

## Meric Technology Represents

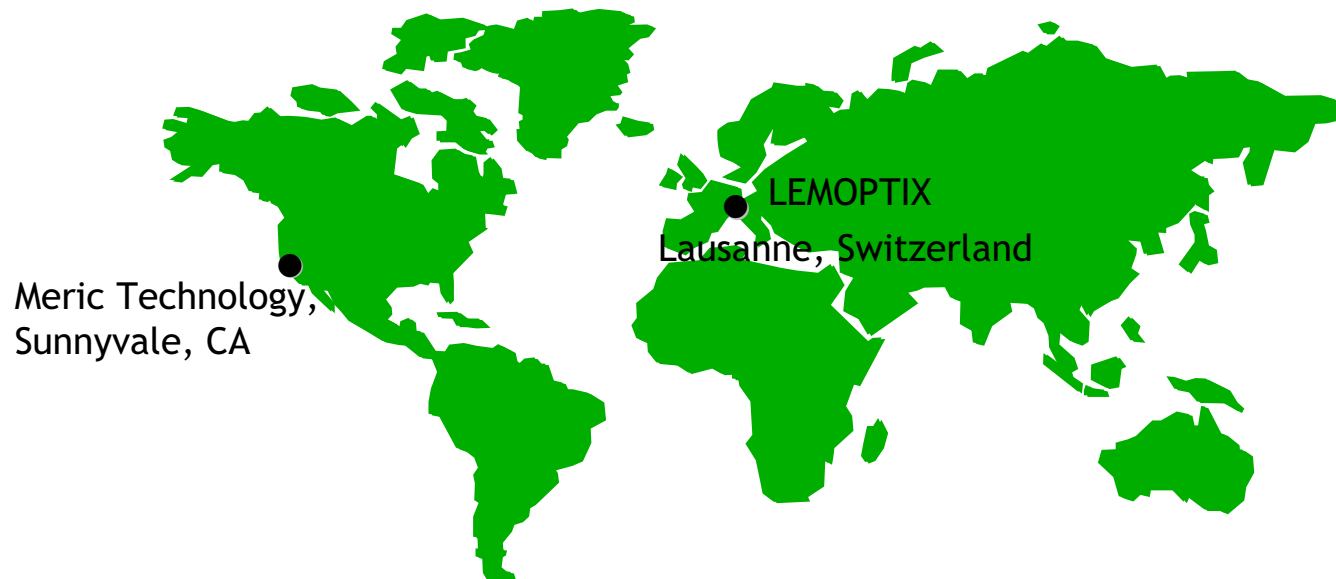


### MEMS Laser Scanning Micromirrors and Microprojection Modules



## LEMOPTIX at a Glance

- Expert in MOEMS (Micro Optical Electro Mechanical Systems) Micromirror Technology
- 10 year R&D Experience - Headquartered in Lausanne, Switzerland
- Founded 2008, spin-off from EPFL (Swiss Federal Institute of Technology), Lausanne, CH
- Modeling, Design, Fabrication, Wafer Level Packaging, Optical and Electronic System Dvt.
- Fabless Business Model; using EPFL Facilities for Product Design and Small Volumes



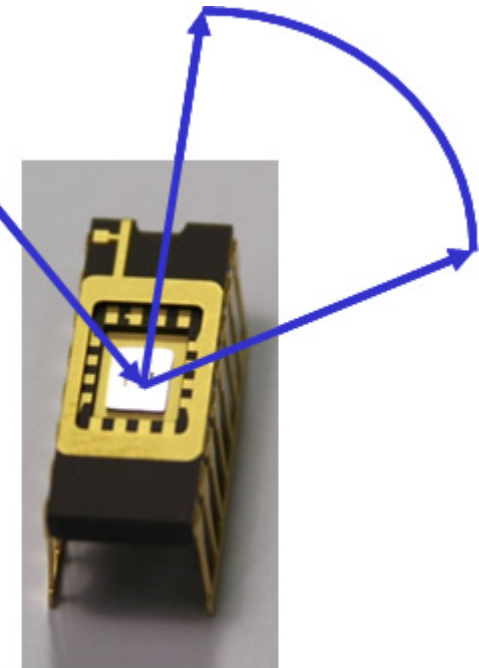
## LEMOPTIX MEMS Laser Scanning Micromirror Overview

- Silicon Based MEMS (Single Crystal)
- Resonant or Static Operation
- Standard Products and Custom Services Available
- Wafer Level Hermetic Packaging
  - No Manipulation
  - No Humidity
  - No Dust Contamination
- Micromirrors Can be Delivered Fully Encapsulated or Not
- Usually Mounted on Rigid PCB. Ceramic/Flex PCB Possible



Fully hermetically encapsulated  
MEMS micromirror

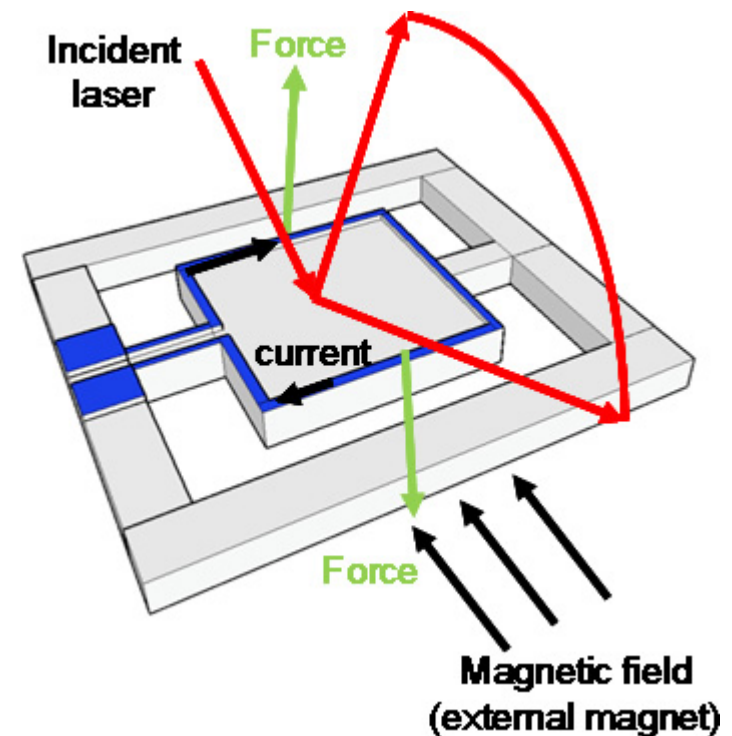
Incident laser



**1D and 2D micro-scanner**

## LEMOPTIX MEMS Laser Scanning Micromirror Characteristics

- Mono-Crystalline Silicon Structure
- Magnetic Field Actuation 1D - 2D
- Continuous Optical Scanning - Angle Up to  $60^\circ$
- Scan at Mechanical Resonance (250Hz - 70KHz)
- Non-Resonant Frequency DC to 100Hz (Static)
- Mirror Size 0.5 - 4mm side - Good Linearity
- Light Reflection  $> 85\%$  from Visible to IR
- Integrated Mirror Tilting Position Sensor
- Low Voltage Operation  $< 3V$



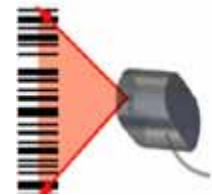
## LEMOPTIX 1-D Micromirror Advantages and Applications

### Advantages

- Ultra Small Size MEMS and Driving Electronics
- Low Operating Voltage <3V - Low Power Consumption
- Static to High Operating Frequency
- Fatigue-Free Magnetic Actuation
- High Reflectivity (Enhanced by Metal or Coating)
- Excellent Linearity

### Main Applications

- Optical Spectrometers
- Barcode scanners
- Endoscopes
- Medical Imaging
- Laser Beam Pointing



## LEMOPTIX MEMS Laser Scanning Micromirror Standard Offering

- **LSCAN-F Series: Resonant MEMS mirrors**

- 1D1-F3: 3.3KHz / 60°
- 1D1-F4: 5KHz / 50°
- 1D1-F5: 11KHz / 30°
- 1D1-F6: 15KHz / 24°
- 1D1-F7: 19.5KHz / 18°

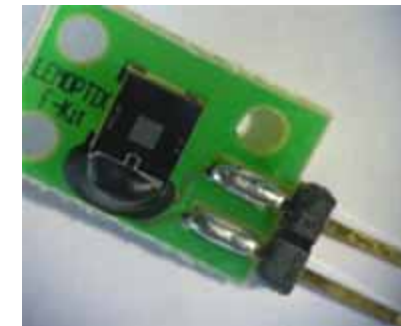
(Actuation with AC - See datasheet for details)



- **LSCAN-DC Series: Static MEMS mirrors**

- 1D1-DC2: 700Hz / 30°
- 1D1-DC3: 1200Hz / 30°

(See datasheet for details)



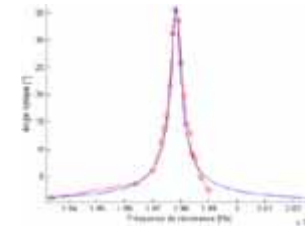
- Reflectivity > 85%

- Delivered on Rigid PCB, no Glass Packaging

## LEMOPTIX MEMS Laser Scanning Micromirror Custom Services

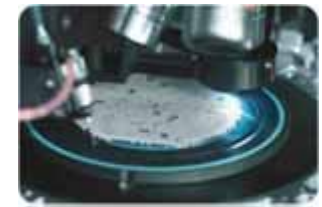
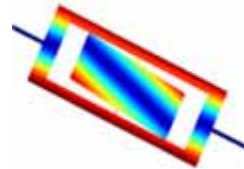
### ▪ Initial Feasibility Study

- Modeling Expertise and Tools
- Measurements, Simulation, Target Analysis



### ▪ Micromirror Design to Tested Prototypes

- 1D-2D to Suite Exact Need
- Frequency and Size
- Reflective Material (Al, Au)...



### ▪ Driving and Sensing Electronics

- Standard Driving Electronics with Position Sensing
- Custom Interfaces to Suite Existing Electronic Platforms



### ▪ Assembly and Mounting

- Encapsulated or Not
- Rigid PCB (Standard), Flex PCB and Ceramic Mounting

## Next Step

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## Microprojector Modules

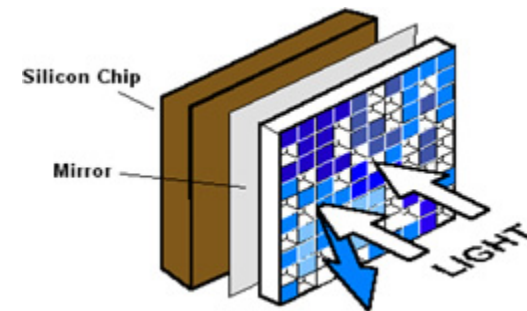
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## Competing Microprojection Technologies

### ▪ Matrix Based Technologies

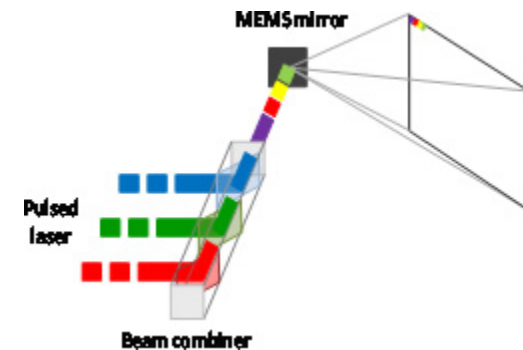
- DLP® (Digital Light Processing from Texas Instrument)
  - Millions of Digital Switching MEMS Al Mirrors
  - Lamp/LED Continuous Illumination
- LCOS (Liquid Crystals on Silicon)
  - Millions of Liquid Crystals on Silicon
  - Reflected Light in Liquid
  - Lamp/LED Continuous Illumination
- FLCOS (Ferroelectric Liquid Crystals on Silicon)
  - Uses Ferromagnetic LC Material



### Sequential projection of RGB Colors

### ▪ LASER Beam Steering Technology (LBS)

- Lemoptix Technologies
- Continuously Scanning Micromirrors
- Pixel-By-Pixel Ultra Fast Scanning and Pulsed Laser
- Fast Axis and Low Refreshing Axis



## LEMOPTIX Microprojector Advantages (1)

- **High Brightness**

- Laser Light Source vs LED
- Highly Reflective MEMS Coating



- **Miniature**

- Few mm Thick vs cm Range
- Few Components (No Optics, No Projection Lenses...)

- **Always in Focus**

- Laser Collimation
- Custom Interfaces to Suite Existing Electronic Platforms

- **Energy Efficient**

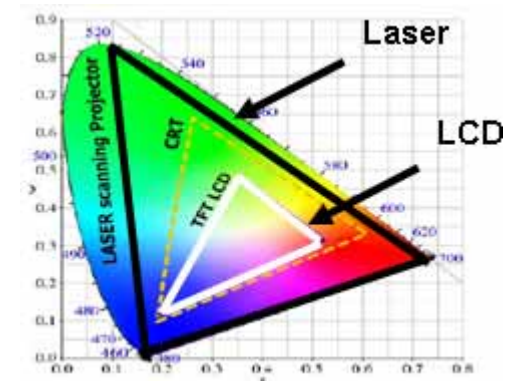
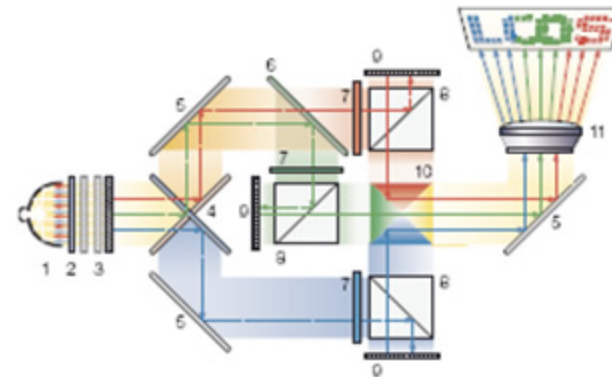
- ~100% of the Light Hits the MEMS
- Light On Demand 3 times More Efficient
- No Losses with Intermediate Optics



## LEMOPTIX Microprojector Advantages (2)

- **Low Cost**
  - Low Silicon Foot-Print Chip
  - Low Number of Components
  - No Autofocus Device Needed
  
- **Vibrant Colors**
  - Largest Spectrum Range with Lasers
  
- **Future Product Orientations**
  - Full Eye Safety
  - Distorsion Auto Correction
  - Projected Tactile Display

*LCOS projector for comparison*



## LEMOPTIX Microprojector Ideal Solutions for:

### ▪ Professional Applications

- Industrial Displays
- Head-Up Displays (HUDs)



### ▪ Consumer Applications

- Laptops
- Mobile Devices



### ▪ 3D Volume Measurement Systems





**«Simple is Best !»**