



- 1 LDC (Light Deflection Cube), scan head equipped with IPMS MEMS scanner.
- 2 Control panel: Software GUI.
- 3 Driving electronics board.

## LDC (LIGHT DEFLECTION CUBE) – 1D SCANNER MODULE

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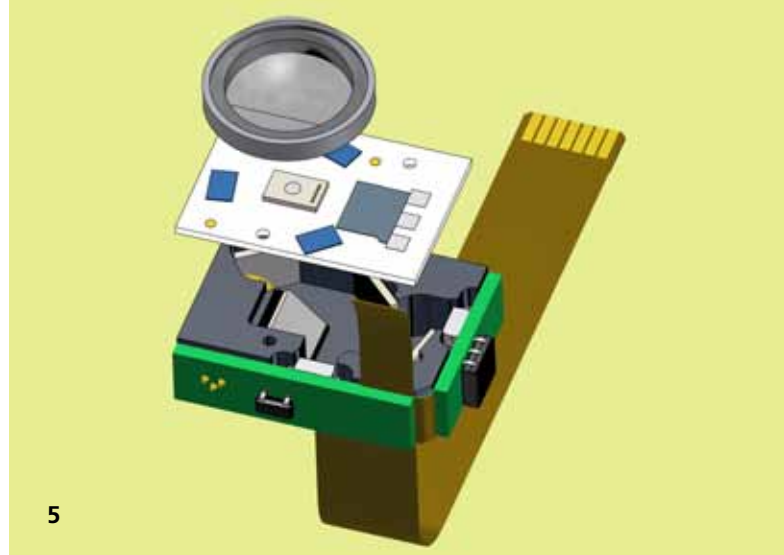
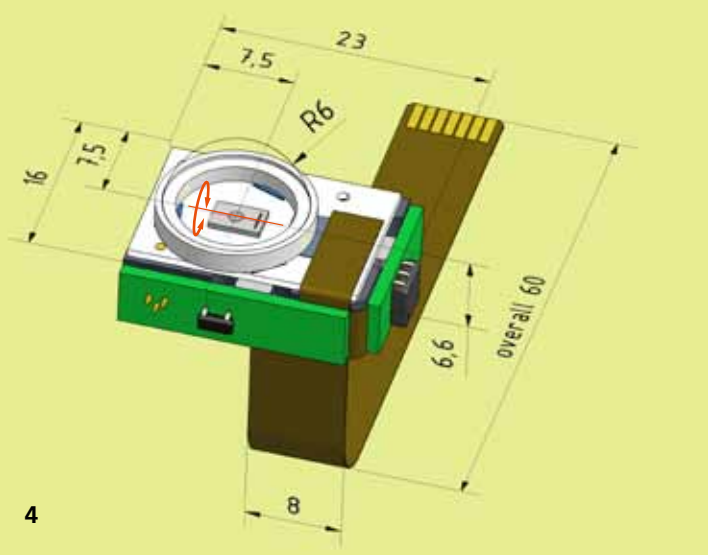
### Introduction

Optical scanning is a well known and widely spread technique to collect data, to measure 3D topologies, to project images or to scan the lights' spectral components across a single detector. Micro mechanical scanning mirrors offer a high degree of miniaturization, high scan frequencies, high mechanical robustness and the potential for low cost manufacturing at high volumes. MEMS scanners are very promising especially for small and portable systems. The development and fabrication of customer-specific scanning mirrors has been a well established process at the Fraunhofer IPMS for many years. Our areas of expertise cover MEMS fabrication in state-of-the-art clean room facilities as well as system solution development.

The integration of each individual MEMS scanner design depends on the particular

application and requires a number of different development stages from the bare chip to the ready to use module. The MEMS system integration requires a thorough understanding of the micro scanning mirrors and of the application, and thus requires personnel and long training periods in most cases.

Based on its competence in system integration of micro scanner devices Fraunhofer IPMS realized in cooperation with the Carinthian Tech Research AG (CTR) / Austria the 1D micro scanner module LDC. Its modular platform approach was developed to bridge the gap between the supply of bare MEMS dies and the final system integration in the customer application enabling a drastic enhancement of the short term availability of OEM-capable customized MEMS solutions. The



application-specific MEMS scanner system LDC is based on a modular approach where several prefabricated components can be flexibly combined to meet our customer's demands. All processes and components are also compatible with large-scale fabrication, which allows cutting down large-scale production times and development efforts. The LDC platform can be used with MEMS selected from the Fraunhofer IPMS VarioS® platform and thus is an ideal complement to VarioS®.

### System Description

The complete modular system platform LDC consists of:

#### Scanning head, with

- Micro scanner device (customer's choice from IPMS-VarioS®, other available IPMS-MEMS devices or customized MEMS design fabricated at Fraunhofer IPMS)
- Chip carrier with housing and front optics
- Optoelectronic position sensor for deflection control

**Driving electronics board** generating all necessary signals and voltages, communication via

- SPI interface
- Digital output ports (MEMS-drive synchronous signals)

#### Software package

- Graphical user interface for function control and amplitude setting
- C#-API and DLL for usage with customer's software

#### SPI interface adaptor

#### Power supply and connection cables

### MEMS Scanner

Scanner type	Electrostatic resonant 1D
Scanning frequency	500 Hz ... 50 kHz (≥ 200 Hz on request)
Optical scan angle (FOV)	Depending on scanner, optical scan angle up to 80° (mechanical scan angle ±20°) supported
Active mirror diameter	1 ... 4 mm
Active mirror surface	Aluminum, reflectivity 88 ... 90% in visible wavelength range (400 ... 700 nm)

### Scan Head

Substrates with available technologies	Ceramic (standard), glass or PCB on request
Sealing	Dust-proof
Optical interface	Dome with anti-reflective coating; option: plane window on request
Mirror position control	Optical, integrated in scan head, signal processing on driving electronics board
Electrical interface	Flexible flat cable connected to sensor system
Module footprint	16 × 23 mm <sup>2</sup>
Working temperature	0 ... 45 °C (extended temperature range on request)

### Driving Electronics Board

Dimensions	77 × 46 mm <sup>2</sup>
Supply voltage	5 V DC
Internally generated driving voltage for scanner	15 V ... 200 V, max. 3 mA
Operating modes of the scanner control	amplitude-controlled (above 8° scanning angle) or voltage-controlled
Interfaces	SPI, I/O ports

### Examples of Available MEMS Scanners

Parameter	Platform			
		VarioS®	IPMS pre-developed	
Scanning frequency	Hz	1000 ... 50,000	250	25 000
Amplitude (mech.)	± °	5 ... 30	15	10
Mirror diameter	mm	1 ... 3	1.5	1.2
Driving voltage	V	15 ... 200	15	140
Dimensions of scanner chip	mm <sup>2</sup>	5.37 × 4.54	3.5 × 2.8	4.1 × 2.7

◇ VarioS®: see Scanner Configurator of Fraunhofer IPMS, [www.micro-mirrors.com](http://www.micro-mirrors.com)

4 Scanning head: main dimensions.

5 Scanning head: components design.