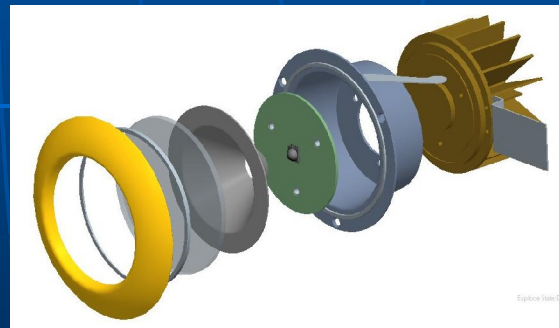


# LED Specialists – Introduction and Capabilities



March 3, 2009

# Our Background

- Company founded 2003 – Kings Park, NY
  - Specializing in LED based product development for transportation and industrial environments
  - Engineering Capabilities:
    - Lighting/optical Design
    - Electrical Design
    - Mechanical/Thermal Design
    - Test and Evaluation
    - Certification
- Principals have 20+ years combined experience in aviation cabin lighting product development:
  - Commercial aviation specifications
  - RTCA - DO160
  - FAR 21.853 Flammability
  - FAA regulatory requirements and certification process
- Participant in SAE A20A/C committee for past 10 years
  - Led development of ARP5873 – LED Reading Light

# Our Mission

*"Enable" Lighting OEMs for SSL Leadership*

## LED Specialists:

- LED Technology Knowledge
- Industry Relationships
- LED Lighting Design
- Electronics Design
- Mechanical Design
- Test and Evaluation
- Rapid Prototyping
- Subassembly Manufacturing



## OEM Partner:

- Market Leader
- Customer Influencer-Relationships
- Fixture Design
- Manufacturing
- Marketing/Sales
- Distribution

# Transportation – Interior Lighting Products



Imtra

Marine



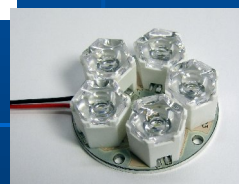
## Features:

- Light output equivalent to 10W or 20W Halogen fixtures
- Cool, Warm, Red and Blue
- 40° to 60° light patterns
- Comfortable viewing, no glare, no hot spots
- 10-30VDC/VAC; < 3-5 Watts
- Transient protection
- Anodized Aluminum Housing/Heat sink
- Rugged and sealed (IP 65)

Buses, Trucks,  
Trailers, RV, Rail



# Outdoor Lighting – Industrial and OEM



## Features:

- Screw-in replacement for PAR20/30 type bulbs
- Savings in cost of energy and maintenance
- 300 and 500 lumen versions
- Outdoor environment
- Compact internal 115VAC driver
- Will be UL1993 listed
- Leverages latest high power LED devices

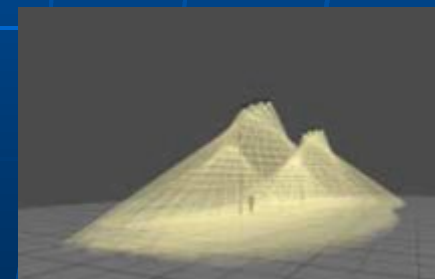
# LED Retrofit Lamp

- Similar height and diameter as A19 or CFL
- GU24 base and Edison adapter
- Intended for use in open style pendant fixtures
- 11 Watts
- 450 lumens
- 41 lms/W @ 4000K



# LED Street Lighting

- Participated on winning team for NYC “City Lights” design competition:
  - Efficiency on par with HPS
  - Improved light quality
  - Reduced maintenance



# Other Business Highlights ...

- Contract with CML Innovative Technologies for manufacturing and distribution of SSL Engines:



- Designer of LED 6S6 replacement replica lamp:
  - 25% of the power
  - 10x life

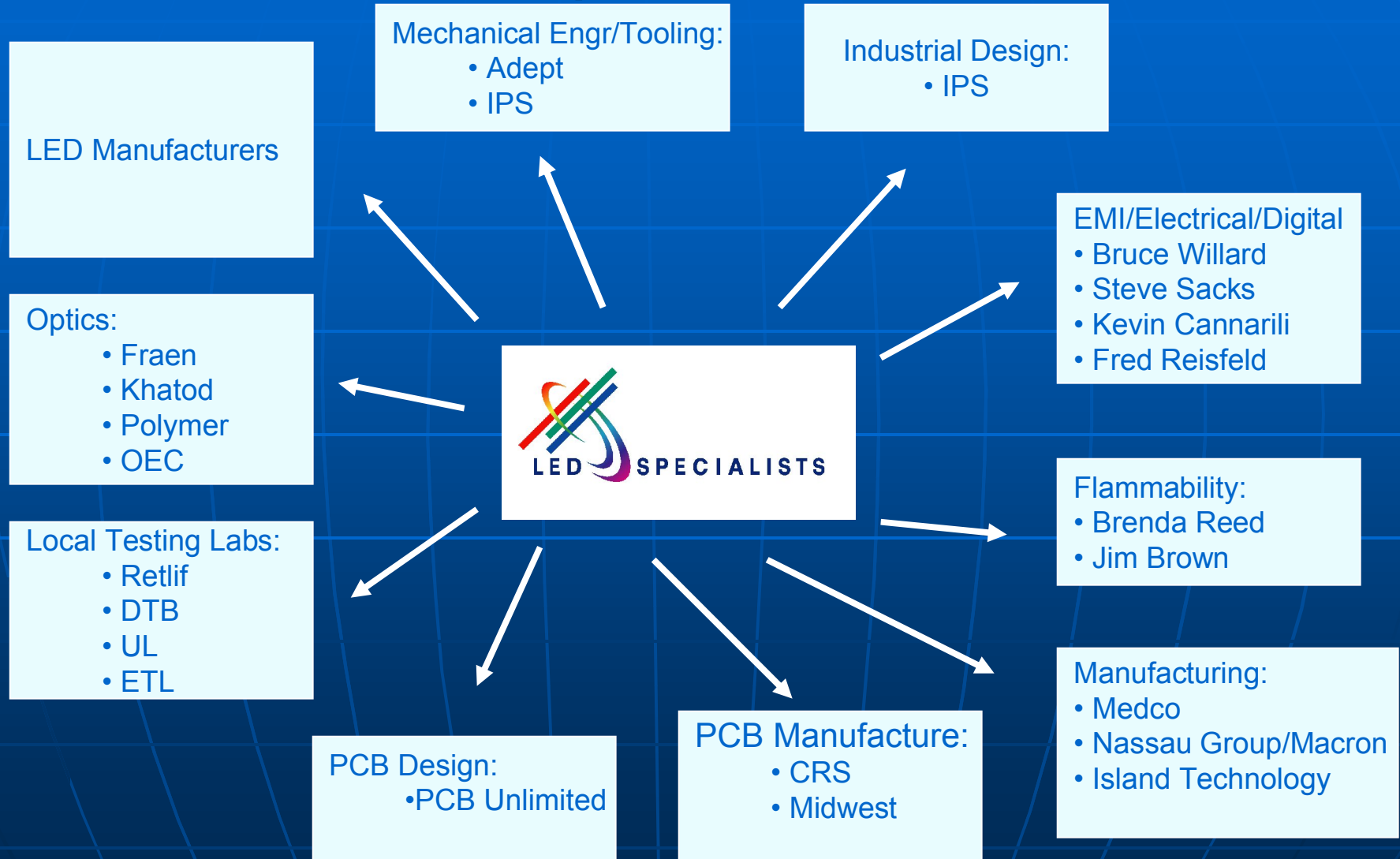


- Other project underway for industrial environments and aviation





# Extended Development Infrastructure:



# LED Technology

Efficacy: lumens/Watt      CRI      Binning (color, flux, Vf)

Lumen  
Depreciation

Color Consistency

Mounting

Availability



Thermal Resistance

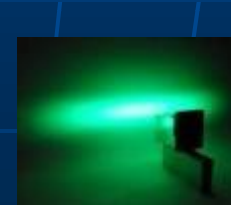
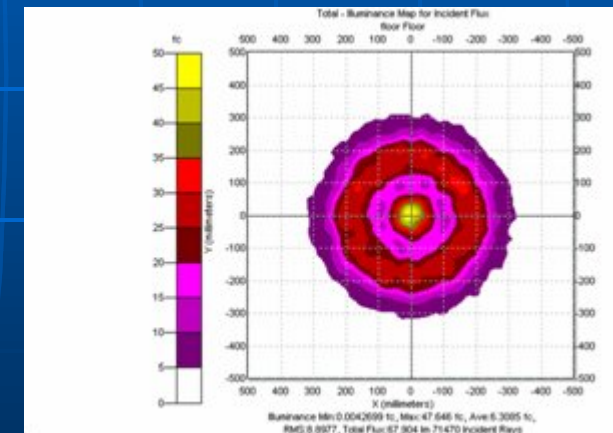
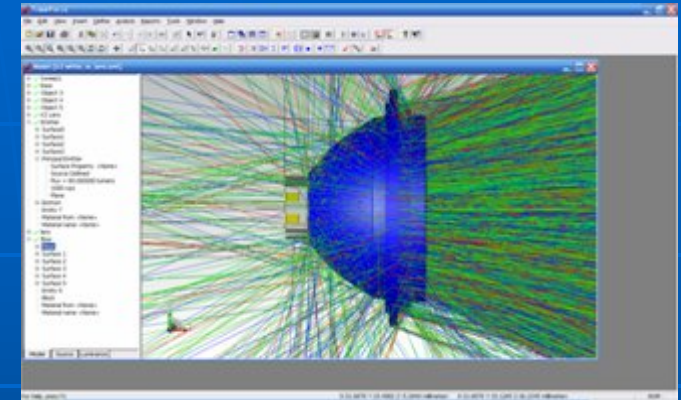
Life Testing

Cost

*We Evaluate all Major Suppliers*

# Lighting Design

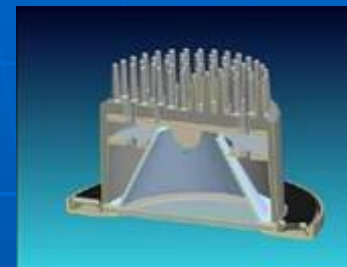
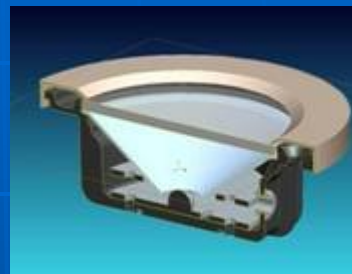
- Maintaining awareness of range of LED technology
- Matching LED to customer requirements:
  - Intensity, Distribution, Color Temperature, Color Rendering, etc.
- Lighting System Design
  - Simulation (Trace Pro)
- Optical Component Specification
- Prototyping and test



# Our Lighting Designs



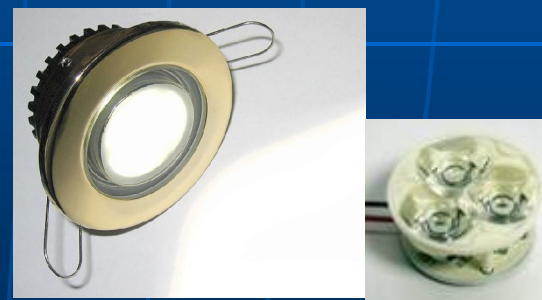
Direct View  
(high brightness, low cost)



Reflector/Diffuser  
(Great Aesthetics, wide pattern)



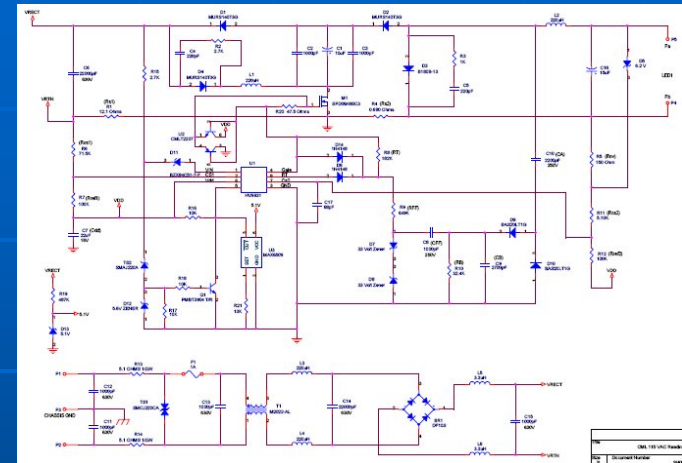
Collimating Optic  
(precise pattern)



Collimating Tri-Optic/Diffuser  
(Spotlight, good aesthetics)

# Electrical Design

- Load requirements (type & # LEDs)
- Input Power Source
- System requirements:
  - Cost
  - Size – space constraints
  - Reliability (temperature)
  - Environmental (e.g. EMI, current harmonics)
  - Power factor correction
  - Surge and transients
- Other potential requirements:
  - Dimming
  - Color Control
  - Temperature Compensation
  - Optical Feedback
- Safety and regulatory:
  - Short circuit, overload, component de-rating
  - UL / FCC / CSA / CE approval



# Our LED Driver Designs



10-30VAC/VDC  
6 Watts



10-30VDC  
4 Watts



115VAC/60hz  
15 Watts



115VAC/60hz  
25 Watts



10-30VDC  
12 Watts



115VAC/400hz  
6 Watts



4.5VDC Battery  
Driver

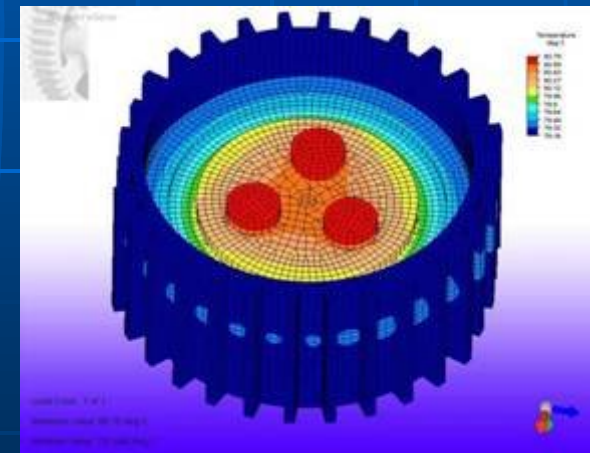
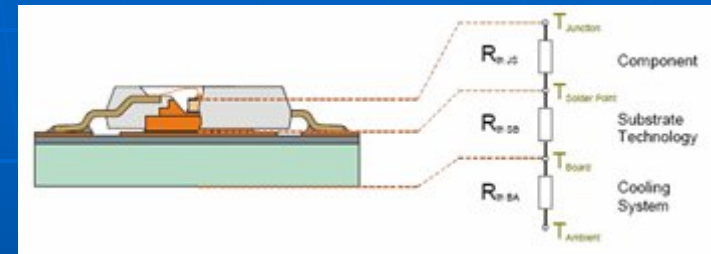


PWM Dimmer

Features: High Efficiency, Load Regulation, Transient Protection, EMI filtering <sup>14</sup>

# Mechanical Design

- 85% of LED energy is converted to heat at junction
- Thermal Management:
  - Junction Temperature of LED
  - Thermal Resistance – from LED to external environment
  - Ambient Temperature Range
  - Heat dissipation mechanisms:
    - Conduction
    - Convection
    - Radiation
- Fixture Integration:
  - Size, materials, finishes, cost, etc.
- Environmental:
  - Temperature and Humidity
  - Shock and Vibration



# Our Mechanical Designs



Newport



Portland



Norfolk



Hatteras



PAR20/30 LED

Features: Anodized aluminum housings, IP65/67 sealing, shock/vib. resistant



# Test and Evaluation

- LED life testing
- Lighting:
  - Flux (Lumens)
  - Illuminance (Lux)
  - Color coordinates (CIE)
  - Color temperature
  - Color Rendering Index
  - Luminance ( $\text{cd}/\text{m}^2$ )
  - Spectrum
- Temperature testing



# Our Services:

- LED Product Development – concept through detailed design
- LED Drive Electronics – customized to achieve efficiency, cost, performance and features set
- Optical Design – maximizing lighting effectiveness
- Mechanical Design – housings and thermal management
- Integration – into luminaire or system
- Prototyping – rapid turn-around and application assessment
- Test and Evaluation
- Qualification and Certification
- Project/Program Management
- Subassembly Manufacturing

