Standard Mirrorcle Development Kit - Contents

- **Three** Gimbal-less Dual-Axis MEMS Mirrors
  - 1.2mm, 2mm, 3.6mm diameter, Aluminum coated
  - TinyPCB LCC20 3.x connectorized packages

- USB MEMS Controller
  - Includes all necessary cables and connectors

- Mirrorcle Software Suite, with comprehensive documentation

- Laser and Optical Breadboarding
  - Red Laser module — with TTL modulation input
  - 90° optical mount for the laser module on a ½”-diameter post
  - 4.5” x 4.5” optical plate and two post holders
  - 2-axis kinematic mount with MEMS MiniPCB on a ½”-diameter post

- **OPTIONAL Add-ons listed on Development Kit Optional Add-Ons page**
Semi-Custom Mirrorcle Development Kit - Contents

- **Three** Gimbal-less Dual-Axis MEMS Mirrors
  - User chooses types, sizes, coatings and packages for all three devices
- **USB MEMS Controller**
  - Includes all necessary cables and connectors
- **Mirrorcle Software Suite, with comprehensive documentation**
- **Laser and Optical Breadboarding**
  - Red Laser module – with TTL modulation input
  - 90° optical mount for the laser module on a ½”-diameter post
  - 4.5” x 4.5” optical plate and two post holders
  - 2-axis kinematic mount with MEMS MiniPCB on a ½”-diameter post
- **OPTIONAL Add-ons listed on Development Kit Optional Add-Ons page**
Development Kit – Optional Add-ons

- **Wide-Angle-Lens** – Multi-element afocal lens to magnify optical angles ~3X
- **Wireless Option** – Bluetooth module for wireless communication with Controller
- **Laser Tracking Bundle** – Includes a photo sensor with multistage amplifier, reflective tape, software upgrade, code examples and documentation
- **Android Development** – Includes the ‘Wireless Option’ Add-on, an Android Tablet with preloaded sample Apps, and an Android SDK with documentation
- **Linux Development** – Includes a Raspberry Pi with MicroSD card preloaded with Linux based OS for Raspberry Pi, sample applications and a C++ SDK with documentation
Development Kits – USB-SL Option

- Mirrorcle MEMS Controller with an MCU and 125kB of RAM
- Embedded Mirrorcle MEMS Driver with hardware filters for electrostatic MEMS driving, 0V - 160V Output
- 16 bit outputs for X and Y axis control
- Sample rates up to 100kHz
- Powered and controlled by USB
- 8 Correlated Digital Outputs
- Sync Port for synchronization with additional Controllers
- 2x 12-bit Analog Inputs with +/- 10V range
- Standalone functionality with Autostart of user settings and data from flash memory
- Dimensions: Approx. 80mm x 115mm x 30mm
- Weight: Approx. 140g

*Available as OEM Controller (provided as PCBs with no boxes or cables and require minimum order quantities)
Standard Kit - MEMS Mirror Devices

- Standard Development Kit - Includes the following MEMS mirror devices in TinyPCB LCC20 connectorized packaging:
  - A3I12.x – Integrated 1.2mm diameter, Aluminum mirror
  - A7M20.x - Integrated 2.0mm diameter, Aluminum mirror
  - A7B2.x – Bonded 3.6mm diameter, Aluminum mirror

- Semi-custom Development Kit - Mirror sizes from 0.8mm to 5.0mm in diameter are available. Integrated mirrors up to 2.4mm and bonded mirrors for larger diameters. Multiple packaging and mounting options.

- Packages are covered with a broadband anti-reflection (AR) coated window. Three different AR coatings are available:
  - Coating Type A: 400nm - 675nm
  - Coating Type B: 675nm - 1040nm
  - Coating Type C: 1040nm - 1600nm

MEMS Mirrors in Standard Development Kit.
Development Kits - MEMS Mirror Packages and Mounted MiniPCBs

DIP24

LCC20
LCC28

TinyPCBs:
LCC20
LCC28
LCC48

Device package directly mounted onto PCB for easy connectorized integration

Easiest and safest manual handling, insertion and extraction.
5mW Optical Power TTL Red laser module, modulatable up to 40kHz

MiniPCB with ZIF socket on a kinematic mount

Example of assembled development kit optical breadboard with post holder for MiniPCB and a laser module. The optical breadboarding also includes a swivel and post holder if the wide-angle lens is purchased with the kit.
Several ways of communicating with the USB-SL M4 Controller are available, whether by USB interface or by Bluetooth interface with a PC or an Android or Linux device.
USB-SL M4: Various Ways to Control

**APIs in several languages**

- Comprehensive APIs for generation of content (MEMS positions and correlated digital outputs), for control and streaming of the content, reading of analog inputs, synchronization with additional Controllers or peripherals, tracking, etc.
  - C++ SDK (Windows and Linux)
  - LabVIEW and Matlab SDKs
  - Java (Android) SDK

- Easy-to-use GUI and Console Applications such as MirrorcleDraw, MirrorcleLinearRaster, MirrorcleTrack, for various platforms (previous slide)

**Serial Terminal Commands**

- Serial port terminal commands are available for more basic MEMS mirror control without the use of the Windows, Android, Linux APIs.
Mirrorcle Software Suite

- The Mirrorcle Software suite comes with the Windows executables and development software. The CD includes application manual and comprehensive Software Development Kit (SDK) guides.

- Executables:
  - MirrorcleDraw – Windows Executable
  - MirrorcleLinearRaster – Windows Executable
  - MirrorcleListDevices – Windows Executable
  - MTIDevice-Demo – Windows Executable (made from SDK example)

- For Development:
  - C++ SDK
  - Matlab SDK
  - LabView SDK
Mirrorcle Software Suite - Executables

- **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**
  - Use the arrow keys on the keyboard or enter coordinates to direct the MEMS to a desired location. Import Keypoint or Sample files to be scanned.
  - Executable made from C++ SDK example code by the use of MTIDevice and MTIDataGenerator function calls.
Mirricle Software Suite - SDKs

- **C++ based Software Development Kit**
  - The Software Development Kit (SDK) of the Mirricle 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 Matlab-based software development kit allows the user the fastest and easiest route to development of micromirror applications. Multiple examples included.

- **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.
Optional Add-on - Wide Angle Lens

- Custom designed and built afocal lens with 3 lens elements that will magnify the optical scan-angles of the system by approximately 3X. This magnification is substantially linear, resulting in overall development kit scan capability of over 45° optical FoV. Includes 1/2" and 1" diameter lens elements and comes mounted on a 1/2" optical post.
Optional Add-on - Wireless Option

- USB-SL Controller with Bluetooth transceiver
- The firmware on the USB-SL Controller supports USB and Bluetooth operation
- In wireless mode, the communication remains as high as 921kBaud
- Windows executables like MirrorcleDraw can detect wireless controllers if the host PC has Bluetooth connectivity and has paired with the Controller
Optional Add-on – Laser Tracking Bundle

- PhotoSensor – Connects to the USB-SL Controller’s Analog Input Port
  - Silicon Photodiode with an optical (daylight) filter
  - Multistage amplifier with a bandpass filter for noise reduction
- Reflective ‘target’ tape samples
- API for the tracking library classes
- An example Visual C++ project to illustrate the use of the tracking library classes
Optional Add-on - Android Development

- Includes the ‘Wireless Option’ - Mirrorcle USB-SL MEMS Controller with Bluetooth
- Android SDK: Application example Eclipse Project using Mirrorcle Android API 10.x
- Android SDK Guide
- Android Tablet or Smartphone device with preloaded application examples

- Controller powered by USB connection (possible by rechargeable USB battery)
Optional Add-on – Linux Development

- Raspberry Pi with preloaded application examples and sample code
- Linux C++ SDK: Application example project using Mirrorcle C++ API 10.x from Raspberry Pi Controller
- C++ SDK Guide
- Controller powered by USB connection (possible by rechargeable USB battery)
Thank You!

If you have any further questions please contact us:
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