Basic Use of Metrology Tools for QC Based on 3D Scanning and Point Clouds

UNIMETRIK
METROLOGY AND CALIBRATION

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Contents

Key concepts of metrology

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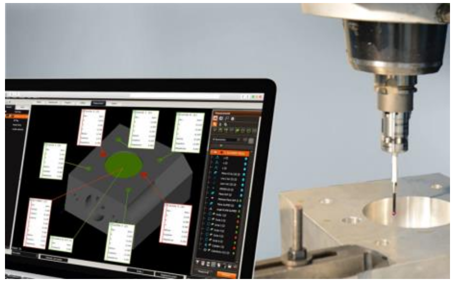
What is Industrial Metrology?



The **word** “metrology” **originated** from two Greek words, **“Metron” meaning measurement**, and “**Logos” meaning study**. Metrology is **the scientific study of measurement**.

It covers the **calibration, maintenance, and quality control of measurement instruments and products** used for **industrial application** and **society** in general, **ensuring their suitability**.

Each time **products** become **more detailed** and the limits of **efficiency get pushed** to new extremes, thus the **manufacturing** space has **ever-tighter tolerances and precision** to keep up.

However, achieving this level of precision is only the first step; **tolerances need to be measured and verified through metrology**.

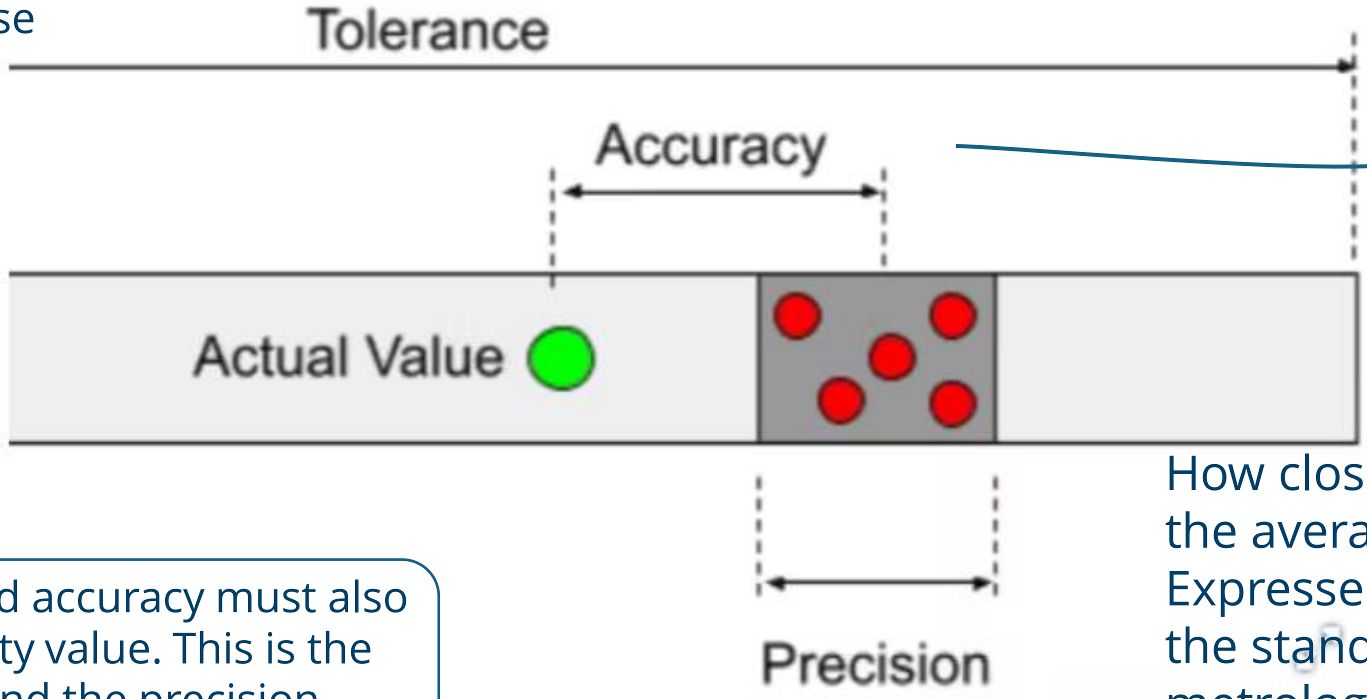
Proper measurement **is critical in the industry** as it **affects the value and quality of the final product**.

Metrology is important in all day-to-day tasks as it **provides some quantitative information on the actual state of physical variables and processes**.

Some key concepts are...

Variation within a part's dimensions that is considered acceptable. A factor to consider is the manufacturing machine's ability to achieve these tolerances.

How close the average of a set of measured values is to the reference value, X. In manufacturing, this is the difference between the actual produced product and the CAD model or technical reference drawing.



How close each measurement is to the average of the measured values. Expressed statistically in terms of the standard deviation (σ). In metrology, the "standard" for standard deviation is $\pm 2\sigma$.

Expressions of precision and accuracy must also have an attached uncertainty value. This is the sum of the accuracy error and the precision error.

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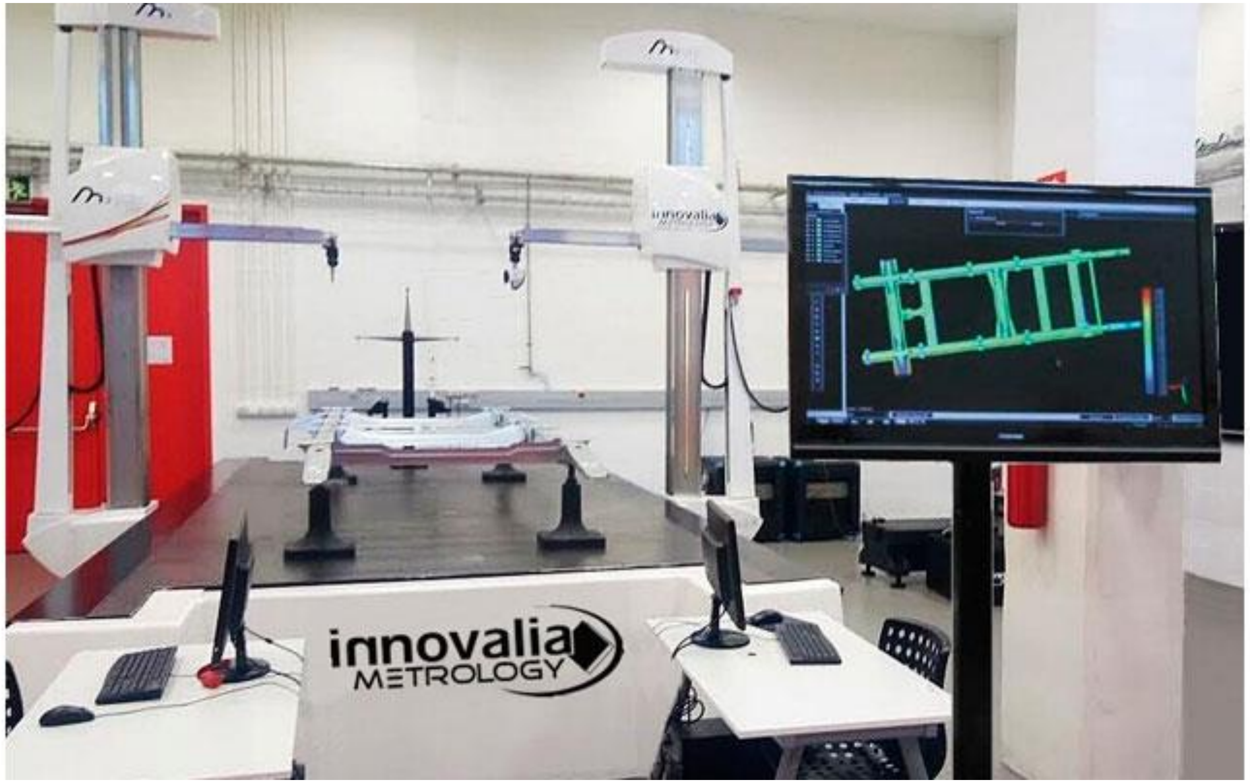
Quality Control sensors and software

3D laser scanner and point clouds management SW

2

Devices used for Dimensional Quality Control



Non-contact sensors

- Collects data from larger surface area in less time – high speed
- Lower accuracy
- Coverage of entire surface (not single measurement tracks)
- Sensivity to surface characteristics

Contact sensors

- Versatile and flexible
- Sub-micron level of accuracy
- Long measuring time
- Unsuitable for flexible or deformable components

+ Metrology software

Coordinate Measuring Machine

Measures the geometry of physical objects by sensing discrete points with a probe or optical sensor, that **can move along three axes, X, Y and Z**, orthogonal to each other in a three-dimensional Cartesian coordinate system. CMMs **provide accuracy in the order of microns**.

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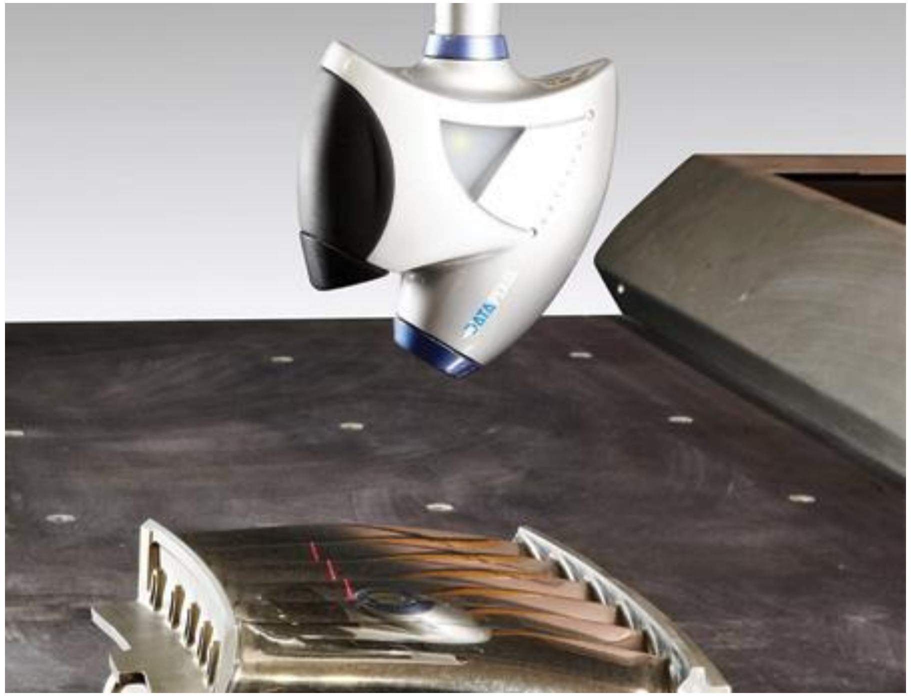
3D Laser Scanners

The one used for OPTIMAI Project (Microchip parts)

Generally use semiconductor lasers characterized by a red colored beam.

Digitization begins with the emission of a rectilinear laser beam which deforms on contact with the object.

Through the camera, the 3D scanner analyzes the deformation of the line emitted by the laser on the reliefs of the object in order to determine, by means of trigonometric calculations, its position in space.



Laser triangulation 3D scanners

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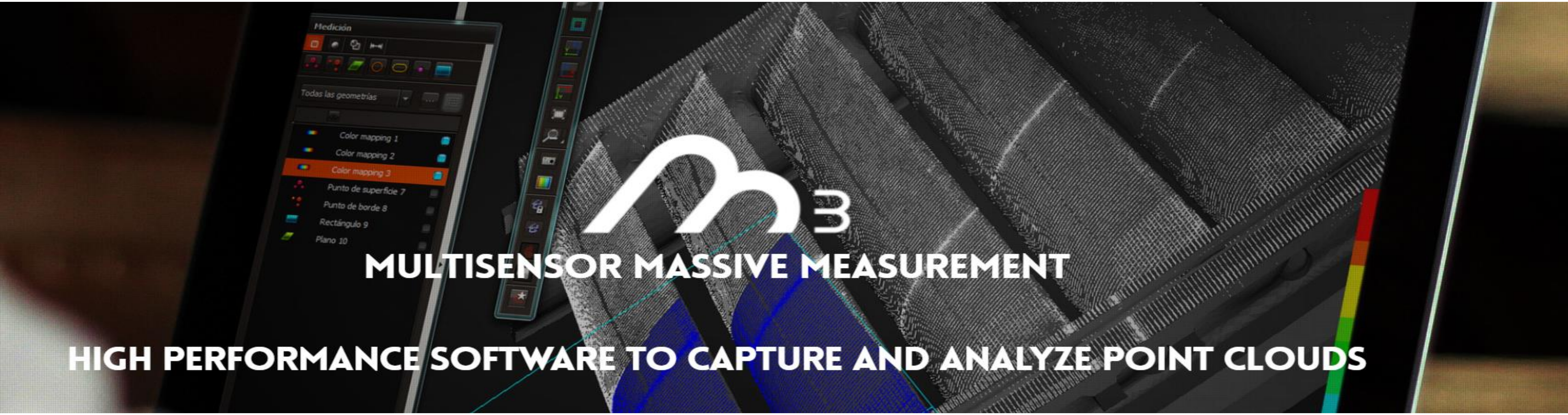
Metrology Software



- Traceability
  Just one workflow for optical and contact measurement
- Adaptability
  Suitable for parts of all sizes and materials
- Productivity
  Features specifically designed for in-line inspection
- Data Tracking
  Customized reports and statistics

Capture the reality – actual parts digitization

Scan the part and capture its point clouds, obtaining a virtual part, a very precise digital copy with high fidelity representation of the surfaces to allow automatic dimensional analysis.

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Reference arquitecture of the QC solution

Sensor + software package (inputs & outputs)

3

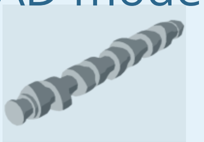
Workflow of the Solution 3D Scanner + M3 Software

Physical part

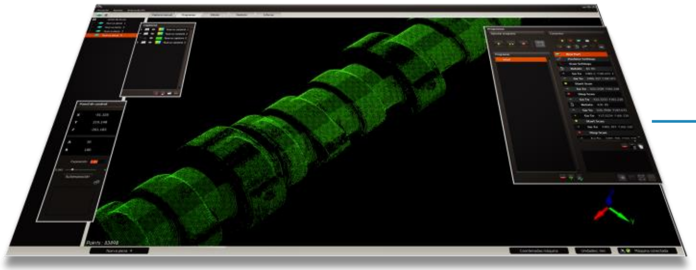
CMM

Optiscan

CAD model

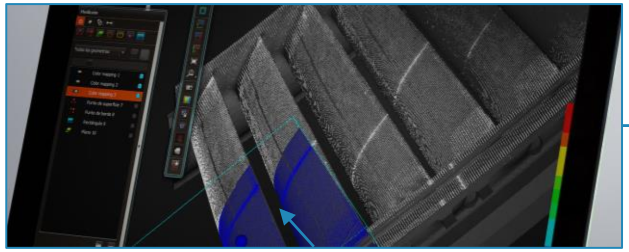


M3 software



Raw point cloud processing
Pointcloud digital copy

Comparison of point clouds
digital copy with CAD
model
Disparity map



Results data in different
formats as needed:
pdf report, stl with
annotations, XML QIF file

See module related to QIF standard*

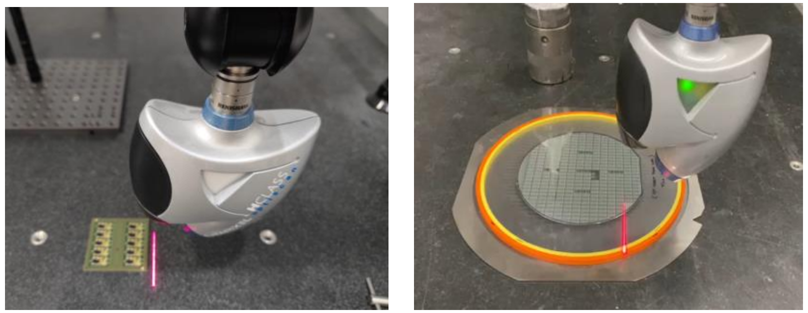
Work applied to Microsemi parts

Physical part

CMM

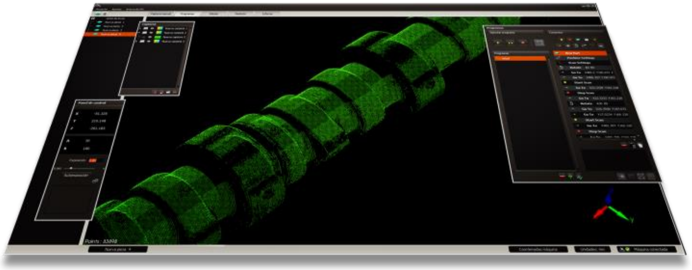
Optiscan

3D laser scanner

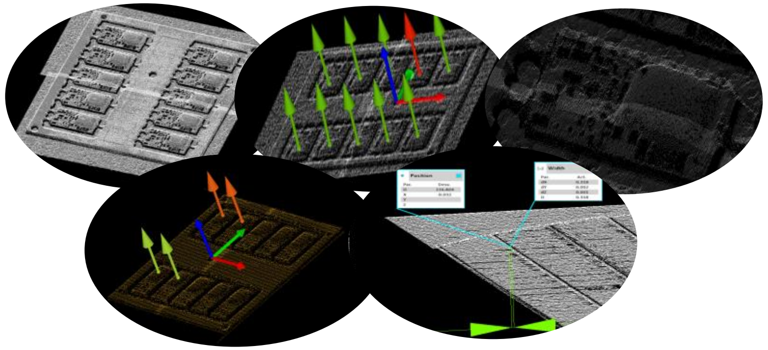


MTCL encapsulated PCBs and wafers

M3 software



Raw point cloud processing
Pointcloud digital copy



Measurement analysis

Basic Guide for the use of the Solution

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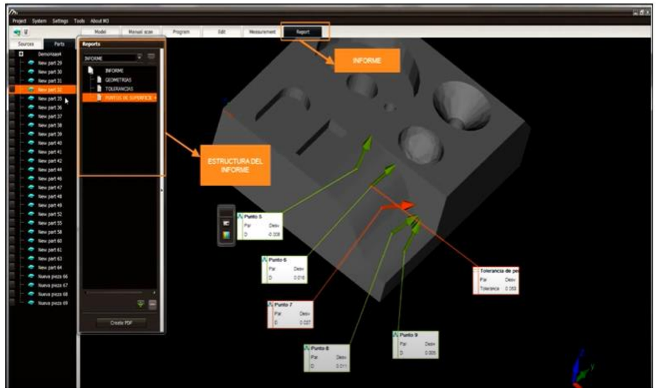
Principal Characteristics of M3

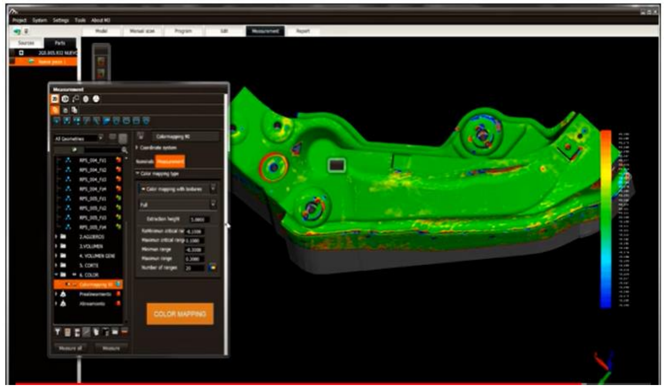
MULTISENSOR

MULTIMACHINE

+ Intuitive software user interface

Workflow in M3 Software - General Steps





1. Upload the CAD file of the part to the software
2. Create a measurement plan based on a STEP file (preparation of all needed geometries required to perform the measurement in the machine)
3. Perform the alignments (as part of the measurement plan)
4. Prepare the geometric tolerances needed for the validation of the part
5. Run the measurement program (with an optical sensor in this case)
6. Connect to the machine and execute the programs that measure the geometries in the part
7. Generate the results visualization in the software, by selecting any of the geometries that have been measured
8. 2 options for this visualization: Create a report or visualize a color deviation mapping image for a comparison between CAD design and the actual measured part.
9. Export results in different formats: QIF, DMO, CSV, STEP IGS

Next Steps

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Next Steps

- Additional information can be found at
  - https://www.innovalia-metrology.com/
  - https://www.unimetrik.es/

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Thank you

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