

39(38)-channel 50mm piezoelectric deformable mirror system technical passport

OKO Technologies,

OKO Technologies is the trade name of Flexible Optical BV

1 Technical data

The mirror, shown in Fig. 1, consists of 39 or 38 piezoelectric column actuators bonded to the base holder. Reflective plate is bonded to the top of the actuator structure and coated to form the mirror. The shape of the faceplate is controlled by the voltages applied to the actuators.

The device can be used for fast dynamic correction of low-order optical aberrations such as defocus, astigmatism, coma, etc, in lasers, telescopes, ophthalmology, displays and general imaging optics.

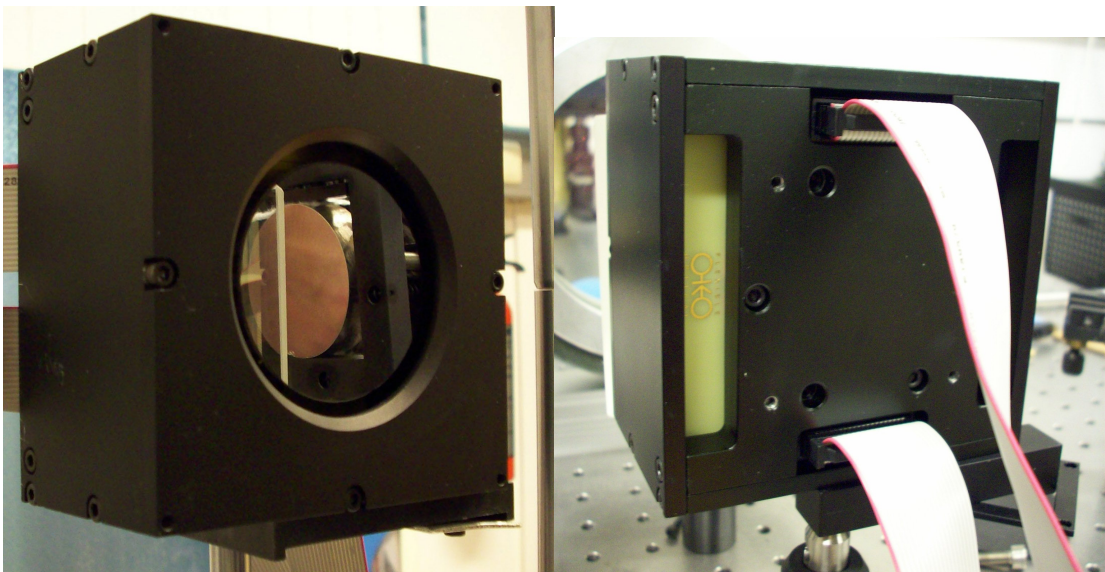


Figure 1: Typical front and back view of a 50mm piezoelectric deformable mirror.

The mirror can be supplied with initially slightly curved spherical surface. This sphericity is caused by the stress in the mirror coating. It does not influence the parameters of the mirror, but should be taken into account when the mirror is incorporated into the optical setup.

Due to hysteresis of actuators, the initial aberration may change during the mirror usage and deviate more from the reference sphere. This deviation is a superposition of actuator response functions and is irrelevant in active setups with closed-loop control, though it may slightly reduce the correction range.

2 Control amplifier unit

The mirror is controlled by a high-voltage amplifier unit. To use the unit, you must connect it to the mirror, to a DAC USB unit (or PCI boards) and to the wall outlet (85

Table 1: Technical parameters of the mirror.

Parameter	Value
Aperture shape	circular 50mm in diameter
Mirror coating	Protected Au (3Photon)
Actuator voltages	0 + 400V (with respect to the ground electrode)
Recommended maximum voltage	300V
Number of electrodes	38(see Fig. 2)
Actuator capacitance C_a	$\sim 5\text{nF}$
Initial RMS deviation from reference sphere	less than $0.1 \mu\text{m}$
Main initial aberration	coma
Maximum stroke	$8\mu\text{m}$ at +400V $6\mu\text{m}$ at +300V
Actuator geometry	placed in two rings, 43 and 48mm diameter
Mirror serial number	18.05
Shipped with	USB DAC # D40V2g05

to 250V AC, 50 to 60 Hz). Connect the mirror with a supplied flat ribbon cables to the 20-pin connectors on the front side, and the driver boards or the USB unit to the 26-pin connectors.

The HV unit supplied with your mirror is tuned to secure safe operation of the mirror.

In case of OEM version of the system, the mirror is controlled by two high-voltage amplifier boards. Each board contains 20 non-inverting DC amplifiers with gain 35, 59, or 79 depending on the board type, and should be connected to a high-voltage ($< 400\text{V}$) power supply and to a stabilized $\pm 15\text{V}$ DC supply. Connect the ground, +15V and -15V to the pins marked G,+ and -. Connect positive high-voltage stabilized DC supply to the pin marked V_high, connect negative high voltage terminal to the ground (see Fig. 5). **The high voltage supply should not exceed 400 V DC.** Use the flat ribbon cable supplied to connect the driver board to the mirror socket.

3 DAC Unit

A single “DAC-40-USB” unit can control up to 40 channels. Please see the separate unit description for detailed installation guide.

The pinout of the DAC unit and the pinouts of the board cable and the cable coming from the high voltage board are shown in Fig. 6. The DAC unit connector pinout is given for one of its male connectors. The cable pinouts are given for the cable female connectors viewed from the front side.

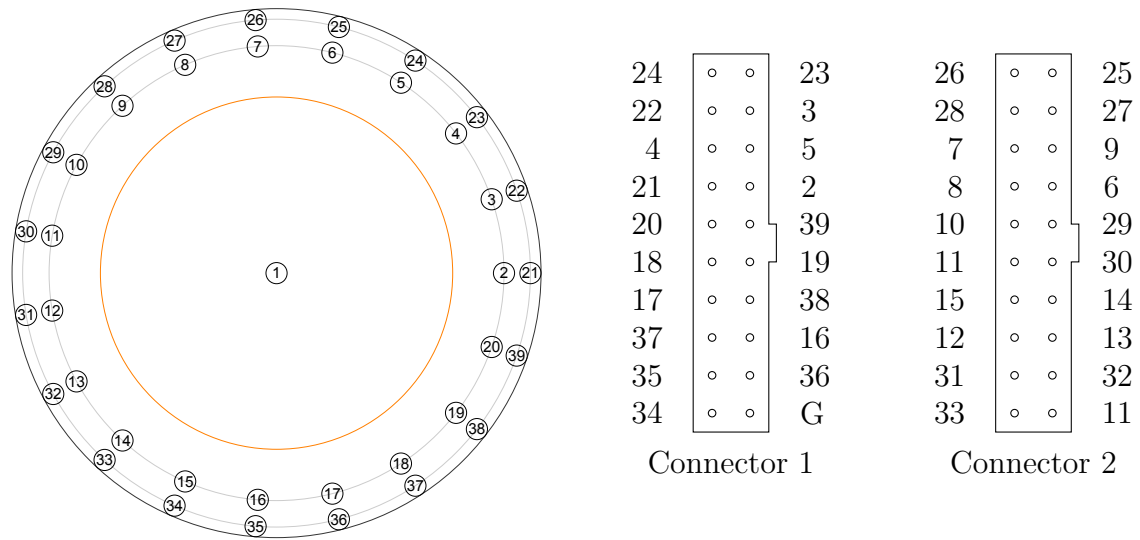


Figure 2: The geometry of the mirror actuators (for 39- and 38- channel version; 38-channel version doesn't have the central actuator). Diameters of a) the external ring of actuators is 48 mm; b) internal ring of actuators is 43 mm; c) recommended light aperture (shown in orange) is 33 mm.

When using two or more USB DAC units, connect together their ground sockets.

4 Optical quality

The interferograms of the mirror obtained before shipping are shown in Fig. 7. **NB!** The interferograms were registered at wavelength $\lambda = 632.8$ nm, with aperture size of 50 mm.

5 First run of the system

- **Read this document through before performing any practical steps.** Follow the instructions exactly, if it's written **connect the cables, switch on the HV unit** — **first** connect the cables and **then** switch on the HV unit.
- The system supplied to you is ready for run after all cables are connected – *you don't need to change anything in the hardware configuration.*
- All following operations refer to DAC-40-USB units connected to a computer running Windows (we used XP SP2 for final tests) and 40-channel HV units.
- Connect the DAC USB units to the computer USB ports directly or through the USB Hub. Install the DAC USB software (refer to the DAC USB unit guide).



Figure 3: 40 channel high-voltage amplifier unit.



Figure 4: Front and back panels of 40 channel high-voltage amplifier unit.

- Connect DAC USB units to the inputs of HV units using supplied ribbon cables with 20- and 26-way connectors. *Mind the cable and connector numbering!*
- Connect HV unit outputs to the mirror. *Mind the cable and connector numbering!*
- Remove the lid from the mirror case. Place the mirror into interferometer or a setup with a wavefront sensor. Fix the cables to the optical table. You can also test the mirror by reflecting a good collimated beam from the mirror surface and observing the near field intensity distribution.
- Control the initial mirror figure (should be close to sphere).
- Switch on the amplifier units. The control LEDs should glow evenly, without blinking. Blinking LED indicates failure of a hardware component of the HV amplifier unit. *Never use an HV amplifier unit with blinking LED!*
- Use test programs (e.g. `rotate.exe` or `degauss.exe`) to verify that all channels function correctly.

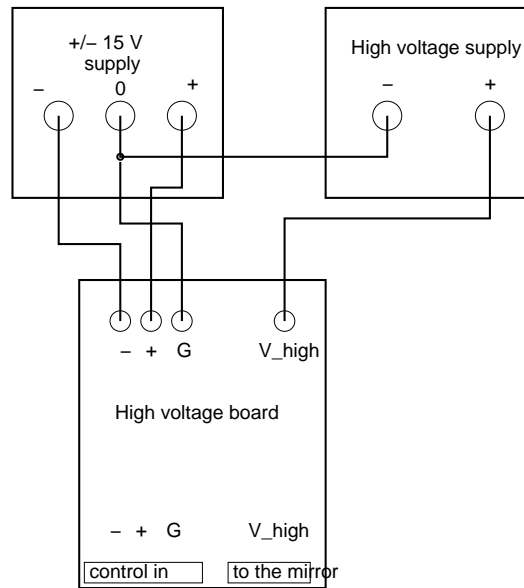


Figure 5: Power supply wiring for OEM version of the system. Position of the connectors can be different; refer to the board manual and/or marking on the board.

- You may start to use the mirror if all channels work. Use the source code supplied as a template to write your own control programs.

6 Remarks

For OEM version. Use high-quality stabilized filtered high-voltage supply. Some high-voltage supplies generate short high-voltage spikes at the output, these deviations can destroy the mirror, driver electronics and even the control computer. Do not turn on V_high directly to its maximum value. Set V_high to 100V before switching the system off. Switch the system on with V_high not higher than 120V. Increase V_high to its working value after switching on the digital boards and setting the control voltages to zero.

The jumpers on the amplifier board or in the amplifier unit, in the DAC USB control unit are preset before shipping; this configuration should not be changed. **The system and jumper configuration were tested before shipping.**

The mirror surface can be cleaned using any standard procedure for cleaning dielectric mirrors.

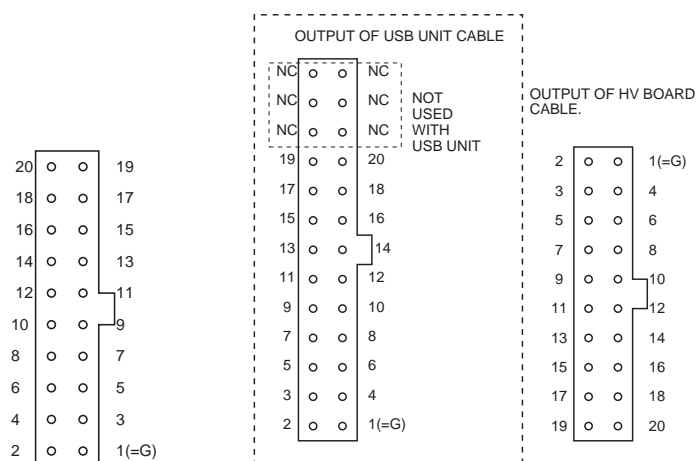


Figure 6: Pinouts of the first connector of the “DAC-40-USB” unit and cables. The numbers correspond to the numeration of “DAC-40-USB” output channels. Second connector is connected in a similar way.

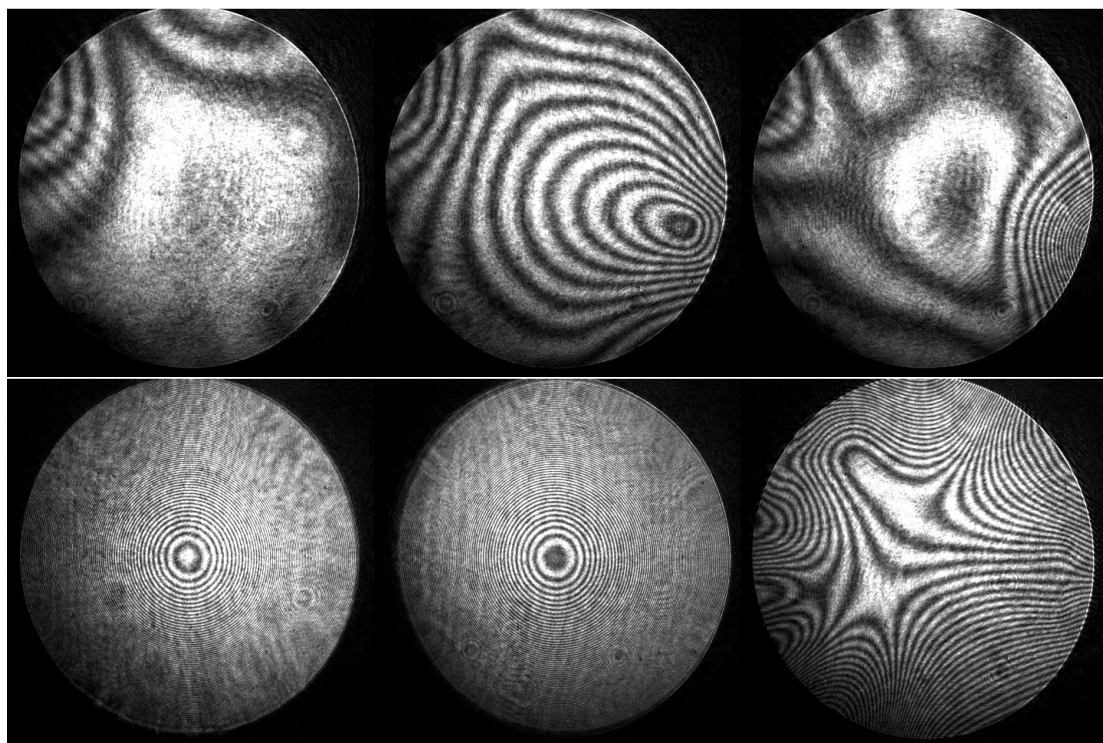


Figure 7: Test of the mirror: initial shape and response functions of certain actuators; response of the mirror to the extremal voltages set to internal and external rings of actuators; random min-max voltages sent to all actuators.

7 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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8 Contact person

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

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2288 GG Rijswijk ZH,
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Date:

Signature:

(Dr. Oleg Soloviev,
Senior Associate)