COMPLEX PHOTONIC SYSTEMS FOR VOLUME MANUFACTURING

Solutions to overcome challenges in Optical Design, Assembly & Industrialization

Simon Schwinger
February 3, 2020
OUR VISION

To be the most technologically advanced and trusted manufacturing solutions provider

Our Company
- 50+ Years of Innovation
- $25.3B FY19 Revenue
- 200k Employees
- 100+ Sites
- 52M Square Feet Manufacturing

Our Markets
- Consumer
- Packaging
- Energy
- Printers
- Smart Home & Appliances
- Retail
- Healthcare
- Automotive & Transportation
- Enterprise, Cloud & Communications
- Industrial & Capital Equipment
- Defense & Aerospace

Our Reach
- INNOVATE
- DESIGN
- DEVELOP
- MANUFACTURE
- DELIVER
- SERVICE

Our Approach
- Empowered Experts
- Innovation Acceleration
- Engineering Excellence
- Manufacturing Agility
- Supply Chain Orchestration

Our Difference
- Global Operational Excellence
- Workcell Model
- Sustainability
- Distributed Manufacturing
- Supply Chain Intelligence & Agility

Our Company
- Deep Technical Expertise
- Stable & Tenured Management Team
- Process Innovation
- Distributed Manufacturing
- Integrity, Ingenuity & Innovation

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Optical Design

Active Alignment (AA)
Optical Design

Active Alignment (AA)
# DOT PROJECTOR: CONFIGURATION

<table>
<thead>
<tr>
<th>Parameter</th>
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**Diagram:**
- Projected pattern
- Best focus
- Near distance
- Module height: 3 – 8 mm

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## DOT PROJECTOR: GRID PITCH

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![Spot size vs. projection distance](image)

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**DOT PROJECTOR: FOCAL LENGTH**

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![Graph showing spot size vs. projection distance](image)

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## DOT PROJECTOR: TOLERANCE DIVERGENCE

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### Spot Size vs. Projection Distance

- **Fast Axis 1/e²-Diameter**: Purple line
- **Slow Axis 1/e²-Diameter**: Green line
- **Grid pitch**: Orange line
- **Fast Axis TOL div**: Black line
- **Slow Axis TOL div**: Blue line
- **Fast Axis TOL focus as build**: Red line
- **Slow Axis TOL focus**: Pink line

Out of specification points are indicated by red circles.
DOT PROJECTOR:
TOLERANCE FOCUS WITHOUT ACTIVE ALIGNMENT

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Spot size vs. projection distance

Out of specification
**DOT PROJECTOR: SHIFT LD**

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![Projected pattern](image)
**DOT PROJECTOR: AS BUILD PERFORMANCE**

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**As build performance including AA**

**Spot size vs. projection distance**

**Parameter Value**
- Wave length: IR 940nm
- Focus distance: 0.2m – 1.2m
- Grid pitch: 320 x 180
- FoV: 63° x 35.5°
- LD: TO38:Ø 3.8mm / height ~3.3mm, COS: 0.225 x 1 x 0.14 mm³
- Focal length: 2.2mm
- Divergence fast axis: 17°±3°
- Divergence slow axis: 8°±3°
- TOL focus without AA: 30µm
- Shift emitter point: 80µm

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Optical Design

Active Alignment (AA)
ACTIVE ALIGNMENT (AA) FOR LIDAR & 3D SENSING USING PIXID PLATFORM

USE CASES
• Lens collimation
• Receiver alignment
• Structured light projection alignment
• Camera lens alignment for structured light inspection
• Module to module relative pointing (tip, tilt, rotation)
• Module to module baseline distance setting (XY)

FEATURES
• Single or dual head - 6 axis Active Alignment
  • 0.2um linear resolution
  • 0.01deg angular resolution
• Automated adhesive dispense with post dispense inspection for quality control
• Customized AA feedback systems and AA algorithms
• Automated UV curing
• Systems delivered with turnkey process for high volume manufacturing
PIXID MACHINE LAYOUT FOR DUAL HEAD LASER PROJECTION MODULE AA

- Machine Enclosure
- Align Module 1
- Align Module 2
- Spare Station
- Rotary Module
- Target Module hangs over align and rotary modules
- Dual Load Station
- Dispense Module
DUAL HEAD LASER PROJECTION MODULE AA FEEDBACK SYSTEM

Camera
(course adjustment, finds spot on target screen)

Target Screen

Beam Profiler
(fine adjustment)

Laser Path
LASER COLLIMATION OPTIMIZATION
LASER PROJECTION MODULE TESTING
MODULE ASSEMBLY AND INTEGRATION FOR 3D SENSING

NIR/RGB CCM AA (focus and pointing)

NIR CCM to RGB CCM Alignment (pointing and baseline distance)

LPM to NIR AA (pointing and baseline)

LPM AA (collimation and XY)

Integrated 3D Sensing Module (NIR CCM, RGB CCM, LPM)
ACTIVE ALIGNMENT CAPABILITY ANALYSIS

Competitor’s screw-in active alignment 36.2% yield loss

Jabil Optics 5 DOF active alignment 6.1% yield loss

Process Capability Report for Lowest Corner - Screw In
Calculations Based on Weibull Distribution Model

Process Data
LSL 0.49
Target *
USL * Sample Mean 0.505935
Sample N 111
Shape 22.2678
Scale 0.554748

Observed Performance
PPM < LSL 288288.29
PPM > USL *
PPM Total 288288.29

Process Capability Report for Lowest Corner - AA
Calculations Based on Weibull Distribution Model

Process Data
LSL 0.49
Target *
USL *
Sample Mean 0.506595
Sample N 111
Shape 9.26655
Scale 0.53409

Observed Performance
PPM < LSL 362405.79
PPM > USL *
PPM Total 362405.79

YIELD IMPACT CONCLUSIONS

Screw In – 36.2% Yield Loss
Jabil Optics AA – 6.1% Yield Loss

Screw In | Jabil Optics AA
Ppk | .12 | .52
PPM Defects | 362,405 PPM | 61,114 PPM
Jabil Optics
WHAT JABIL OPTICS CAN DO FOR YOU…

PROCESS DEVELOPMENT
- Advanced process solutions
- Optimal material and component selection
- Customized adhesive solutions
- Equipment guidance and selection

MANUFACTURING ENGINEERING
- Design and procurement of optical lens assemblies and sub-assemblies
- New product introduction
- High-volume production of optical solutions
- Final goods assembly
- Test
- Pack-out

ACTIVE ALIGNMENT
- Active alignment
- Precision components placement
- Lens assemblies
- Gluing technologies
- Chip-on-board, Chip-on-flex
- Chip-on-stiffener, FlipChip
- Wire-bonding and ACF bonding
- Assembly automation

PRODUCT DESIGN
- World class optics design
- Electrical engineering
- Design for high-volume manufacturing
- Design to cost
WHAT YOU CAN DO FOR JABIL OPTICS…

Enable cutting edge technologies

Have strong brands

Fund innovative products

Seek a strong manufacturing partner
JABIL SUCCESS STORIES…

https://www.jabil.com/case-studies.html