Fraunhofer Institut Zuverlässigkeit und Mikrointegration

Test Report Grid-Lok System

Fraunhofer Institut IZM

December 2006

Ben-Technologies
SERVICE & SUPPORT

Object Under Test:	Grid-Lok GHD 8712
Length:	330 mm
Test vehicle:	Circuit board mounted on one side Dimensions 240 x 135 x 1.6 mm Material FR 4 Mixed SMD components mounted on one side Solder: Heareus SnAgCu Grain 4
Printer:	EKRA E4
Squeegee blade:	EKRA squeegee angle 60° Thickness of squeegee blade Squeegee blade width
Stencil:	SMD stencil 120 µm thick Bonded in screen measuring 540 x 540 x 40 mm
PCB fixing	Top side fixing by knife edges
Printing speed.	60 mm/s
Screen lift-off:	0 mm
Test procedure:	Spread in one direction with increasing squeegee pressure, simultaneously measure the load of the circuit board at the contact points with the Grid-Lok system.
Pressure measuring: System	Interlink FSR 155 Repeatability +/-2%
Temperature:	21°C air-conditioned
Air humidity:	65%

Author: Dipl. Ing. Ulf Oestermann
Benjamin Englmeier

Preliminary Consideration

When solder paste is applied to circuit boards mounted on both sides, the problem during stencil printing on the second side is that the board underside is already printed, mounted and soldered. Dependent on their casing shape, the devices on that side may no longer be subjected to high forces in the Z direction. In particular, optoelectronic or micromechanical devices react very sensitively to this process. An efficient method that is frequently applied to prevent this situation is to use milled pressure supports that are cut out at precisely those points where sensitive devices are located. The costs for this type of worknest are dependent on the material and the board complexity. Another problem is that the design must be modified or a new design must be produced for every change in board layout or when the board is retooled for a different product.

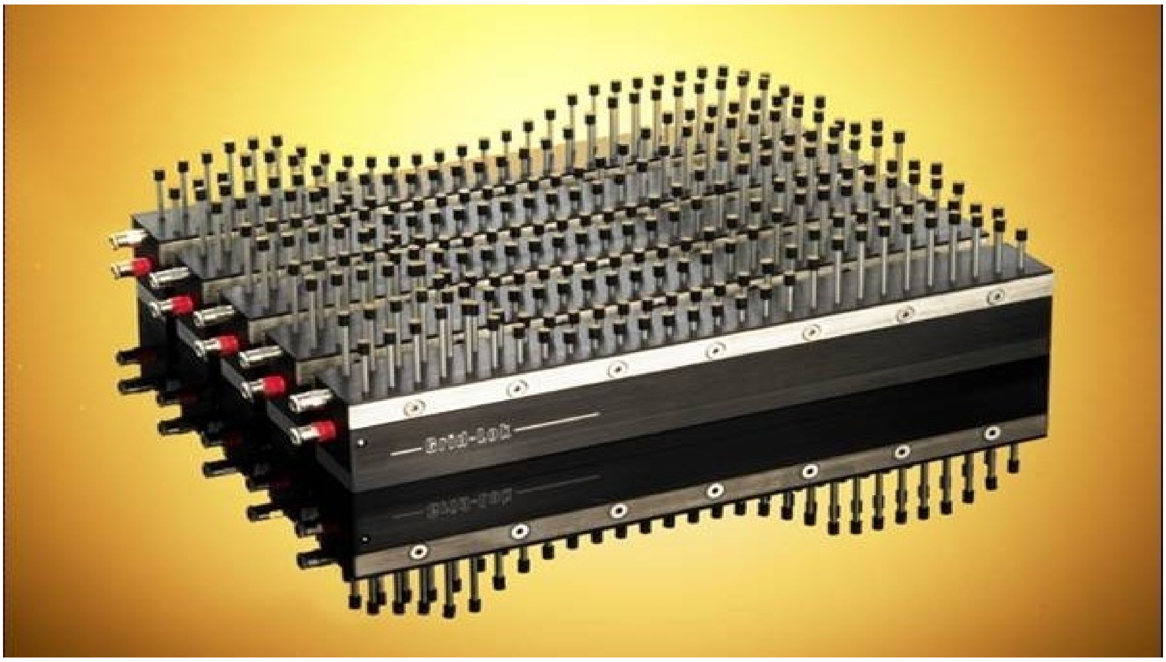

Figure 1: Grid-Lok System

The Grid-Lok system provides the user in production with a practical alternative compared with previous systems. The system operates with individual support pins that contact the board at various points on the underside. They are then stopped and fixed as soon as they come into contact with various features of the topology. The pin spacing is available in a number of different pitches.

A plastic cover is located on the contact surface between the pins and the board underside to absorb the force of the pin tip during the print process. In this way, the surface load applied to the entire system by the squeegee and the set squeegee pressure on the stencil top side during the print cycle is absorbed by the number of pins used on the board underside.

Test Procedure

The aim of the test at the Fraunhofer IZM was to determine the maximum occurring point loads on the device surfaces located on the board underside. The test vehicles selected were two circuit boards mounted on the underside and equipped with pressure sensors. Measurements were taken at eight different points, directly on the board top side and on individual exposed devices.

The devices on the underside were monitored by pressure sensors during the entire print process. The module was mounted both with passive 0805, 0402 and 0201 devices as well as with active devices.

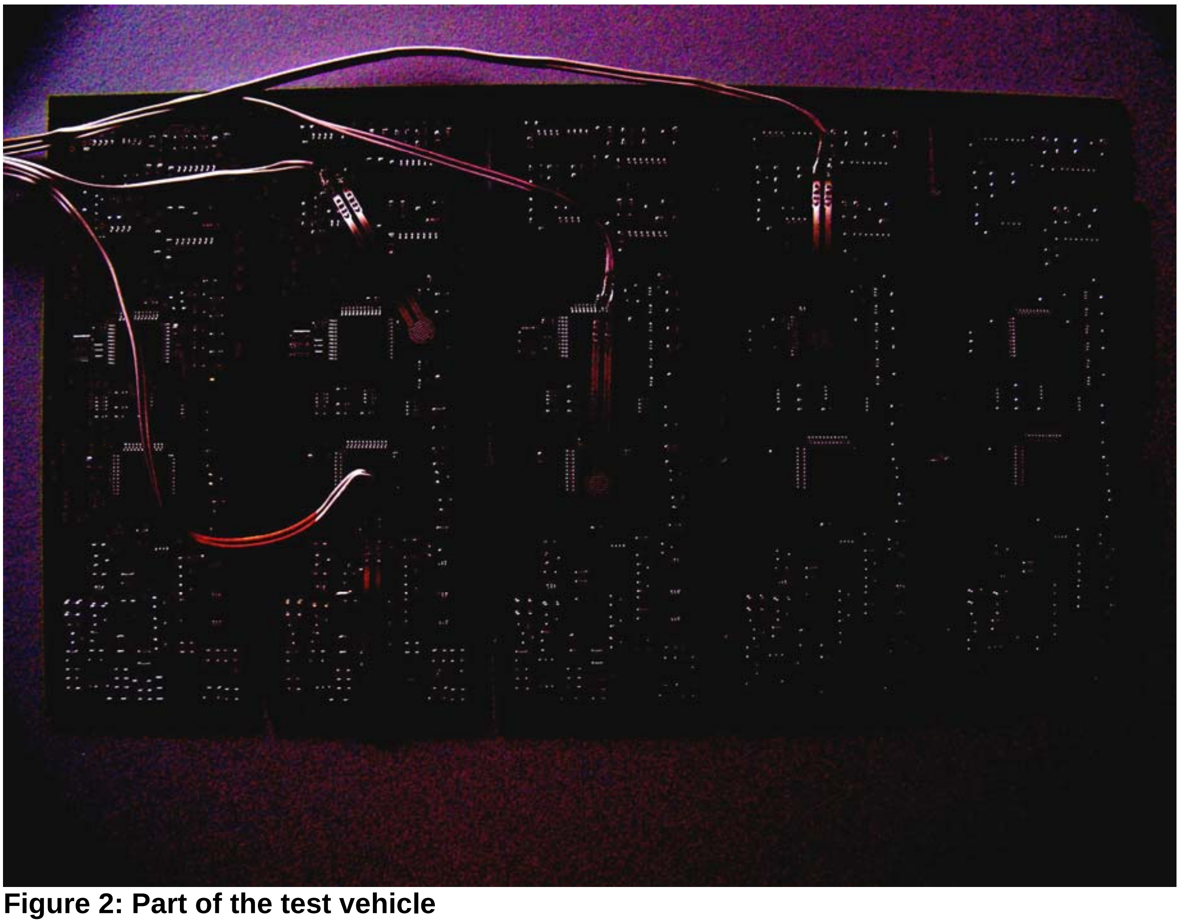

Figure 2: Part of the test vehicle

The measurements taken were the pressure load on the devices in the Z direction. The squeegee pressure was increased from 40 N to 160 N over several print passes. The devices were subjected to light and X-ray microscope tests before and after the tests in order to determine any changes to the contacts.

The stencil top side was printed with a standard squeegee fitted with a steel blade at an angle of 60°. Observations during the print passes showed that the squeegee blades sagged further the higher the squeegee pressure.

This explains the non-linear response of the pressure on the device surface.

Sensor	Position	
1	Centre	BGA 10x10mm
2	Centre right	QFP 10x10mm
3	Centre left	SOT 10x10mm
4	Centre rear	0806 resistor
5	Front in vicinity of board fixture	
6	Front right	QFP 7.5x7.5mm
7	Front left	BGA 10x10mm
8	Rear right	SOT 10x10mm

Table 1: Sensor arrangement

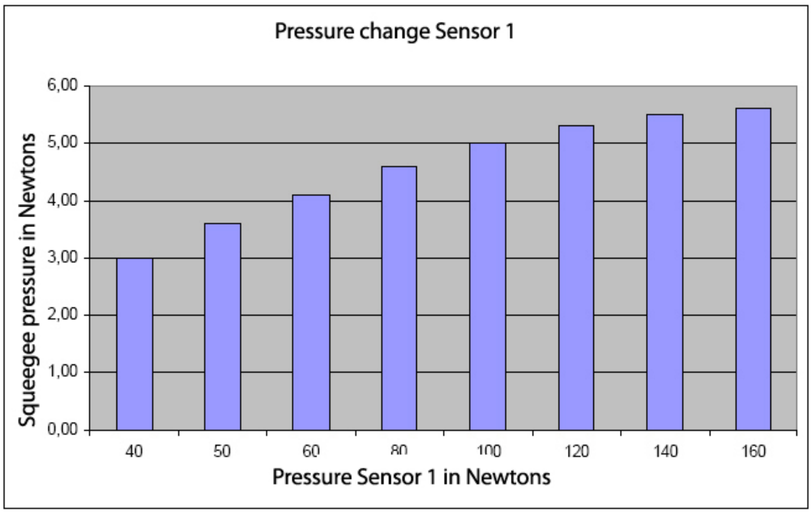

Figure 3: Pressure loads on Sensor 1

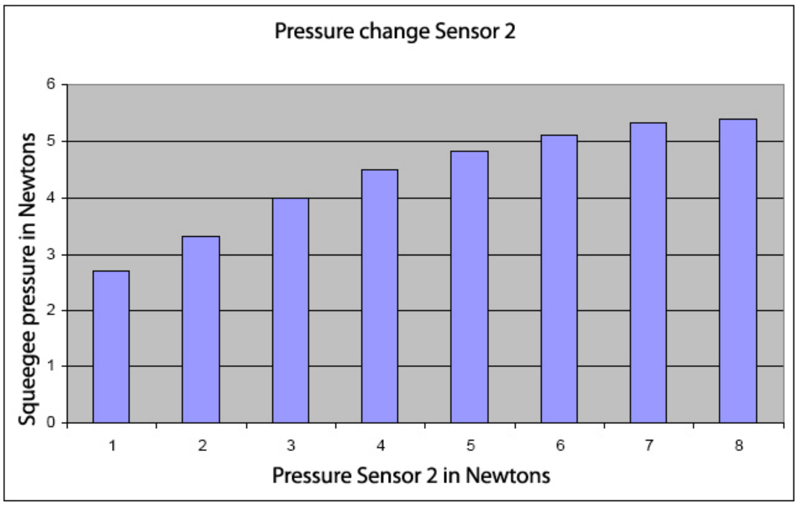

Figure 4: Pressure loads on Sensor 2

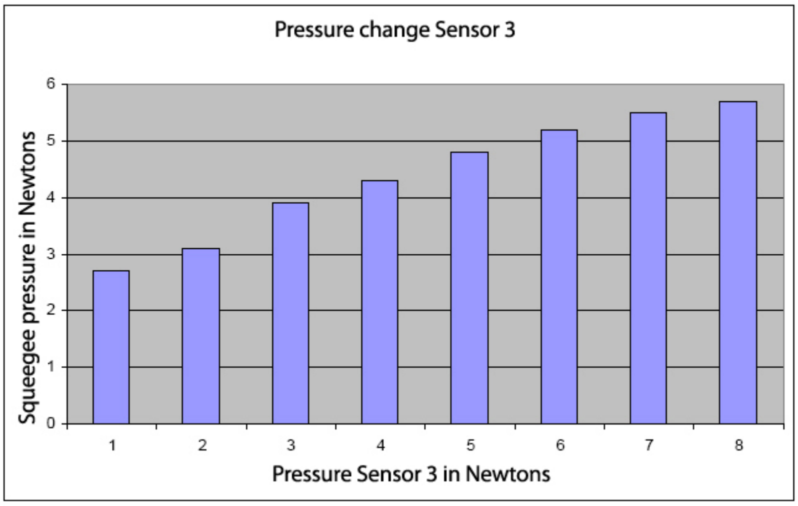

Figure 5: Pressure loads on Sensor 3

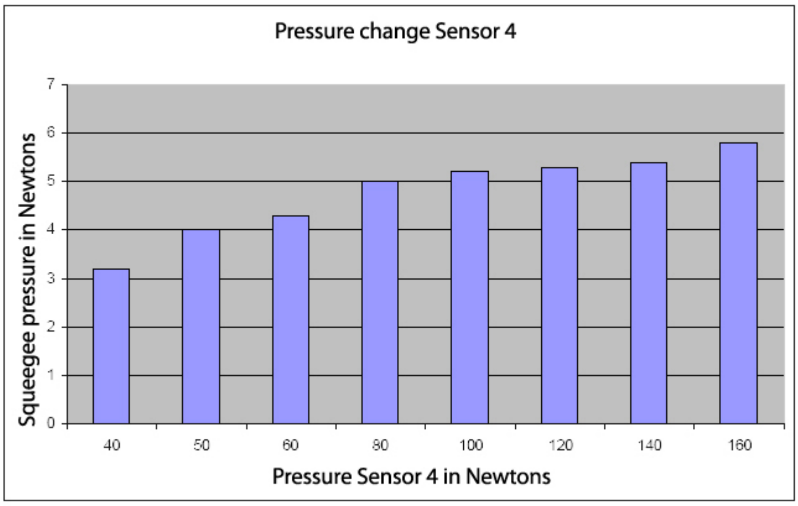

Figure 6: Pressure loads on Sensor 4

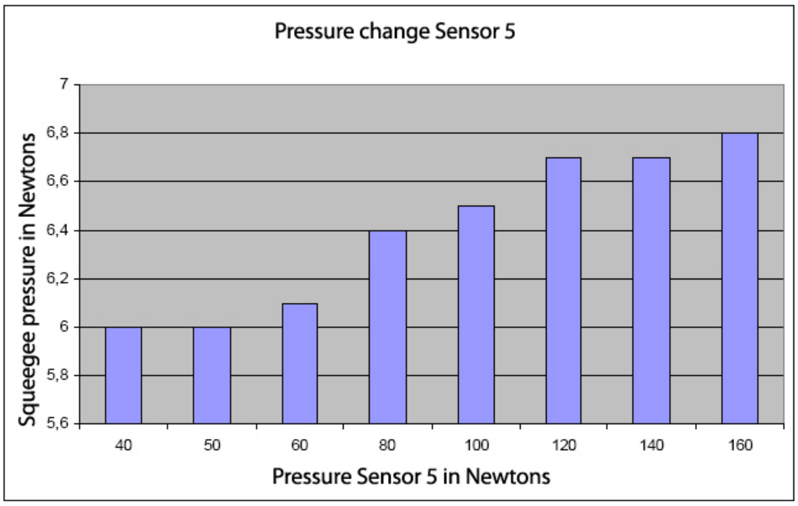

Figure 7: Pressure loads on Sensor 5

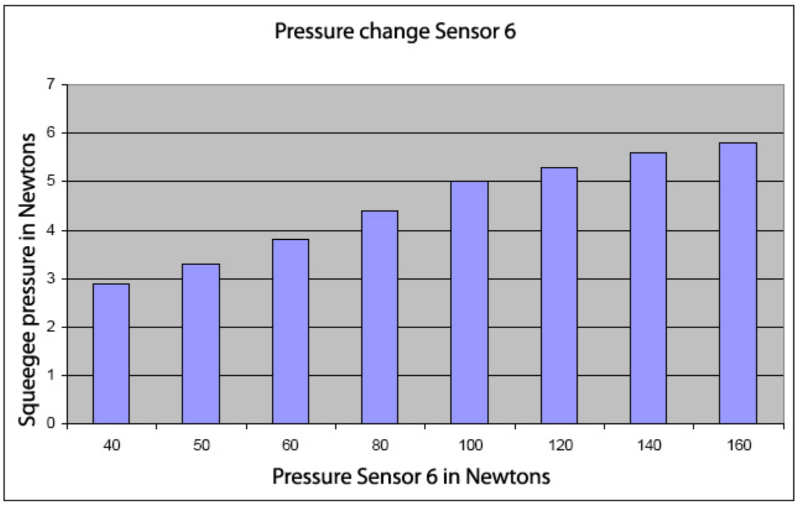

Figure 8: Pressure loads on Sensor 6

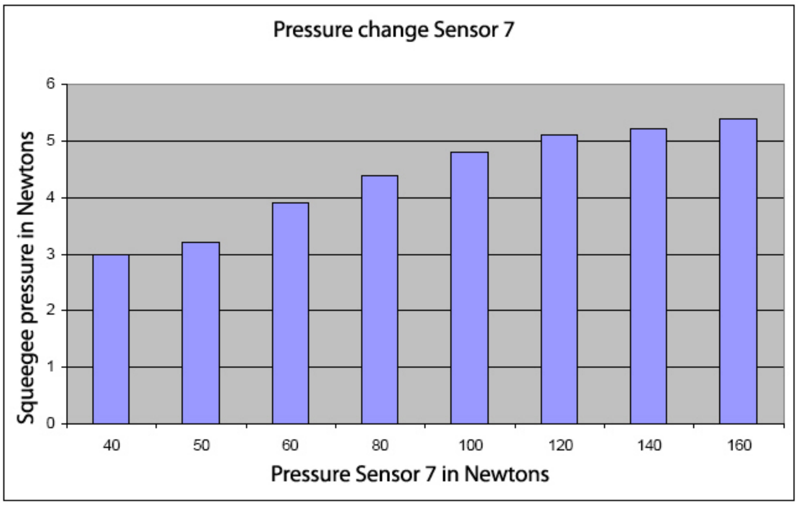

Figure 9: Pressure loads on Sensor 7

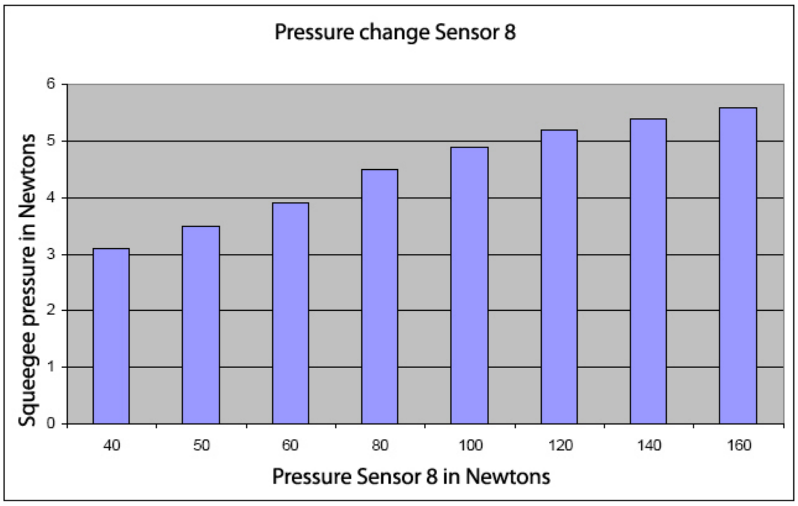

Figure 10: Pressure loads on Sensor 8

The response of pressure sensor 5 can be explained by its proximity to the circuit board fixture. As a result, higher initial forces than on the remaining board area occur in the vicinity of the knife edges from the start of the print cycle. The pressure tests were followed by an examination of the contacts of each device using light and X-ray microscopes.

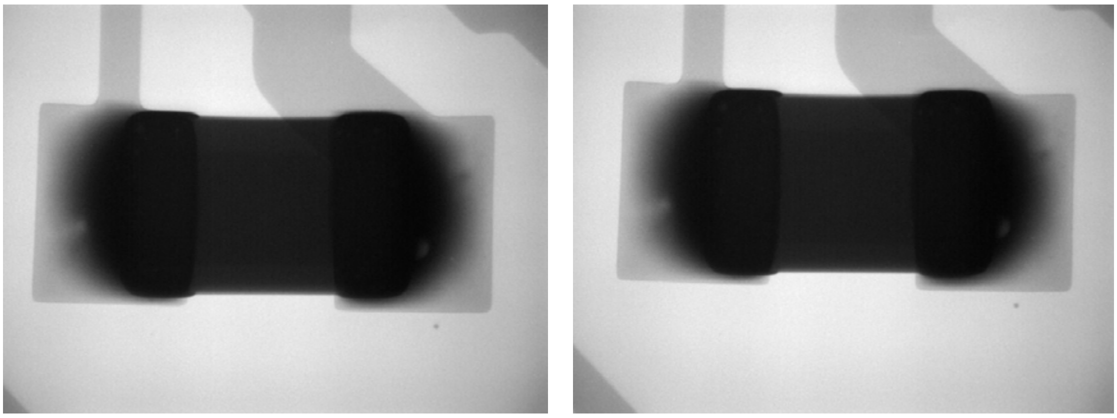

Figure 11: X-rays of 0603 device: before-after photos

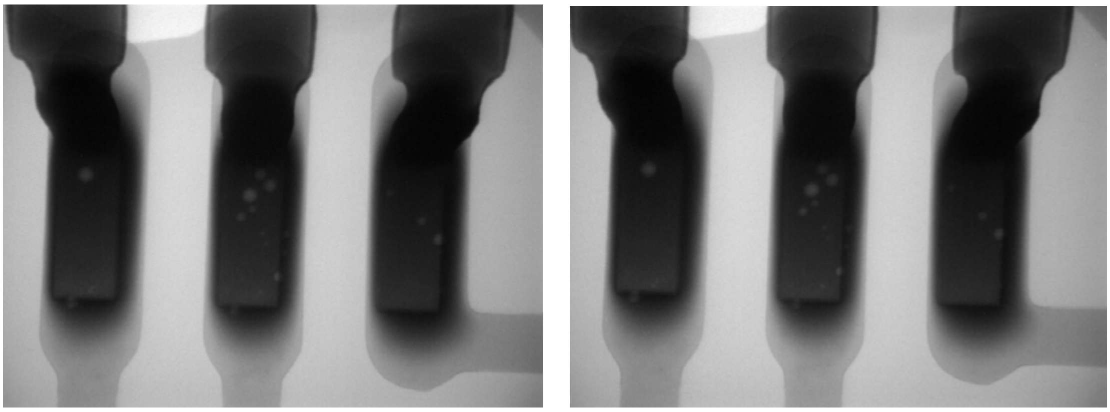

Figure 12: X-rays of SOT device: before-after photos

No damage was detected on any of the contacts examined. All devices were undamaged. No damage was found on any of the surface-mounted devices. As a result, before-after comparisons of only four contacts are shown.

Evaluation

No visible or measurable overloads were observed over the entire squeegee pressure range. Since the applied squeegee pressures range up to the topmost pressures that are no longer used in practice, no damage need be feared using any of the conventional printing methods. A commercially available lead-free solder with a 4 grain was used for the contacts on all devices. All solders that are comparable in strength, brittleness and flow characteristics can be used without a problem. X-ray microscope examinations showed no changes of any kind on the solder contacts. The greatest load measured on a device surface was 8 N/cm^2. It is recommended to shield the sensitive surfaces of devices such as LC displays or similar from contact with the support. This can be achieved simply by covering with masking tape or using the pins.

In addition to the items discussed above, use of the Grid-Lok drastically reduces the tooling time during a product change.

Contact:
Dipl. Ing. Ulf Oestermann
Fraunhofer IZM
Gustav Meyer Allee 25
13355 Berlin
Email: ulf.oestermann@izm.fhg.de
Tel: +49 (0)30 46403235