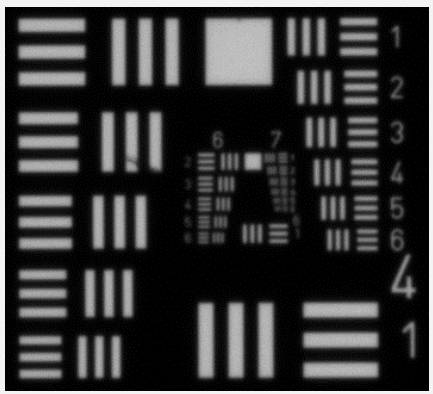
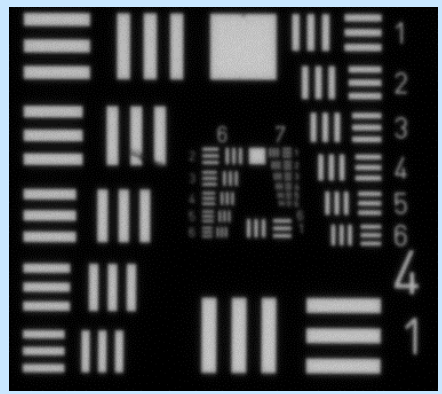
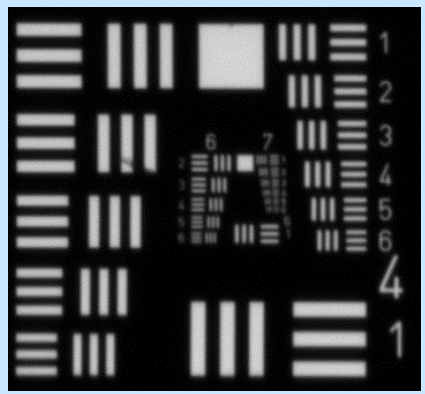
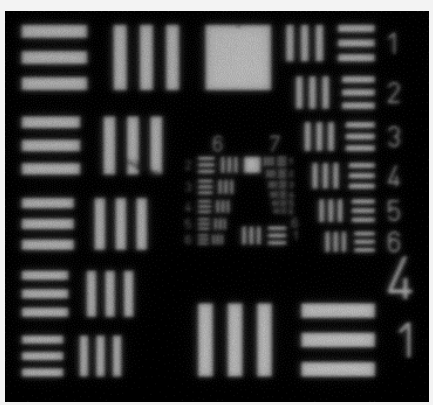
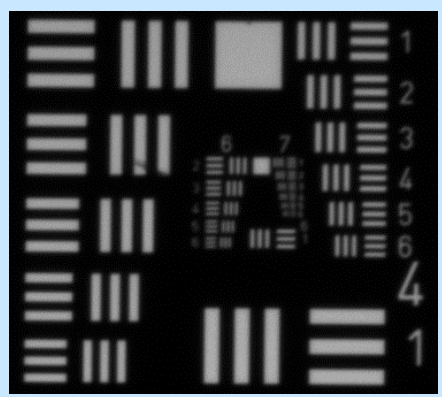
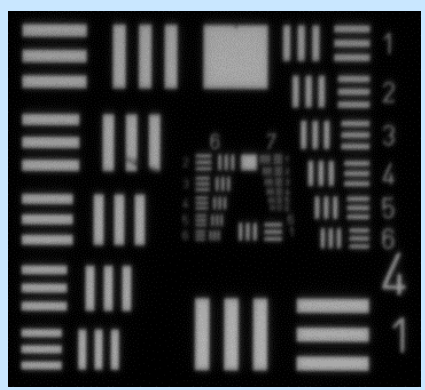
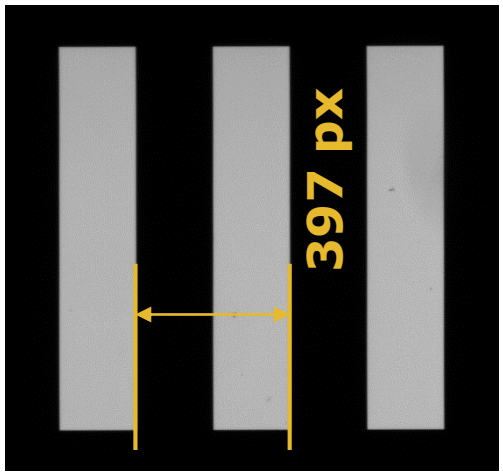
No resolution loss

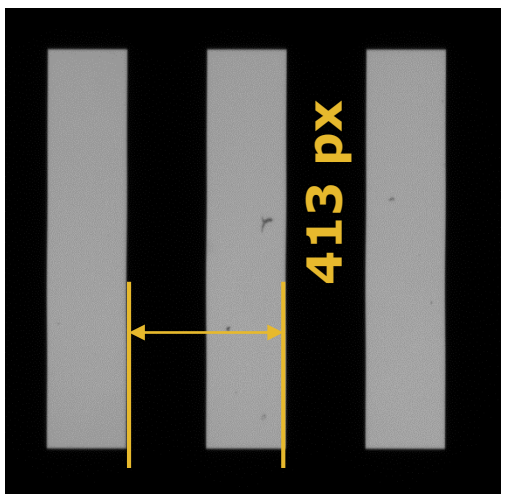
	No EL	EL-16 @ 0dpt	EL-16 @ 3dpt
Center			
Corner			

Magnification change below specified uncertainty



No EL:

0.98x magnification



EL-16 @ 0dpt:

1.01x magnification

It is easily possible to improve these numbers!

Tuning the distance between camera and lens assembly changes the obtained magnification.

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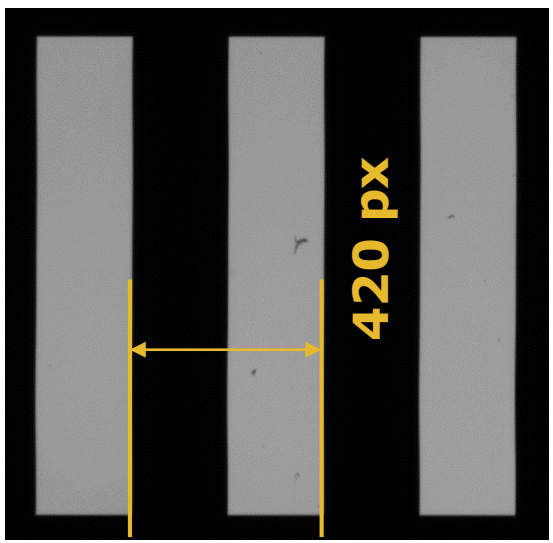
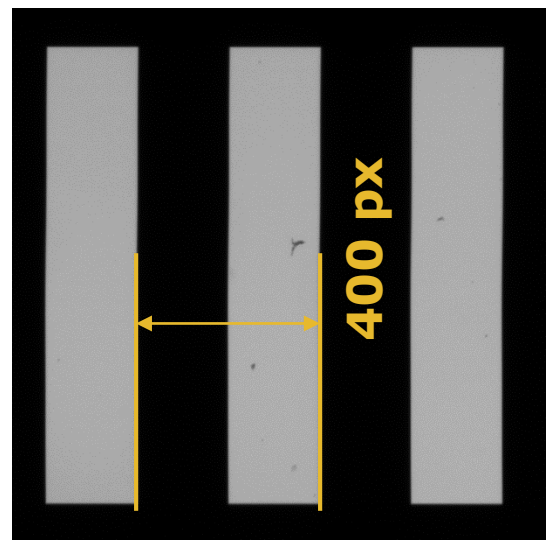
Small magnification change when tuning can easily be compensated in software

The magnification change is small, reproducible and linear.

Thus it can be easily compensated via software.



Less than 5% magnification change over complete 15mm Z-range



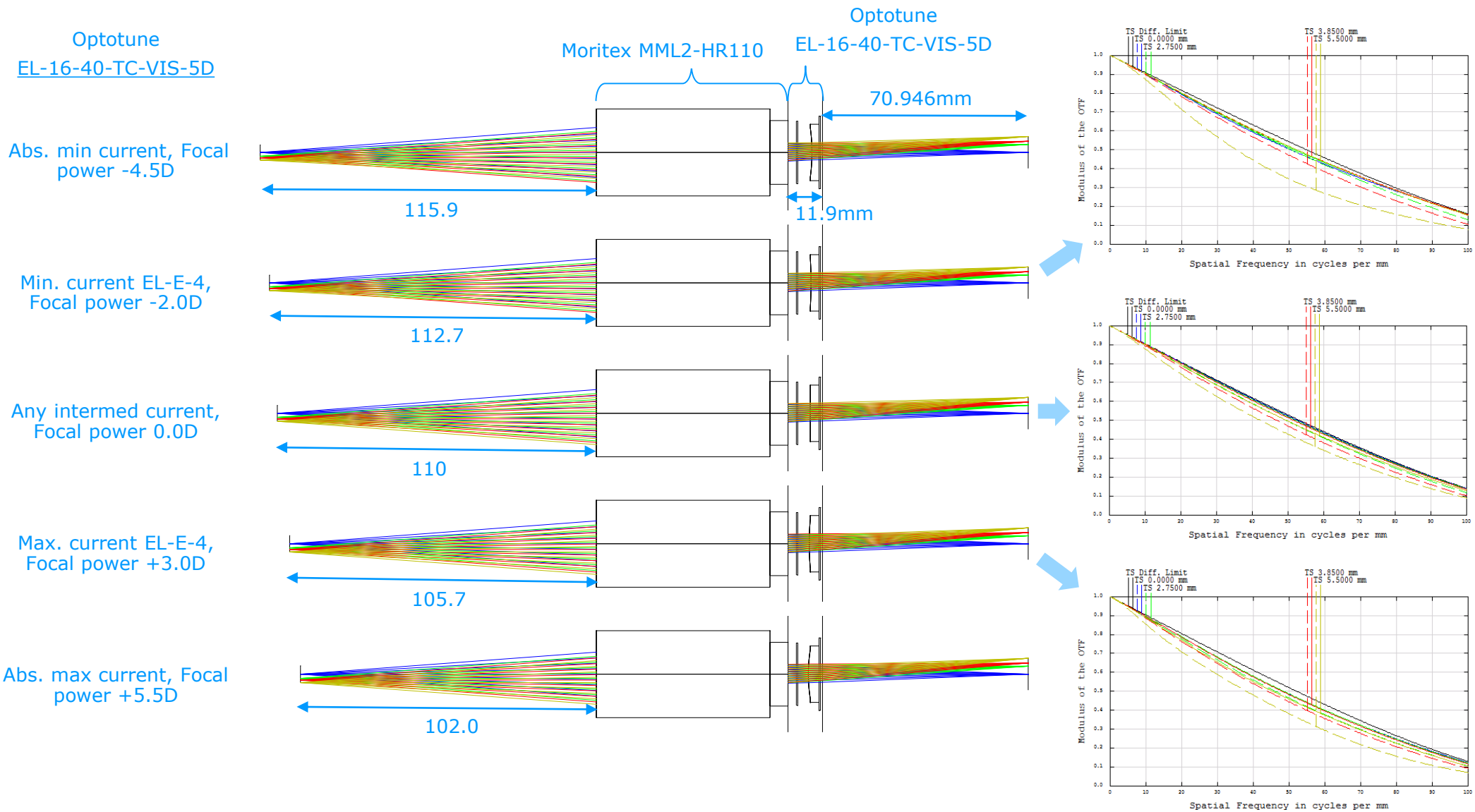
EL-16 @ -2 dpt

161 mm WD

EL-16 @ +3 dpt

146 mm WD

Outlook: Combination with MML2-HR110 also shows great performance



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