INSIDIX

INNOVATIVE TECHNOLOGY FOR INTERFACE EVALUATION

TDM®

References

TDM is used for product development and optimization by global companies, market leaders in a wide range of applications.

Automotive
Power Electronics
Consumer Electronics
Telecommunications
Aerospace
Defense

JEDEC* High Temperature Package Warpage

TDM complies to the Measurement Instrument Requirements as defined by the JEDEC JESD22B112 Standard

- Reflow representative thermal stress
- Active top and bottom heating and cooling
- No reference grating, no artifacts due to grating expansion
- Dynamic measurement of moisture desorption and thermal stress relaxation
- Interactive software for warpage analysis and representation

Warpage and in-plane measurement specifications

Imaging	Direct sample illumination, contact free measurement
Sample size	400x400x60 mm max. (15.7'' x 15.7'' x 2.4'')
Field of view (x,y)	25x25 mm – 200x200 mm (1" x 1" – 7.9" x 7.9")
Depth of view (z)	4 – 32 mm (0.2" x 1.3")
Resolution	2000 x 2000 pixel grid
In-plane (x,y) measurement resolution	∆l/l = 5x10-5
Accuracy	z-direction : 1/10.000 of sample size x-y-direction : 5x10-5 of sample size
Repeatability	z-direction : 1/10.000 of sample size x-y-direction : 5x10-5 of sample size

Heating and cooling capabilities (for <150 x 150 mm FR4 PCB)

Temperature range	20°C – 300°C continuous (-60°C – 300°C optional)
Temperature gradient	Up to +3°C/s heating, up to -6°C/s cooling
Accuracy	+/- 5°C
Temperature control	PC controlled temperature progression

Full software driven

Acquisition	Easy to use Windows operating program, mouse driven
In-plane (x,y) representation	Vector diagram, strain field, iso-displacement lines
Topography (z) representation	Color encoded cartography, isometric view, 3D surface diagrams
Quantitative evaluation	Absolute 3D cartography Quantitative deformation evaluation: tilt, strain, planarity
Reference plane	Absolute or relative deformation measurements Reference plane easy to adapt within analysis software
Data exchange format for modeling	ASCII

General characteristics

Footprint dimensions (w x d x h)	1200 x 1000 x 2000 mm (47.2" x 39.4" x 78.7")
Weight (approx.)	300 kg (660 lbs)
Incoming service	110 / 220 VAC, 50/60 Hz, 4000 VA, Compressed air, 8 bar

About INSIDIX

Founded in 1996, Insidix is today a leading supplier of non destructive test equipment in the electronics industry.
Due to its international activity as contract laboratory, Insidix has gained vast experience in all possible applications of its products, including TDM, Scanning Acoustic Microscopy (SAM), and X-ray analysis (µ-XCT and µ-XRF).

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You need the excellence …

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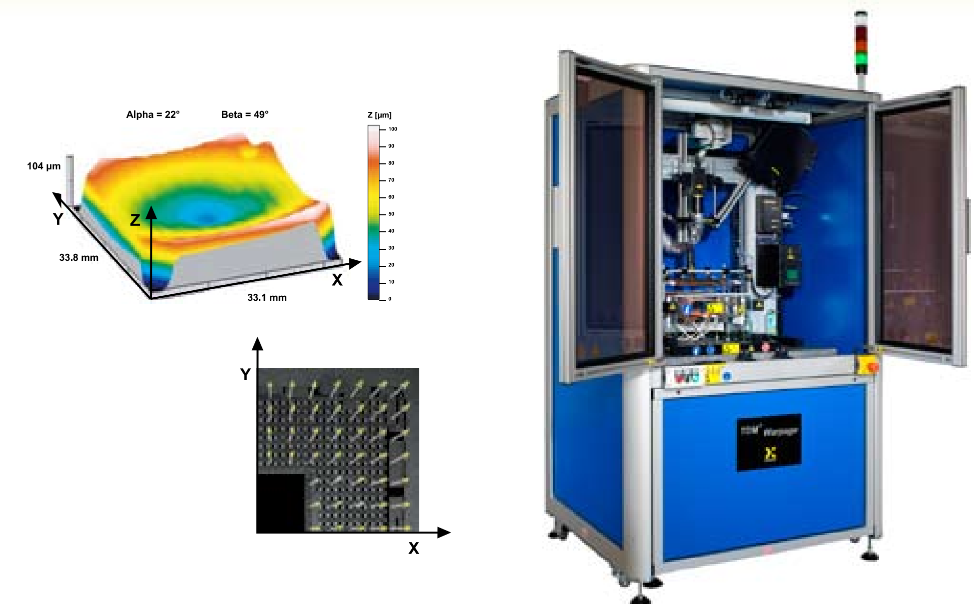
3D Topography & Deformation Measurement

Revolutionary Dynamic Imaging System with Thermo-Mechanical Stress

High and Low Temperature Warpage (z) and In-Plane (x,y) Deformation Measurement

- **Components**
- **PCBs**
- **Assemblies**



All specifications are subject to change without any notice.
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TDM is protected by international patents.

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Warpage (z) and in-plane (xy) 3D deformation analysis

Representative thermal stress — Real time dynamic imaging

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TDM Challenges

PCB deformation during soldering
BGA balls breakage at interfaces
Delamination prediction
Deformations from moisture soak
Unknown RoHS consequences
Thermal management
Complex packaging understanding

High integration of electronics components results in devices assembled from a multitude of materials.

Due to different, and partially unknown, Coefficients of Thermal Expansion (CTE), each material reacts differently on temperature variations.

Therefore, each temperature variation inevitably induces mechanical deformation and stress into the device.

Deformation, premature aging, delamination and finally product failure are the consequences. Device aging is accelerated by sudden temperature changes, like those induced during On/Off cycles of electronic power devices.

New solder alloys, complying to the RoHS standard, add further constraints to production and assembly, by limiting the use of well known materials.

Therefore proper device design, taking into account the temperature variations the component will encounter during its life time, has become a key imperative in the electronics industry.

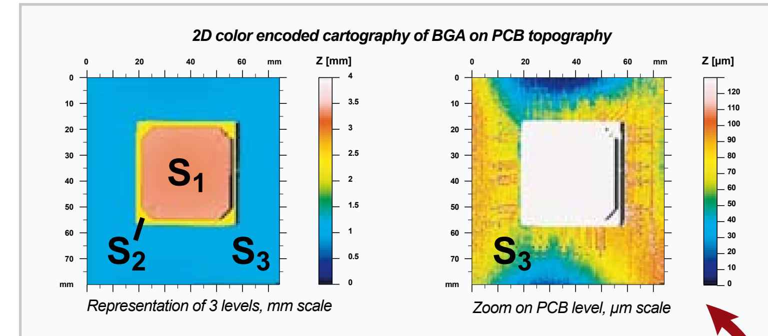
TDM Applications

Dynamic deformation mapping
Thermal relaxation analysis
Moisture / Reflow control
CTE quantification
Device aging analysis
PCB soldering optimization
Thermal studies of On/Off cycles
Heat sink effect

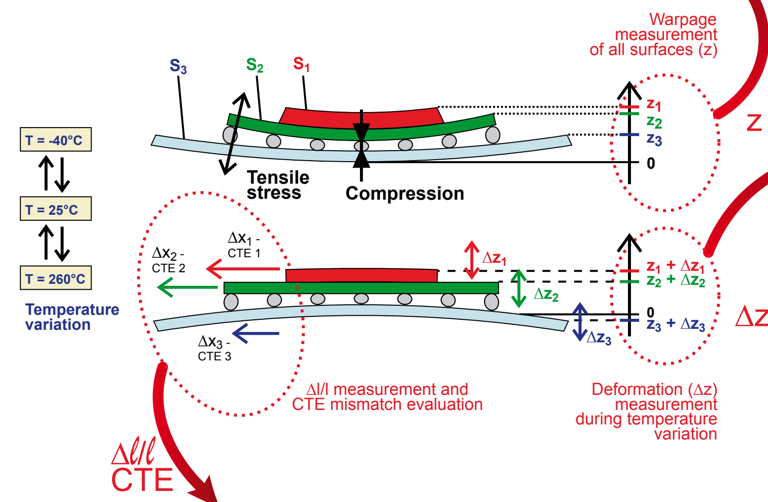
Warpage analysis

Large depth of view : BGA (S1, S2) and PCB (S3) surfaces in one single run

A key condition for the inspection of real life PCB's is that the instrument's depth of view is larger than the greatest height of a component on the PCB. Therefore, **TDM**'s optics are designed for a large depth of view, resulting in a vertical field from 4 up to more than 10 mm.



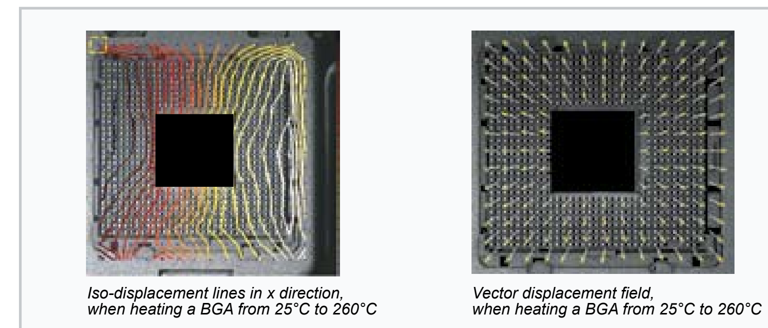
Representation of 3 levels, mm scale — Zoom on PCB level, µm scale



In-plane xy-deformation analysis

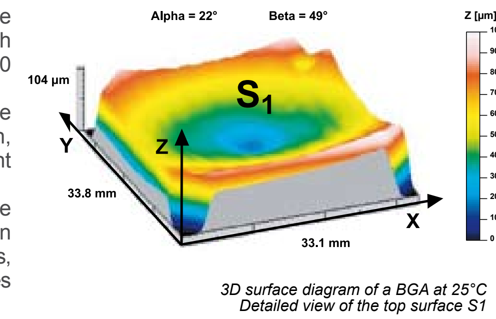
with high resolution

Some materials regularly encountered in electronic devices, like ceramics, have very low thermal expansion coefficients. **TDM** performs reliable measurements even for these low CTE materials. The high resolution optics combined with powerful data processing software results in a lateral (x,y) resolution of up to 5×10^{-5}.


Iso-displacement lines in x direction, when heating a BGA from 25°C to 260°C — *Vector displacement field, when heating a BGA from 25°C to 260°C*

Absolute 3D cartography

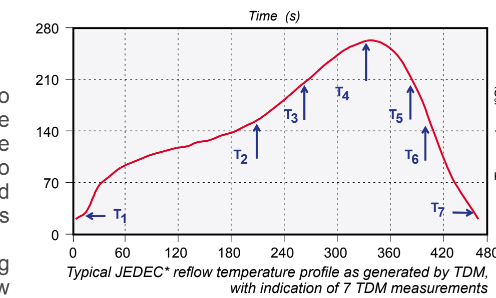
TDM acquires a full absolute 3D cartography of devices with dimensions up to 200 x 200 mm^2.
xy- and z(x,y)-deformations are measured within a single run, resulting in short measurement times.
The integrated software package provides tools for representation of the results as vector diagrams, isometric views, or as 2D profiles following user defined cut lines.



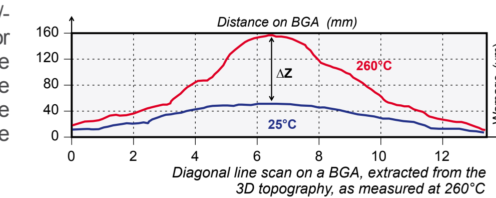
3D surface diagram of a BGA at 25°C
Detailed view of the top surface S1

Representative thermal stress

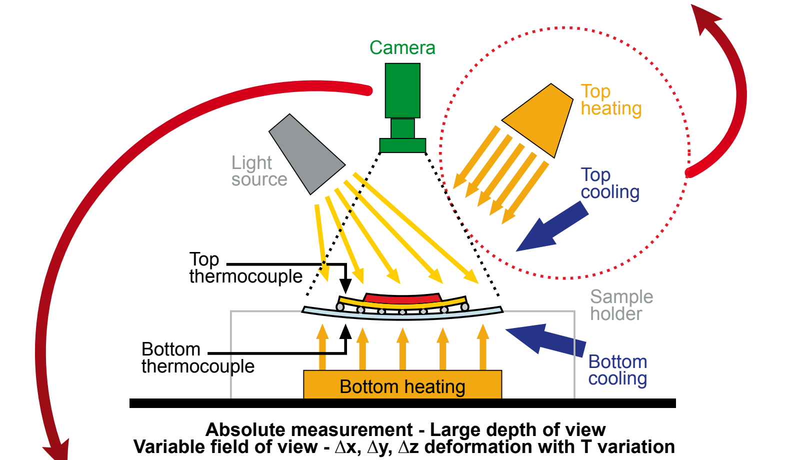
The operator can choose to do simple and fast Jedec* type temperature profiles, or impose any other user defined profile to the sample (On/Off, accelerated aging analysis, power electronics heat simulation).
Powerful top and bottom heating and cooling elements allow temperature gradients up to +/- 3°C/s, independently controlled for both sides of the component. The sample is monitored by multiple sensors to ensure a temperature accuracy of better than 3°C on the sample surface.



Typical JEDEC reflow temperature profile as generated by TDM, with indication of 7 TDM measurements*



Diagonal line scan on a BGA, extracted from the 3D topography, as measured at 260°C



Absolute measurement - Large depth of view
Variable field of view - Δx, Δy, Δz deformation with T variation

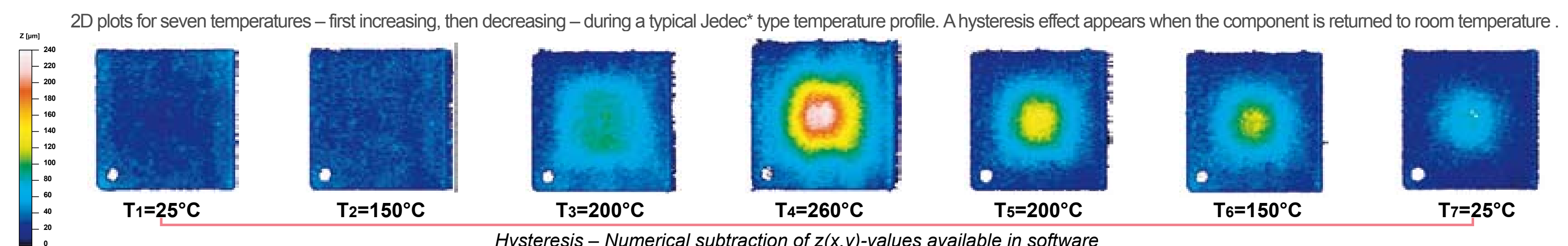
Real time dynamic imaging

An easy to use Windows program drives the temperature progression as selected by the user. During the application of the profile, deformation measurements are either triggered by temperature, by time, or interactively by the user. The control program is complemented by a comprehensive software package for data analysis, representation and storage. Generating 2D profiles, 3D contour plots, or line scan warpage representations is done by simple mouse clicks.

* cf. IPC/JEDEC J-STD-020 norm

Total warpage magnitude

2D plots for seven temperatures – first increasing, then decreasing – during a typical Jedec* type temperature profile. A hysteresis effect appears when the component is returned to room temperature .



Hysteresis – Numerical subtraction of z(x,y)-values available in software

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TDM Solutions

Large depth of view
Simultaneous xy and z cartography
Real time dynamic imaging
Top and bottom heating and cooling
Contact free measurement
Real thermal stress
Absolute and relative measurement
Non destructive

TDM exerts thermal profiles and cycles on electronics components, in the same way as they are imposed on devices during production processes and throughout the whole product lifetime.

During the thermal cycle **TDM** measures the 3D deformation of the device, directly related to the internal stress due to temperature variation. Applications range from SMD soldering on PCB to failure analysis during successive thermal ON/OFF cycles.

With **TDM**, simple and fast detection and elimination of failure risks for virtually any kind of component becomes an integral part of the development and qualification process.

Comparing modeling results with dynamic 3D deformation measurements during temperature variations validates numerical simulation, multiplying the power of each software package.

Each risk of failure identified in an early development step dramatically reduces the time to market, while simultaneously decreasing the risk of field return.

TDM Benefits

Failure understanding
Reduced time to market
Risk analysis
Reduced customer returns
Enhanced modeling
Reduced development time
Prevention and anticipation

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