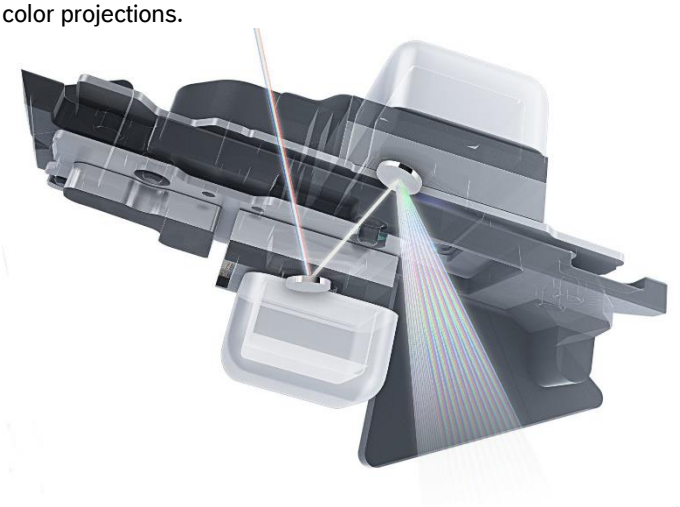
BML050
Microscanner

GENERAL DESCRIPTION

The BML050 microscanner is the first product within Bosch Sensortec's new product family of optical microsystems. BML050 combines a compact wafer-level module package with the essential control circuits that are needed to implement a laser scanning projector. This includes:

- MEMS scanning mirrors, encapsulated, optically aligned
- Mirror control circuits, video processor and interface
- Laser driver ICs and power management ICs

The BML050 microscanner draws an image by deflecting a collimated laser beam line by line across a screen while modulating the laser accordingly.
The combination of three lasers (red, green, and blue) allows full color projections.



Microscanner working principle

The main benefits of this approach and its implementation in the BML050 are:

- Focus-free projection – no need to adjust the focus, independent of the projection distance
- Compact size combined with power efficiency, making the BML050 ideal for space- and power-restricted devices
- Robust and well-established core technology for fast and simple integration

MICROSCANNER

The BML050 combines two dedicated MEMS scanning mirrors for horizontal and vertical deflections. The mirrors are deflected by electrodynamic drives, which allows operation at low voltages

BML050 evaluation kit

contributing to power efficiency. The mirrors are hermetically encapsulated on wafer level and thus protected against particles, moisture and air pollution.

MEMS mirror features include:

- Pre-aligned MEMS mirrors for easy integration
- High precision position feedback, allowing for closed-loop motion control
- Fail-safe detection that enables compliance with laser safety requirements

The dedicated control circuit includes:

- Fully featured video pipeline for image correction (keystone, distortion), optimal video quality (color calibration, speckle contrast), and extensive monitoring
- Individual image calibration for each microscanner

BML050 TARGET APPLICATIONS

- Interactive projection as an ideal user interface for any device ranging from robotics to home automation
- Pico-projectors as an accessory or built into mobile devices including tablets and notebooks
- Pico-projectors as primary display, e.g. for IoT applications, wearables, home appliances and head-up displays

EVALUATION KIT

Bosch Sensortec has developed a projector evaluation kit that includes all of the BML050 system components as well as the laser light source including the laser diodes and optics. The close tailoring of all reference components provides significant advantages:

- Brightness of more than 25 lm (depending on laser type and settings)
- Unique speckle reduction technology
- Hardware implementation of fail-safe mechanisms, that ensures a shutdown of the lasers within less than 1 µs in compliance with safety requirements

INTERACTIVE PROJECTION

BML050 provides all necessary features to easily implement gesture feedback by monitoring the laser reflection. This approach offers:

- A robust, calibration-free interaction with the projected image
- A flexible user interface that is available only when needed
- A user interface that offers rich options for tiny devices, making it ideal for many IoT devices and even wearables

TECHNICAL KEY SPECIFICATIONS

Optical projection angle	Horizontal axis, max.	±15.0 °
	Vertical axis, max.	±9.1 °
Throw ratio	Projection distance / image diagonal	1.63
Aspect ratio	Standard	16:9
Video resolution	Standard	854 x 480
Frame rate	Standard	60 Hz
Recommended laser wavelength	Red	635 – 640 nm
	Green	515 – 525 nm
	Blue	450 – 460 nm
Speckle contrast	Reference implementation, parameter dep.	12 %
Wake-up	from sleep	<1 s
Contrast	Full-screen contrast	>10000:1
Operation temperature		0 – 60 °C

SOFTWARE AND SERVICES

If required Bosch Sensortec can provide software support for major operating systems (e.g. Android ®) that manage operation and settings, e.g. of image parameters.

In addition, design-in support can be offered. Proven designs for optical and electronic implementation as well as software to support integration (calibration, test) can be licensed.

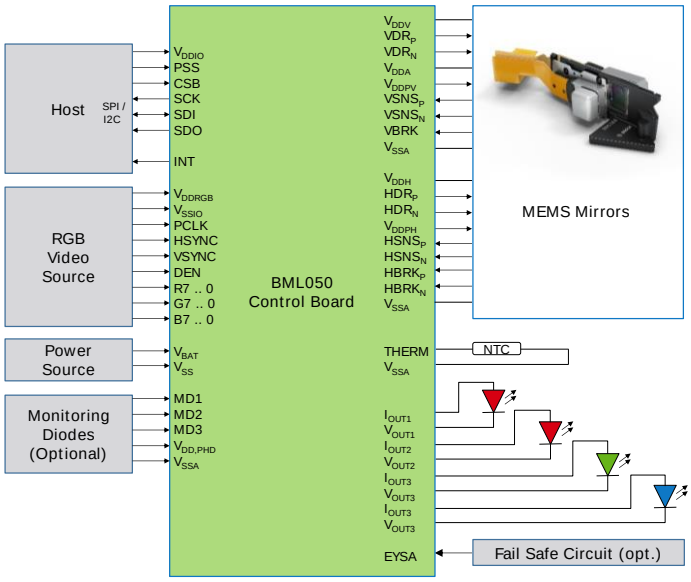
OPERATION

The BML050 provides an RGB888 video interface as well as I²C and SPI interfaces for communication with the host system.

SYSTEM COMPATIBILITY

BML050 has been designed for best possible fit into modern mobile consumer electronics devices.
As BML050 is intended for use with collimated lasers, targeted use cases may be subject to laser safety regulations. Compliance with these regulations falls to the final product. However, considerable effort has been taken to implement failsafe and tamper protection against misuse.

Bosch is the world market leader in MEMS sensors. BML050 from Bosch Sensortec combines extensive experience with reliability for consumer applications.



BML050 block diagram

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Doc.-Number: BST-BML050-FL000-01 / Version_2.0_290917