杭州利珀科技有限公司
Hangzhou Leaper Technology Co., Ltd.

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# LEAPER VISION

## VISION-BASED INSPECTION SOLUTIONS FOR PHOTOVOLTAIC

The LP$^{solar}$ series, independently developed by LEAPER, can provide systematic and complete machine vision industrial inspection solutions for the whole manufacturing process of crystalline silicon cells, controlling product quality while providing feedback on the processes, managing production efficiency, and enabling the upgrade from manual labor to automation. In 2022, LEAPER's photovoltaic inspection products reached a cumulative shipment of over 8,000 units; in 2023, the total shipments exceeded 20,000 units. As a specialist of Machine Vision in PV industry, we continue to output advanced and realiable products as well as improving our service level.

## ABOUT LEAPER

LEAPER specializes in providing industrial inspection solutions by using machine vision software. The core technologies are self-developed machine vision algorithm and optical imaging systems. We offer solutions for different application scenarios, including defect inspection, high-precision mechanical guiding and positioning for production process tracking, product quality monitoring and manufacturing process optimizing.

### PRODUCTS

- Leaper Vision Toolkit
  SDK Toolkit
- IntelliBlink™
  Machine Vision Software
- IntelliBlink-AI
  AI Platform

### APPLICATIONS

- Photovoltaic
- Film
- Li-ion Battery
- Semiconductor
- Laser
- Logistic

# LEAPER Solutions for the Photovoltaic Industry

## Comprehensive Coverage: Upstream, Midstream, Downstream

### Wafer Manufacture

- Raw rod inspection
- Square rod inspection
- Silicon wafer stack appearance inspection
- Silicon wafer inspection and sorting equipment
- Cassette inspection for wafer slicing

### Cell Manufacture

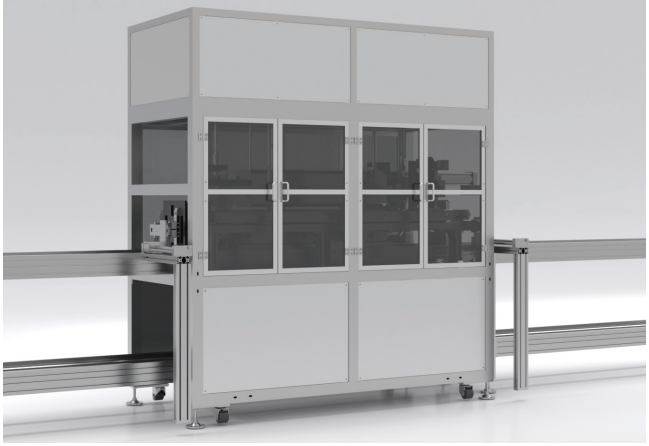
- PL inspection
- Micro crack inspection
- Cassette inspection for silicon cells
- Quartz boat inspection
- Watermark inspection
- PE inspection
- Graphite boat inspection
- Screen printing inspection
- Final product sorting

### Module Manufacture

- Incoming insulating glue inspection
- Module lamination inspection
- Module final inspection

## Wafer Manufacture Solutions

### Square Rod Inspection



### Silicon Wafer Stack Appearance Inspection

### Silicon Wafer Inspection and Sorting Equipment

## Raw Rod Inspection

### Inspection Station/
After Cutting

### Inspection Content/
Microcracks, dislocations, appearance defects, size

### Inspection Accuracy/
1. Microcrack length : 1mm
2. Size : 0.01mm

### Inspection CT/
Single station 360s, multiple stations 240s (75M rod)

### Core Components/
1. Infrared Camera
2. Customized Infrared Light Source
3. 3D Camera
4. High-Resolution Area/Line Scan Camera
5. i7 Advanced Generation Industrial Computer + Graphics Card
6. Integrated Automation Equipment

## Square Rod Inspection

### Inspection Station/
1. After cleaning, before pairing rods
2. Incoming inspection at the wafer manufacture

### Inspection Content/
Microcracks, dislocations, appearance defects, size

### Inspection Accuracy/
1. Microcrack length : 1mm
2. Size : 0.01mm
3. Appearance defects : 0.5mm

### Inspection CT/
28s per rod (900mm rod)

### Core Components/
1. Infrared Arsenic Camera
2. Customized Infrared Light Source
3. 3D Camera
4. High-Resolution Line Scan Camera
5. i7 Advanced Generation Industrial Computer + Graphics Card
6. Integrated Automation Equipment

## Silicon Wafer Stack Appearance Inspection

### Inspection Station/
1. After sorting, before packaging
2. Incoming cell materials

### Inspection Content
Appearance defects, counting

### Inspection Accuracy/
1. Appearance defects : 0.05mm

### Inspection CT/
5s

### Core Components/
1. 8K Line Scan Camera
2. High-Resolution Area Scan Camera
3. Customized Coaxial Line Light
4. i7 Advanced Generation Industrial Computer + Graphics Card
5. Automatic Adjustment Structure

## Silicon Wafer Inspection and Sorting Equipment

### Inspection Station/
After cleaning

### Inspection Content/
Appearance defects, TTV, microcracks, size, resistivity

### Inspection Accuracy/
1. Appearance defects : 0.05mm
2. TTV repeatability : 0.5μm
3. Microcrack : 0.5mm length
4. Size : 0.01mm

### Inspection CT/
High-speed machine capacity 21,000 pcs/hour

### Core Components/
1. High-Speed 8K Line Scan Camera
2. 2500W Area Scan Camera
3. Infrared Camera
4. High-Speed Line Laser
5. Resistivity Sensor
6. Support-Spec i9 Industrial Computer + Support-Spec Graphics Card
7. High-Speed Triple Feeding + Suction Unloading Automation

## Cassette Inspection for Wafer Slicing

### Inspection Station/
After cleaning, before sorting

### Inspection Content/
Debris, stacked wafers, misplaced wafers, missing wafers within the cassette

### Inspection Accuracy/
1. Debris: Damage visible to the camera on the edge of the silicon wafer, length ≥8mm
2. Stacked wafers: ≥2 wafers in a single cassette slot
3. Misplaced wafers: ≥ one tooth
4. Missing wafers: ≥1 wafer

### Inspection CT/
≤2s

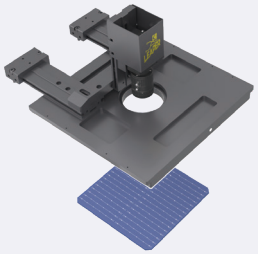
### Core Components/
1. 500W Global Area Scan Camera
2. Customized Large Size Panel Light Source + High-Brightness Line Light Source
3. Linear Motion Module
4. i7 High-Performance Industrial Computer + Graphics Card

# Cell Manufacture Solutions

PL Inspection

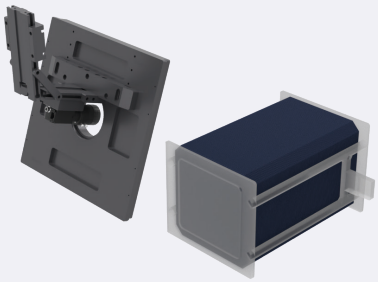
Micro Crack Inspection

PE Inspection



Screen Printing Inspection

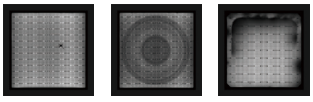
Cassette Inspection for Silicon Cells



Quartz Boat Inspection

Final Product Sorting

## PL Inspection



### Inspection Station/

1. Offline: Entire Process
2. Online: Coating, Processing Products, Final Products

### Inspection Content/

Microcracks, scratches, black spots, concentric circles, etc.

### Inspection Accuracy/

1. Microcrack length : 1mm
2. Scratch length : 1mm
3. Gray scale ≥30, visible distinct rings
4. Minimum length and width ≥6 pixels, gray scale ≥30

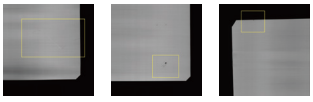
### Inspection CT/

<0.7s

### Core Components/

1. Infrared Camera/Arsenic Camera
2. Laser Light Source

## Micro Crack Inspection



### Inspection Station/

1. Before texture
2. After texture

### Inspection Content/

Microcracks, edge chipping, V-shape, debris

### Inspection Accuracy/

1. Accuracy for inspection missing corners, V-shape and edge chipping ≥0.3mmX0.3mm
2. Silicon chipping (delamination) detection accuracy ≥0.5mmX0.5mm
3. Microcrack length ≥0.5mm

### Inspection CT/

<0.7s

### Core Components/

1. Infrared Camera
2. Laser Light Source/Customized LED Light Source

## Cassette Inspection for Silicon Cells

### Inspection Station/

Cassette as a carrier during the process stage

### Inspection Content/

Missing corners, wet debris, stacked wafers, misplaced wafers, missing wafers within the cassette

### Inspection Accuracy/

1. Misplaced wafers: inspectable if displaced by one tooth or more
2. Stacked wafers/double wafers: inspectable if two complete wafers are present
3. Wet debris: inspectable size ≥10mmX10mm (excluding areas obscured by cassette rods visible to the camera)
4. Missing corner debris: inspectable if the size of the missing part is ≥30mm in both dimensions, with angular variation within 2° detectable by the camera
5. Missing wafers: inspectable

### Inspection CT/

≤4.5s

### Core Components/

1. 4K Line Scan Camera
2. Customized Large Size Panel Light Source
3. Linear Motion Module
4. i7 High-Performance Industrial Computer

## Quartz Boat Inspection

### Inspection Station/
High-Temperature Process

### Inspection Content/
Full silicon wafer boat debris, half silicon wafer boat debris, empty boat debris, support tooth debris

### Inspection Accuracy/
1. Full silicon wafer boat debris: >8mmX8mm
2. Half silicon wafer boat debris: >8mmX8mm
3. Empty boat bottom debris: >10mmX10mm
4. Support tooth debris: >20mmX20mm

### Inspection CT/
≤1.5s

### Core Components/
1. 1200W Color Area Scan Camera
2. Customized Perforated Size Flat Panel Light Source
3. Modular Structure
4. i5 High-Performance Industrial Computer

## Watermark Inspection

### Inspection Station/
After etching, PSG/BSG

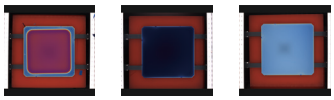
### Inspection Content/
Debris, over-etching, stacked wafers, watermarks

### Inspection Accuracy/
1. Debris: Visible range ≥5mmX5mm
2. Over-etching: Visible gray scale ≥30 levels, minimum length and width ≥4 pixels (1mmX1mm)
3. Watermark: Visible gray scale ≥30 levels, minimum length and width ≥4 pixels (1mmX1mm)
4. Stacked wafers: Visible in image range, inspectable

### Inspection CT/
Match Production Capacity

### Core Components/
1. 4K Line Scan Camera
2. Customized Size Strip Light Source
3. High-Precision Fiber Optic Sensor
4. i7 High-Performance Industrial Computer

## PE Inspection



### Inspection Station/
Coating Process

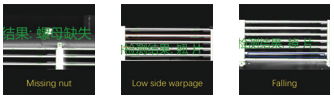
### Inspection Content/
Color variations, color spots, bright spots, dirt, over-etching, oil stains, pinch point charring, scratches, chipping, missing corners, throughholes, size, white spots, fingerprints, etc.

### Inspection Accuracy/
1. Chipping, missing corners, throughholes: ≥0.5mmX0.5mm
2. Other appearance defects: Gray scale ≥30, area ≥0.25mm²
3. Thickness of SiNx and ellipsometry standard deviation: Area scan solution ±2nm, line scan solution ±4nm

### Inspection CT/
≤0.6s

### Core Components/
1. Area/Line Scan Camera
2. Customized Light Box Light Source/ High-Brightness Line Light Source
3. i7 High-Performance Industrial Computer

## Graphite Boat Inspection




### Inspection Station/
Coating Process

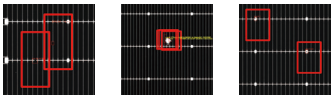
### Inspection Content/
Visible defects including warping, missing pieces, boat foreign objects, boat deformation, nut anomalies

### Inspection Accuracy/
1. Gap for warping ≥1mm
2. Single piece of debris on boat surface >30X30mm
3. Abnormal slot gap & straightness of boat leaves, with an accuracy of 0.1mm
4. Nut detachment

### Inspection CT/
Area Scan: None; Line Scan: 10s

### Core Components/
1. Area Scan Camera/Line Scan Camera
2. High-Brightness Strip Light Combination

## Screen Printing Inspection



### Inspection Station/
Printing Process

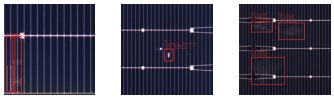
### Inspection Content/
Missed paste, busbar deviation, broken busbar

### Inspection Accuracy/
1. Busbar deviation 100μm
2. Appearance defects such as missed paste, missing corners 0.3mmX0.3mm

### Inspection CT/
0.6s

### Core Components/
1. 2500W High-Speed Area Scan Camera
2. Customized Polarized Surface Light Source
3. i7 High-Performance Industrial Computer + Graphics Card

## Final Product Sorting



### Inspection Station/
Cell Final Product Inspection Process

### Inspection Content/
Color Sorting, Appearance Defects

### Inspection Accuracy/
1. Chipping and missing corners : 0.1mm
2. Visible defects : 0.5mm×0.5mm
3. Color sorting with 8 grades

### Inspection CT/
0.75s

### Core Components/
1. 2500W High-Speed Area Scan Camera
2. Customized Four-Color Drum Light
3. i7 High-Performance Industrial Computer

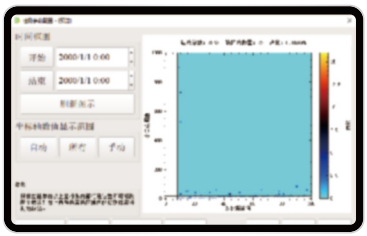
# Leaper Industry Adviser

## Agile BI and Data Visualization Platform

01 Cooperating with Industrial Clients and System Integrators

02 Providing Data BI Analysis & Visual Reports by large Screens

03 Releasing Development Manpower for Data Visualization Systems

- Can be deployed in the enterprise's internal LAN, integrating with the current user system to achieve separated sign-on within the LAN
- With support of OEM
- Friendly Interface, Excellent Interaction Experience, able to build data visualization pages through drag-and-drop in 5 minutes
- Plentiful Charts types: Over 50 chart types and more than 10 large screen templates to fully meet complex visualization needs
- Multi-Platform Support,real-time access via PC or mobile
- Supporting multiple data source access (Excel/CSV, ACCESS, MySQL, Sqlite, SQL Server, PostgreSQL, Oracle, Kylin, Hive, Spark SQL, Impala, Presto, Vertica, etc.)
- Plentiful report format: Reports developed by the Industrial Consultant platform can be publicly released and rapidly deployed within enterprises LAN
- Professional Reports: Leaper has deeply cultivated in the industrial inspection domain for years, summarized over 200+ useful reports to quickly enhance enterprise efficiency and product yield rates

# System Advantages

### More Comprehensive Feedback

Providing data reporting services and mobile access to data, supporting data feedback for manufacturing process.

### More Accurate Inspection ability

Equipped with deep learning function, based on image classification training to realize more accurate defect recognition and more accurate grading of cells.

### Powerful Compatibility

Self-Developed Cycling Vacuum-Pad System, perfectly integrated with most of automation equipments, high compatibility with minor defects, reliable inspection performance.



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