Modular Manufacturing

Sensible design and incorporation of standardized assemblies into a product

Need
- Aggressive competition on a global scale
- Shorter product life cycles
- Rapidly changing market conditions
- Consumer customization
- Changing regulatory requirements
- Capacity utilization

Industries
- Automotive
- Computer/Cell Phone
- Construction
- Software
- LED lighting …..

Faster, Better, Cheaper
Modular Manufacturing and its Benefits

Features
• High degree of automation
• Module heavy vs system test
• Ease of integration, reduced labor
• Quick product change over
• Fewer building blocks

Benefits
• Reduced cost
• Reduced development time - parallel
• Reduced inventory
• High product mix on fewer lines
• Failsafe assembly
• Increased product reliability, reduced maintenance

Simplified Agile Manufacturing

Rapid circuit board assembly
Modular wiring
Scalable designs
Outdoor Luminaire Manufacturing Today

**Light Engine**
- MCPCB Manufacturing
- Assemble LEDs on MCPCB
- Test
- Manufacture of casting
- Integration of LED board into casting
- Addition of optics
- IP rated sealing and glass

**Casting**

**Controls, Sensors, Assembly and Wiring**
- Final assembly and test
- Wiring of control and power
- PE Sensor Connections
- Insert driver, SP and controls in casting

**Driver**
- PCB Manufacturing
- Surface Mount Assembly
- Holding of SMT components
- Through-hole radial components
- Manual placement of odd form parts
- Bend and insert wires
- Insertion in case, potting and test
Lighting is a high mix application. Needs building block, bussed, approach, with repetitive blocks (driver, light engines) for higher lumens.

**Light Engine**
- Reconfigurable engines
- Plug and play optics
- Origami optics
- Custom lumens, CCT, CRI

**Assembly and Casting**
- Full space utilization
- Reduced enclosure weight
- Sectionalized assembly
- Hybrid composite enclosure

**Wiring and Controls**
- Socketed/connector approach
- Common Bussed Architecture
- Flex-circuit interconnect
- Wireless/analytics sensing

**Driver**
- Automated assembly driver
- Standardized power blocks
- Integrated surge protection
- Wide input and output range

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**Modular Assembly Vision**

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**Assembly and Casting**

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**Wiring and Controls**

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**Driver**
Factors to Consider for Automation and Modularity

- Smaller power blocks, smaller magnetics on tape and reel
- Increase SMT component percentage to increase throughput
- Integrate external and internal SPD (surge)
- Wide band gap devices to handle voltage and input range efficiently
- No potting, alternative cheaper coatings – minimize time and labor
- Modular connectors (SMT or automated placement)
Summary of Enablers

- Standardized, modular units with highly automated assembly
- Minimized modular unit count with optimal functionality
- Customizable building blocks for Light engines and drivers
- Modular interconnects – Socketed, connectorized, bussed architecture
- Sectionalized/functionalized composite enclosures
- Future: Additive methods- rapid prototyping of high complexity components with heavy labor content

The approaches to, and advantages of modular design/manufacturing are numerous! Be smart, consider tradeoffs.
Questions?

Thank you!