



Ensure 100% Traceability and Quality of Your Products using Omron Microscan Automatic Identification and Machine Vision Systems



Presenter: Steven J. King – Machine Vision Product Manager

Date: Oct 26, 2017

Agenda

- Automatic Identification and Machine Vision Tool Set
- Traceability
 - Automatic ID Code Types
 - Code Marking Methods
 - Code Reading
 - Code Verification
- Machine Vision Inspection
 - Presence/Absence
 - Color ID/Color Match
 - Count
 - Measurement/Gauging
 - Assembly and Assembly Verification
 - Defect Detection

AutoID and Machine Vision Basic Toolset



Read
Codes



Read
Text



Presence/
Absence



Locate



Count



Color
Detect



Verify
Code
Quality



Verify
Text
Quality



Measure



Logic

Traceability

Blade Runner Trivia –
Who made the Replicant snakes?

■ Strategy

- Mark all parts with codes
- Enables automation
- Build a complete manifest of what goes into a product
- Track from cradle to grave

■ Requirements

- Marking
- Mark quality verification
- Reading
- Data recording



Abdul Ben Hassan

Code Marking Types

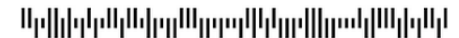
■ Human Readable Codes

OCR-A OCR-B SEMI-OCR 1 2 3 4 5 6 7 8

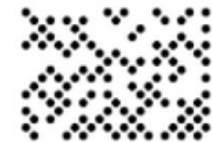
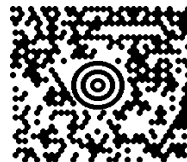
■ Machine Readable Codes

Highest read reliability

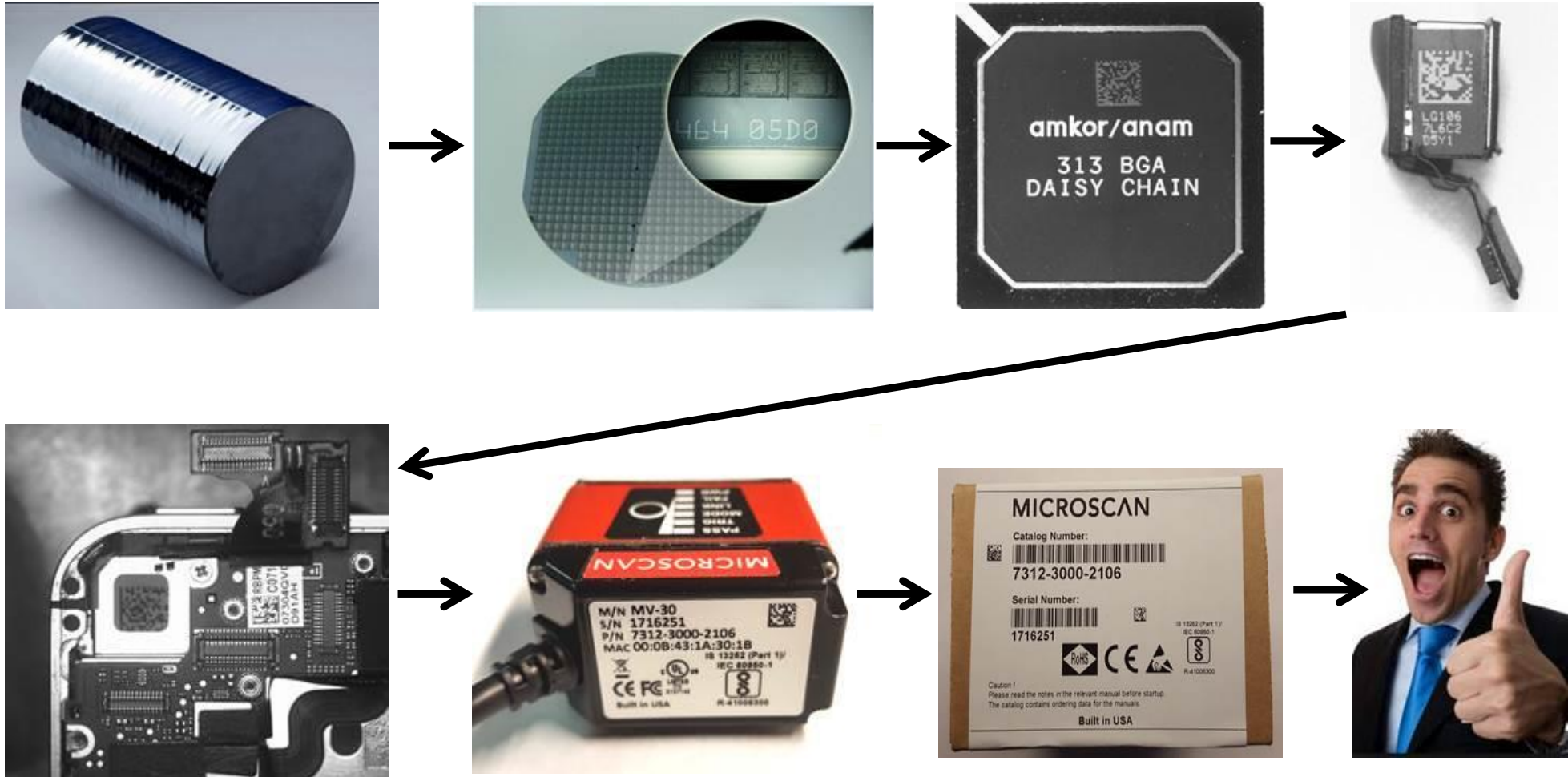
• 1D Bar Codes



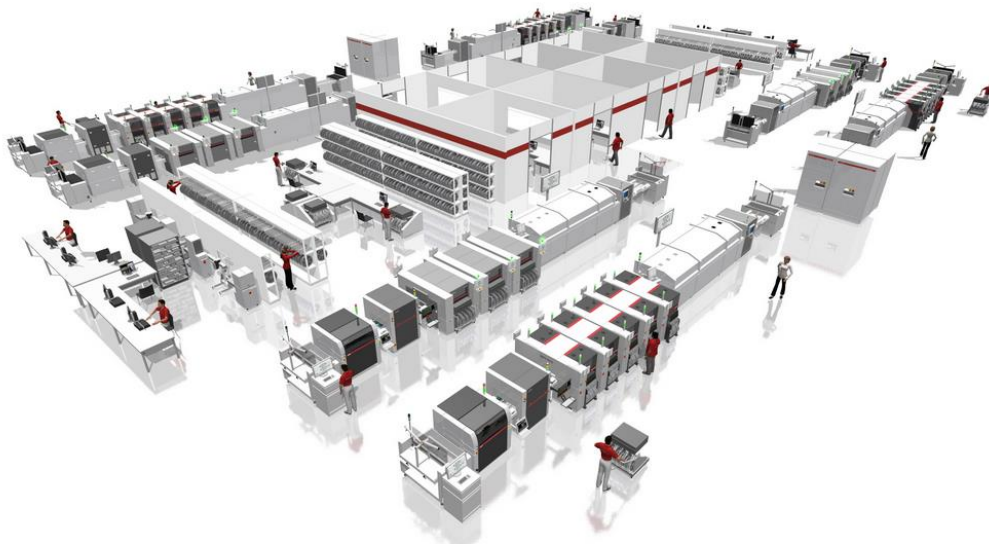
• 2D Symbolgies



Traceability



Traceability



■ Track

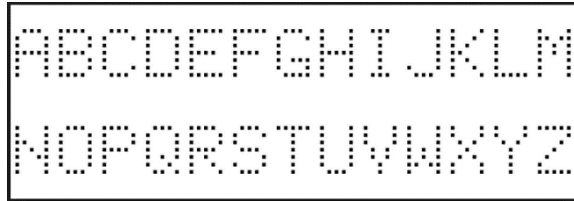
- In house
- Part tracking
- Process control
- Process optimization

■ Trace

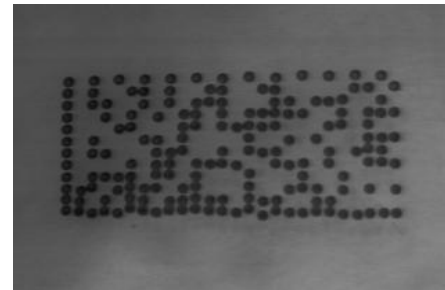
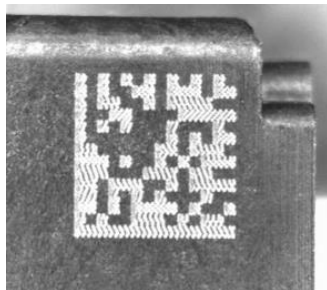
- Part Genealogy
- Defective Part Tracking
- Spill Containment
- Selective Recalls
- Anti Diversion
- Counterfeit Prevention
- Nabbing replicants

Code Marking Methods

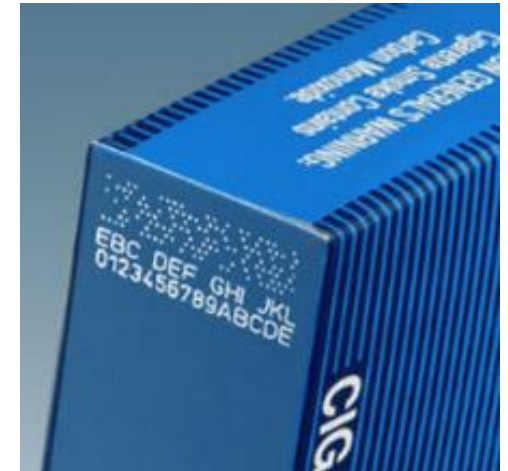
- Labels – Ink Jet, Laser, Thermal



- Direct Part Marks – Laser, Dot Peen, Ink Jet

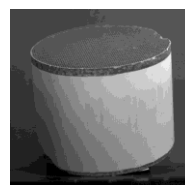


Direct Part Mark Application Examples



Automotive Applications

- Engine component traceability
 - Head and block traceability
 - Assembly error proofing
 - Selective pairing of components
- Transmission components traceability
- Fuel injector traceability
- Catalytic converter traceability
- PCB traceability
- Final assembly and WIP verification



Code Readers

- Handheld label reader – HS 21
- Handheld DPM (Direct Part Mark) reader – Mobile Hawk
- Fixed mount label and DPM reader – MicroHAWK ID20, ID30, ID40
- Fixed mount vision system with reading – MicroHAWK MV, HAWK MV



HS-21



Mobile Hawk



MicroHAWK ID Reader
MicroHAWK/HAWK MV

AutoID and Machine Vision Basic Toolset



Read
Codes



Read
Text



Presence/
Absence



Locate



Verify
Code
Quality



Verify
Text
Quality



Count



Color
Detect



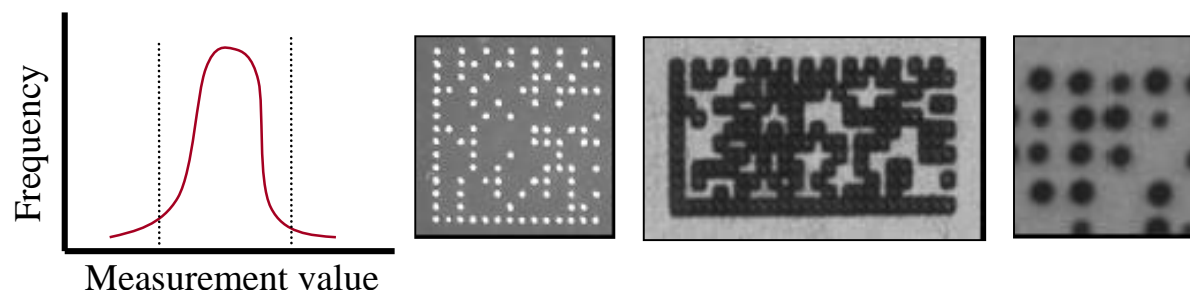
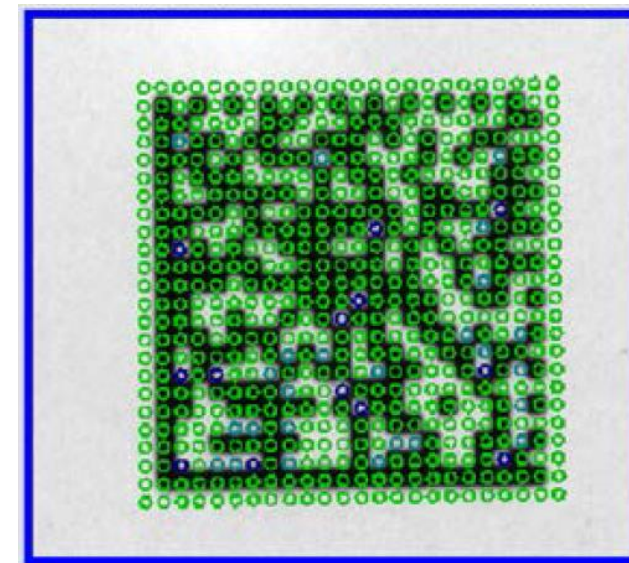
Measure



Logic

Code Verification – Check the handwriting

- Marking processes drift from nominal settings ultimately leading to unreadable marks
- Verification allows adjusting of marking process before unreadable marks are made
- Verification is metrology tool to ensure consistent mark quality
- Verifier can tell not only that mark is readable but also how close it is to edge of readability that it is



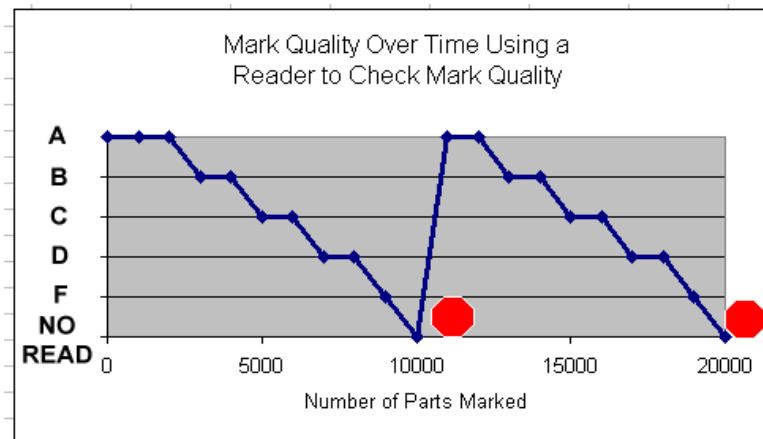
Symbology:	ECC-200
Cell size:	0.343mm
Decode:	PASS
Contrast:	4.0 (A) 89%
Modulation:	1.7 (C)
Axial nonuniformity:	4.0 (A) 0%
Grid nonuniformity:	4.0 (A) 22%
Unused EC:	4.0 (A) 100%

3.5-4.0 (A)	2.5-3.4 (B)	1.5-2.4 (C)	0.5-1.4 (D)	0.0-0.4 (F)
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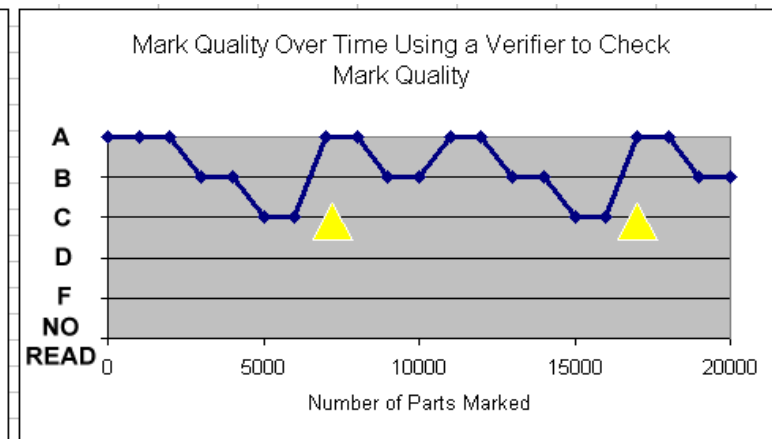
Code Verification



- **Offline** or **Inline** symbol verification
 - Verify or validate the symbol immediately after printing
 - Deviate from the standards if process or circumstances require
 - Provide results that correlate directly with ISO standards
- **Verification** ensures that EVERY product ships with a good quality symbol despite the fact that every marking system will degrade over time



Without verification, some “bad” parts escape into the process



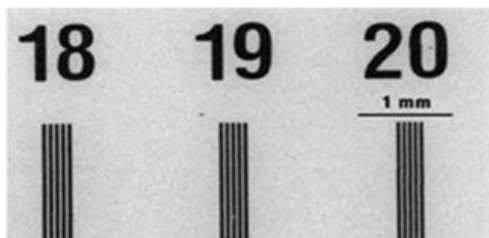
With verification, we prevent bad marks from ever being made.

ISO15416 - 1D Label Verification



■ ISO 15416

- 1D on Labels
- Requires even illumination
- Requires good lens with high MTF



B

(3.3)

Good

Reported Grade:

>>

Decode:

Bar Width:

3.3/3.2 pixels/640/90

Grade: 3.3 / Aperture: 3.2 pixels / WaveLength: 640 / LightAngle: 90

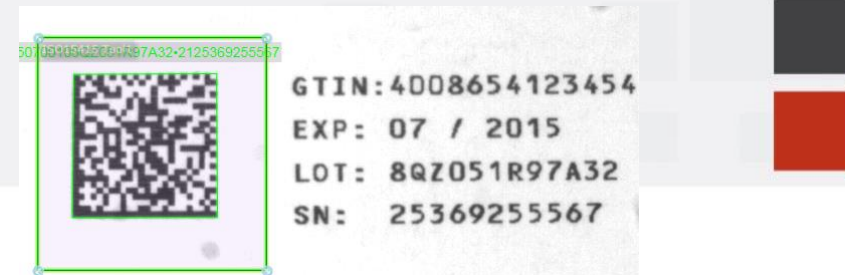
0614141999996

6.4 pixels

Parameter Grades:

	1	2	3	4	5	6	7	8	9	10
Edge Determination	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)
Decode	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)
Symbol Contrast	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)
	80%	79%	79%	78%	83%	81%	80%	81%	80%	81%
Min Reflectance	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)
	(12-92)%	(12-91)%	(12-91)%	(12-90)%	(11-94)%	(11-92)%	(11-91)%	(11-92)%	(11-91)%	(11-92)%
Min Edge Contrast	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)
	58%	58%	57%	56%	56%	58%	58%	55%	58%	58%
Modulation	A(4)	A(4)	A(4)	A(4)	B(3)	A(4)	A(4)	B(3)	A(4)	A(4)
	73%	74%	72%	71%	68%	72%	72%	67%	72%	72%
Defects	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	B(3)	A(4)	A(4)	A(4)
	7	9	13	8	10	8	16	12	8	7
Decodability	A(4)	B(3)	A(4)	A(4)	B(3)	B(3)	A(4)	A(4)	B(3)	B(3)
	63%	61%	62%	64%	58%	59%	66%	64%	58%	61%
QuietZone	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)	A(4)
	(8.9-8.9)	(8.9-8.9)	(8.9-8.9)	(8.9-8.9)	(8.9-8.9)	(8.9-8.9)	(8.9-8.9)	(8.9-8.9)	(8.9-8.9)	(8.9-8.9)
Final	A(4)	B(3)	A(4)	A(4)	B(3)	B(3)	B(3)	B(3)	B(3)	B(3)

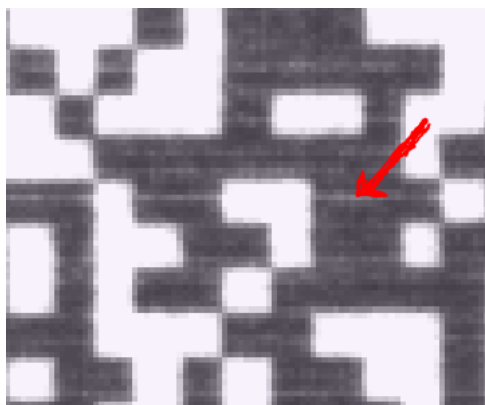
ISO15415 - 2D Label Verification



■ ISO 15415

- 2D on Labels
- Requires even illumination
- Requires good lens with high MTF

■ Modulation



ISO15415 Tool1 : Verification Report

B
Good

Reported Grade: 3.0/4.0 pixels/640/90
>> Grade: 3.0 / Aperture: 4.0 pixels / WaveLength: 640 / LightAngle: 90
Decode: 010400865412345417150700108QZ051R97A322125369255567
Cell Size: 7.8 pixels

Parameter Grades:

	Grade	Score	Units
Symbol Contrast	A	74	%
Modulation	B		
Reflectance Margin	B		
Fixed Pattern Dmg	A		
Axial NonUniformity	A	0	%
Grid NonUniformity	A	14	%
Unused Err Correction	A	100	%

Calibration Data:

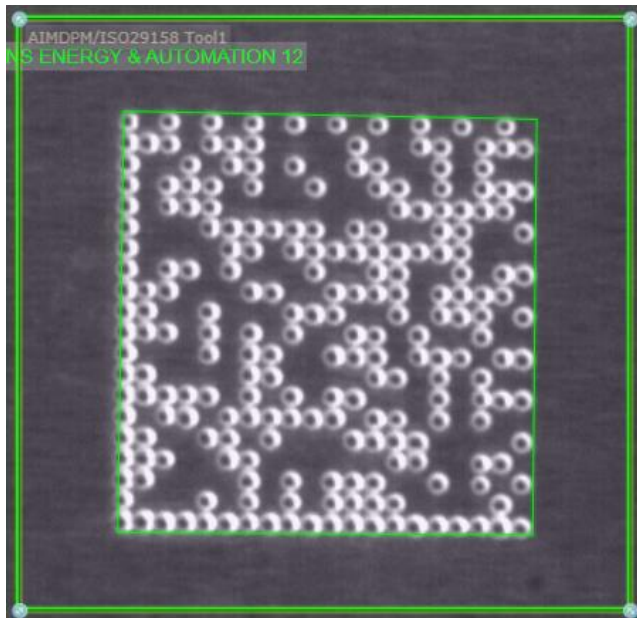
State:	Not Calibrated
Target Symbol 1 Width:	0.24
Target Symbol 2 Width:	0.48
Maximum Exposure:	32000
Target Rmin:	4
Target Rmax:	82

Options... Save...

ISO 29158 - 2D DPM Verification

■ ISO 29158

- Direct Part Marks
- More forgiving spec
- Requires application specific lighting



AIMDPM/ISO29158 Tool1 : Verification Report

A
Good

Reported Grade: DPM4.0/8.1 pixels/640/90
>> Grade: DPM4.0 / Aperture: 8.1 pixels / WaveLength: 640 / LightAngle: 90
Decode: SIEMENS ENERGY & AUTOMATION 12
Cell Size: 10.1 pixels

Parameter Grades:

	Grade	Score	Units
Cell Contrast	A	42	%
Cell Modulation	A		
Reflectance Margin	A		
Minimum Reflectance	A	100	
Fixed Pattern Dmg	A		
Axial NonUniformity	A	1	%
Grid NonUniformity	A	13	%
Unused Err Correction	A	100	%

Calibration Data:

State:	Not Calibrated
Target Symbol 1 Width:	0.24
Target Symbol 2 Width:	0.48
Maximum Exposure:	32000
Target Rmin:	4
Target Rmax:	82

Options... Save...

Verification Example: Inkjet on cartons



- Direct inkjet printing is economical
- But the results are not always pretty
- **No reads at big retail customers result in fines for each unreadable code**



- Inline verification after printing ensures NO bad symbols ship

Code Verifiers

■ Offline

- Handheld label and DPM verifier – LVS-9580, LVS 9585
- Desktop Verifier – LVS-9510

■ Inline

- Fixed mount inline verifier – MicroHAWK MV, HAWK MV-4000



LVS-9580, LVS 9585



LVS-9510



MicroHAWK, HAWK MV

Code Verification at the printing source

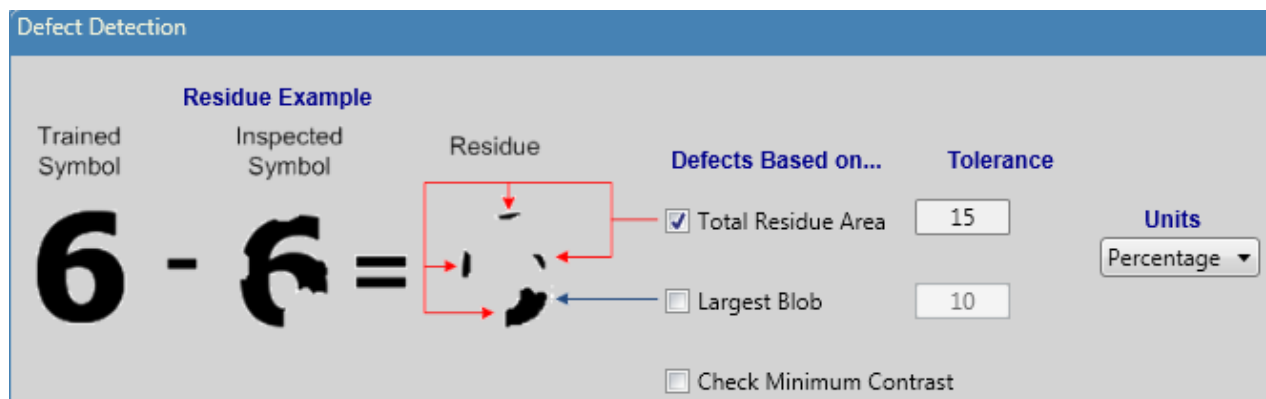


Optical Character Verification

- **Show and Go Tool** - Validate printed text by training on a good sample
- Detects common printing problems and provides pass/fail output



- Symbols are compared against trained golden symbol

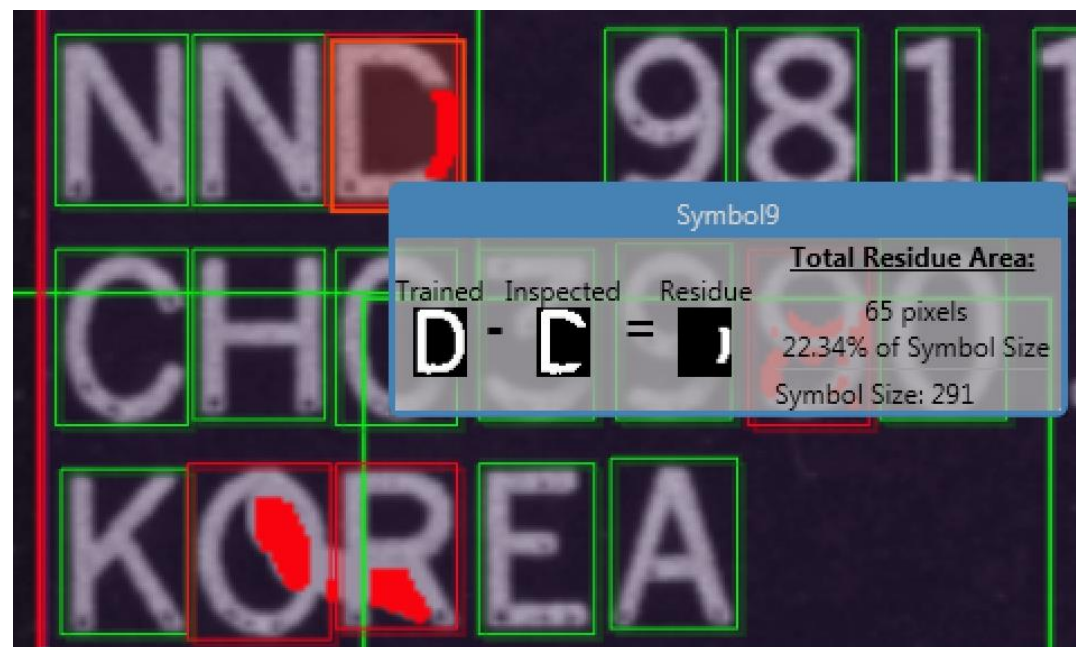


- Symbols are rejected if the total residue exceeds the set tolerance
- Optional tests for Largest single defect, character breaks, contrast, and blurriness

Optical Character Verification - Example



Pad Printing
OCV on ICs



AutoID and Machine Vision Basic Toolset



Read
Codes



Read
Text



Verify
Code
Quality



Verify
Text
Quality



Presence/
Absence



Locate



Count



Color
Detect



Measure



Logic

Full Machine Vision Smart Cameras – MicroHAWK MV



Brand New High Performance Camera

HAWK MV-4000

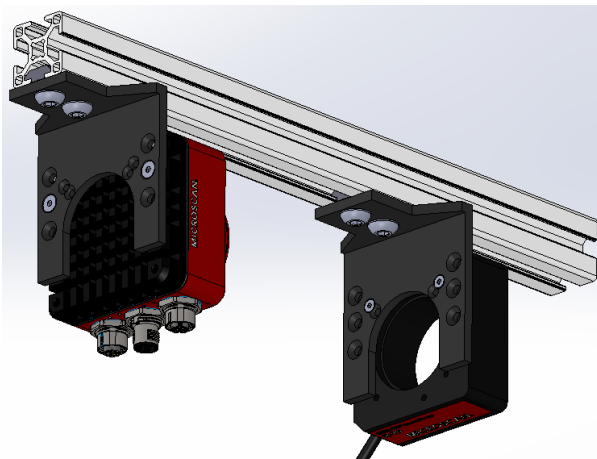
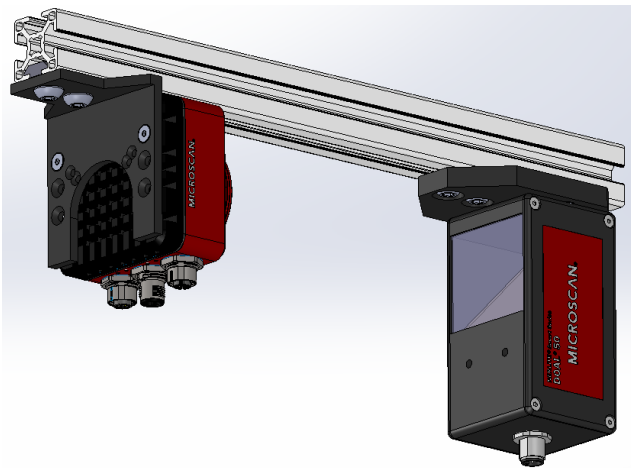
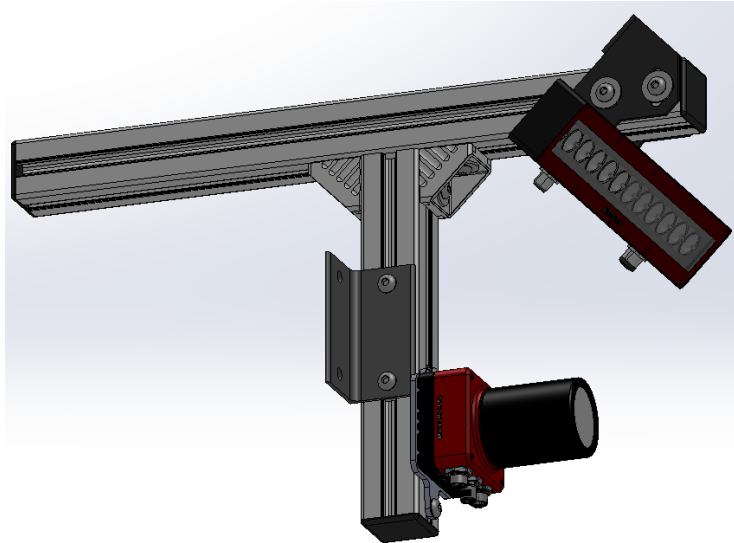
- 8 Models

- MV-4000-03, Mono, 0.3 MP
- MV-4000-03C, Color, 0.3 MP
- MV-4000-13, Mono, 1.3 MP
- MV-4000-13C, Color, 1.3 MP
- MV-4000-20, Mono, 2.0 MP
- MV-4000-20C, Color, 2.0 MP
- MV-4000-50, Mono, 5.0 MP
- MV-4000-50c, Color, 5.0 MP



HAWK MV-4000 Light Kits

Light Kits	
98-9000120-01	Kit, bracket, MAX 300 to HAWK MV-4000
98-9000121-01	Kit, bracket, DOAL to HAWK MV-4000
98-9000122-01	Kit, bracket, Ring 60/70 to HAWK MV-4000
98-9000123-01	Kit, bracket, Ring 100 to HAWK MV-4000
98-9000137-01	Kit, Smart Series, Pharmalite, HAWK MV-4000



Presence/Absence of Critical Parts and Features

■ Count Pixels

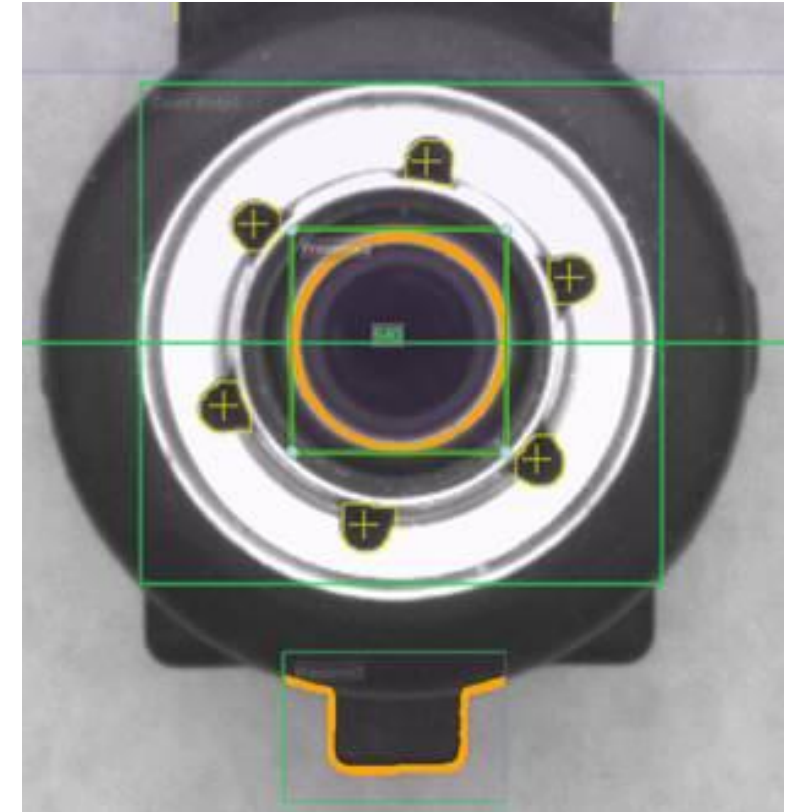
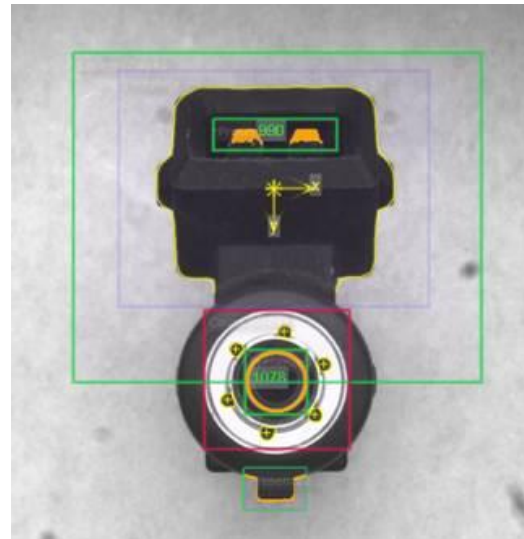
- Within range of grayscale intensity
- Edge pixels (brightness invariant)

■ Tolerance

- Compare count to min and max values

■ Output

- Pixel count
- Pass/Fail



Presence/Absence using Color

■ Color ID

- Determine color from library of colors

■ Color Check

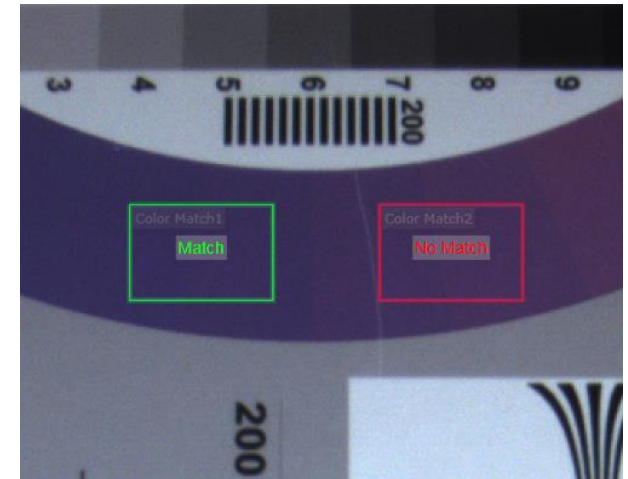
- Compare color to one specific color

■ Tolerance

- Compare pixel count to min values

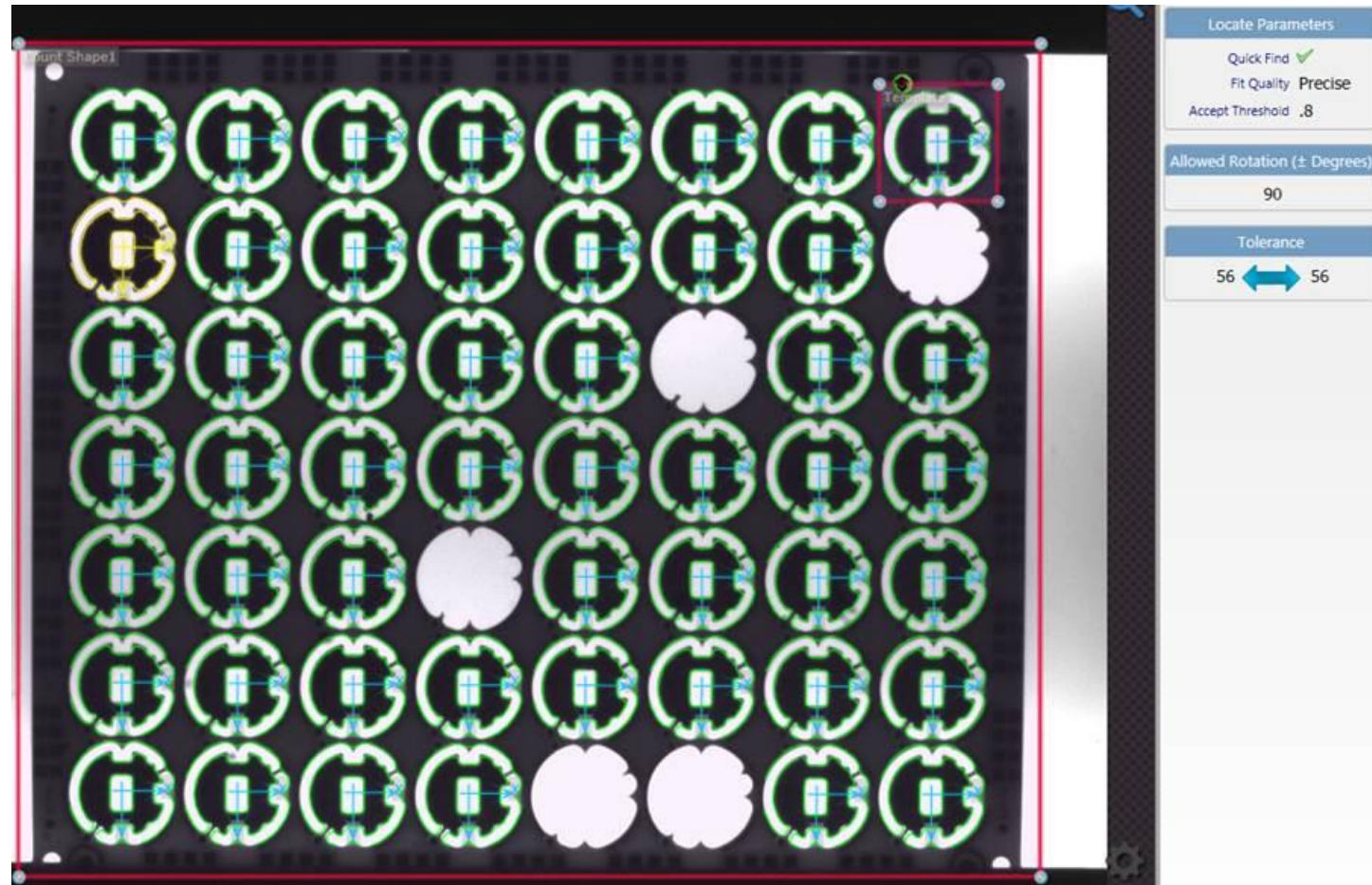
■ Output

- Color
- Count of pixels
- Pass/Fail



Count

- **Locate features**
 - Shape based
- **Tolerance**
 - Compare count to min and max allowed values
- **Output**
 - Count
 - Locations



Count

■ Locate features

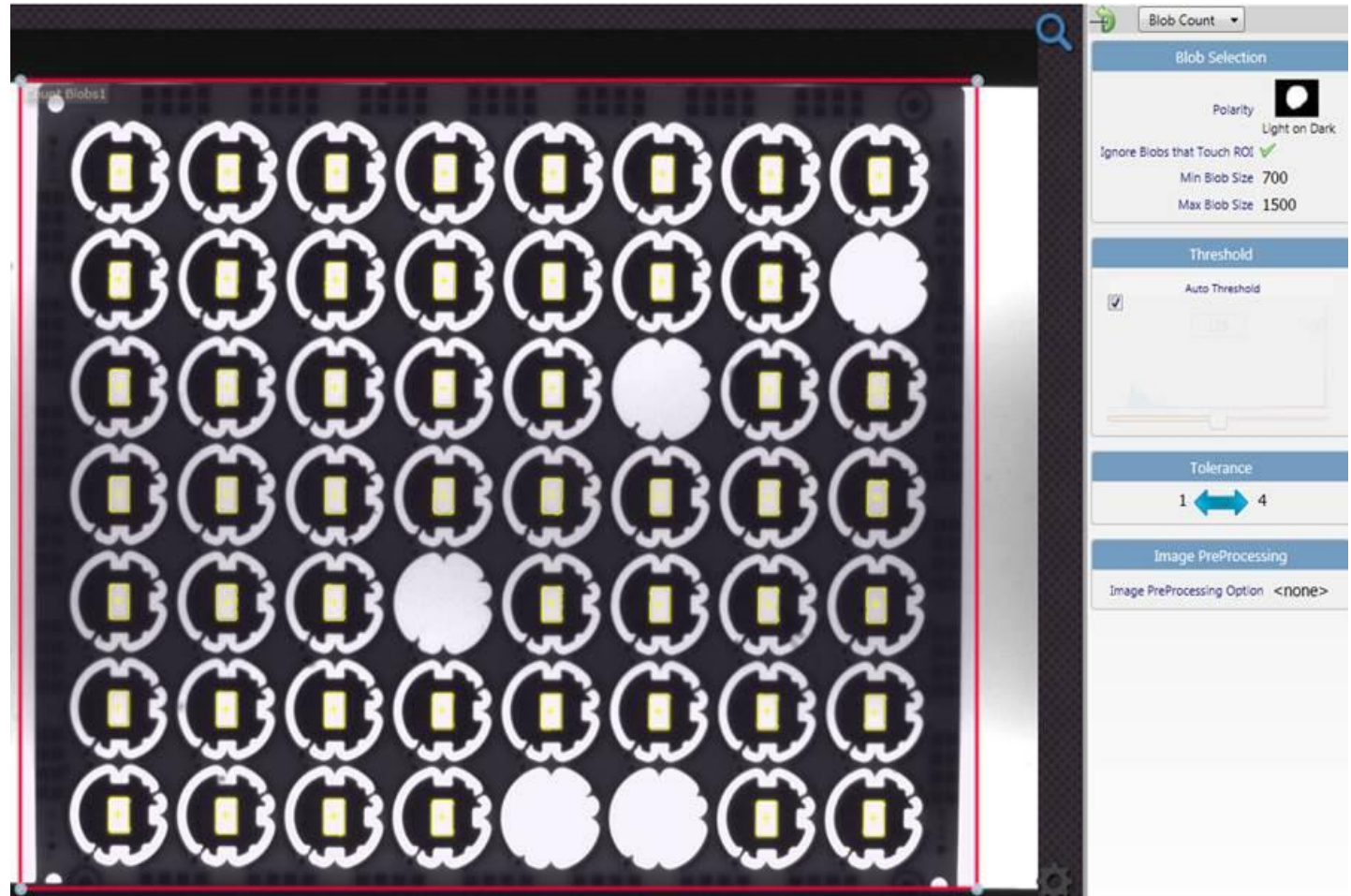
- Blob based
- Select based on min and max size of blob

■ Tolerance

- Compare count to min and max values

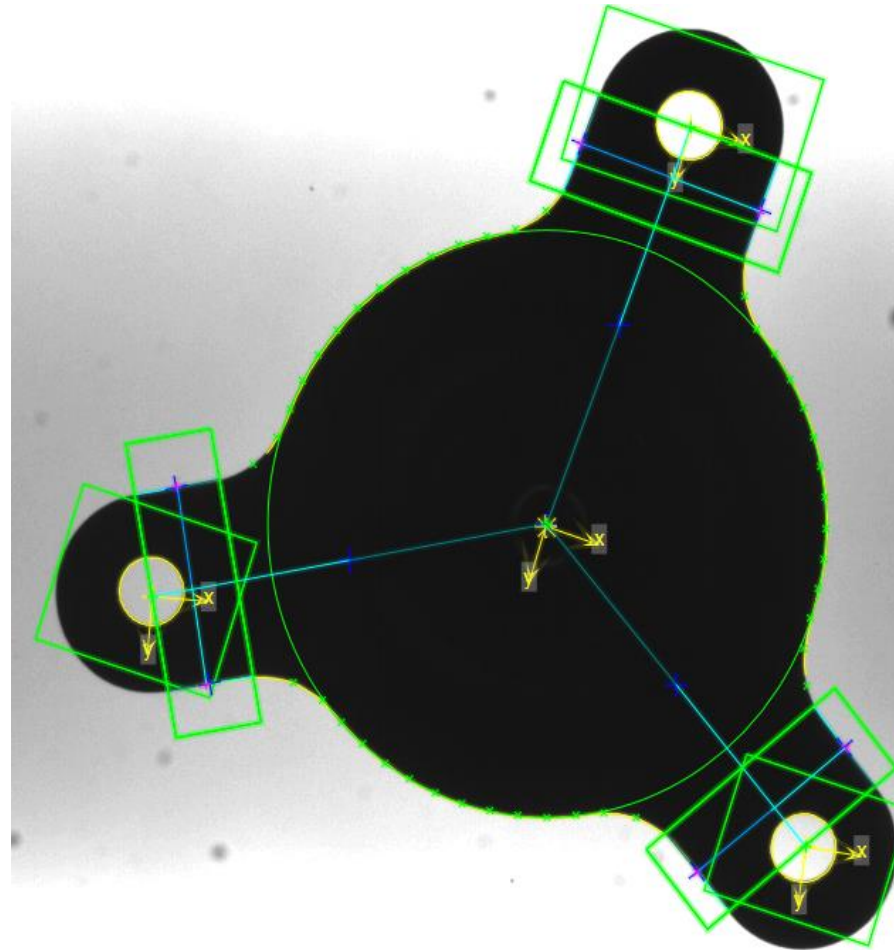
■ Output

- Count
- Locations



Measurement

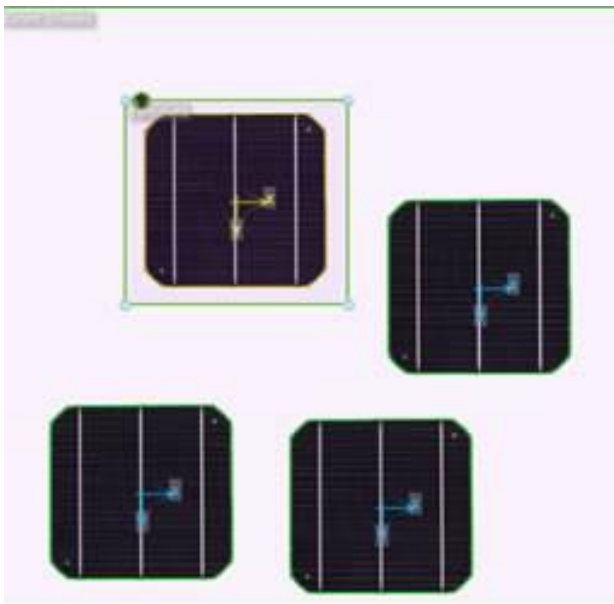
- Locate features
 - Lines
 - Points
 - Circles
 - Patterns
- Measure
 - Line to Line
 - Point to Point
 - Point to Line
- Calibration
 - Convert pixels to real world units
- Tolerance
 - Compare to min and max values
- Output – OK/NG



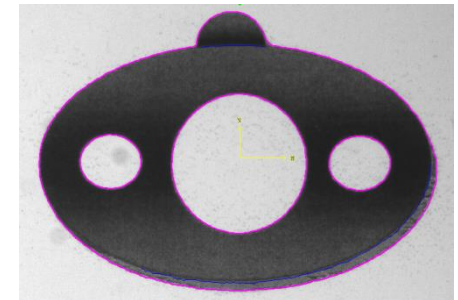
✓	Inspected:	Passed:	Failed:
	1089	1089	0
Process	70	Cycle	98
Draw	0	Cycle Worst	104
Idle	20	PPM	612
		PPM Worst	576
Buffers	2 of 10 used (20%)		
Overruns	None		
📍	Locate Shape1 Pos = (604.54 , 564.65) Angle = 17.9°		✓
🔍	Count Shape4 1		✓
🔍	Count Shape5 1		✓
🔍	Count Shape6 1		✓
📏	Circle1 Pos = (605.37 , 562.09) Angle = 0.0° Radius = 250.419		✓
📏	Pt to Pt1 361.757		✓
📏	Pt to Pt2 360.736		✓
📏	Pt to Pt3 359.087		✓

Location and Guidance

- Train a pattern
- Return X, Y, Theta
- Add encoder based offset for “pickup down the belt”



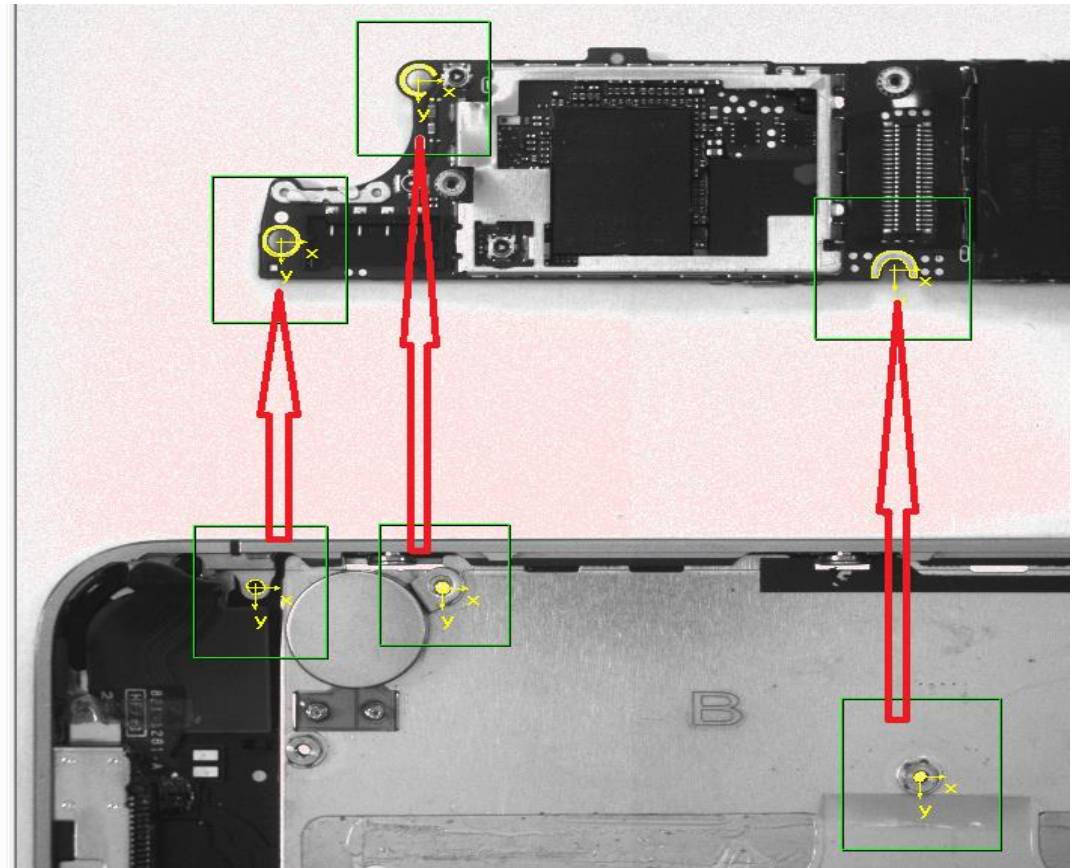
- Intellifind Tool
 - Edge Based Pattern Matching
 - Allows 360 degree rotation
 - Allows scale changes
 - Lighting invariant
 - Finds patterns amongst clutter



Assembly

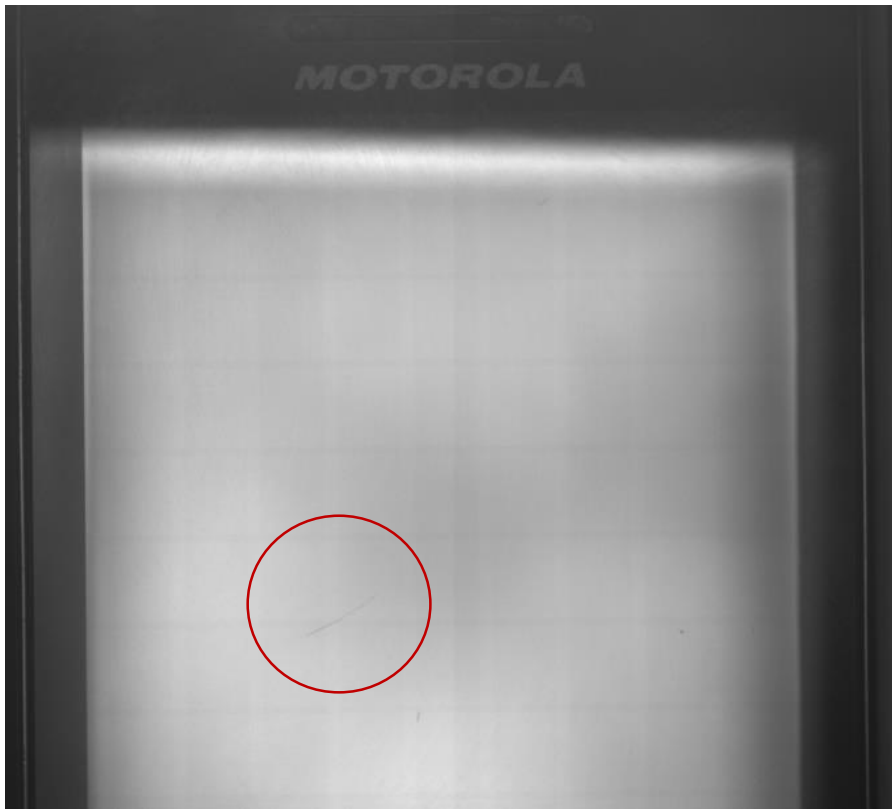
- Train pattern of points on each part
- Compute offset of part 1 to blueprint
- Compute offset of part 2 to blueprint
- Compute offset part 1 to part 2
- Output X, Y, Theta to assemble part 1 onto part two
- Uses “rigid body fit” algorithm

✓ Inspection
✓ Snapshot
✓ IntelliFind Tool
✓ IntelliFind Tool
✓ IntelliFind Tool
✓ IntelliFind Tool
✓ IntelliFind Tool
✓ Wait Step

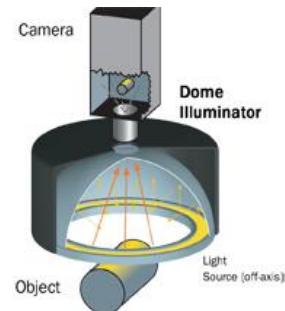
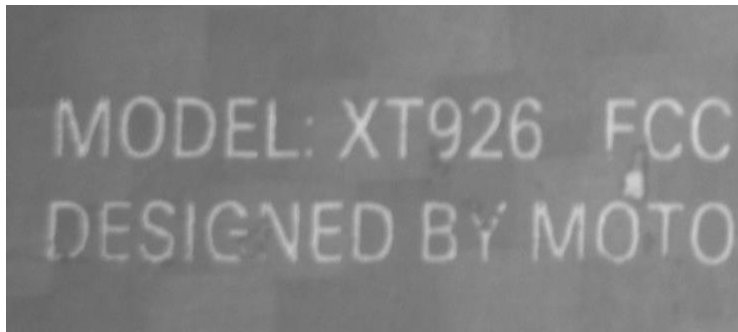
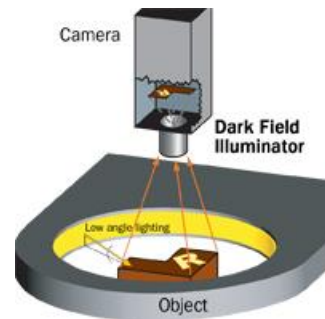
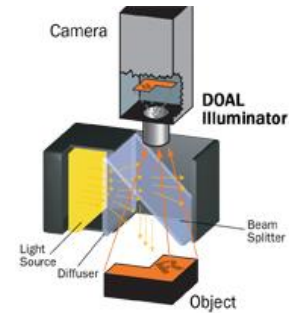


Defect Detection

- Often difficult – Defects similar in size and shape to allowed features
- Highly dependent on lighting to create contrast

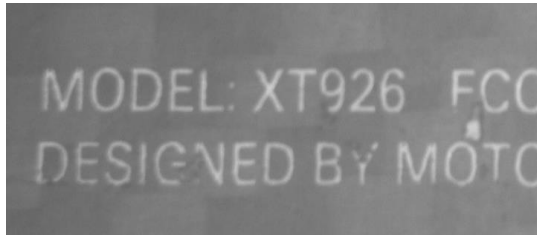


Defect Detection – Lighting Dependency



Defect Detection – Using OCV

- OCV is not just for characters
- OCV can be used for individual shapes or symbols
- OCV computes difference between trained and inspected shape
- OCV combined with color checks is very powerful



Wrap Up

- **Modern Machine Vision Systems contain tools for**
 - Automatic Code Identification
 - Code Verification
 - Machine Vision
- **Traceability is a Strategy that involves**
 - Picking the correct code types
 - Picking the correct code marking methods
 - Code Reading
 - Code Verification
- **Traditional Machine Vision is used for**
 - Presence/Absence
 - Color ID/Color Match
 - Count
 - Measurement/Gauging
 - Assembly and Assembly Verification
 - Defect Detection

Last Trivia Question

- What is a Machine Vision Engineer's favorite quote from Blade Runner?



HAWK MV-4000
Coming in Dec 2017!

- I just do eyes!

Thank you!

For more information... visit booth number

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Technical Publications, Knowledge Base*

MicroscanCommunity

Blogs, Videos, Photos

helpdesk@microscan.com

Technical support

MICROSCAN®

Thank You!



Any Questions?

Contact: Steven J. King

sking@microscan.com

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