

Back to Basics: Introduction to Barcode Reading & Symbologies



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Kasey Tipping

Agenda

- **What is a barcode?**
- **1-D codes**
- **2-D codes**
- **Marking methods**
- **Laser scanning**
- **Image-based reading**
- **Hardware and software**
- **Communication**
- **How to select a reader**

What is barcode reading?

- A barcode is a machine readable representation of data related to the object it is attached to.
- A barcode reader is used to read these codes in order to track the object throughout its lifecycle.
- **3 main reasons for barcodes:**
 - **Universally understood**
 - **Marketing**
 - **Traceability**



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Where are barcodes used?

- The first product ever scanned was in 1974.
- By 1980s, retail scanning was worldwide.
- Today, there are 1-D and 2-D codes.
- Where can I find barcodes?



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Where are barcodes used?



Food



Packaging



Medical & Pharmaceutical



Electronics



Automotive



Aerospace

1-D barcodes

Types
Industry terminology
Common uses

Common 1-D barcodes



UPC-A



Code 39



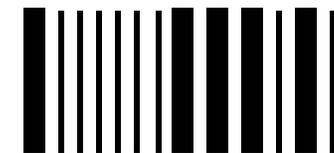
Code 128



Interleaved 2 of 5



Codabar

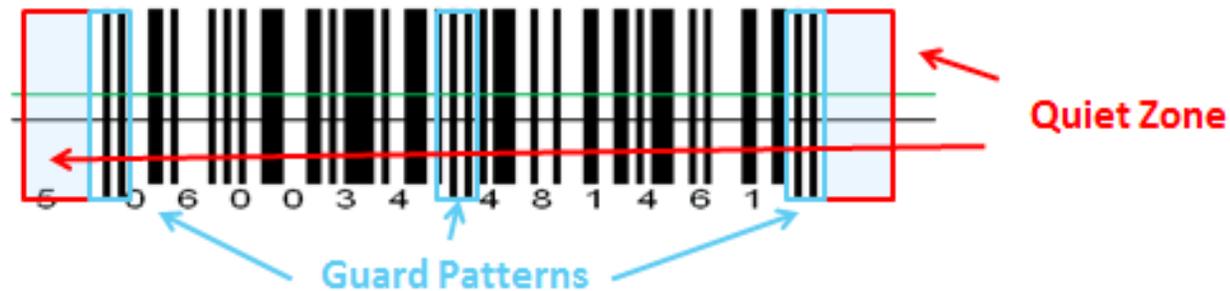


Pharmacode

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1-D barcode terminology

- Quiet zone
- Narrow Bar Width (NBW)
- Guard pattern



2-D barcodes

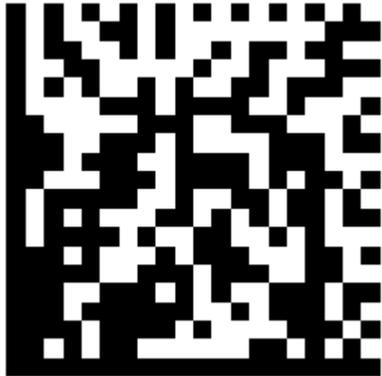
Types

Industry terminology

Marking methods

Common uses

Common 2-D codes



Data Matrix



QR Code



MaxiCode

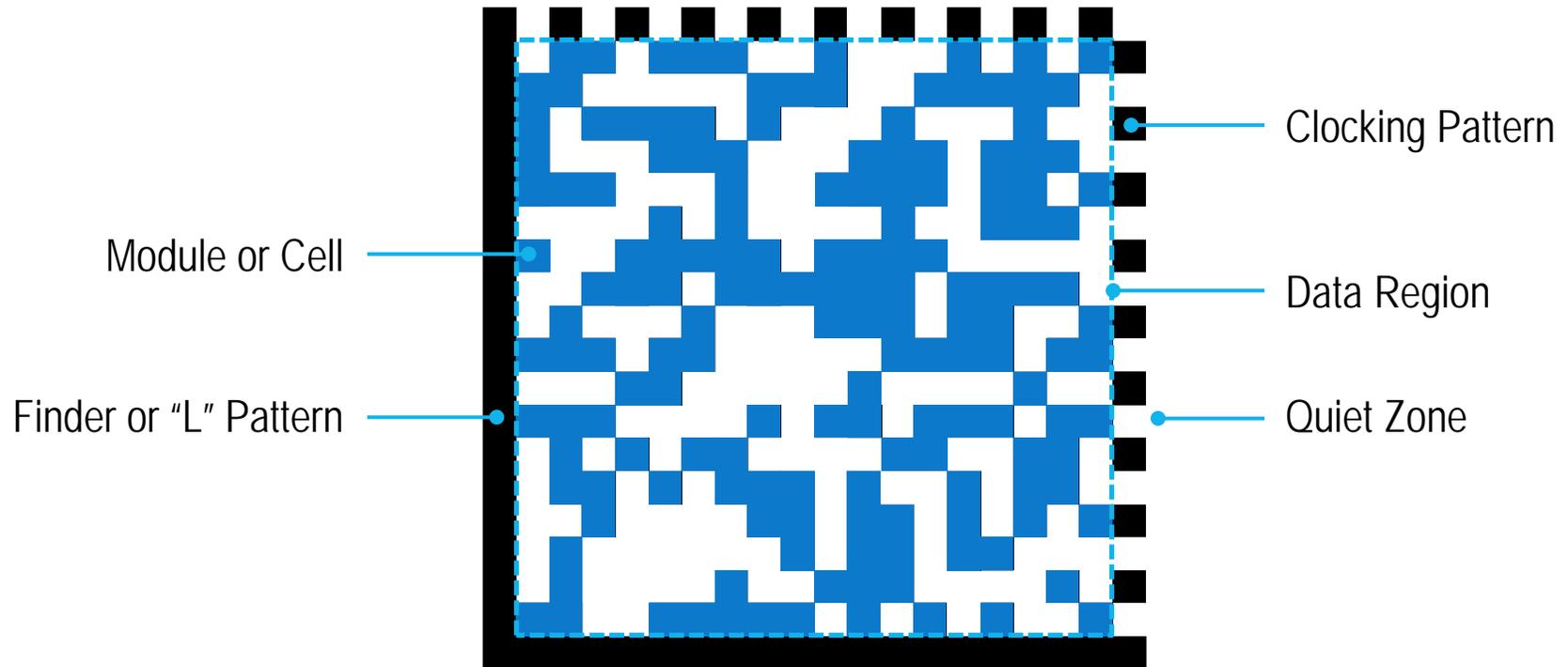


Aztec Code

2-D code specifications

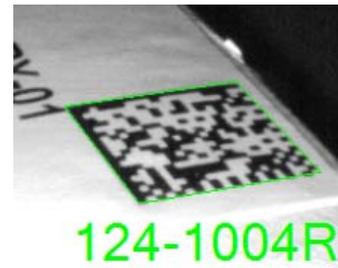
- 24 square and 6 rectangular formats
- 3,116 numeric or 2,335 alphanumeric characters
- Error correction improves read rates
- Reading accuracy
 - 1 misread error in 10.5 million scans

2-D code terminology



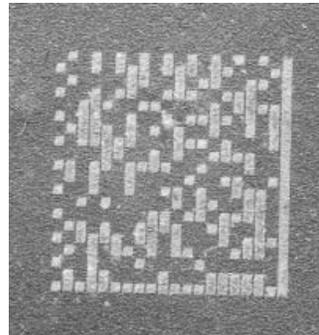
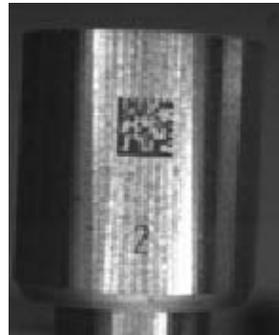
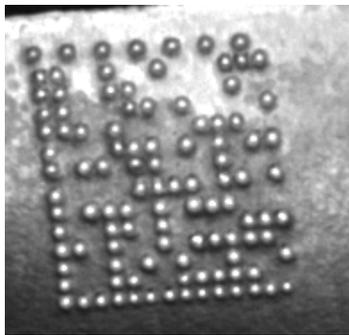
Printing methods: Printed codes

- Inkjet
- Labels
 - Most basic
 - Cost effective
 - Less flexible, pre-determined code data



Marking methods: 2-D direct part mark (DPM)

- Dot peen
- Chemically etched
- Laser marked



Laser scanning technology

What is it?

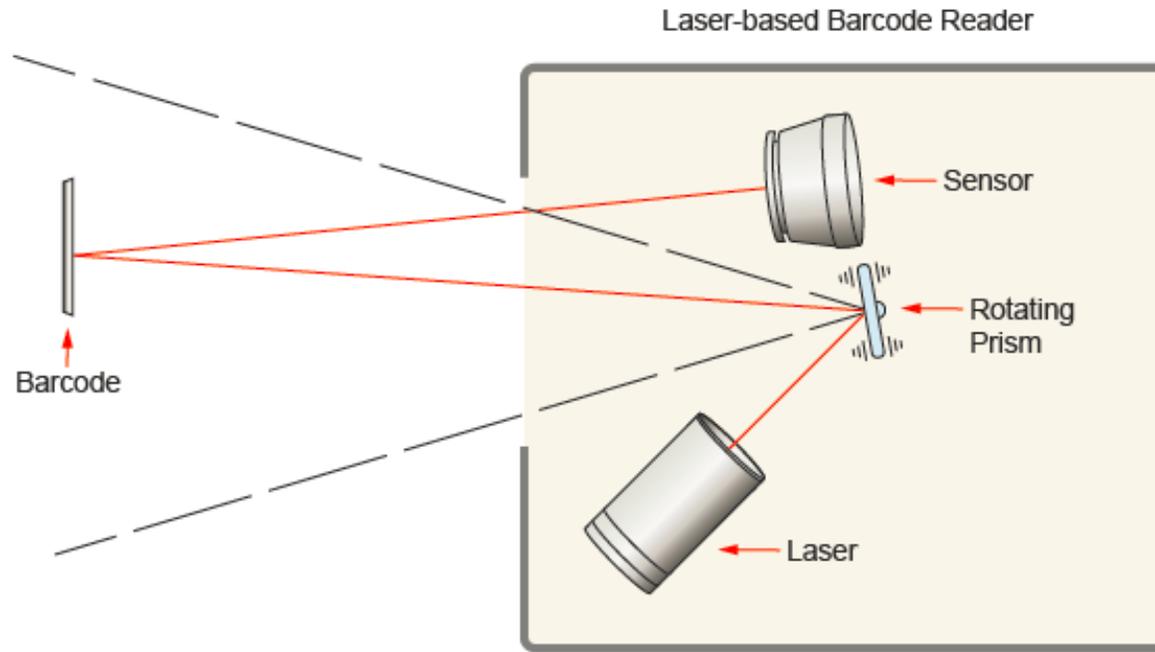
How does it work?

Benefits

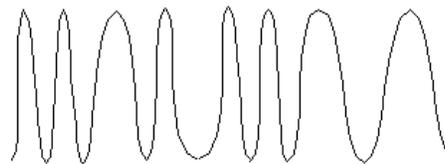
Limitations

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Laser scanning technology



Barcode



Analog Signal



Digital Signal

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Benefits of laser scanners

Longest in use

Cost

- No image processor
- Uses oscillating mirrors

Speed

- Fast scan rates
- Decoding at long distances
- 6 to 24 inches away
- Long range can do multiple feet away



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Limitations of laser scanners

Hard to scan barcodes

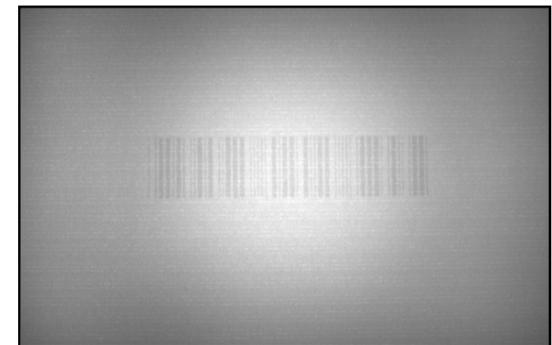
- Poorly printed
- Defective/damaged
- Low contrast
- Specular reflections

Unidirectional scanning

- No omnidirectional (360°) or at least orthogonal (0° and 90°) reading
- Mounting and positioning constraints

Moving parts are subject to failure

Cannot read 2-D codes



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Image-based barcode reading technology

What is it?

How does it work?

Pixels-per-module

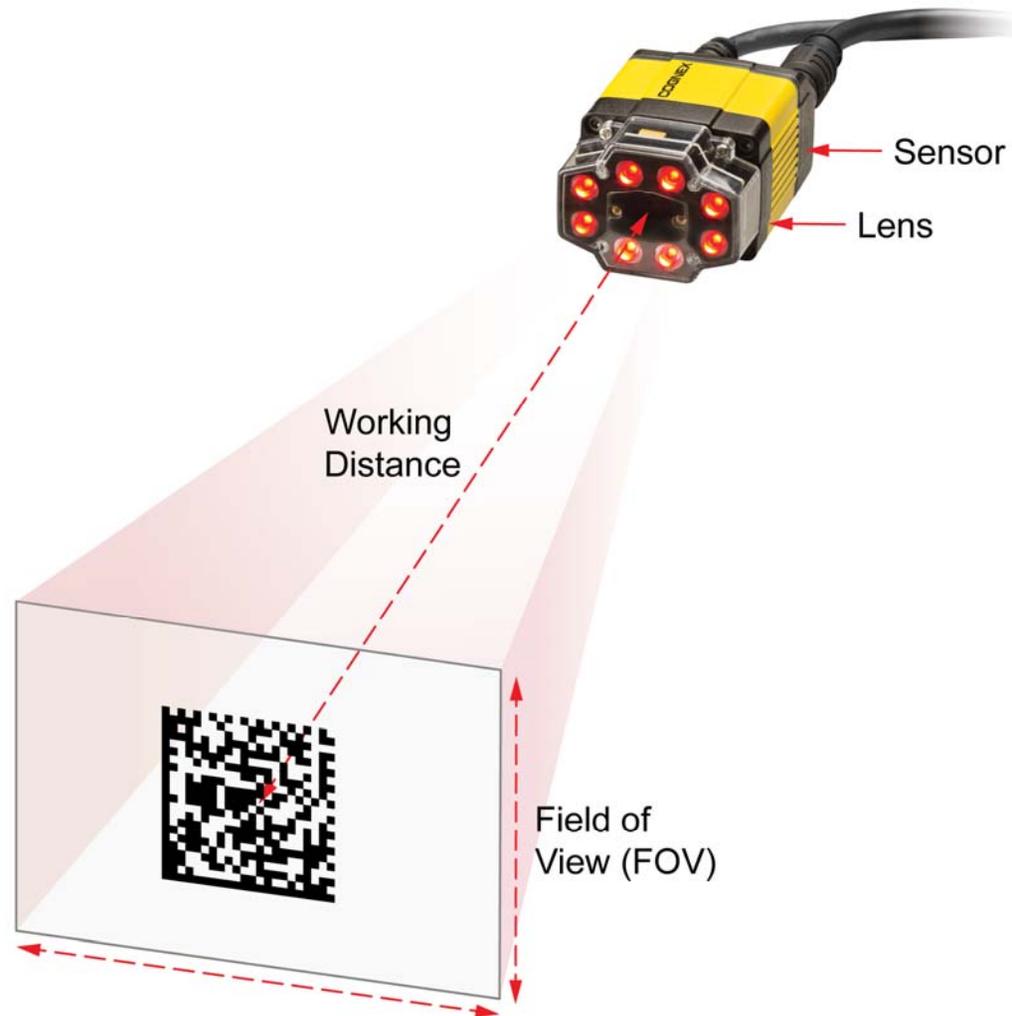
Image formation

Benefits

Misconceptions

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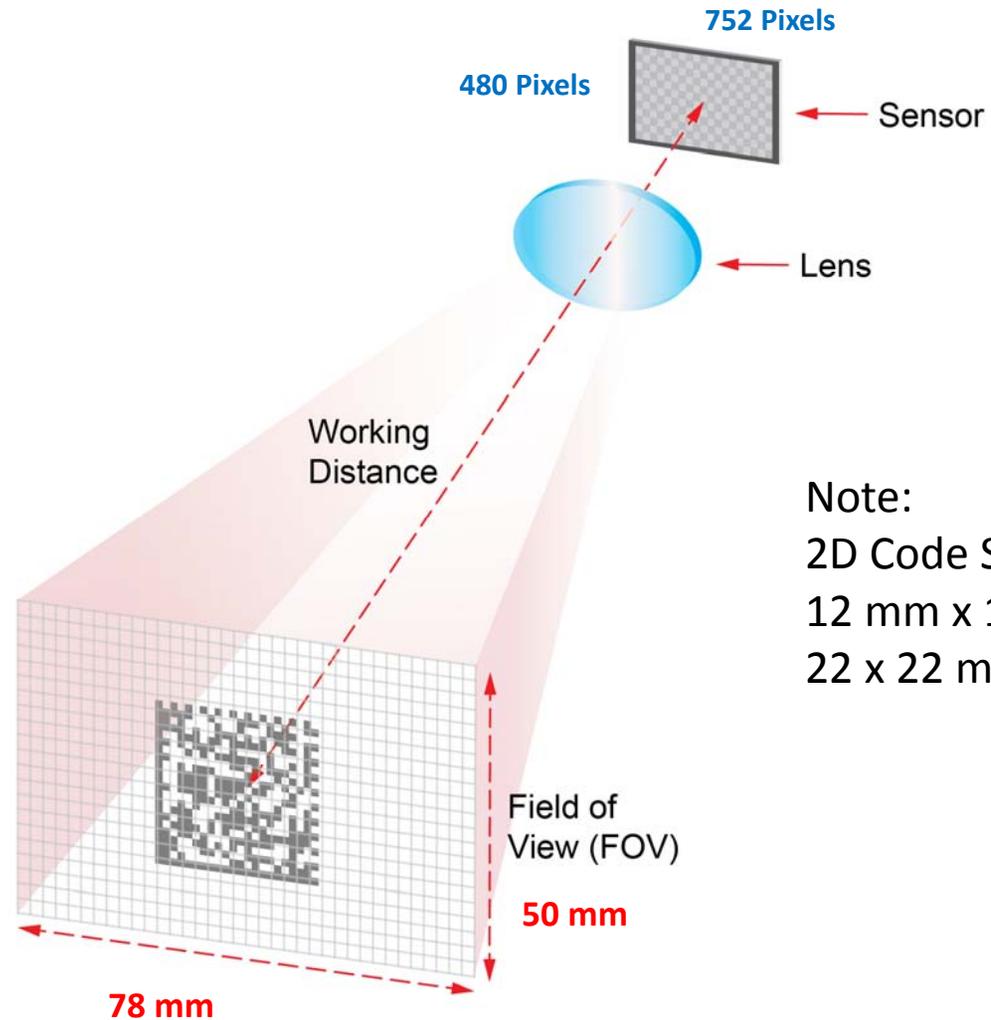
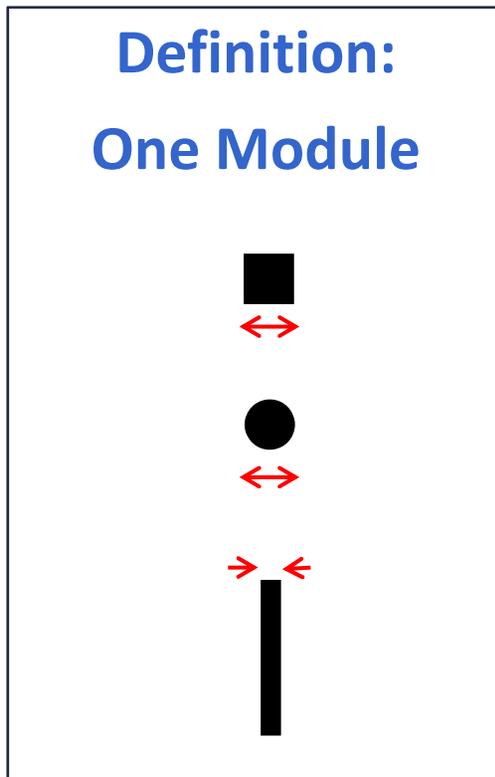
Image-based barcode reading technology



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What is pixels-per-module (PPM)?

The number of *pixels* on the sensor for each *module*, at a focal distance.



Note:
2D Code Size –
12 mm x 12 mm
22 x 22 modules

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Cognex Hotbars II algorithm



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Image-based barcode readers: Hardware

Code size

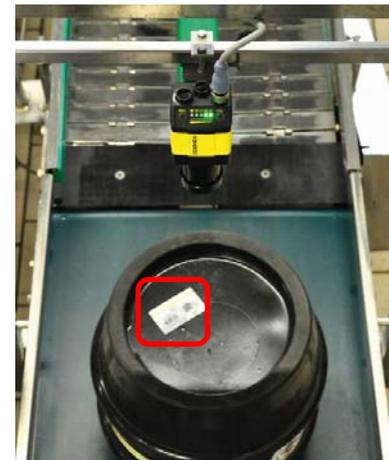
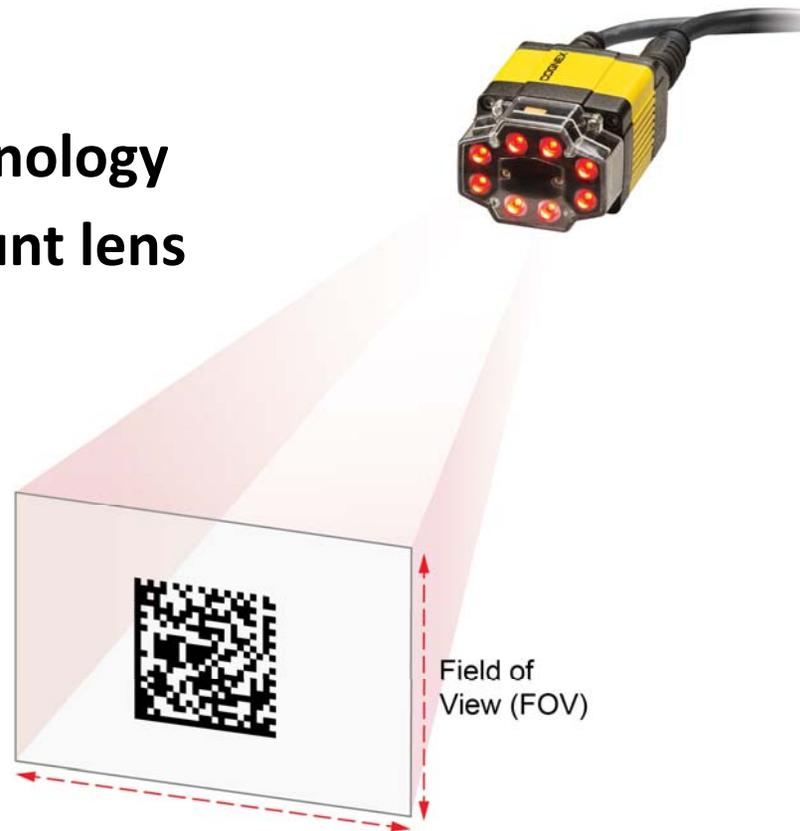
Mounting/reading distance

Lens options

- Liquid lens technology
- C-mount, S-mount lens

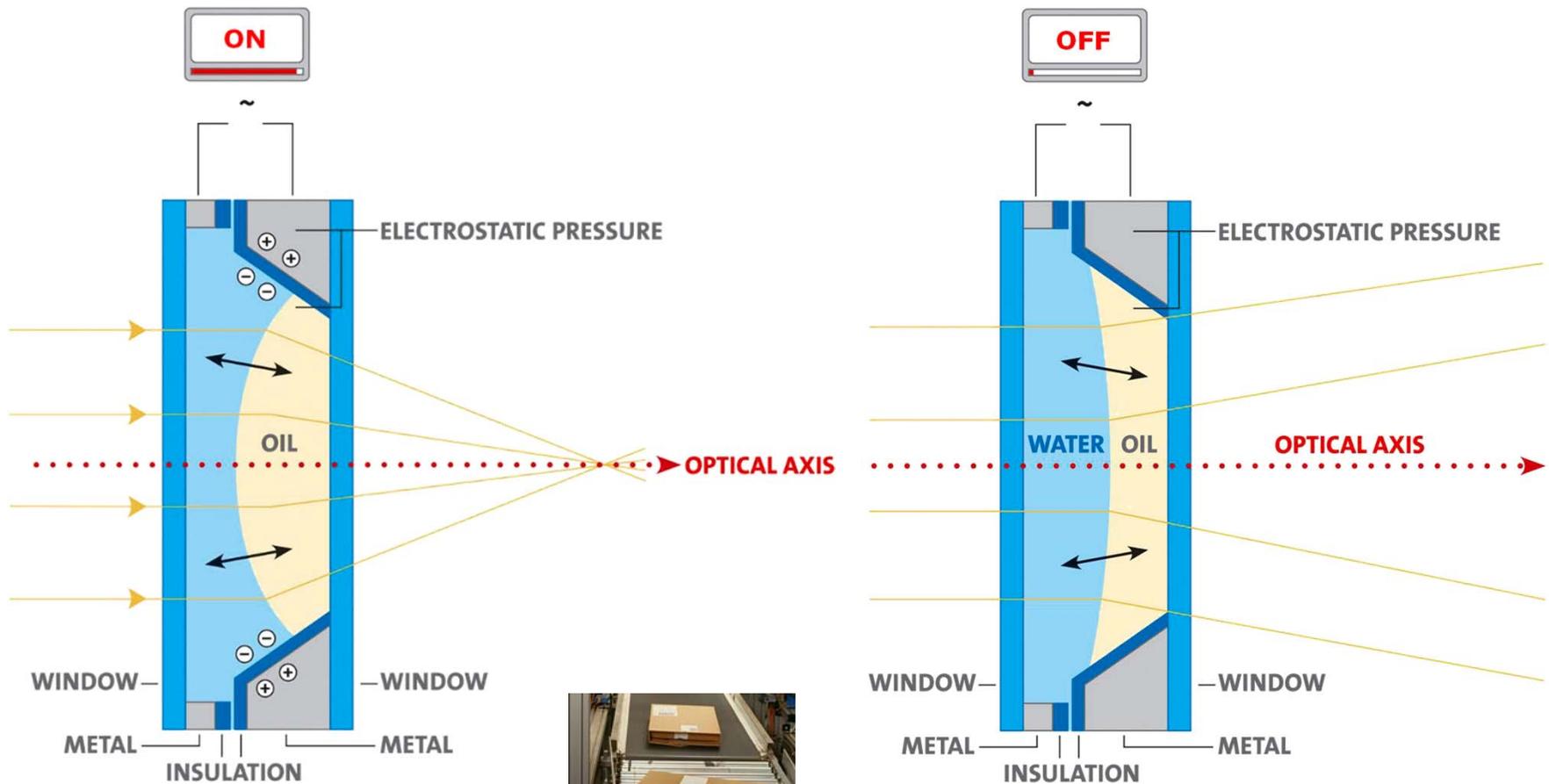
Lighting

- Stable



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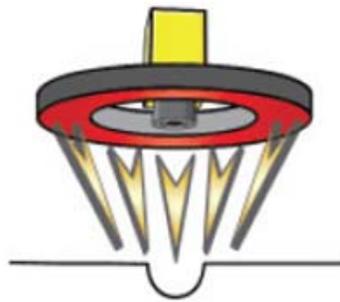
Image-based barcode readers: Liquid lens technology



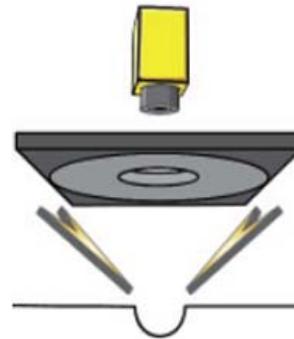
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Image-based barcode readers: Image formation

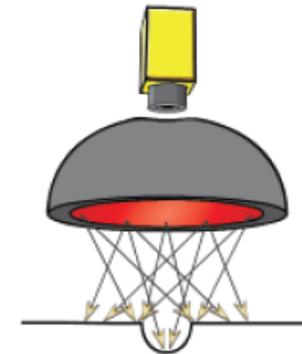
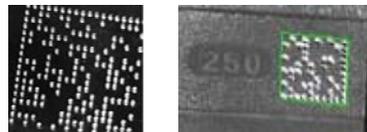
- **Dark ink, light background—simple direct lighting**
- **DPM requires more advanced lighting techniques**
- **Reader should have ideal focus settings**
 - **Lens advisor: S-mount, C-mount, liquid lens**



Bright field lighting
High contrast labels & DPM parts



Dark field lighting
Dot Peen & laser DPM

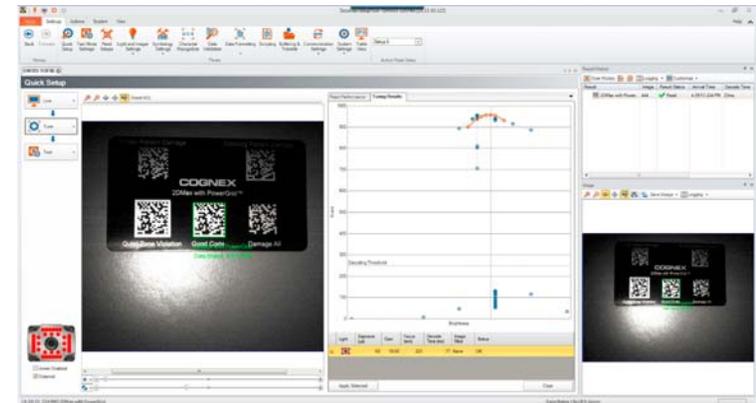


Diffuse dome lighting
Reflective & curved surface DPM reading



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Image-based barcode readers: Software



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Misconceptions of image-based barcode reading technology

Cost

- Imager processors are very expensive

Speed

- Older readers can be slow due to less advanced processors

Difficult to setup

- Software is needed for some systems
- Need a good image for processing

Communication protocols

Ethernet TCP/IP

RS-232

USB

Keyboard-mode

Discrete I/O

FTP



Integrating your barcode reader

PLC integration

- Ethernet/IP: Allen Bradley
- PROFINET: Siemens
- MC Protocol: Mitsubishi
- Modbus TCP: Schneider Electric

Storing data to a database

- Oracle
- SAP: Enterprise Resource Planning (ERP)



How to select a reader

Read rates

Durability

Ease of setup

Communication

Cognex readers

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Considerations when selecting a barcode reader

Read rates

- Algorithms
- Image formation
- Reduce No-Reads and Misreads

99.9%

Durability

- Solid state device
- IP rated

Ease of setup

- User friendly software
- Tuning

Communication

- Supports your protocol



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Read rates: 1-D barcodes

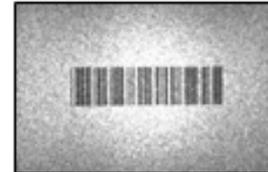
Best-in-class algorithms

- 1DMax+ with Hotbars II
- >1ppm

Ability to read hard codes

- On cardboard
- Marked with a pen
- Poor factory lighting

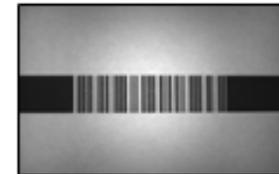
Noise



Specularity



Perspective



Quiet Zone Violation

Contrast



Uneven Illumination



Damages



Voids

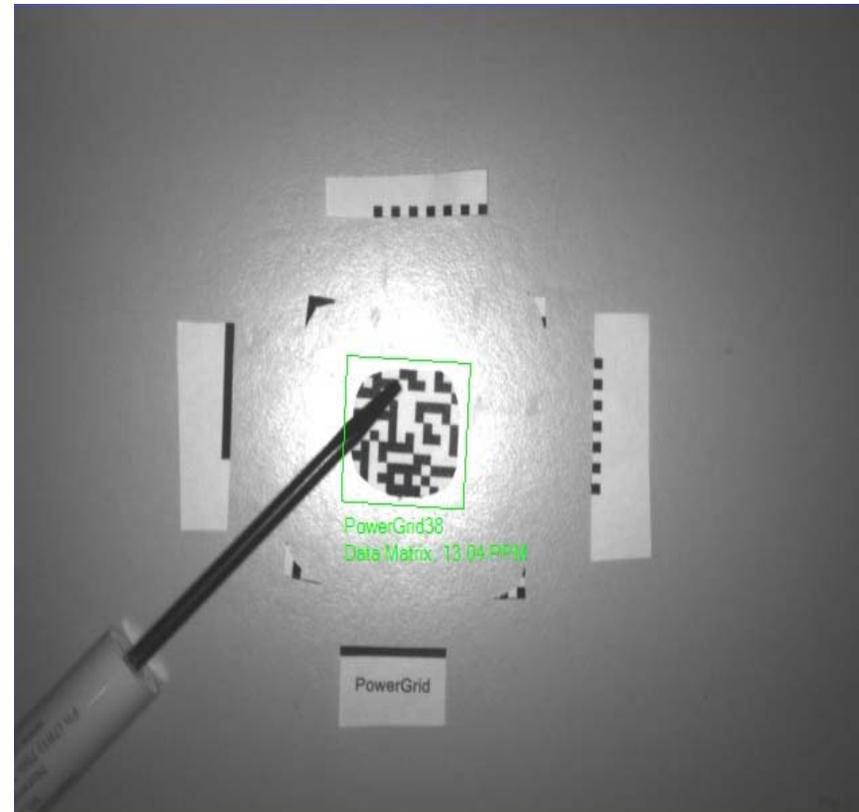
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Read rates: 2-D codes

Best-in-class algorithms

- 2DMax with PowerGrid
 - Missing clocking pattern
 - Missing finder pattern
 - Damaged code corner

ALL AT ONCE



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Read rates: Image formation

Lights

- Integrated and external lighting options
- Red, blue, white, and infrared integrated lighting options

Lens

- S-mount, C-mount, and liquid lens options



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Cognex image-based barcode readers

Durability

- Solid state design with no moving parts
- Handheld readers are drop test rated
- Fixed-mount readers are IP rated

Easy setup

- Easy tuning in software and hardware
- User-friendly software

Communication

- Supports industrial and communication protocols



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Cognex image-based barcode reader family



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Summary

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QUESTIONS?