

**ALPAO Deformable Mirrors (DM)** feature large strokes, high dynamic motion and an excellent optical quality. **ALPAO DM** are providing state-of-the-art performances which will meet and exceed your requirements for fast and accurate wavefront correction.



## Key features

### LARGE DEFORMATION

Up to 80 $\mu$ m PV for tip-tilt  
(>120 $\mu$ m optional)

### HIGH DYNAMIC MOTION

Settling time as low as  
500 $\mu$ s at +/-10%

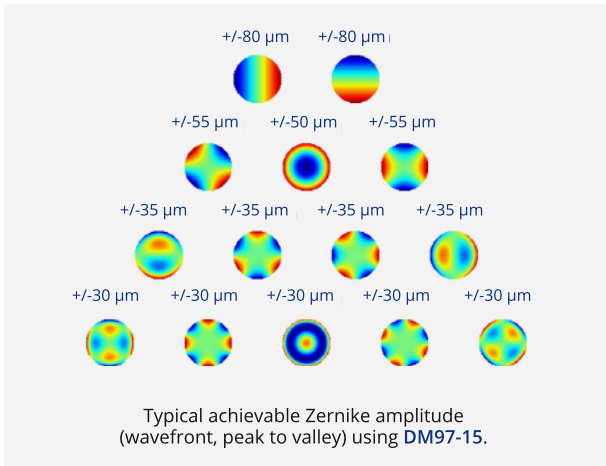
### EXCELLENT OPTICAL QUALITY

Active best flat <7nm RMS  
(<3nm RMS optional)

## LARGE DEFORMATION

Using **ALPAO DM** you can correct large aberrations and shape wavefronts with high precision, including high-order Zernike.

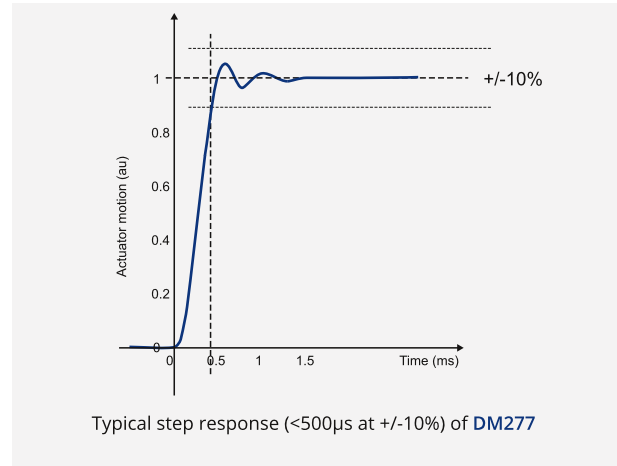
Such large amplitude of deformation allows you to use adaptive optics as never before. You can, for example, correct directly the tip-tilt and/or use the large defocus capability or correct some optical misalignment.



## HIGH DYNAMIC MOTION

The settling times **ALPAO DM** are down to  $<500\mu\text{s}$  (at  $\pm 10\%$ ) with very low overshoot.

Consequently, the deformable mirror provides excellent correction because adaptive optics temporal errors are drastically reduced.



## ALPAO PERFORMANCES

	DM69	DM88	DM97-08	DM97-15	DM241	DM277	DM468 <sup>1</sup>	DM820 <sup>1</sup>
Number of actuators	69	88	97	97	241	277	468	820
Pupil diameter	10.5mm	20.0mm	7.2mm	13.5mm	37.5mm	24.5mm	33.0mm	45.0mm
Pitch	1.5mm	2.5mm	0.8mm	1.5mm	2.5mm	1.5mm		
Maximum mirror best flat in close loop	7.0nm RMS (no print through effects)							
Minimum tip/tilt stroke (PV, wavefront)	60μm	40μm	80μm	60μm	40μm	15μm		
Minimum focus/astig. stroke (PV, wavefront)	40μm	30μm	40μm	40μm	30μm	10μm		
Minimum 3x3 stroke (PV, wavefront)	25μm						10μm	
Maximum settling time (at +/-10%)	800μs	1.6ms	800μs	1.6ms	500μs			
Minimum bandwidth <sup>2</sup>	800Hz	400Hz	800Hz	400Hz	2 000Hz			
Minimum frequency at phase lag of 45°	500Hz	300Hz	500Hz	300Hz	1 500Hz			
Hysteresis error	< 2%							
Non-linearity error	< 3%							
Coating	Protected Silver (other coatings available)							
Operating temperature <sup>3</sup>	-10 to 35°C							

Additional typical features and benefits:

- Vacuum compatibility
- Sub nm average step size
- No protective glass
- Surface roughness  $<15\text{\AA}$  RMS
- LIDT for protected silver coating<sup>4</sup>:  $880\text{mJ}/\text{cm}^2$  (@12ns,10Hz, 1064nm) / 50W (CW @ 1064nm)

- Wavefront inter-actuator stroke  $>5.0\mu\text{m}$  PV
- MTBF<sup>4</sup>:  $10^{11}$  cycles
- Few W average power dissipation
- $<10\text{nm}$  RMS open loop stability over hours<sup>4</sup>
- Thin and flexible cables

Note 1: preliminary specifications

Note 2: first resonance of the membrane (higher bandwidth available upon request)

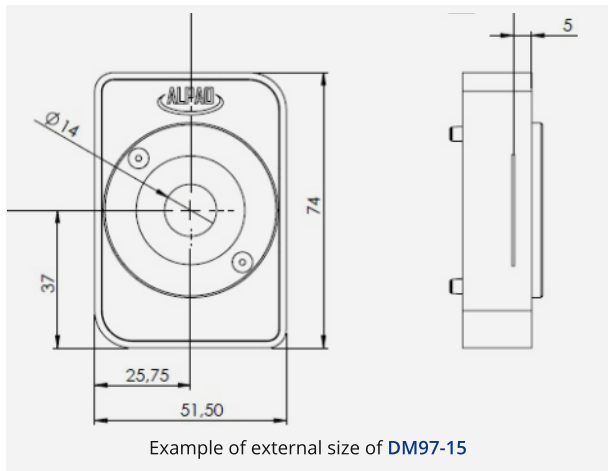
Note 3: compatible with cryogenics environment

Note 4: technical note available upon request

## DIMENSIONAL OUTLINES

	Dimensions WxHxD (mm)	Dimensions WxHxD (Inch)	Weight (kg / pds)
<b>DM69</b>	52 x 74 x 22	2.0 x 2.9 x 0.9	0.18 / 0.4
<b>DM88</b>	60 x 78 x 20	2.4 x 3.1 x 0.8	0.19 / 0.4
<b>DM97-08</b>	52 x 74 x 32	2.0 x 2.9 x 1.3	0.22 / 0.5
<b>DM97-15</b>	52 x 74 x 22	2.0 x 2.9 x 0.9	0.18 / 0.4
<b>DM241</b>	91 x 113 x 27	3.6 x 4.4 x 1.1	0.33 / 0.7
<b>DM277</b>	100 x 100 x 100	3.9 x 3.9 x 3.9	1.7 / 3.7
<b>DM468</b>	90 x 110 x 120	3.6 x 4.3 x 4.7	1.9 / 4.2
<b>DM820</b>	120 x 120 x 120	4.7 x 4.7 x 4.7	2.0 / 4.4

3D files are available on request.



## EXCELLENT LINEARITY AND LOW HYSTERISIS

ALPAO DM have almost no hysteresis (<2%), as well as high linearity (<97%) and great stability.

Straightforward control of an ALPAO DM results in very low residual wavefront errors

## SOFTWARE DRIVERS

ALPAO DM include software drivers for Labview®, Matlab®, C/C++ and Python.

Our hardware and software are compliant with Microsoft Windows® XP (32bit), 7, 8.1, 10 (32/64bit) and many Linux® (32/64bits) operating systems.

## LOW VOLTAGE ELECTRONICS

ALPAO DM come with a robust low-voltage 14bit control electronics.

	DM69, DM88, DM97-08, DM97-15	DM241, DM277, DM468, DM820
PC connection	USB / Ethernet	PCIe card (included)
Power consumption	<150W	<500W
Power supply	from 110 - 250V AC, 50 to 60Hz	
Weight	6kg - 12pounds	10 kg - 22 pounds
Dimensions	43.6 x 17.7 x 35.5cm 17.2 x 7.0 x 14.0 inches	45.0 x 17.5 x 35.6cm - rackable 19 x 7 x 14 inches
Operating temperature	0 to 35 °C	
Cable length <sup>5</sup> (power supply, PC to drive electronics, drive electronics to DM)	2m - 6.5 foot	
Analog response time	< 10µs	



Electronics of DM69, DM88, DM97-08 or DM97-15



Electronics of DM241, DM277, DM468 or DM820

Note 5: longer cable available upon request

Microsoft Windows, Linux, MathWorks, Labview, are registered trademarks.

## OPTIONNAL ITEMS



- **Large stroke** option provides +50% additional tip-tilt, defocus, and astig. stroke. Settling time is increased by 100%. Bandwidth and phase lag are decreased by 50%.
- **High speed** option provides 100% increased bandwidth and phase lag frequency at -45°. Settling time and tip-tilt, defocus, astig. stroke are decreased by 50%. This option is not available with the large stroke DM option. It includes a PCIe connection.
- **High-optical quality** option provides you with a <3nm RMS best flat DM.
- **Other coatings:** gold, aluminium or dielectric for higher LIDT.
- **High stability option** provides increased open-loop performances.

## ACCESSORIES

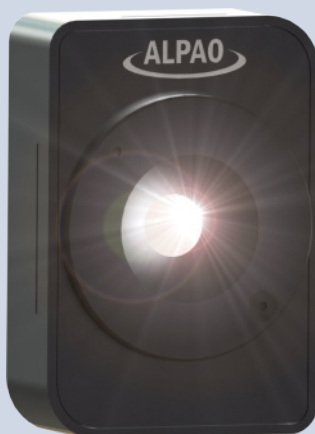


ALPAO provides helpful optional accessories for easy integration into your system:

- **Rotation stage** for sharp tip-tilt and alignment adjustment.
- **Dummy static mirrors** which use the same housing and mirror positioning. A dummy static mirror can replace your ALPAO deformable mirror when you must move the DM to a different optical bench.
- **LEDBOX:** 64 LEDs on the LEDBOX represent your DM (one LED per actuator). This device helps advanced users to develop and test their control software prior to any optical installation.
- **Trigger-IN and trigger-OUT** to synchronise sharply the hardware of your system.

Contact the **ALPAO** team to learn about **our custom deformable mirrors**. No matter what your needs are; OEM versions, custom pitch or diameters, custom number of actuators (up to several thousand), we can build the DM to suit your needs.

## ORDER TODAY



Need more information?

Fitting simulation, open loop control, LIDT, MTBF, software compatibility, cryogenic environment, external size drawings, 3D files or any other requests, we have more information to share.

Contact us for one-to-one guidance and technical support.

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