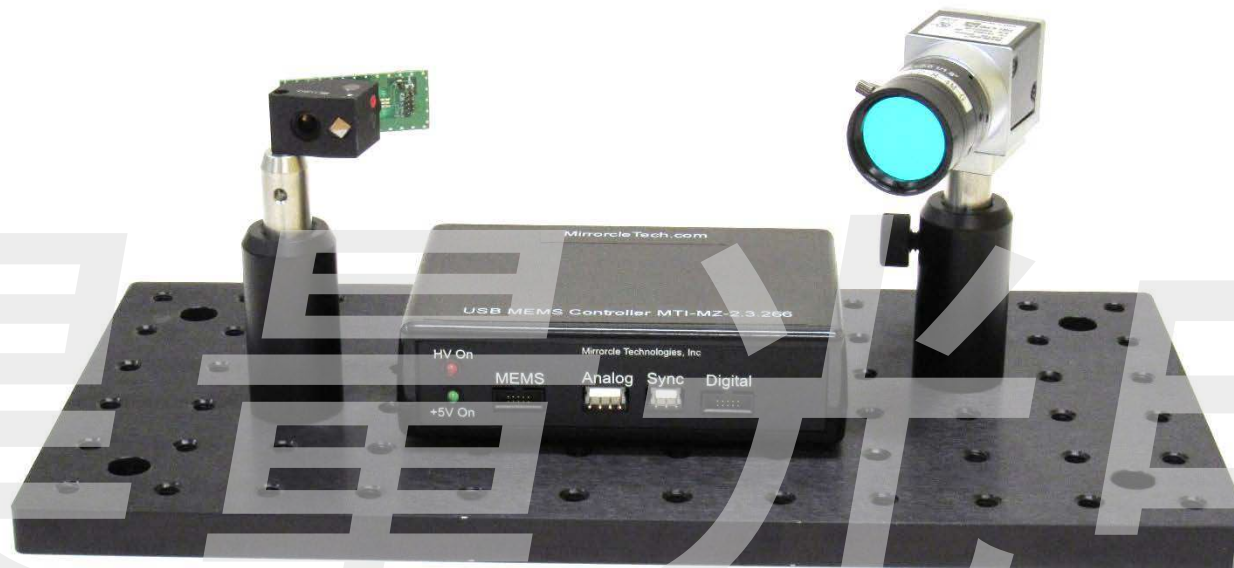


The products discussed in this User Guide are intended for development and prototyping purposes as **OEM** subsystems for incorporation into customer's prototypes and end products. Therefore, they do not comply with the appropriate requirements of FDA 21 CFR, section 1040.10 and 1040.11 for complete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



3D SCANNING DEMONSTRATOR KIT (DEMO-06)

mirrorcle
TECHNOLOGIES, INC.

Last Revised: August 2020

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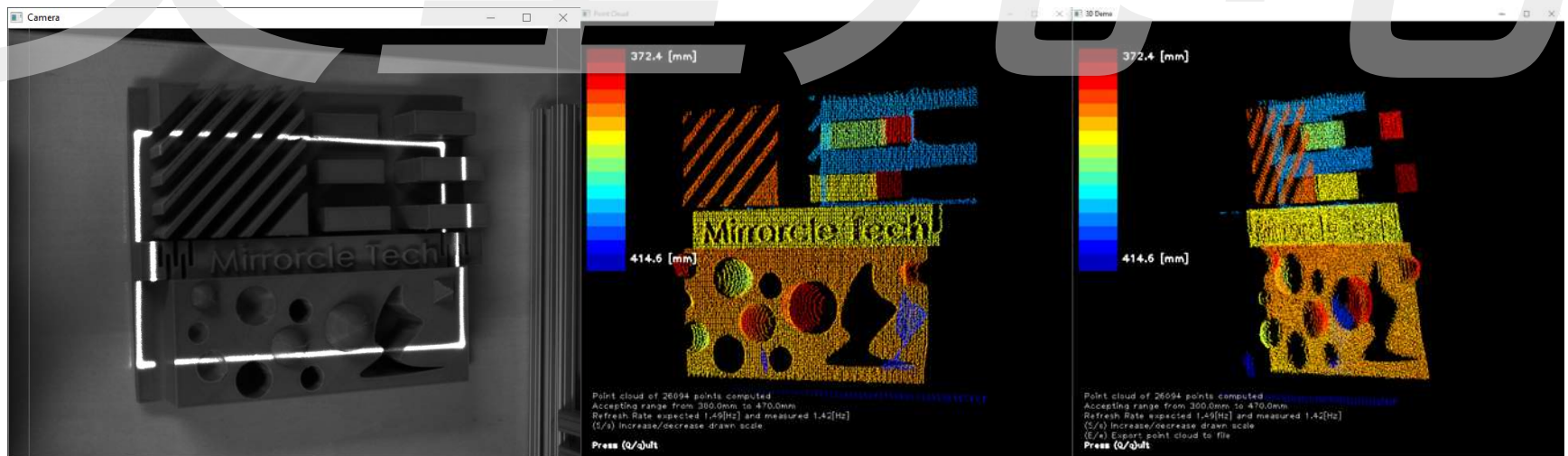
Mirrorcle Technologies, Inc.

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Introduction

- The **3D Scanning Demonstrator Kit** is a plug-and-play kit with a **MEMS-mirror based Scan Module**, **USB MEMS Controller**, and a **USB 3.0 Camera**.
 - Part Number: **DEMO-06**
- The kit is designed to demonstrate the capabilities of Mirrorcle's MEMS mirror and controller with simple Windows based applications to provide **Programmable Illumination** for 3D Scanning applications. Users may programmatically steer a laser over a field of regard of $\sim 32^\circ \times 32^\circ$ and more. In conjunction with the camera it offers additional capabilities of imaging and 3D metrology of objects in camera's field of view with a laser.

3D Scanning Demonstrator Kit



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What does the DEMO-06 Kit do?

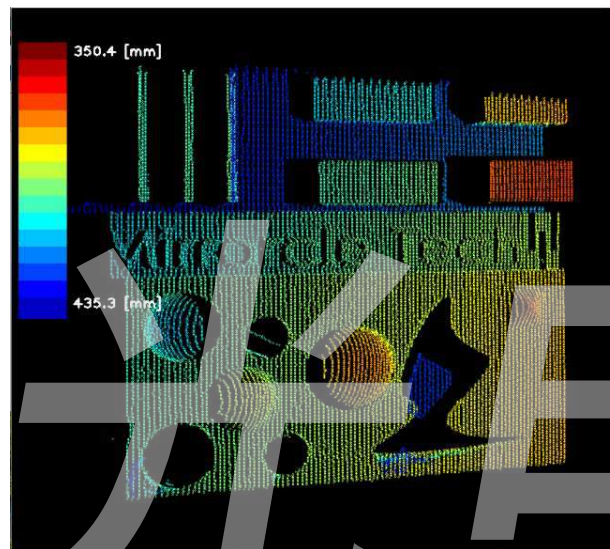
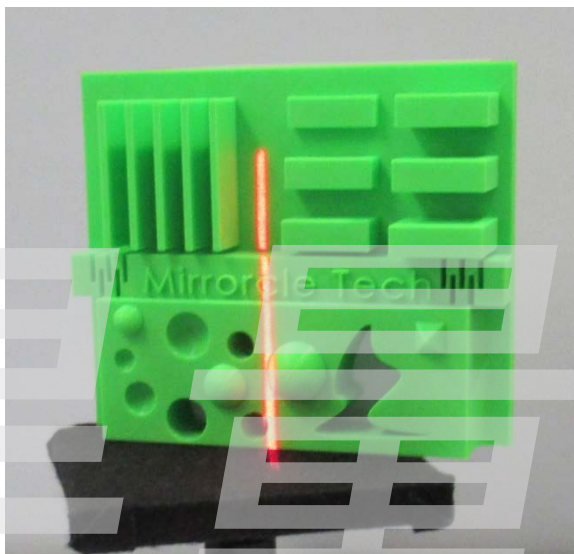
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3D Scanning with Programmable Illumination

- DEMO-06 takes advantage of a finely calibrated opto-mechanical setup to triangulate positions by using the MEMS scan module as a source of illumination and the USB 3.0 camera as a receiver.
 - MEMS Scan Module's FoR is a calibrated LUT of angles, which are used with illuminated pixels on the USB 3.0 camera receiver to **triangulate and generate 3D point clouds.**
- Application Areas:
 - Metrology – Optically measuring distances between locations in 3D
 - 3D Scanning – optically illuminating and measuring 3D positions of objects
 - Mapping
 - Biomedical Imaging



3D Scanning with Programmable Illumination



- With **programmable illumination**, users can modulate the number of scan lines as well as position, rotation, size, and speed of the scan.
- Programmable illumination is possible through the use of Mirrorcle's dual-axis MEMS mirrors as the laser beam steering component.
 - Mirrorcle MEMS support arbitrary, point-to-point beam steering

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What does DEMO-06 include?

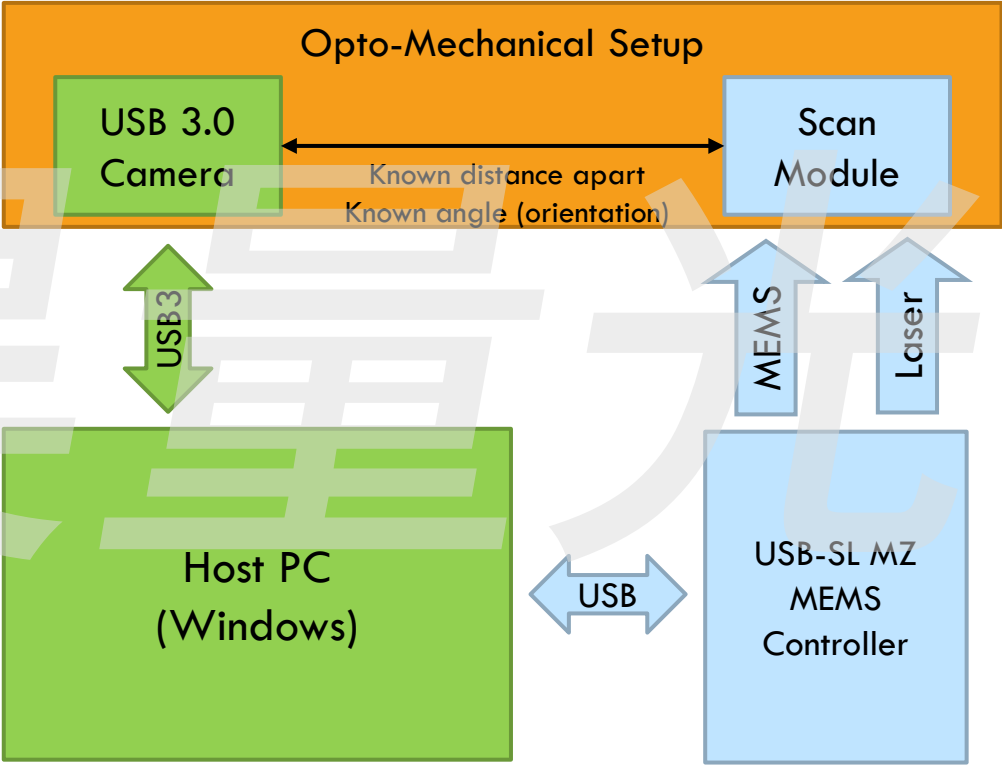
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Demonstrator Kit - Contents

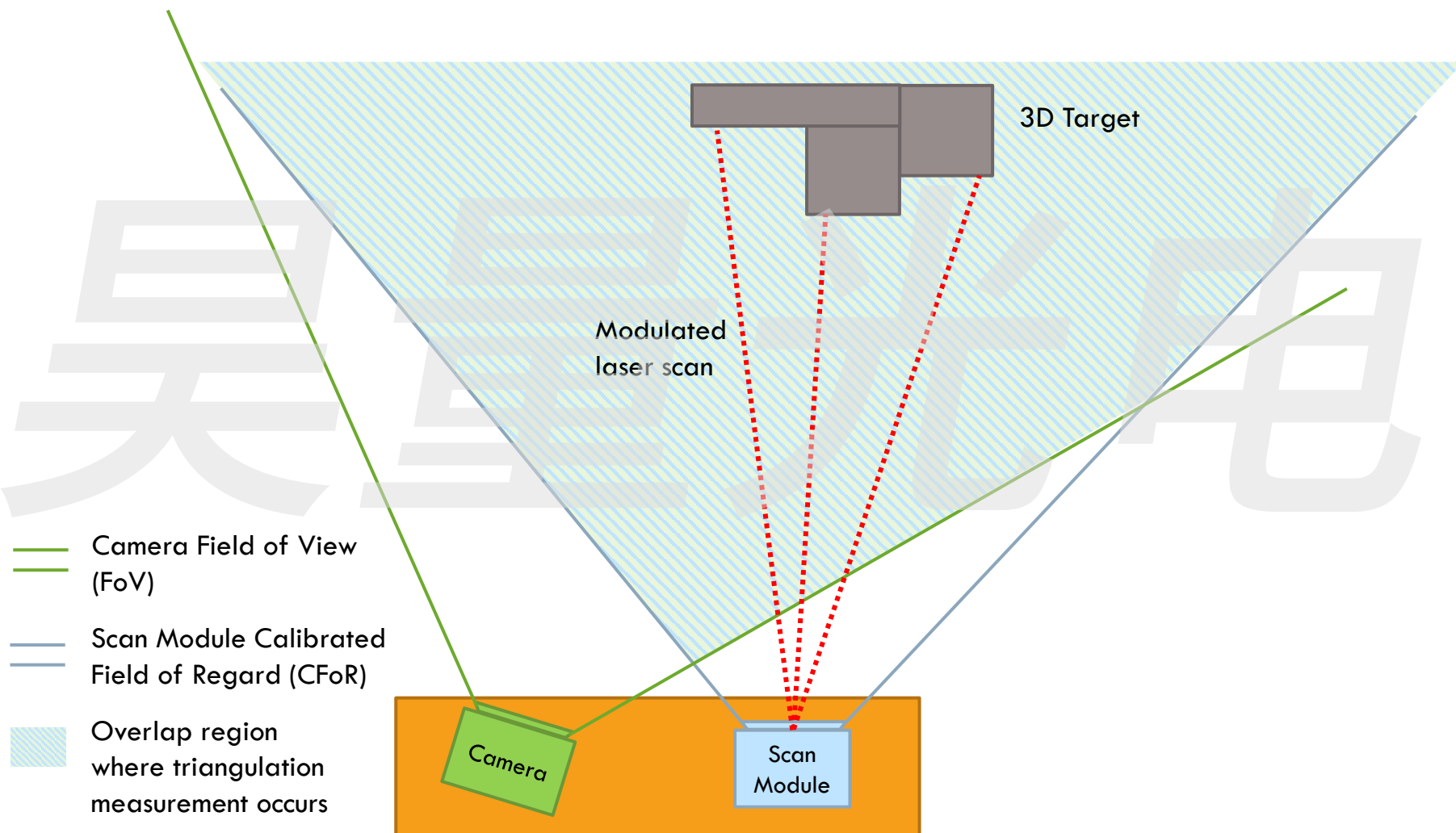
- **EaZy4.0V Scan Module** - optomechanical cell with mirror, laser and optics, designed to be driven by USB MEMS Controller (below)
 - MEMS Mirror: A7M10.2-1000AL
 - Violet Laser module (405nm)
 - Wide Angle Lens and optics with 32° optical FoV
- **USB 3.0 Camera** with 8mm lens (~34.5° x 26.2° FoV)
 - 720x540 pixels, capable of up to 500 fps
- Mechanical mounting for Camera and Scan Module
- USB-SL MZ **USB MEMS Controller**
 - PIC32MZ MCU and Embedded MEMS driver
 - USB powered and controlled by USB (software API) commands
- Mirrorcle **Software Suite** + Camera Sense API
 - Software Examples (C++) specific to DEMO-06
 - Comprehensive **Documentation** and Software **Support Hours**



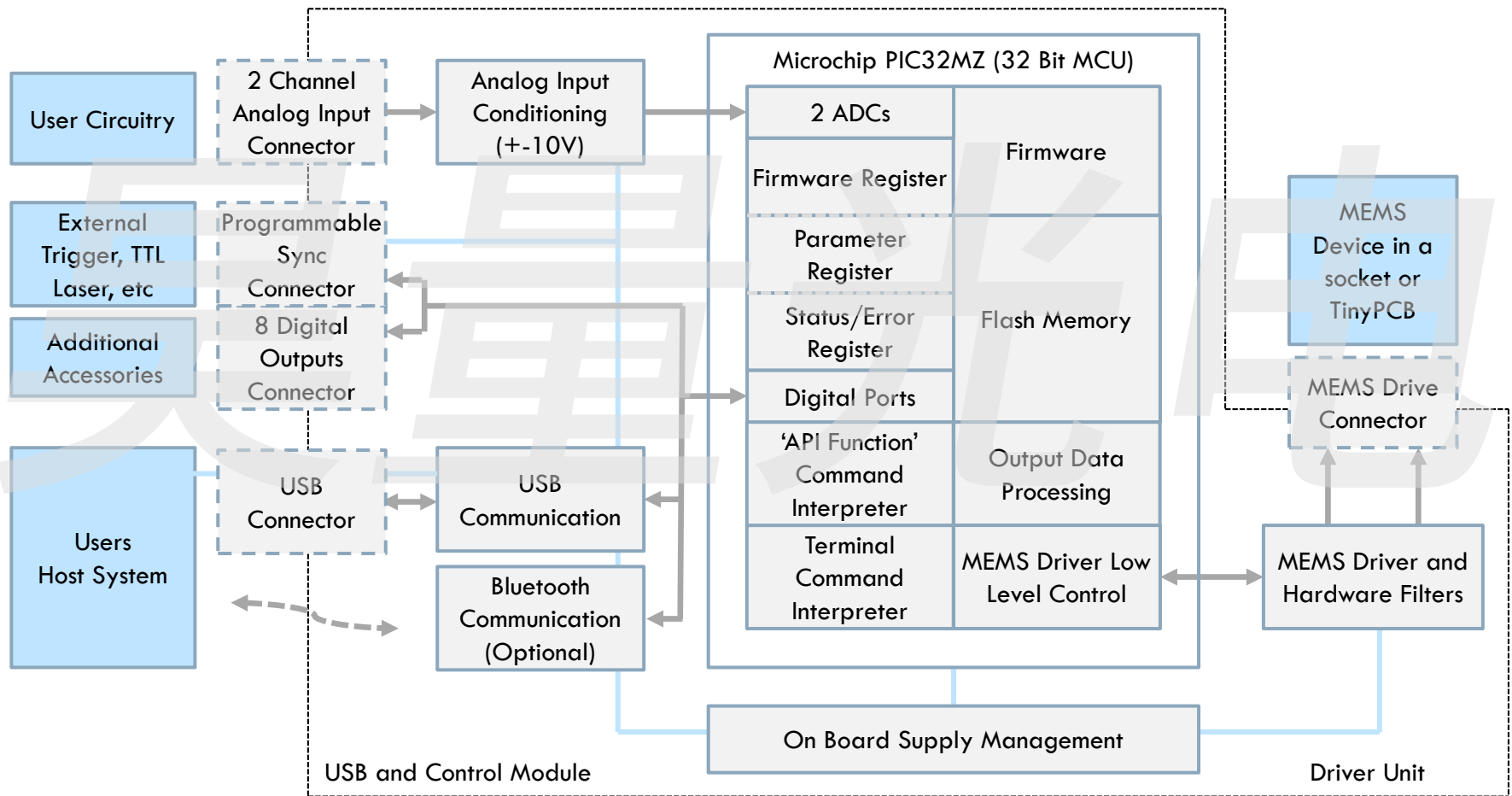
Block Diagram



Optical Diagram



USB MEMS Controller “USB-SL MZ”



USB MEMS Controller vs. MEMS Driver

- A Controller converts software input commands to 8 high voltage outputs to command X,Y positions as well as to 8 low voltage digital outputs (trigger pins or M output). Mirrorcle's USB-SL MZ MEMS Controller is designed for plug-and-play simplicity and is paired with an expansive, open application programming interface (API) for users to interact with the Controller and develop their own applications.
 - Mirrorcle's USB-SL MZ MEMS Controller design is based on Microchip's PIC32MZ MCU
- A MEMS Driver (here fully integrated inside the Controller) converts low voltage input commands (e.g. analog -10V to +10V from 2 inputs X,Y or digital SPI) to 4 high voltage outputs to command X,Y positions. Use of a MEMS Driver (as a general Mirrorcle product for OEM customers) instead of a Controller requires bench-top lab equipment such as function generators or a data acquisition (DAQ) card.

Mirrorcle Software Suite - Applications

Mirrorcle Software Suite (“MSS”) has Windows Applications and software development kits (SDKs)

- **MTICamera-3DScan**
 - Explore 3D Scanning with the DEMO-06 kit. Includes a number of scanning example as well as all the calibration and system setup functions.
- **MirrorcleDraw**
 - Powerful Windows application to fully control the MEMS Mirror. (E.g. freehand and polyline sketches, parameterized mathematical curves, import of data files, text or clock output modes, raster patterns with various settings and a function generator with various settings)
- **MirrorcleLinearRaster**
 - Creates uniform velocity linear raster scans and controls the number of lines, points per line, line scan times, rotation etc. Possible to export raster scan data files (.kpt and .smp).
- **MirrorcleListDevices**
 - Scans the COM ports of the computer and provides a table of connected MTI devices with their properties.
- **MTIDevice-Demo**
 - Executable made from C++ SDK example code by the use of MTIDevice and MTIDataGenerator function calls.

For information on compatibility with other platforms such as Linux and other Add-On options, contact

sales@mirrorcletech.com and/or browse the [Development Kits overview document](#)

Mirrorcle Software Suite - SDKs

□ C++ based Software Development Kit

- The Software Development Kit (SDK) of the Mirrorcle Software Suite allows users to develop their own applications.
- C++ API - The interface provides classes and functions for analog output, control of laser output, sample rate, filter settings, amplitude, device communication, etc.
- An example Visual C++ project is provided to illustrate the use of the API and several ways of driving devices in point-to-point, rastering, and other modes.



□ Matlab-based Software Development Kit

- Similar to the C++ version, this is a Matlab-based software development kit (SDK) allows the user the fastest and easiest route to development of micromirror applications. Multiple examples included.
- This SDK does not include Camera-related functionality, only MEMS Mirror control – it is included in this suite for general purposes.



MATLAB

□ LabView-based Software Development Kit

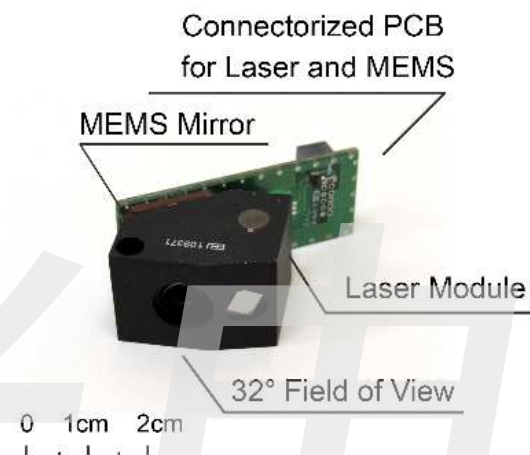
- Includes multiple examples of content generation (and content importing) and driving of MEMS mirror devices from National Instruments LabView software.
- This SDK does not include Camera-related functionality, only MEMS Mirror control – it is included in this suite for general purposes.



LabVIEW

EaZy4.0V Scan Module

- **MEMS Mirror:** A7M10.2-1000AL
- **Bandwidth:** ~2400Hz in LPF-based driving
- **FoR:** Approx. 32° x 32° Field of Regard
- **Wavelength:** Single laser diode source in:
 - Violet (~405nm), up to 25mW CW power
- **Divergence (half angle):** <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:**
 - Vbias = 90V
 - VdifferenceMax = 140V
 - HardwareFilterBw = 2400Hz

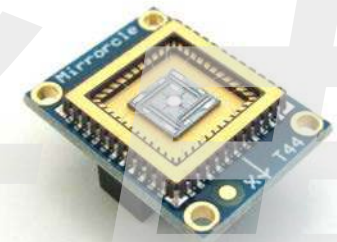


Example application of a Scan Module in Vector Graphics Laser Projection (VGLP)



MEMS Mirror Device - A7M10.2-1000AL

- EaZy4.0 Scan Modules are powered by Mirrorcle's fast **dual-axis quasi-static** MEMS Mirror A7M10.2-1000AL
- Key features:
 - 1mm Diameter (clear aperture)
 - Aluminum thin film coating, very **high optical quality**
 - Gimbal-less design optimized for **point-to-point** optical beam scanning
 - **Fast** resonant frequency in both axes above 4 kHz
 - Positional precision at least 14 bits on each axis
 - **Highly repeatable** with no detectable de-gradation over time (>50,000 hr lifetime)



A7M10.2-1000AL-TINY48.4-NW
Example

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Pricing and Availability

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Pricing and Availability

- Contact sales@mirrorcletech.com for a formal quotation with most up to date pricing and lead time
- Typical lead time is 3-4 Weeks

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Thank You for Choosing

Additional Resources:

- [Mirrorcle MEMS Mirror Technical Overview](#)
- [Mirrorcle Software Suite – Applications Guide](#)
- [Mirrorcle Software Suite – SDK Documentation](#)

