Aeri™ Atmospheric Turbulence Simulator

Device Description

Based on the Unifi Deformable Mirror System, the Aeri™ ATS is a complete unit consisting of an AgilOptics' deformable mirror and a specially modified D64USB high-voltage driver. Control circuitry within the driver can store a 3-D pattern representing arbitrary turbulence patterns and rapidly display the pattern on the mirror surface.

Using the provided software tool the user can create the desired aberrations on his computer and then download the pattern file to the Aeri over a USB cable. The ATS will then start driving the mirror to generate the specified aberrations.

The Unifi™ Deformable Mirror System is the next generation of AgilOptics' powerful adaptive optic systems. Unifi operates on a single 5V wall block using 2.5W of energy. Even though the package is small and low-power, the output on the mirror face can achieve a bandwidth of 4 kHz.

Features

- Fits in standard 4” optical mounts
- Includes 61-actuator Deformable Mirror (50mm-61 actuators) (typical),
- Uses USB 2.0 Interface (Type B Connector)
- 4 kHz Mirror Bandwidth (updates in 250µsecs cycles)
- System sends ~2 Million actuator updates per second, serially, one every 0.5µsec
- 61 actuator updates, every 0.5 µsec, means full frame updates are every 30µsec
- System sends about 8 voltage updates per 250µsec cycle, mirror integrates and smoothes temporal performance.

![4kHz Pattern for Each Actuator](image)

4kHz Pattern for Each Actuator
Derived from 30µsec pulses

At 2 M Updates/sec, entire pattern updates in 30 µsec -- 8-step cycle generated at 4 kHz

<table>
<thead>
<tr>
<th>t = 0</th>
<th>t = 30 µsec</th>
<th>t = 60 µsec</th>
<th>t = 90 µsec</th>
</tr>
</thead>
<tbody>
<tr>
<td>![image]</td>
<td>![image]</td>
<td>![image]</td>
<td>![image]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>t = 120 µsec</th>
<th>t = 150 µsec</th>
<th>t = 180 µsec</th>
<th>t = 210 µsec</th>
</tr>
</thead>
<tbody>
<tr>
<td>![image]</td>
<td>![image]</td>
<td>![image]</td>
<td>![image]</td>
</tr>
</tbody>
</table>
Typical Atmospheric Aberration

Derived Voltage Pattern Map

Aeri™ ATS
Mechanics of DM Pre-correction

Electronics Block Diagram
Ordering Information

**UATS – 50/61 – HR1064**

<table>
<thead>
<tr>
<th>Series Name</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unifi Deformable Mirror System</td>
<td>50</td>
<td>61</td>
<td>HR</td>
<td>1064</td>
</tr>
</tbody>
</table>

A: Mirror Diameter in millimeters (mm)
B: Actuator Count

Standard Mirror Diameter/Actuator Count Combinations:

- 5/4
- 10/4
- 10/8
- 16/37
- 25/37
- 25/61
- 30/37
- 50/37
- 50/61

Custom diameter/actuator counts available to user’s specifications. Contact AgilOptics for delivery and pricing.

C: Coating Type
- HR – High Reflectivity
- AR – Anti-Reflective

D: Wavelength
- Standard Wavelengths
  - Vis – Broad-band visible spectrum
  - Al – Standard
  - AgProt – Protected Silver

Multi-Wavelength Coatings

Single Wavelength Coatings
- 1064nm
- 800nm
- 820nm
- 633nm
- 349nm
- 266nm

Custom coatings can be added to any mirror. Contact AgilOptics for delivery and pricing.
Functional Block Diagram

```
<table>
<thead>
<tr>
<th>50-61 Deformable Mirror</th>
</tr>
</thead>
<tbody>
<tr>
<td>HV Driver</td>
</tr>
<tr>
<td>2 MHz Sequencer</td>
</tr>
<tr>
<td>RAM</td>
</tr>
</tbody>
</table>
```

USB 2.0
5V Power Supply

USB
Wall Power

**Figure 1** Unifi Simplified Block Diagram

**Figure 2** Unifi in working setup
Driver Specifications

Absolute Maximum Ratings

Output Voltage per Channel 295V

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>2.5 W, quiescent</td>
<td></td>
<td></td>
<td></td>
<td>W</td>
</tr>
<tr>
<td>Actuator Bandwidth</td>
<td>Small Signal</td>
<td>4</td>
<td></td>
<td></td>
<td>kHz</td>
</tr>
<tr>
<td></td>
<td>Full Swing, all channels</td>
<td>782</td>
<td>790</td>
<td></td>
<td>Hz</td>
</tr>
<tr>
<td></td>
<td>from 0 – 295V – 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Output per channel</td>
<td>550 µA</td>
<td></td>
<td></td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>Output Voltage per Channel</td>
<td>280 290 295 V</td>
<td></td>
<td></td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>

Other Specifications

Communication

USB 2.0

Enclosure Dimensions

- Tube: 3.5” (88.9 mm) x 3” (76.2 mm) OD
- Mirror Housing: 4.157” (105.6 mm) OD at widest point x 1.46” (37 mm)
- Total Enclosure length: 4.5” (114.3 mm)

Weight

- Total weight with 4” Optical Mount: 2.625 lbs. (1191 g)
- Total Weight without mount: 1.75 lbs. (794 g)
- Electronics: .25 lbs. (114 g) [3 boards]