Flexible Optical B.V.

Adaptive Optics • Optical Microsystems • Wavefront Sensors

Piezoelectric Tip-tilt Mirror

technical passport

OKO Technologies,

OKO Technologies is the trade name of Flexible Optical BV

Table 1: *Technical parameters of the fast steering mirror.*

ParameterActive axes	θ_x, θ_y (1 point suspension)
Number of actuators	2
Control voltage range	
(with respect to the ground electrode)	$0 \ldots + 300$V (recommended)
	$0 \ldots + 400$V (maximum)
Actuator capacitance C_a	5 nF
Hysteresis, typical	7-12%
Dimensions, mm	$50 \times 50 \times 21$
Body material	Al
Weight	90 g
Motion and positioning	
Control type	open loop
Range, minimal	+/- 2 mrad optical (see Fig. **??**)
Resolution	defined by DAC interface
Full range scanning speed	0.5 ms
Resonant frequency	300 Hz
Frontplate used	
Diameter	12.5mm
Thickness	2mm
Mirror coating	Protected Al
Front Surface Flatness (@532nm)	$\lambda/2$, see Fig. 2
Clear Aperture	$> 90\%$ of the diameter
Driver	
Shipped with	tip-tilt driver unit# D4V1d002
Interface	USB 2.0
Number of output channels	3
Resolution	16 bits (65536 levels)
Maximum update frequency	1 kHz
Output voltage range	0..300V (Tunable)
Mirror serial number	14.34

1 Technical specifications

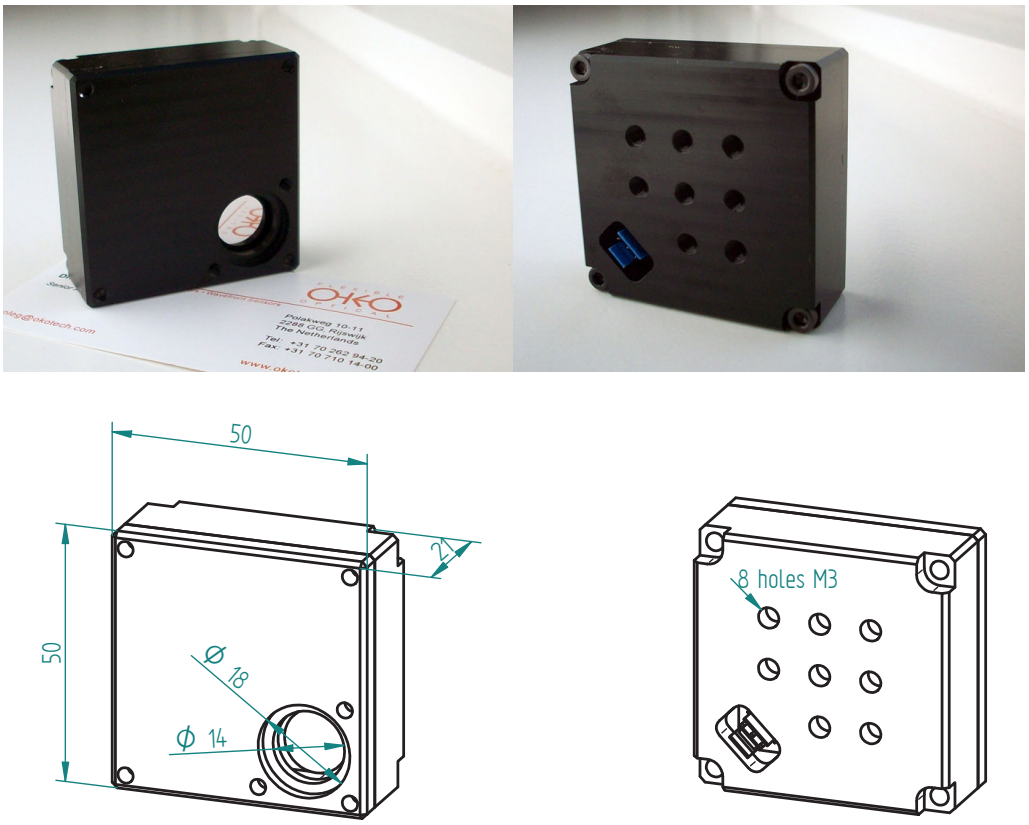

Figure 1: *Piezoelectric fast steering mirror*

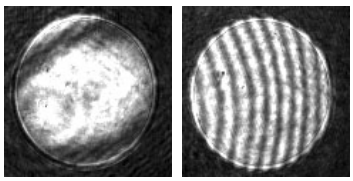

Figure 2: *Optical quality of the reflective plate, interferometrically tested ($\lambda = 532nm$), without and with a tilt introduced in the reference arm*

The fast steering mirror, shown in Fig. 1, is controlled by 2 piezoelectric actuators. See Table 1 for the typical technical parameters of the platform.

The typical frequency range of the mirror is up to 200 Hz, the optical tip-tilt range is +/- 2 mrad.

2 Connection to the control electronics

The unit can be controlled by a single A4MEMS high-voltage amplifier.

Figure 3: *Three-channel high voltage driver includes power supply, USB DAC4, and A4MEMS*

Figure 4: *Output connector of a three-channel high voltage driver and input connector of the tip-tilt mirror*

The computer interface is provided by either EDAC40, USB DAC40, or USB DAC4.

2.1 Three-channel high-voltage USB driver

A three-channel high voltage driver combines USB DAC4 and A4MEMS in a single housing box (see Fig. 3). To use the driver, connect it to the wall outlet (85 to 250 V AC, 50 to 60 Hz), to a USB port computer and to the tip-tilt mirror. The ground pin of the tipt-tilt should be connected to the ground pin of the output connector (see Fig. 4).

To start using the driver, you might need to install FDTI Direct Driver from the folder `/Dac4/Drivers` of the supplied software CD. Updated drivers can be downloaded from `www.ftdichip.com`. The DAC4 module uses architecture similar to that of DAC40, so the programming is very similar. For more details, please read DAC40 manual from `/Dac4` folder or simply modify the sample programs shipped with the unit.

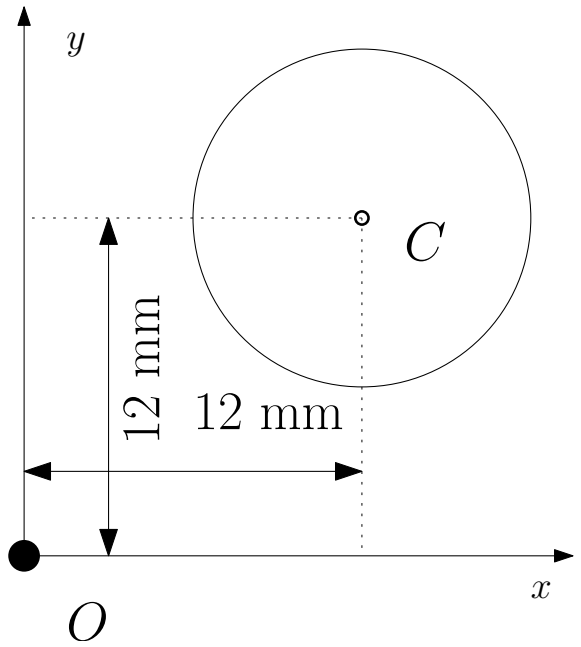

Figure 5: *Position of the pivot point O with respect to the mirror center C*

3 Control of the mirror

The mirror is suspended on two piezoelectric actuators (see Fig. 5), with a fixed pivot point shifted approximately 12 mm by x and y from the mirror center.

Please see the source code of `fullRange.exe` and `square.exe` in `sample programs` folder on the supplied CD for illustration. You can run the programs from the command line window or double clicking on them and monitor a reflected laser beam on a screen to see the results.

4 Warranty

The equipment is covered by a one-year factory-defect warranty.

If the mirror is damaged during shipping, it will be replaced by a similar device within two months. A photo of the damaged device should be sent to Flexible Optical B.V. (OKO Technologies) within 3 days after the damaged device is received.

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5 Contact person

All questions about the technology, quality and applications of adaptive mirror should be addressed to:
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Date:

Signature:

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