Direct Marking

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 2009-10-22

What is Direct Marking?

Direct marking definition:

"Direct marking" is defined as "the generic name for the technology that applies a symbol directly onto the product or packaging container by various methods, and that automatically recognizes the marked symbol" which is different from affixing of label or sticker to a product (goods, parts, and/or package).

Marking technology:

The technology that directly marks the product includes laser marking, dot impact marking, ink jet marking, thermal marking, and sand blast marking.

Marking symbol:

The marking symbols applicable for automatic recognition can be Optical Character Recognition (OCR), linear symbol, two-dimensional symbol, and others. The matrix type 2D symbol is comparatively suited for automatic recognition.

International Trend of Direct Marking

Centered in the United States, the necessity for direct marking is becoming more emphasized rapidly. Especially in the aviation industry (ATA), aerospace industry (NASA), automotive industry (AIAG), and military industry (US DoD, NATO), the direct marking of 2D symbol onto product is swiftly advancing as a consistent effort to ensure safety, improve maintainability, and effectively utilize resources.

Application of data matrix identification symbols to aerospace parts using direct part marking methods/techniques --- NASA Technical Handbook

Integrated Data Processing Materials Management --- ATA SPEC 2000

Specifications For Part And Component Bar Codes ECV/VCVS --- General Motors

Parts Identification and Tracking Application Standard --- General Motors

ISO 21849 Product Identification – Integrated Data Processing Part Management

ATA : Air Transport Association

NASA : National Aeronautics and Space Administration

AIAG : Automotive Industry Action Group

USDoD : United States Department of Defense

NATO : North Atlantic Treaty Organization

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Utilization of Direct Marking I

Servicing

In aircrafts, railroad cars and automobiles, the maintenance is required to ensure safety. In this case, information for each part is needed; when, for example, performing maintenance on 10 different parts, 50 digits or more of information are required for each part. A total of 500 digits or more of key input is therefore required, and consequently a major issue arises with the working efficiency. If information (company name, part name, part number, lot number, manufacturing date, etc.) is directly marked onto a part itself, an **accurate database can be generated efficiently** just by entering the maintenance contents. As a result, **devising of next maintenance plan is made easy**. Also, when a **field trouble (accident) should occur, a cause search becomes easier (quicker)**. Of course, there is a need for each industry to standardize the contents that are to be displayed.

Quality assurance

If trouble occurs in the market, ISO 9000 mandates the determining of trouble cause as well as the offering of countermeasures and feedback for the design. Currently, a field trouble is often processed solely by using slips, making field trouble information more difficult to be obtained promptly. As a result, the response is often delayed with the field troubles that may lead to a recall. Although an actual goods is needed with trouble analysis, a complete collecting of all the trouble goods is impossible, and, inevitably, a selective collection has to be chosen. Under such a circumstance, the current system cannot provide enough information due to the limited data source on a nameplate or others (implementation of measures against lot failure and others is impossible). On the other hand, if detailed information is directly marked onto the part itself, the trouble goods can be **promptly and selectively collected**.

Utilization of Direct Marking II

Reuse and recycle

Currently, recycling of electric home appliances and automobiles is gathering much attention, but the current recycling rate is yet to reach a satisfactory level (targets: 50% with electric home appliances and 75% with automobiles). Moreover, a mere crushing of parts and subsequent separate trash collection do not achieve goals, but a basic concept, such as the one adopted with office equipment industry, to enable reusing of reusable parts is crucial. To further promote the reuse, the current part-contained information alone cannot fulfill the needs, and a means to automatically input information at site is required. In the manufacturing industry, a heavy financial burden is placed when ensuring the provision of maintenance parts for the duration of eight years after a particular product/part becomes discontinued (maintaining and storing of drawing, die, special-purpose jig, etc.). A promotion of reuse allows this eight-year duration to be reduced. Therefore, **it is very important to vitalize the reuse market through the direct marking system**.

Environmental protection

Concerning the past environmental issues associated with chlorofluorocarbon, heavy metals, and endocrine disrupters, the environment-impacting substances had been already released on market when the ill-effects to environment was confirmed, thus rendering the goods collection to be difficult. This difficulty resulted because a sufficient volume of information was not attached to the parts (in particular, resin parts and assembly parts) that contain the environment-impacting substances. In the future, **mandating of goods collection as well as the speeding up of collection are facilitated** through the imparting of detailed information to parts themselves (especially the chemical parts) via direct marking.

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Direct Marking Hierarchy

Layer 5 Application standardization	
ISO TC20, ISO TC122, IEC TC91, AIAG, ODETTE, EIA, EDIFICE, JAMA/JAPIA, JEITA,... Reference standards: ANSI MH10.8.7, AIAG B-4, EIA 706, NASA HDBK-P027	
Layer 4 Information system technology (network search/order placement system)	
Search	**Order placement**
Detailed information, hazardous materials, environment-impacting substances, maintenance, guarantee limits, ...	Company code, location code, product code, manufacturing date, service life, price, quantity, delivery schedule, ...
Layer 3 Contents standardization	
Company code, product code, manufacturing date, guarantee conditions, composition materials, material details, ...	
Layer 2 Marking standardization	
ISO/IEC JTC1 SC31 Reference standards: ISO/IEC 15416 (print quality), ISO/IEC 15423 (reader), ISO/IEC 15426 (verifier)	
Layer 1 Mark reading technology	
Light source	**Reading technology**
Natural light, halogen, fluorescent lamp, electric light, LED	Lighting angle, light reception sensor, decode technology
Layer 0 Marking technology to material	
Material	**Marking technology**
Metal (iron, aluminum, copper), resin (rubber, circuit board), glass, silicon	Laser, dot impact, ink jet, thermal, chemical etching, sand blast, dry transfer

Laser Marker

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Example of Laser Marker (Model Type)

CO2 laser marker

YAG laser marker
(FAYb laser marker)

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Remarkable Feature of Laser Marker

Durability **Easy Traceability Control**

Factors behind the push for laser marker

■Strengthened efforts on ISO 14000 (environment)
■Complete control of record by PL Law / ISO 9000

Direct marking is attracting as:
Non-erasable marking & high quality marking

Conventional print technologies

●Stamp	●Label attachment	●Ink jet printer
Problems	Problems	Problems
・Environmental impact of ink	・Label becomes waste	・Environmental impact of ink & resolvent
・Potential defects in letters	・Running const of label	・Running cost of ink & resolvent
・Contents of printed letters are difficult to change	・Low recyclability	・Trouble by clogged nozzle
	・Label may be removed	・Consisted of many consumables such as ink & resolvent

Demand for direct marking using laser marker is on the rise.

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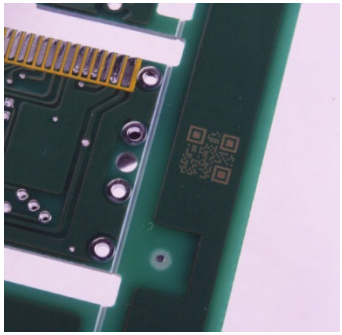
CO2 Laser Marker - Marking Examples I

Marking examples



Ultrahigh-speed printing with high power and high stability ideal for processing various components from shin files, metals, ultra-small parts and to cable trunking.

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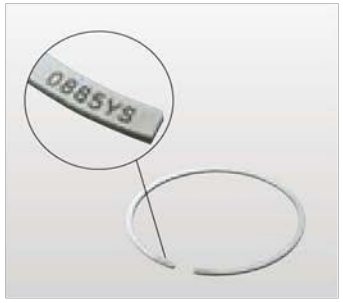
FAYb Laser Marker - Marking Examples II

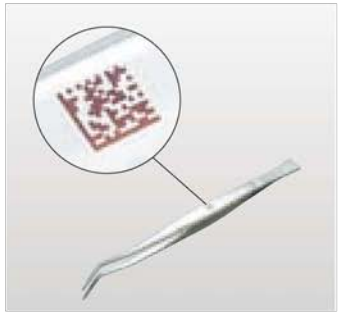
Marking examples



Piston ring

Aluminum parts

Lighting switch

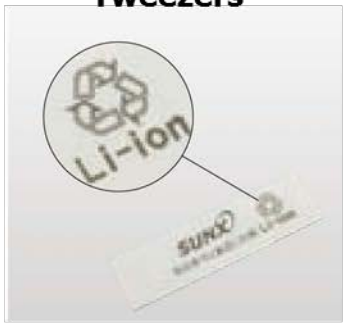


Tweezers

IC

Lead frame

Metal package



Battery case

Driver set

Saw blade

Joint

Coupling

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Dot Impact Printer

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Example of Dot Impact Printer

Mechanical unit

Control unit

Operating unit

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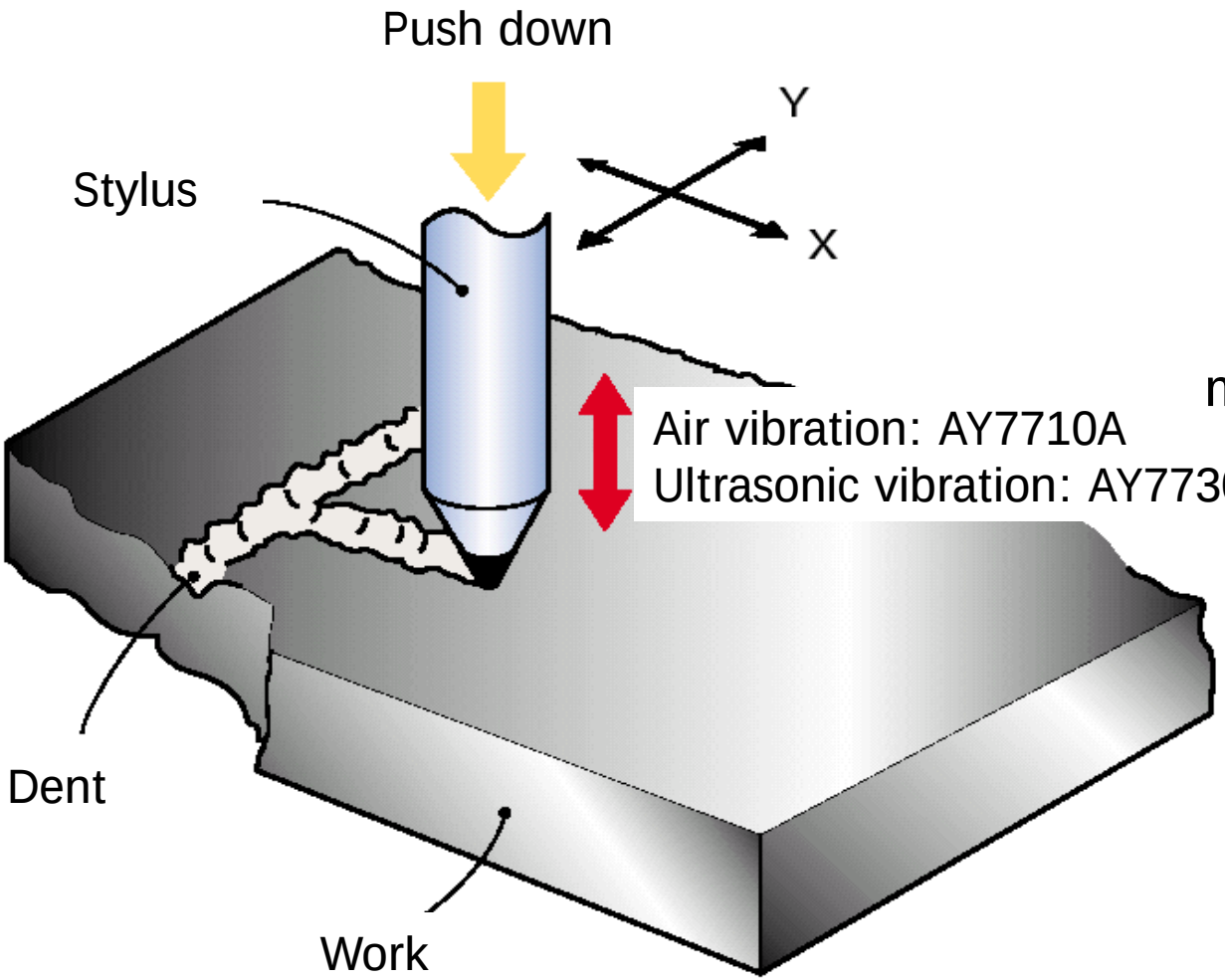
Mechanism of Dot Impact Printer



Strongly push down the stylus

↓

onto the work to

↓

make a dent on the work

↓

Contact method

A dent is created on the marking surface.

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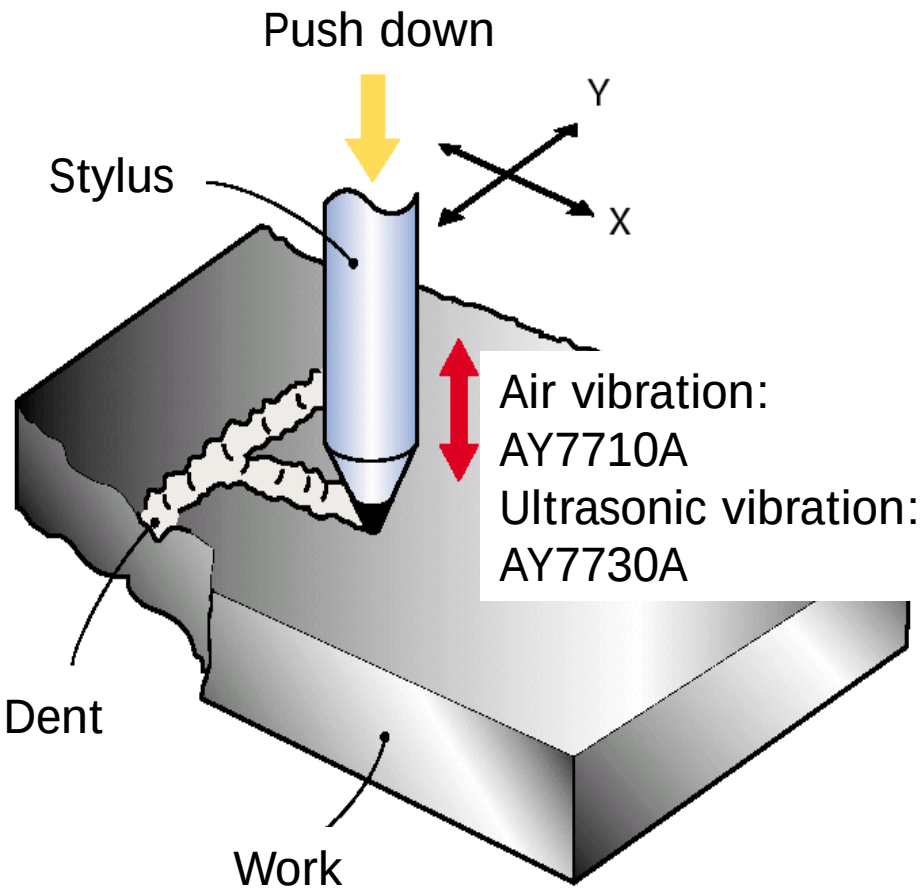
Characteristics of Dot Impact Printer



Matching of objects and information
→ Direct marking on objects

Need of secured tracing
→ Indelible marking

Attachment / delivery / post-processing
→ Dot impact printing

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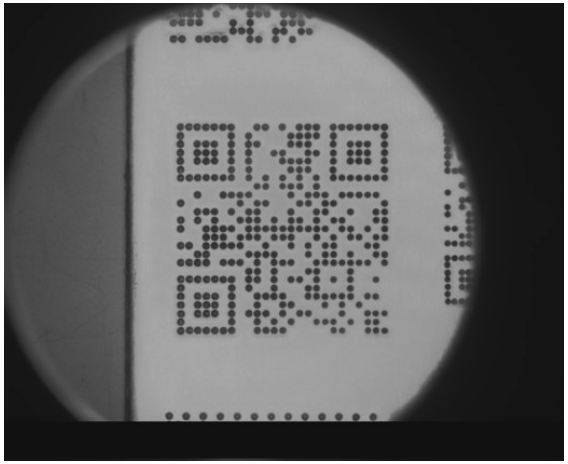
Print Samples

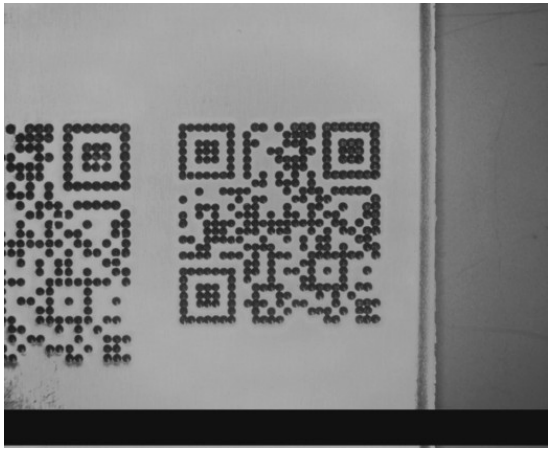
Printing method: Dot impact

Material: Metal KA5052-0

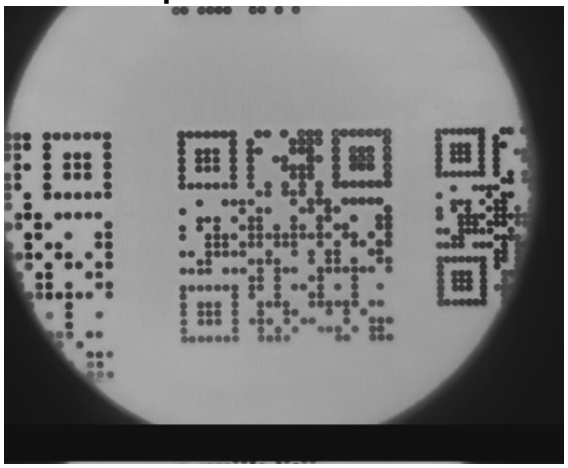
Dot/pitch ratio: 0.8



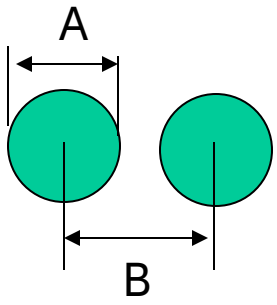
Dot/pitch ratio: 1.0



Dot/pitch ratio: 0.9



Dot/pitch ratio = A/B



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2D Symbol Reader

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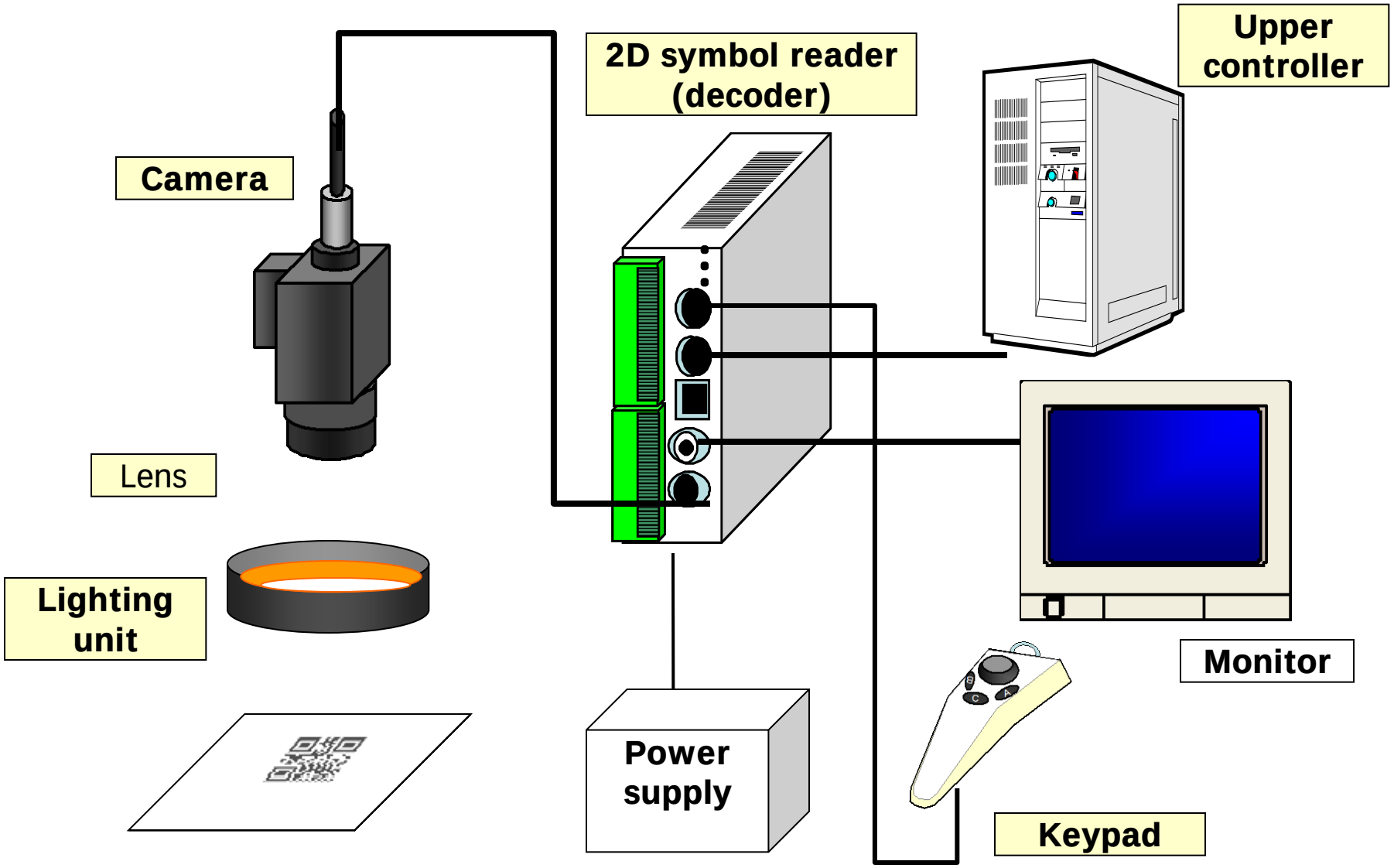
2D Symbol Reading System



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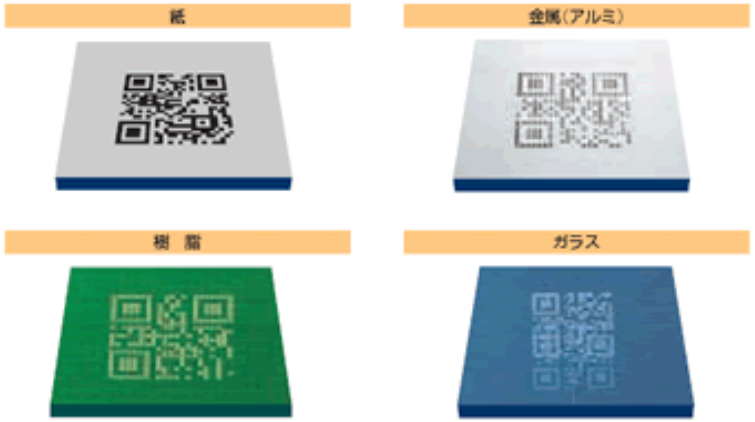
2D Symbol Reader

A fixed reader capable of reading direct-marked 2D symbols. It can control information on items, such as ultra-small parts and glass substrates, which was difficult with the existing technologies.



Besides symbols that are printed on papers, dot-pattern 2D symbols marked on metal, resin or glass materials are also supported.

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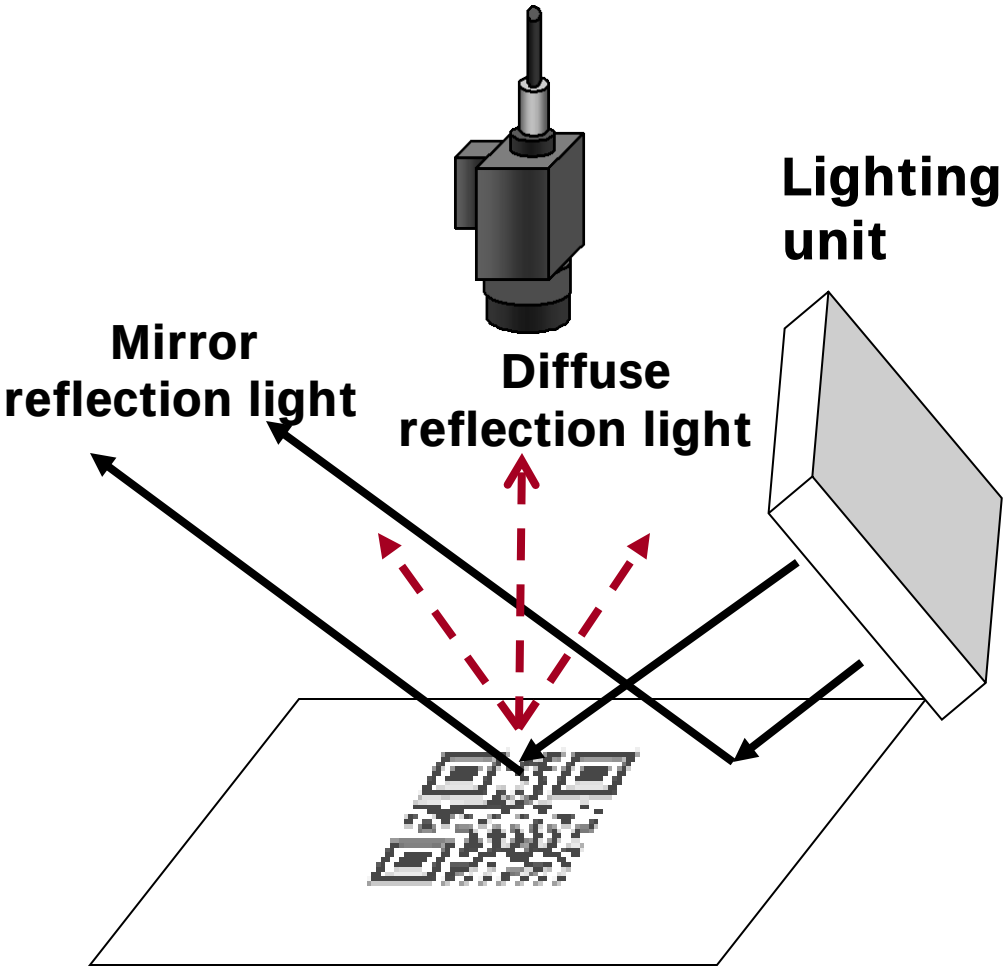
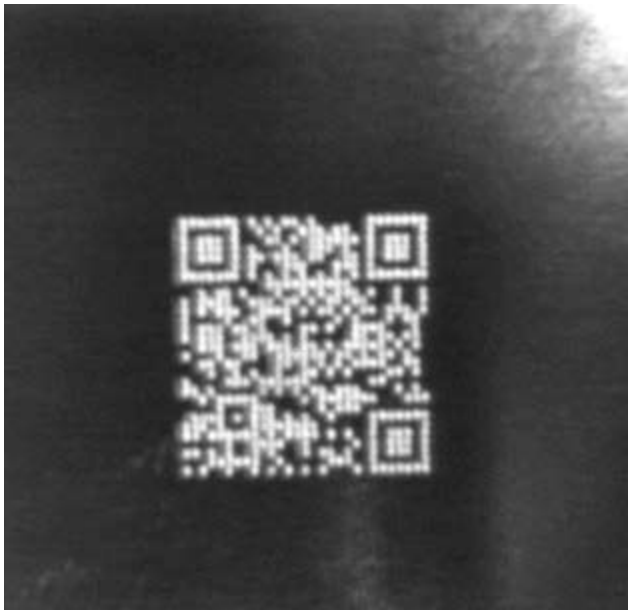
Selection of Lighting　Oblique Lighting





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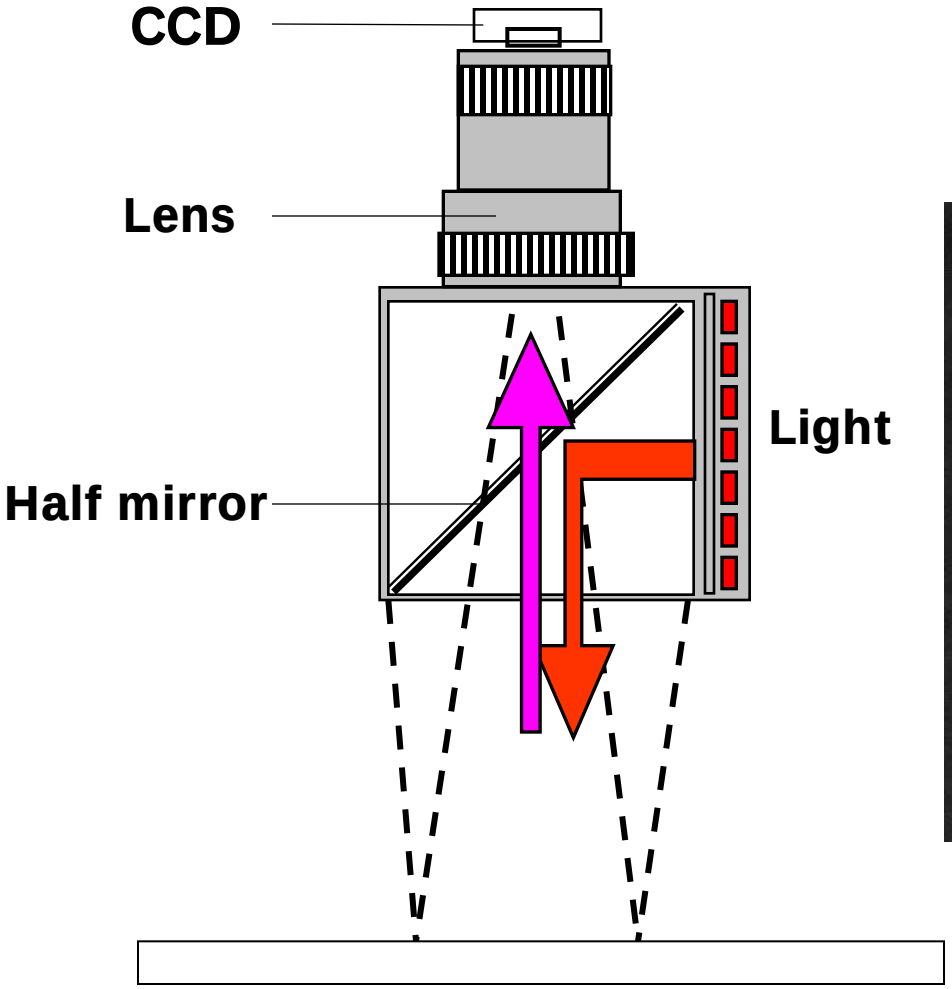
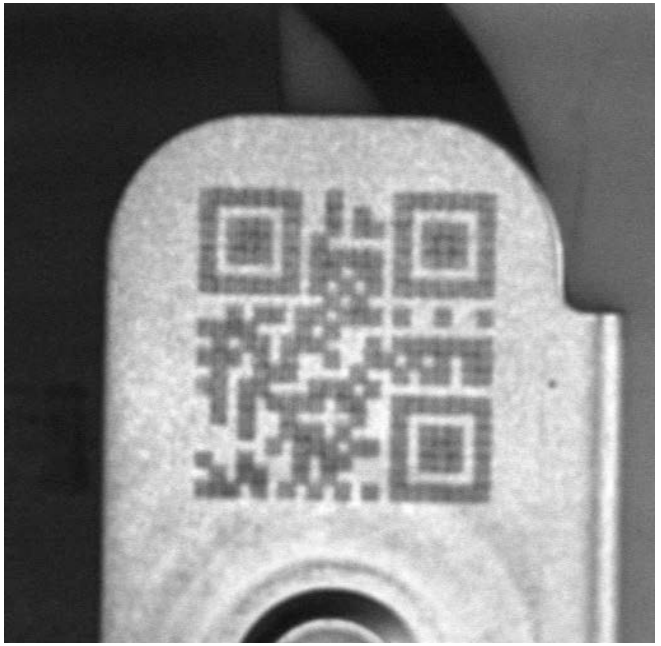
Selection of Lighting　Coaxial Lighting





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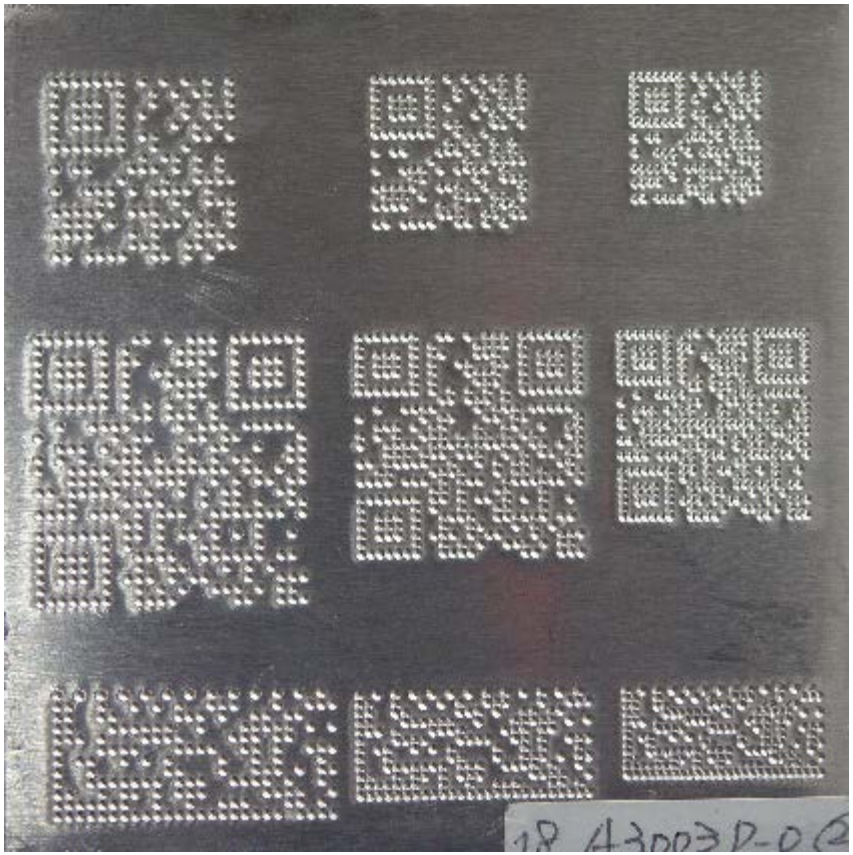
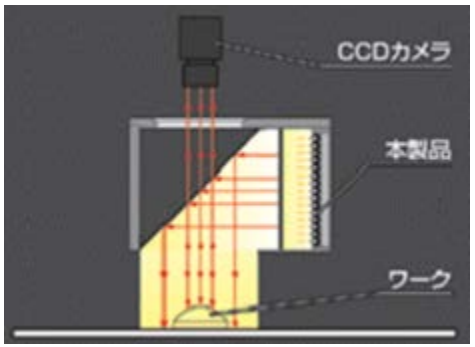
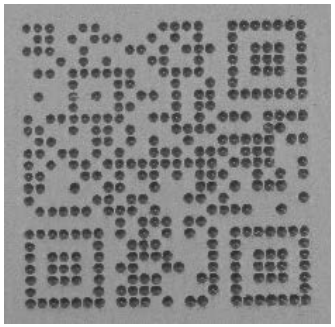
Coaxial Lighting　Image examples



Marking sample

Coaxial lighting





Captured image

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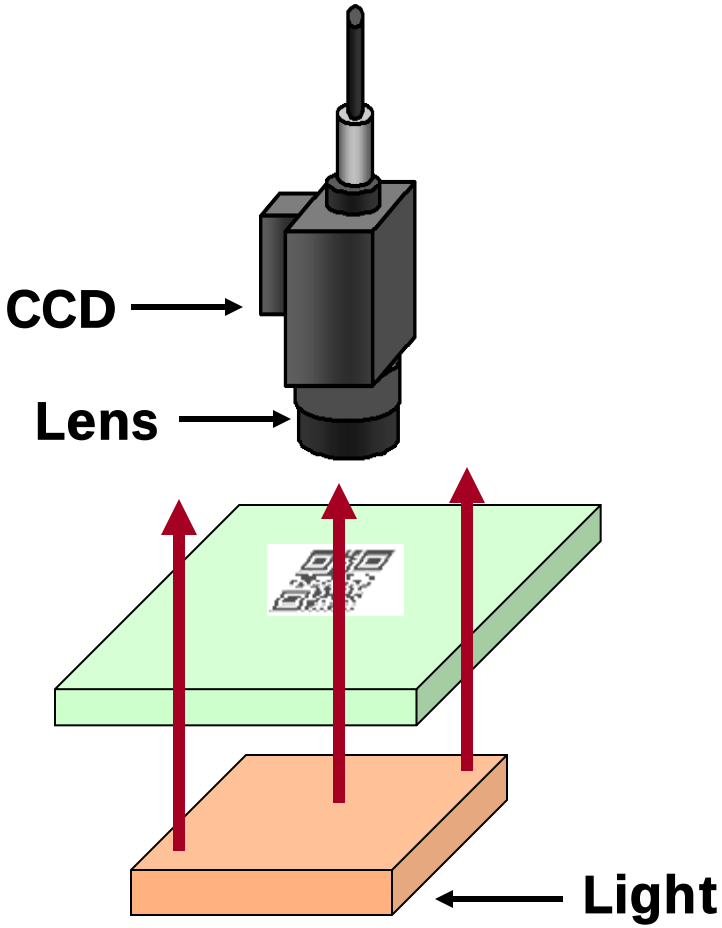
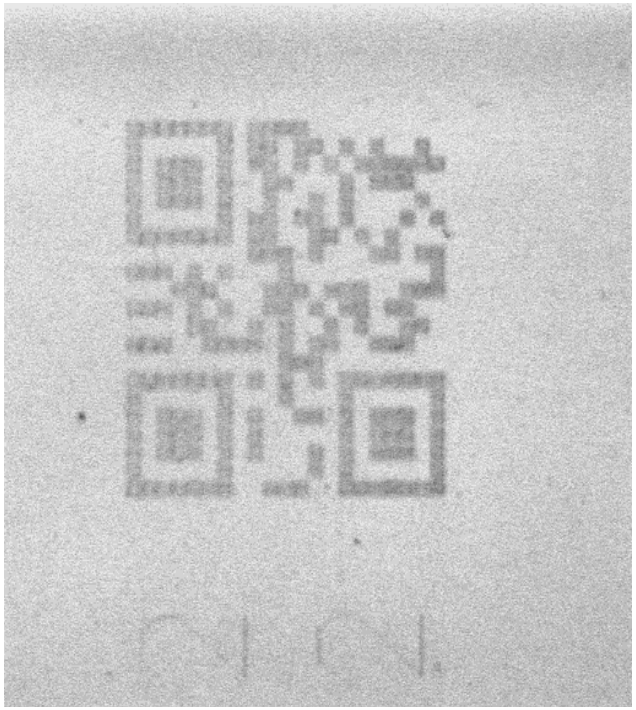
Selection of Lighting　Backlighting





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Quality Evaluator

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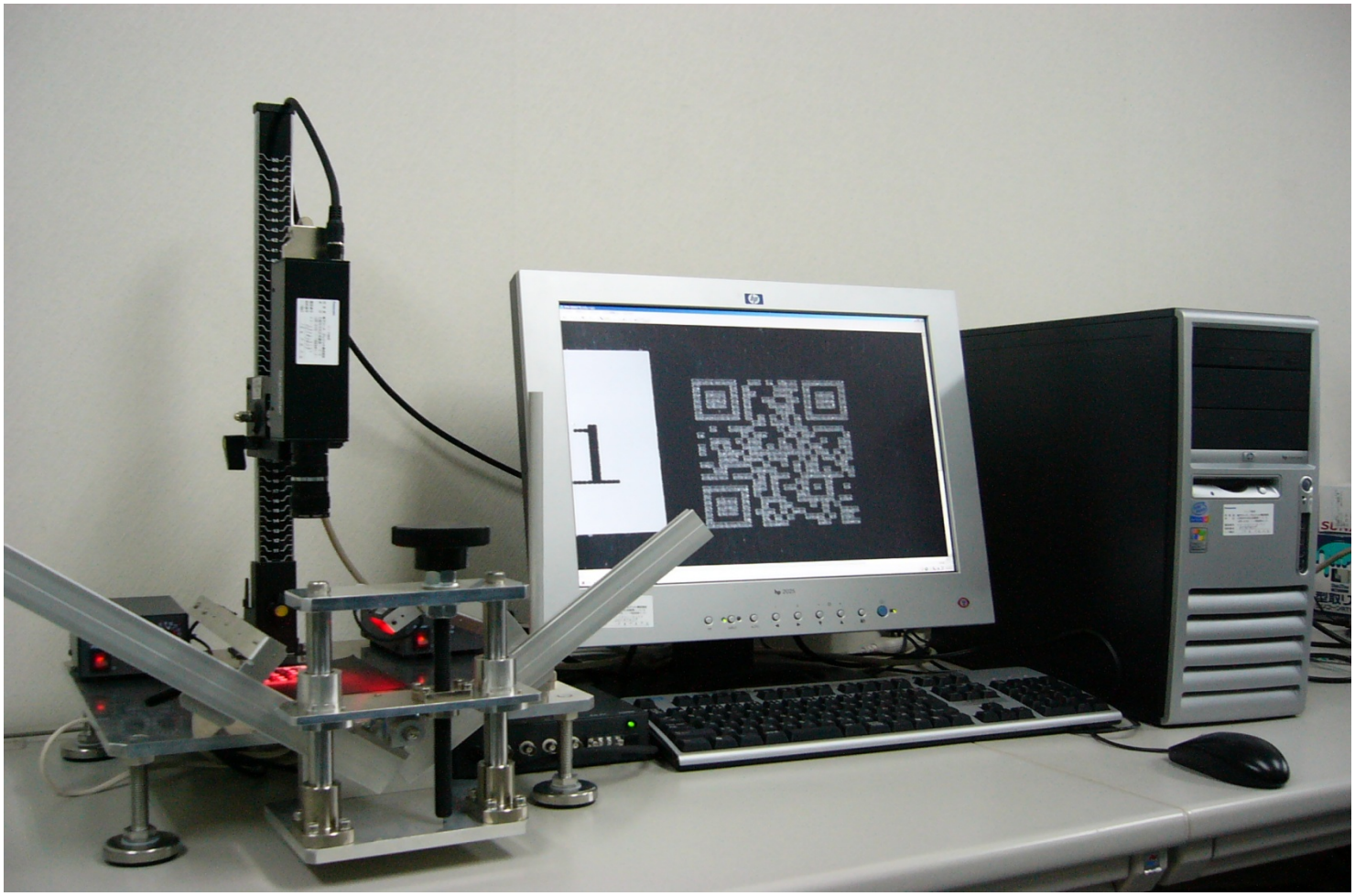
Structure of Quality Evaluator I

Entire system



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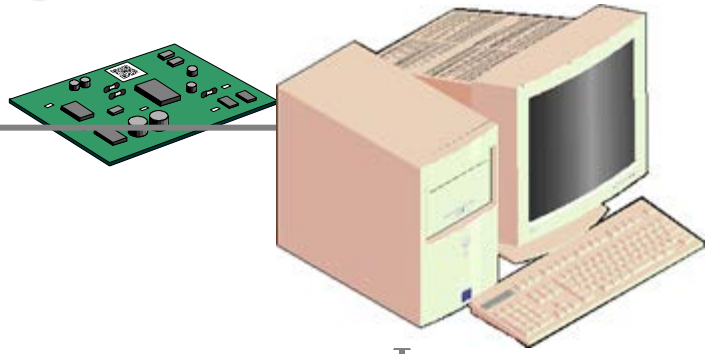
Structure of Quality Evaluator II

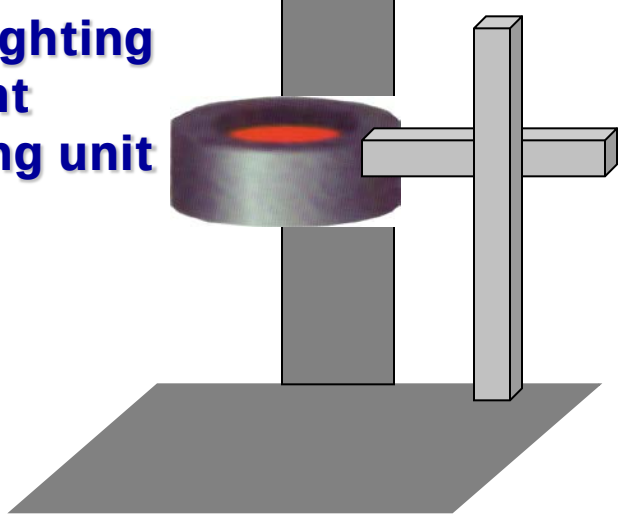
①Mega pixel camera unit

3 million pixels
2080 (H)
x 1544 (V)

③Evaluator



②Lighting
Light
fixing unit



④Evaluation software

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Analysis of Captured Image Data

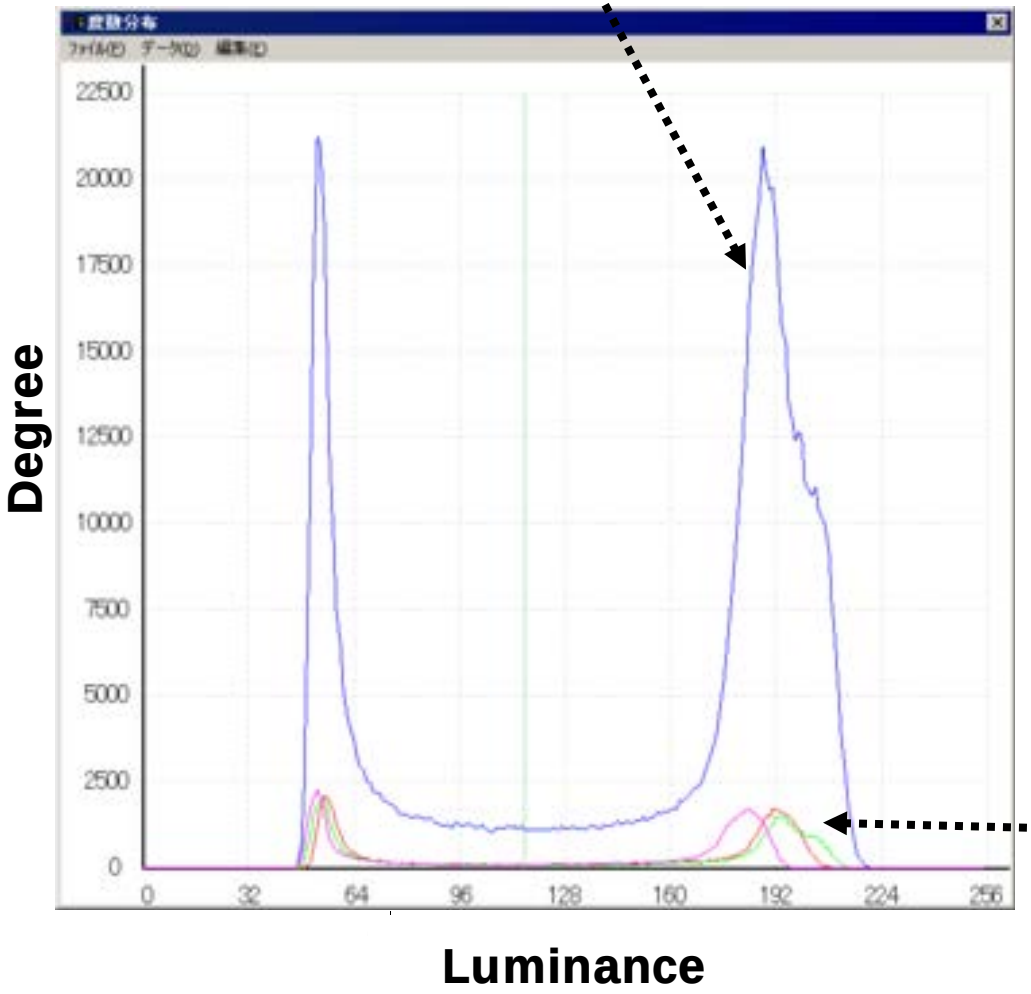
The evaluator is used to process the captured data and analyze the following items.

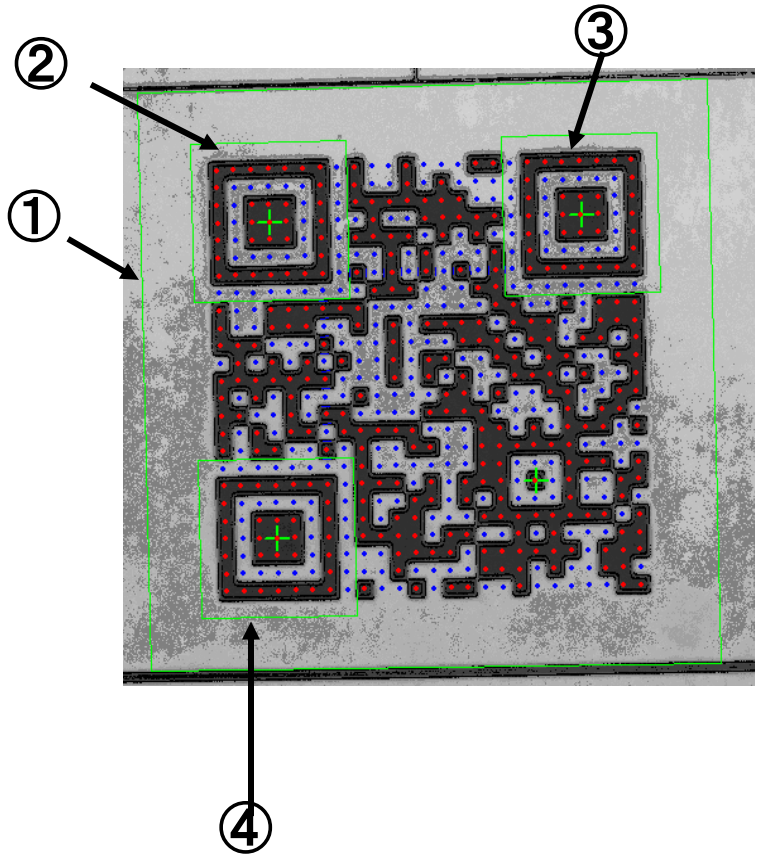
Analysis item	Description
1. Symbol contrast	Analyze contrast distribution in the complete cells.
2. Axis non-uniformity	Compare the sizes of X1 and X2 in the finder patterns.
3. Timing pattern size	Measure a misalignment between the timing patterns.
4. Print disparity	Measure a gain and loss in the timing patterns.
5. Reference decoding	Reading disabled.
6. Error correction use rate	Measure the error correction use rate as general characteristics.

The result of analysis is stored in a file.

Symbol Contrast

Luminance distribution of entire symbol





Luminance distribution of finder patterns

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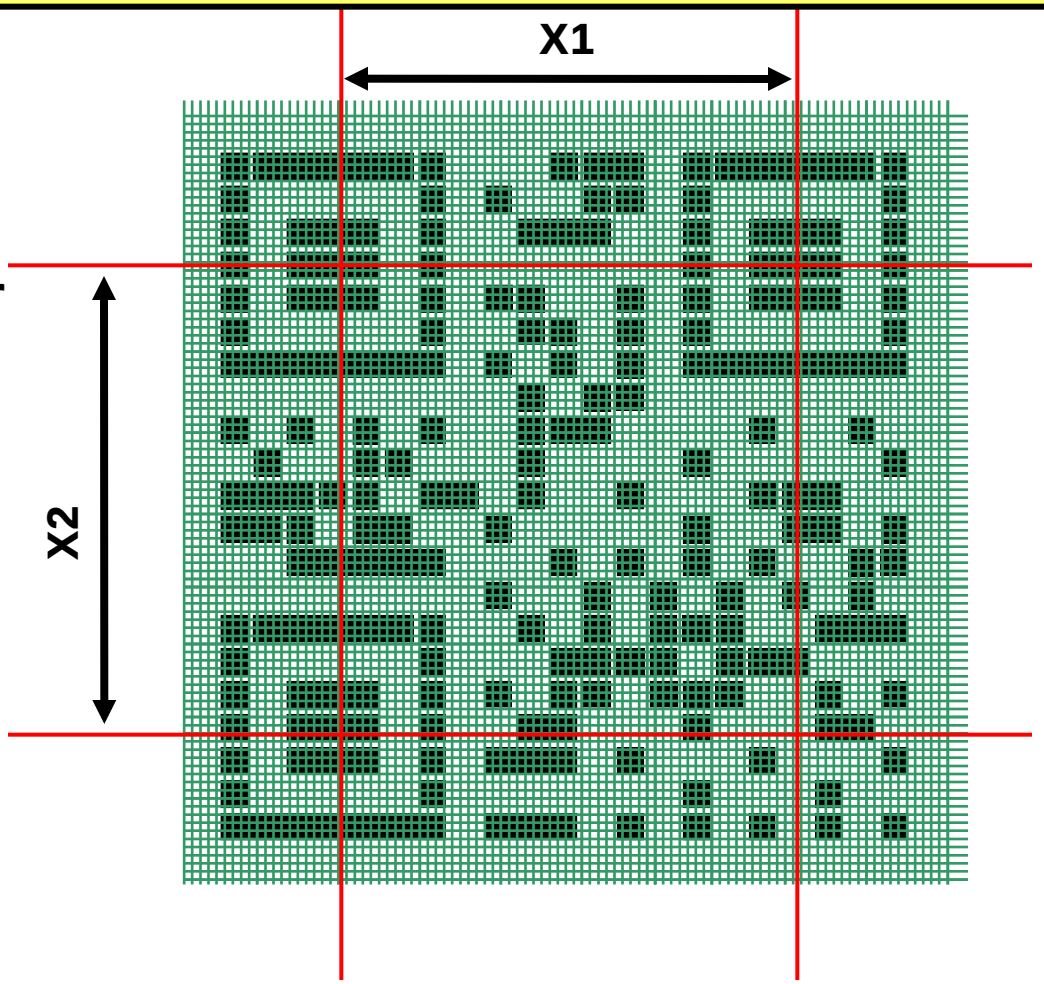
Non-Uniformity of Axis

Evaluate the expansion/contraction and distortion in the entire symbol.

Compare the sizes of X1 and X2 in the finder patterns.

- **Length/width ratio**
  X2/X1 x 100 %

- **Axial angle**



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Thank you for your attention!

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