

# Back to Basics: Introduction to Barcode Reading & Symbolologies



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Kasey Tipping

# Agenda

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- 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?

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- 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**

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# 1-D barcodes

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**Types**  
**Industry terminology**  
**Common uses**

# Common 1-D barcodes



**UPC-A**



**Code 39**



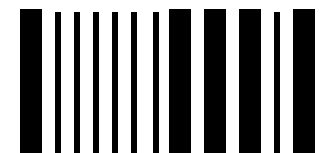
**Code 128**



**Interleaved 2 of 5**



**Codabar**

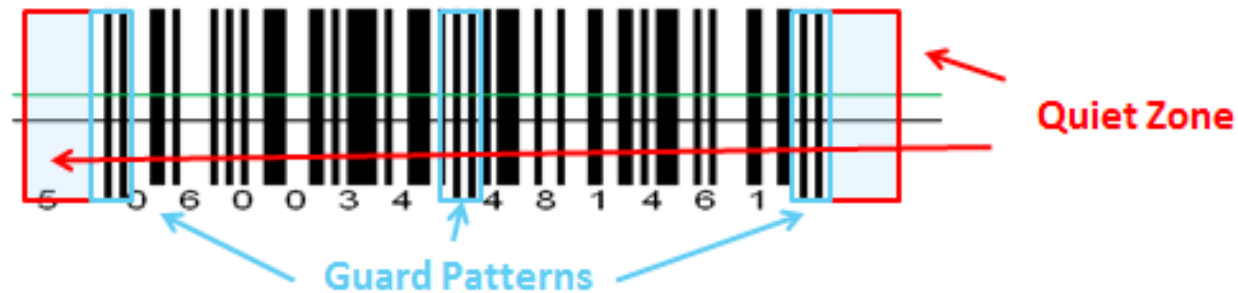


**Pharmacode**

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# 1-D barcode terminology

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



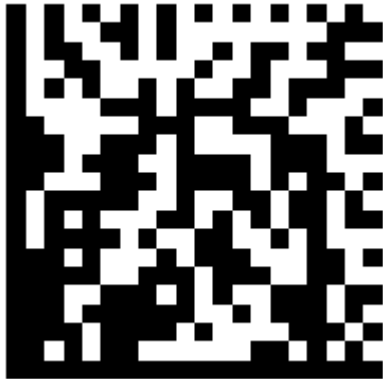


# 2-D barcodes

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**Types**  
**Industry terminology**  
**Marking methods**  
**Common uses**

# Common 2-D codes



Data Matrix



QR Code



MaxiCode



Aztec Code

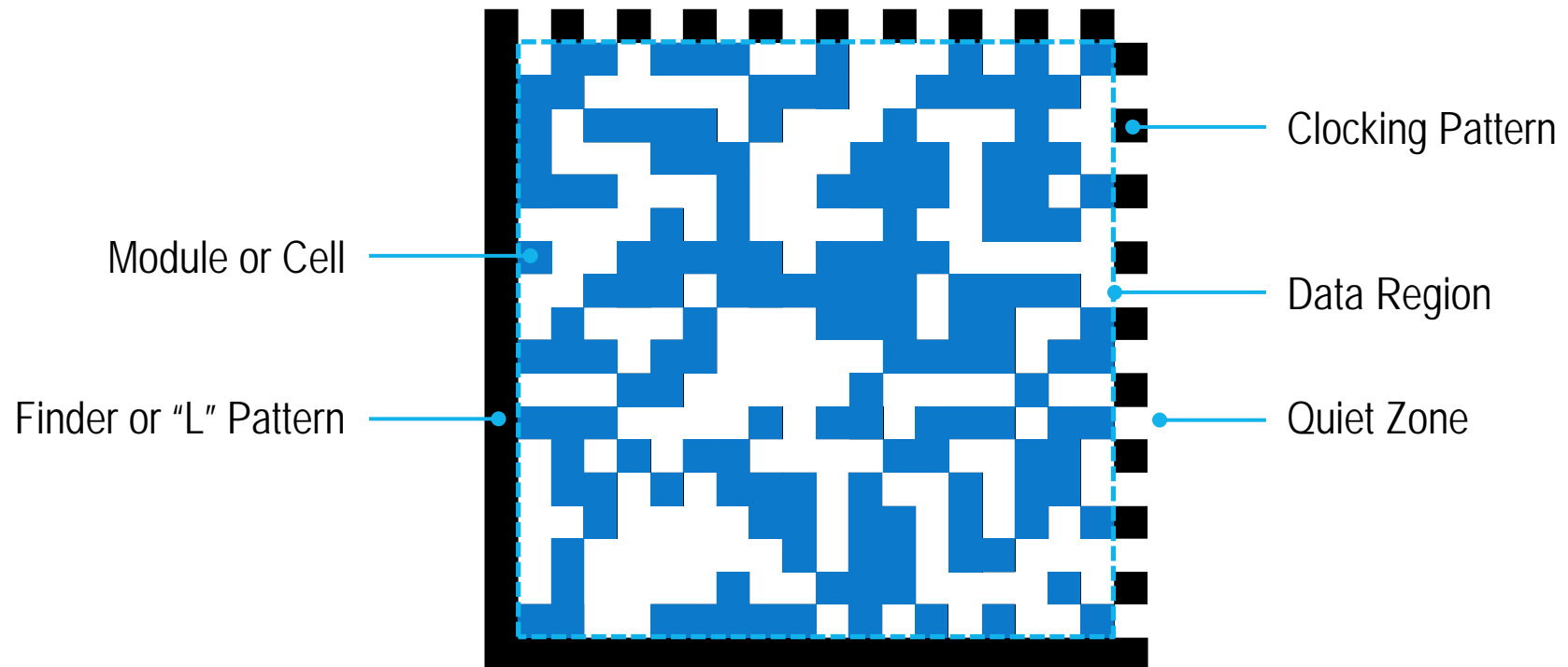
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# 2-D code specifications

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- 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



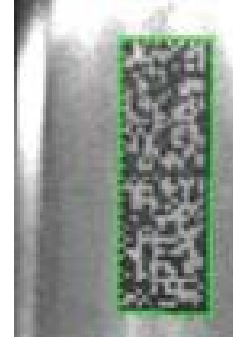
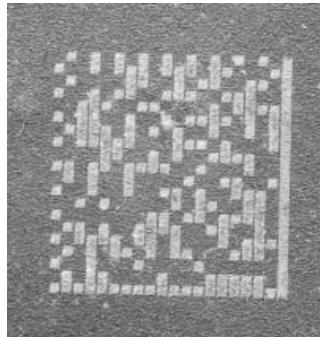
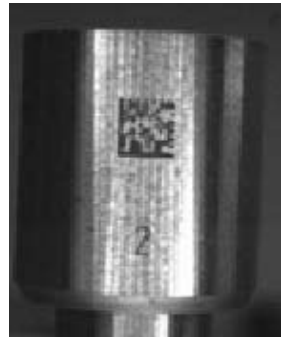
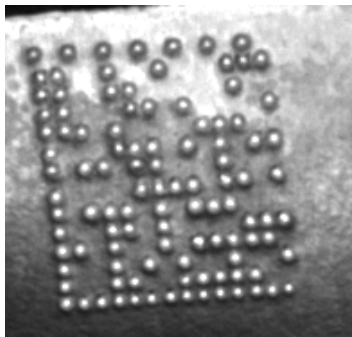
# Printing methods: Printed codes

- 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

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**What is it?**

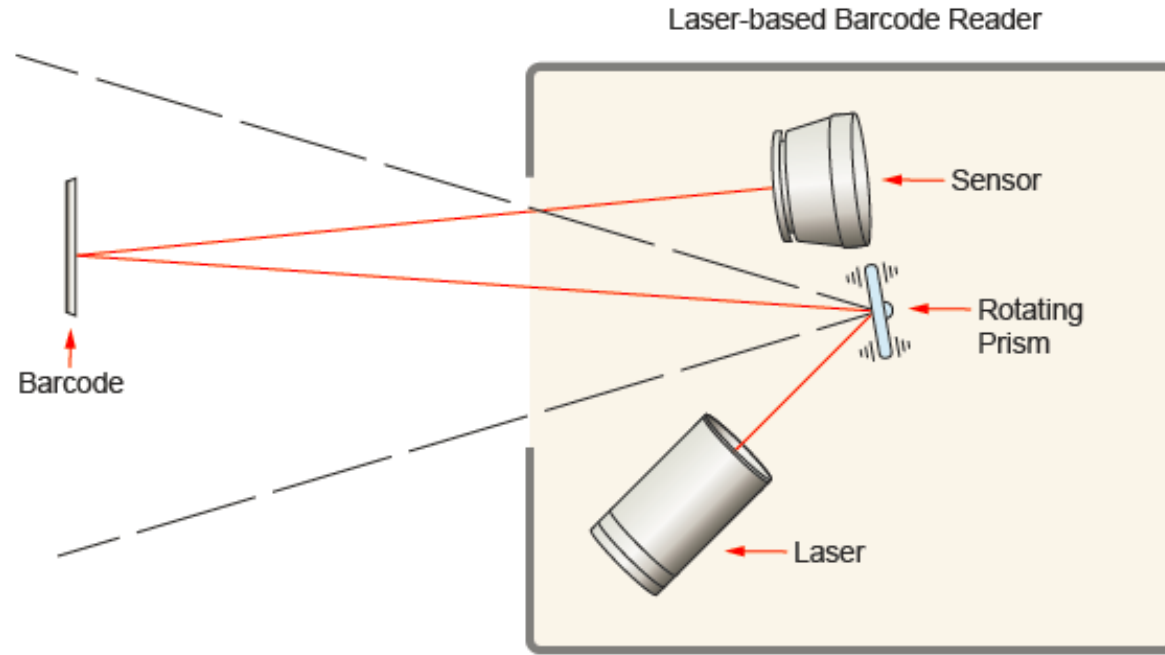
**How does it work?**

**Benefits**

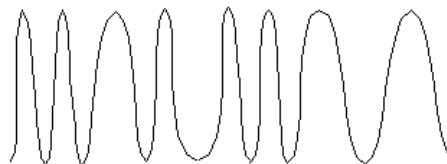
**Limitations**

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# Laser scanning technology



**Barcode**



**Analog Signal**



**Digital Signal**

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# Benefits of laser scanners

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## 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

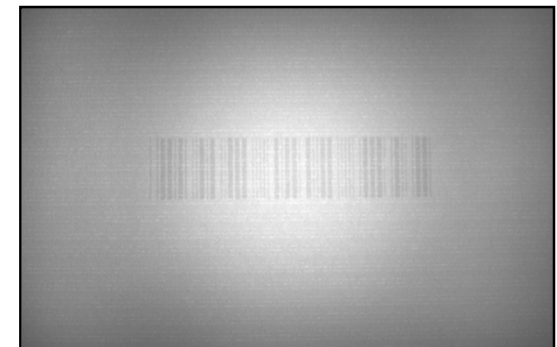
- Poorly printed
- Defective/damaged
- Low contrast
- Specular reflections

## 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

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**What is it?**

**How does it work?**

**Pixels-per-module**

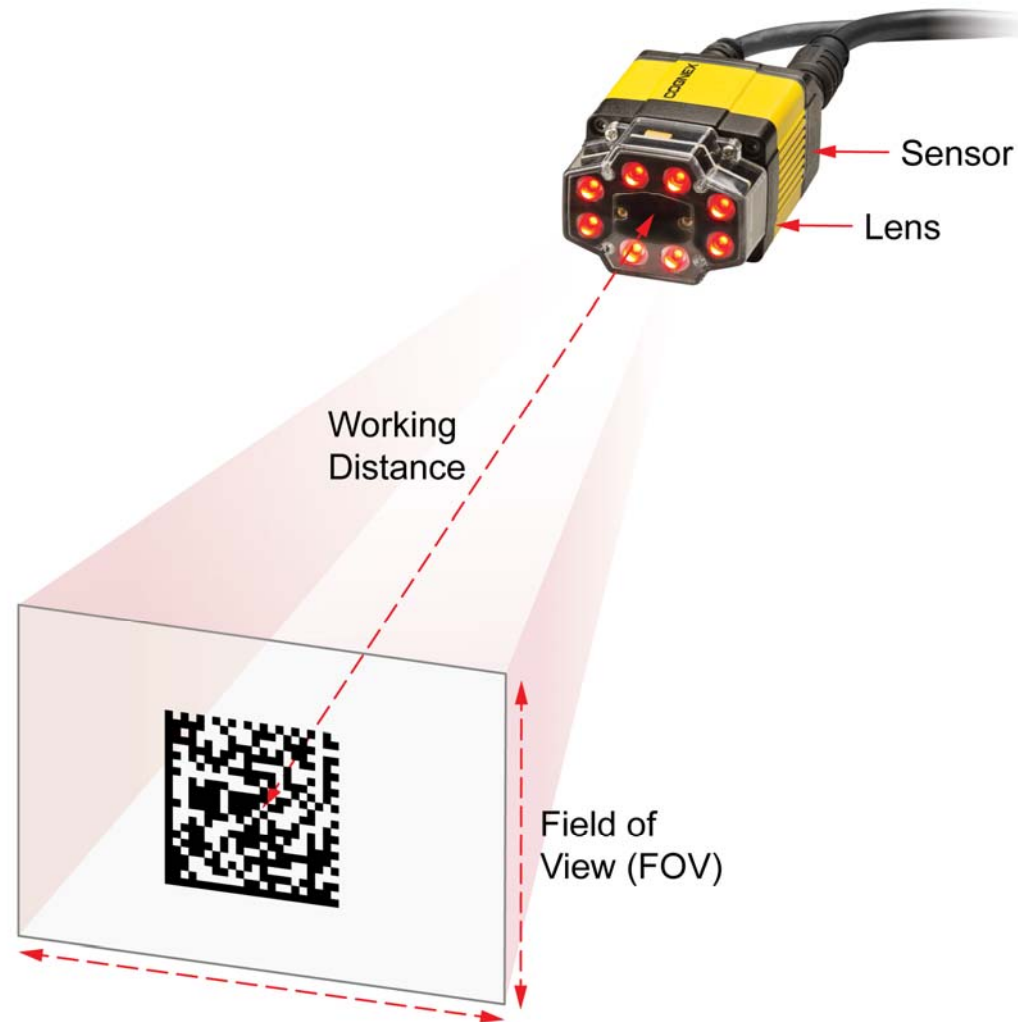
**Image formation**

**Benefits**

**Misconceptions**

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# Image-based barcode reading technology



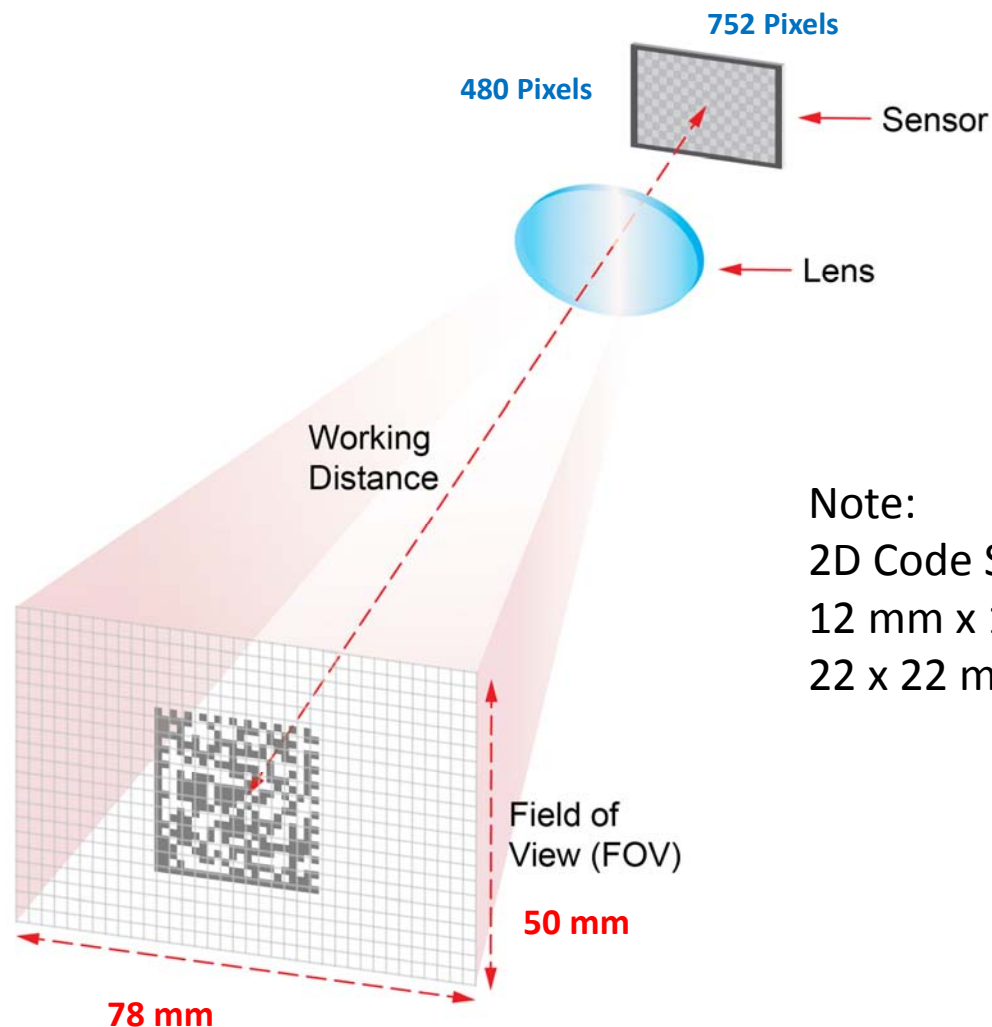
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# What is pixels-per-module (PPM)?

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

## Definition: One Module



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

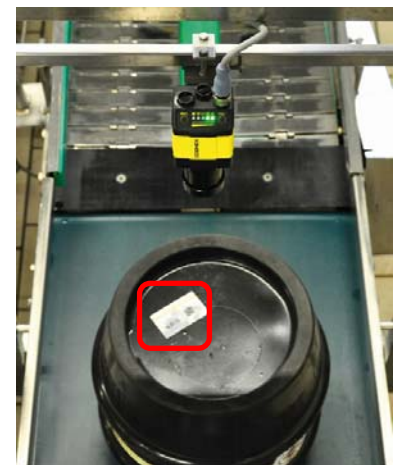
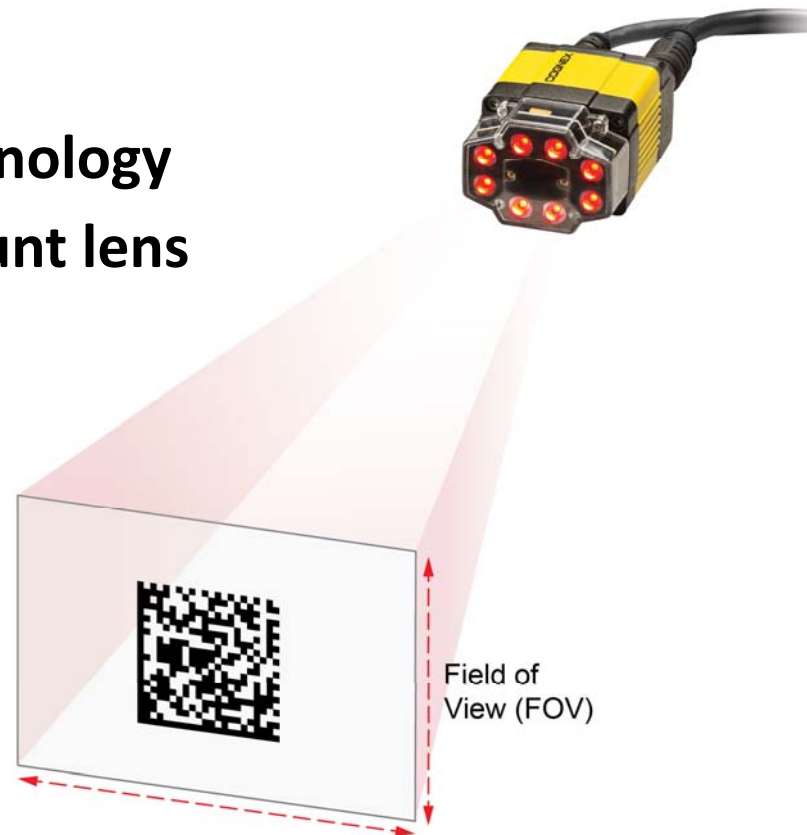
## Mounting/reading distance

## Lens options

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

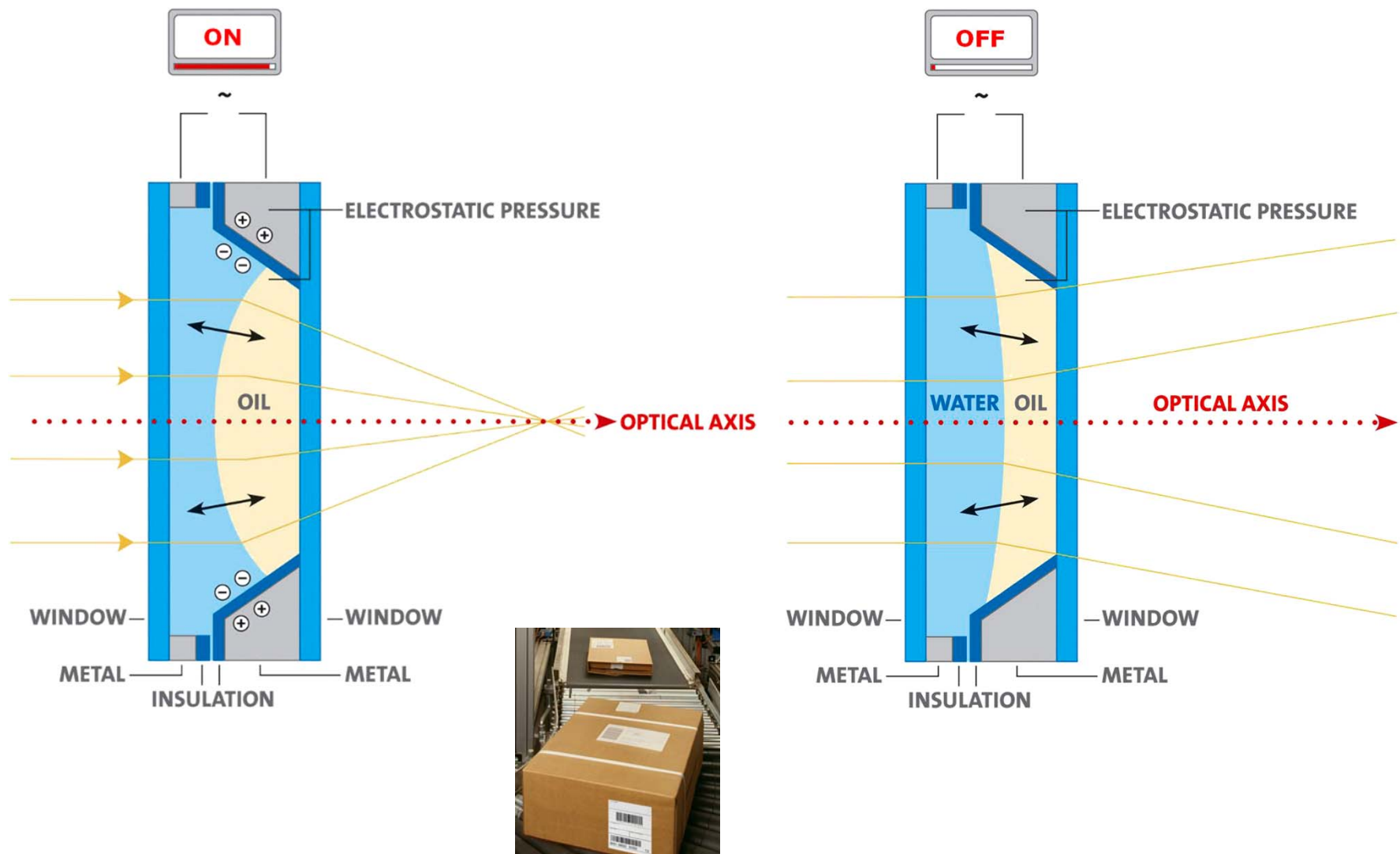
## Lighting

- Stable



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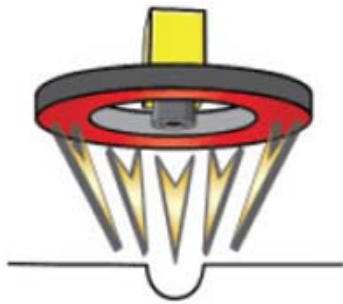
# Image-based barcode readers: Liquid lens technology



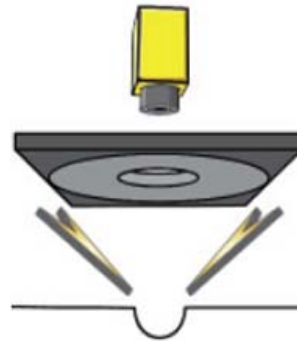
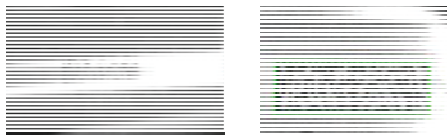
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# Image-based barcode readers: Image formation

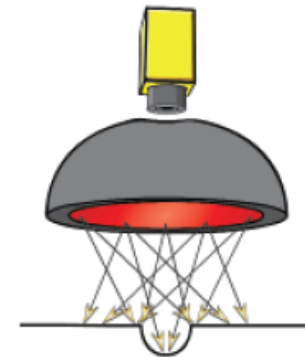
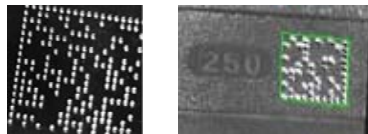
- Dark ink, light background—simple direct lighting
- DPM requires more advanced lighting techniques
- Reader should have ideal focus settings
  - Lens advisor: S-mount, C-mount, liquid lens



**Bright field lighting**  
High contrast labels & DPM parts



**Dark field lighting**  
Dot Peen & laser DPM



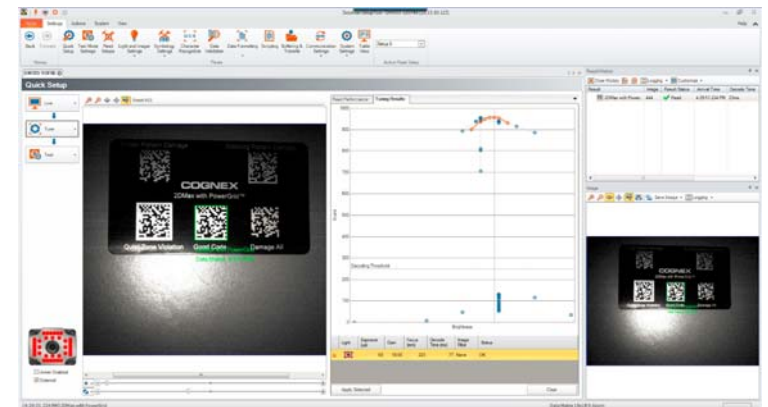
**Diffuse dome lighting**  
Reflective & curved surface DPM reading



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# Image-based barcode readers: Software



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# Benefits of image-based barcode reading technology

## No moving parts

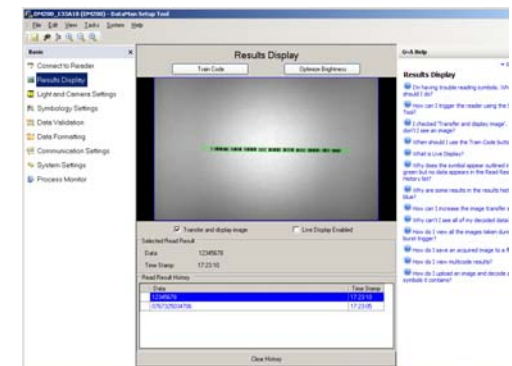
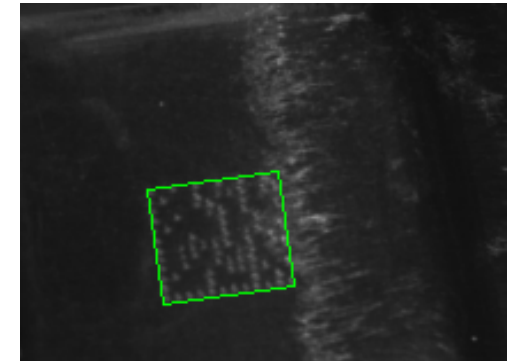
- Solid state device
- Longer life than laser scanners

## High read rates

- Reads damaged/properly marked codes
- Omnidirectional reading
- 2D Codes

## Image feedback

- Store No-Read images



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# Misconceptions of image-based barcode reading technology

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## 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

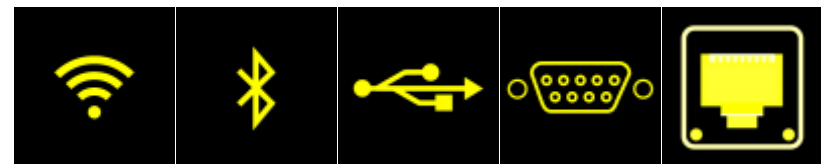
RS-232

USB

Keyboard-mode

Discrete I/O

FTP



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# 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)



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# How to select a reader

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**Read rates**  
**Durability**  
**Ease of setup**  
**Communication**  
**Cognex readers**

# 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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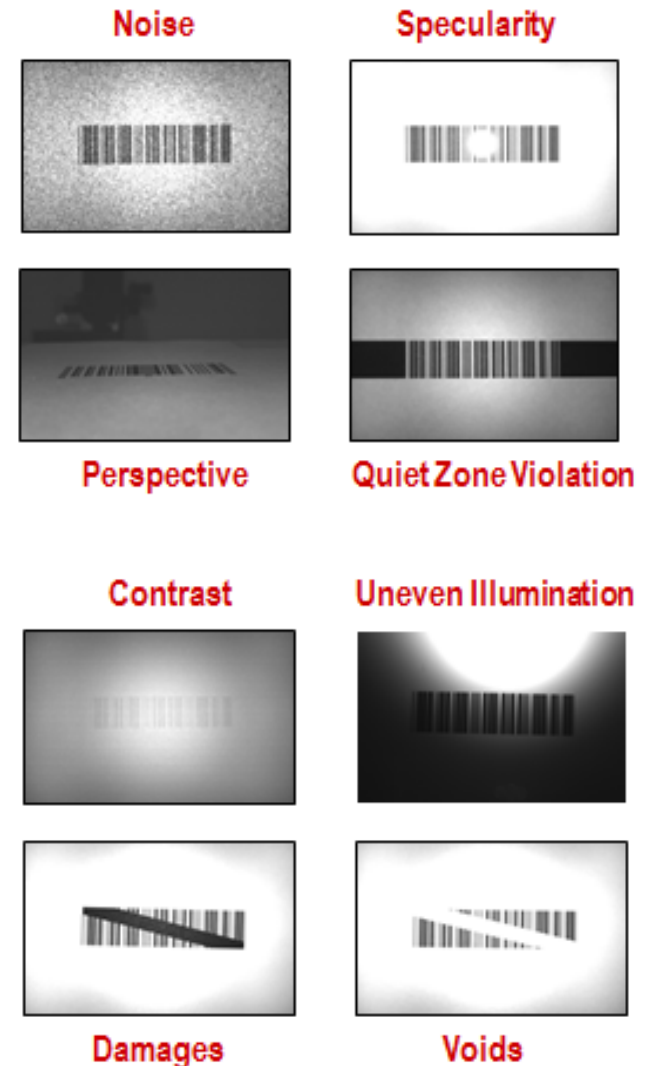
# Read rates: 1-D barcodes

## Best-in-class algorithms

- 1DMax+ with Hotbars II
- >1ppm

## Ability to read hard codes

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



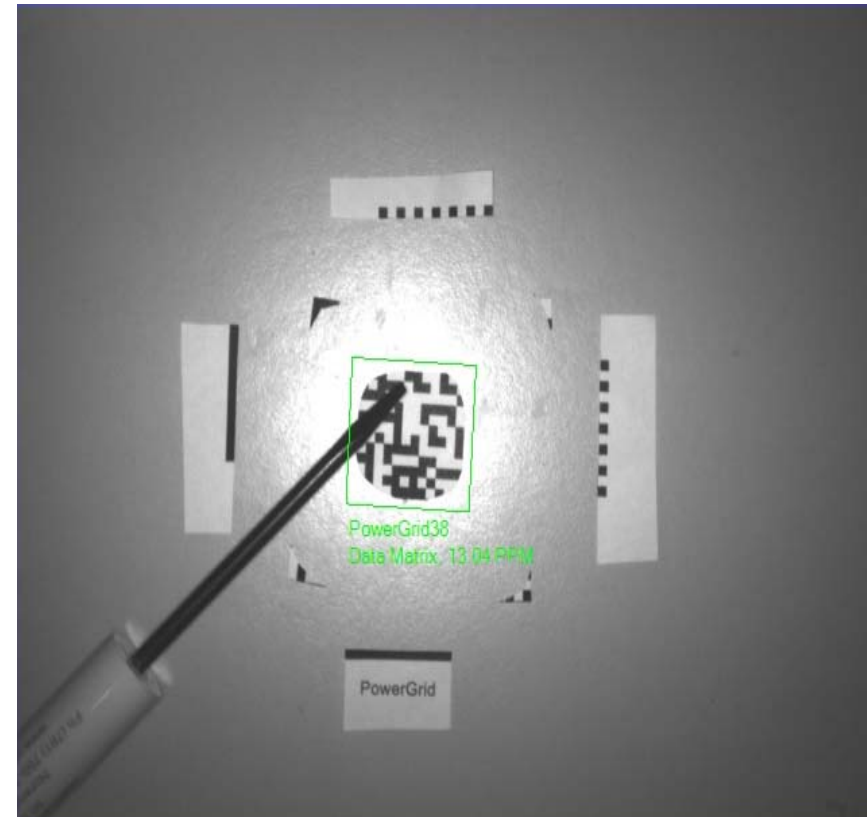
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# Read rates: 2-D codes

## 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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- 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

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# QUESTIONS?