The products discussed in this guide are intended for development and prototyping purposes as OEM subsystems for incorporation into customer’s prototypes and end products. Therefore, they do not comply with the appropriate requirements of FDA 21 CFR, section 1040.10 and 1040.11 for complete laser products.
Scan Module - Overview

- The Scan Module is an easy to use opto-mechanical assembly of a laser source, beam shaping optics, Mirrorcle MEMS mirror and projection lens to achieve a large optical Field-of-View beam-steering capability.
- The modules have the laser diode pins available to be directly driven with an external laser diode driver.
Scan Module – Versions

- There are two distinct Scan Module mechanical designs:
  - EaZy2.0, EaZy4.0 – Folded cell designs with a single connector for laser and MEMS
  - EaZy3.1 – A folded cell design with individual contacts for laser and MEMS

- There are modifications to the scan modules for certain applications such as high-power blue lasers, a different MEMS mirror in the scan module package. These are considered non-standard Scan Modules and are typically not for sale off-the-shelf

<table>
<thead>
<tr>
<th>Design Name</th>
<th>Design Notes</th>
<th>Laser Driver?</th>
<th>MEMS Device</th>
<th>Lasers</th>
</tr>
</thead>
<tbody>
<tr>
<td>EaZy2.0</td>
<td>Folded cell</td>
<td>Single LD + MEMS PCB</td>
<td>A3I12.2-1200AL</td>
<td>R/G/B/V</td>
</tr>
<tr>
<td>EaZy3.1</td>
<td>Folded cell</td>
<td>Optional</td>
<td>A7M10.2-1000AL</td>
<td>R/G/B/V</td>
</tr>
<tr>
<td>EaZy4.0</td>
<td>Folded cell</td>
<td>Single LD + MEMS PCB</td>
<td>A7M10.2-1000AL</td>
<td>R/G/B/V</td>
</tr>
</tbody>
</table>

- R - red (~638nm), <30mW CW power
- G - green (~520nm), <30mW CW power
- B - blue (~450nm), <30mW CW power
- V - violet (~405nm), <30mW CW power
EaZy2.0 Scan Module - Specifications

DISCONTINUED IN Q3/2020

- **MEMS Mirror**: A3I12.2-1200AL
- **Bandwidth**: ~1200Hz in LPF-based driving
- **FoR**: Approx. 40° x 40° Field of Regard
- **Wavelength**: Single laser diode source in:
  - Red (~638nm), <30mW CW power
  - Green (~520nm), <30mW CW power
  - Blue (~450nm), <30mW CW power
  - Violet (~405nm), <30mW CW power
- **Divergence (half angle, average)**: <2.0mrad
- **Repeatability**: <0.005° each axis
- **MEMS Interface**:
  - 10-pin 0.05” Samtec connector, mates with all Mirrorcle MEMS Controllers and Drivers outputs
- **Laser Interface**:
  - Shares 10-pin MEMS Interface connector (see above)
  - Direct access to Laser Diode terminals by header pins
  - Requires separate laser driver to control
- **Recommended Driving Parameters**:
  - $V_{bias} = 80V$
  - $V_{differenceMax} = 120V$
  - $HardwareFilterBw = 1000Hz$

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EaZy3.1 Scan Module - Specifications

- **MEMS Mirror**: A7M10.2-1000AL
- **Bandwidth**: ~2400Hz in LPF-based driving
- **FoR**: Approx. 30° x 30° Field of Regard
- **Wavelength**: Single laser diode source in:
  - Red (~638nm), <30mW CW power
  - Green (~520nm), <30mW CW power
  - Blue (~450nm), <30mW CW power
  - Violet (~405nm), <30mW CW power
- **Divergence (half angle, average)**: <2.25mrad
- **Repeatability**: <0.005° each axis
- **MEMS Interface**:
  - 10-pin 0.05” Samtec connector, mates with all Mirrorcle MEMS Controllers and Drivers outputs
- **Laser Interface**:
  - Direct access to TO38 pins of the Laser diode
  - Requires separate laser driver to control
- **Recommended Driving Parameters**:
  - Vbias = 90V
  - VdifferenceMax = 140V
  - HardwareFilterBw = 2400Hz

The products discussed in this User Guide are intended for development and prototyping purposes as an OEM subsystem for incorporation into customer’s prototypes and end products. Therefore, they do not comply with the appropriate requirements of FDA 21 CFR, section 1040.10 and 1040.11 for complete laser products.
EaZy4.0 Scan Module - Specifications

- **MEMS Mirror**: A7M10.2-1000AL
- **Bandwidth**: ~2400Hz in LPF-based driving
- **FoR**: Approx. 30° x 30° Field of Regard
- **Wavelength**: Single laser diode source in:
  - Red (~638nm), <30mW CW power
  - Green (~520nm), <30mW CW power
  - Blue (~450nm), <30mW CW power
  - Violet (~405nm), <30mW CW power
- **Divergence (half angle, average)**: <2.25mrad
- **Repeatability**: <0.005° each axis
- **MEMS Interface**:
  - 10-pin 0.05” Samtec connector, mates with all Mirrorcle MEMS Controllers and Drivers outputs
- **Laser Interface**:
  - Shares 10-pin MEMS Interface connector (see above)
  - Direct access to Laser Diode terminals by header pins
  - Requires separate laser driver to control
- **Recommended Driving Parameters**:
  - $V_{bias} = 90V$
  - $V_{differenceMax} = 140V$
  - $HardwareFilterBw = 2400Hz$

The products discussed in this User Guide are intended for development and prototyping purposes as an OEM subsystem for incorporation into customer’s prototypes and end products. Therefore, they do not comply with the appropriate requirements of FDA 21 CFR, section 1040.10 and 1040.11 for complete laser products.
Important Operating Guidelines

- Never exceed the maximum voltage level and angles specified for each mirror on the individual datasheet enclosed with your development kit.

- Always perform tests that include any new settings such as new drawings, new refresh rates, new filter settings etc., at low voltage settings until you can verify that those settings are working properly and not exciting the device beyond its mechanical limits.

- The devices are sensitive to electrostatic discharge. Always ensure adequate grounding when handling the packages. A wrist grounding strap with a 10MΩ series resistance is recommended.

- Optical radiation: Laser class 3B. It may pose a danger to eyes and skin in the event of incorrect use. Do not open the housing. Opening the housing may increase the level of risk. Current national regulations regarding laser protection Must be observed.
WARNING AND CAUTION

Danger due to improper use
Any improper use can result in dangerous situations. Therefore, observe the following information:
- Device should be used only in accordance with its intended use.
- All information in these operating instructions must be strictly observed.

Optical radiation: Laser class 3B
The accessible beam may pose a danger when viewed directly. It may pose a danger to eyes and skin in the event of incorrect use.
- Do not open the housing. Opening the housing may increase the level of risk.
- Current national regulations regarding laser protection Must be observed.

Hazardous radiation
If any operating or adjusting other than those specified here are used or other methods are employed, this can lead to dangerous exposure to radiation. Damage to the eyes is possible.
- If the product is operated in conjunction with external illumination systems, the risk described here may be exceeded. This must be taken into consideration by the users on a case-by-case basis.
- Do not look into the light source when it is switched on.
- Comply with the latest version of the applicable regulations on photobiological safety of lamps and lamp systems as well as on laser protection.

Electrical voltage
Electrical voltage can cause severe injury or death.
- Work on electrical systems must only be performed by qualified electricians.
- The power supply must be disconnected when attaching and detaching electrical connections.
- The product must only be connected to a voltage supply as set out in the requirements in the operating instructions.
- National and regional regulations must be complied with.
- Safety requirements relating to work on electrical systems must be complied with.

NOTICE
Modifications and conversions to the device may result in unforeseeable dangers.
Interrupting or modifying the device or Mirrorcle software will invalidate any warranty claims against Mirrorcle Technologies, Inc. This applies in particular to opening the housing, even as part of mounting and electrical installation.
MEMS Controller Connection

- The **USB-SL MZ** MEMS controller, the **OCCIE** MEMS Controller, and **MiniMZ** MEMS Controller 1 are suitable for driving Mirrorcle Scan Modules via their 10-pin header for the MEMS driver output.
  - In the case of the OCCIE and MiniMZ, J2 pins 9 and 10 also have the laser anode and cathode connections respectively for laser driving – in standard version.
  - The USB-SL MZ MEMS Controller for Scan Module operation has the same functions on pins 9 and 10 of the MEMS connector – not present in standard version.

See next page for more details on pinouts for MEMS Driver Connector Outputs
MEMS Controller - Output Pinout

- 4x MEMS Output (high analog voltage)
  - Voltage Range: 0V to 200V
  - DAC Resolution: 16-Bit
  - Sample Rate: up to 100ksps (API sample rate setting)
- 2x Laser Diode Driver Output (low analog voltage)
- Do not probe header for output voltages, pins are closely spaced and probing may result in shorts and driver damage

### MEMS Connector: 10-Pin Header

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>HV_A (X+)</td>
<td>MEMS Channel X+</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>HV_B (X-)</td>
<td>MEMS Channel X-</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>5</td>
<td>HV_C (Y-)</td>
<td>MEMS Channel Y-</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>7</td>
<td>HV_D (Y+)</td>
<td>MEMS Channel Y+</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>9</td>
<td>LD+</td>
<td>Laser Diode (Anode)</td>
</tr>
<tr>
<td>10</td>
<td>LD-</td>
<td>Laser Diode (Cathode)</td>
</tr>
</tbody>
</table>

MEMS Output Connectors Highlighted in Previous page

- Header Digikey Part #: 1175-1629-ND
- Mating Cable Digikey Part #: SAM8219-ND
EaZy2.0 and EaZy4.0 Scan Module Connector

- 4x Connections to MEMS Mirror combdrive rotators
- 2x Connection to laser diode anode and cathode
- Do not probe header for output voltages, pins are closely spaced and probing may result in shorts and driver damage

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<td>10</td>
<td>LD-</td>
<td>Laser Diode (Cathode)</td>
</tr>
</tbody>
</table>
EaZy3.1 Scan Module Connector

- 4x Connections to MEMS Mirror combdrive rotators
- Connection to scan module laser diode anode and cathode is done with ribbon cable
- Option of leaving diode pins open for user provided laser driver
- Do not probe header for MEMS driver or laser driver voltages, it can cause shorts and damage the module

<table>
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<th>Name</th>
<th>Description</th>
</tr>
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<tr>
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<td>HV_A (X+)</td>
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</table>
Laser Emission Reference

- When MEMS Mirror is at origin, laser beam emits from the output (projection) lens of the Scan Module nominally at the center of the lens and perpendicular to the plane of the lens.
- This lens-plane is parallel to the emission-align plane shown below.
Recommended Driving Parameters and Software Setup

- The MEMS Mirrors are a highly complex, non linear mass-spring system. Our API functions provide easy to use, substantially linearized output behavior. However user must use appropriate settings for a given device design to protect from overdriving beyond maximum voltage or tip/tilt angle.

- **Warning:**
  - Wrong MEMS Mirror Controller or Driver settings or wrong Laser Driver settings can damage the Scan Module components!
  - It is strongly recommended not to exceed the maximum voltage difference ("Vdifference") value, voltage bias value ("Vbias"), and low pass filter cut-off frequency value ("HardwareFilterBw") specified in this Guide per Scan Module Specifications.
  - Drive the laser diode only with qualified Mirrorcle Controller and do not exceed maximum laser output power value for the specific Scan Module.
  - Never remove the cable from MEMS Controller to Scan Module during operation or connect a ‘hot’ cable to a Scan Module. Please refer to our separate handling instructions.
Additional Resources

- Manuals for software and hardware are in the USB Thumb Drive’s “Documentation” folder, and after software installation are also placed in the .\Documentation folder

- **Mirrorcle Technologies MEMS Mirrors - Technical Overview** – Overview document about Mirrorcle’s MEMS Devices
- **Mirrorcle Products List**
- **Mirrorcle Online Documentation – Mirrorcle Docs** (online portal)

- SDK and other documentation is available online at: https://www.mirrorcletech.com/documentation/
- Supporting documents, publications and sample device datasheets are available online: https://www.mirrorcletech.com/wp/support/
- If you have any further questions please contact support@mirrorcletech.com
Thank you for Choosing

That’s it! Thank you for reading through this guide.

If you have any further questions or suggestions please email us:

support@mirrorceltech.com