Modular Manufacturing in LED Lighting

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Modular Manufacturing

Sensical 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

Rapid circuit board assembly

Modular wiring

Scalable designs

Simplified Agile Manufacturing

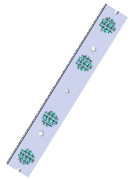
Outdoor Luminaire Manufacturing Today

Light Engine

MCPCB Manufacture

Assemble LEDs on MCPCB

Test



Integration of LED board into casting

Addition of optics

IP rated sealing and glass

Casting

Manufacture of 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 Manufacture

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

Modular Assembly Vision

Light Engine

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

Assembly and Casting

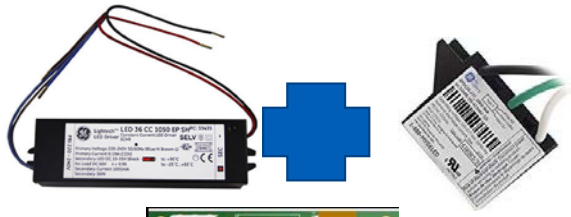
- Full space utilization
- Reduced enclosure weight
- Sectionalized assembly
- Hybrid composite enclosure

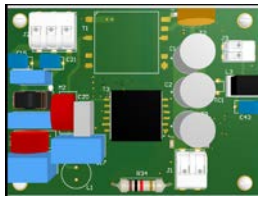
Wiring and Controls

- 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

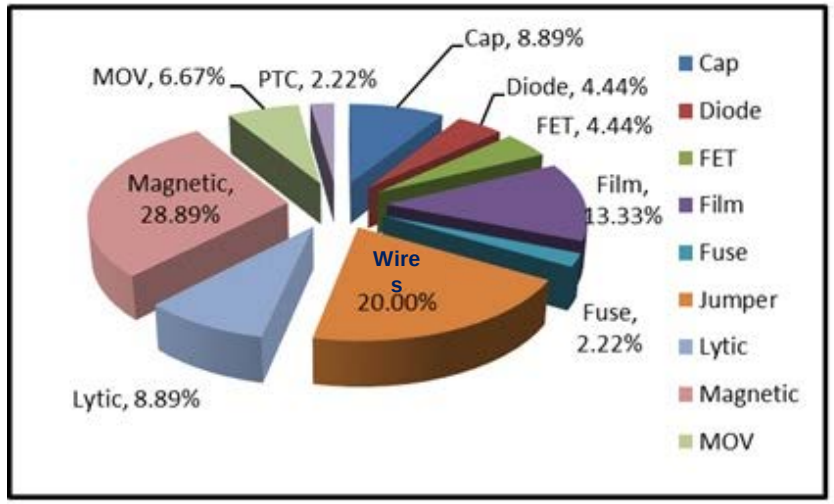


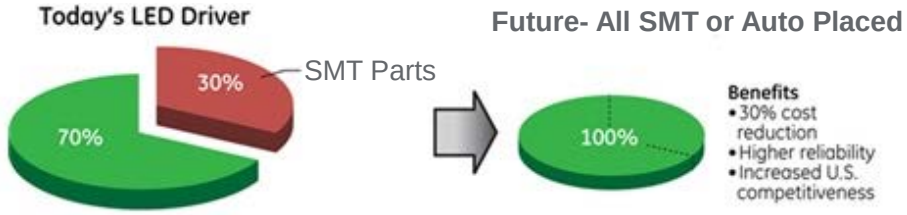


Lighting is a high mix application.

Needs building block, bussed, approach, with repetitive blocks (driver, light engines) for higher lumens

Example: Automated Module Assembly – LED Driver





Non-SMT components challenges

- MOSFET: thermal
- Large film cap
- Large Electrolytic cap
- Larger magnetics
- MOV: 347/480V

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!