LPA EXCIL ELECTRONICS
The Interior Lighting Specialists

Long Life Reliability
does not cost the earth

LED Technology Applied in Rolling Stock Interior Lighting Applications

Railway & MASS TRANSIT interiors
TECHNOLOGY DESIGN
EXPO 2012

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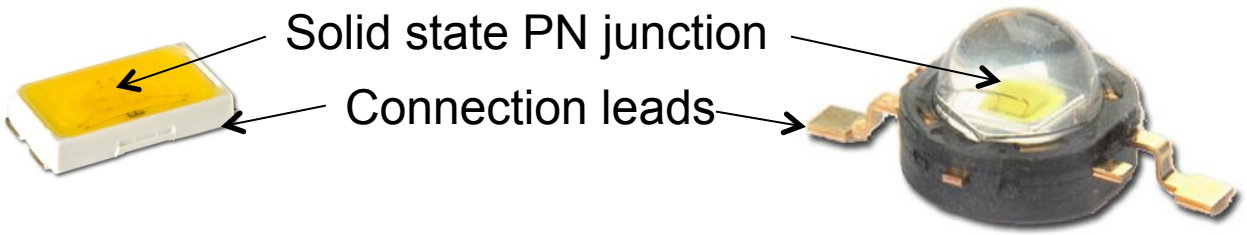
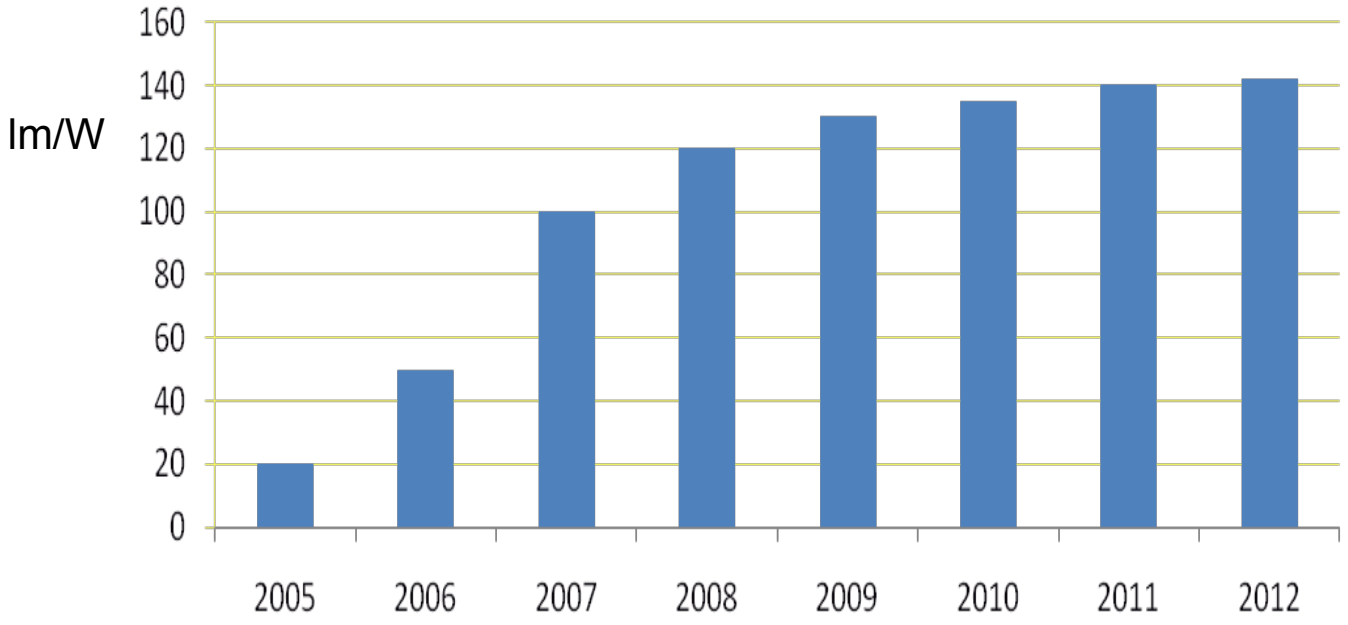
LED Technology Overview

- The LED is a totally solid state device, there are no fragile filaments or gas discharge processes to fail.
- The inherently robust nature of the device renders it perfect for rolling stock interior lighting applications where shock and vibration levels are high.
- When current is passed via the solid state PN junction, photons are released.
- A phosphor coating internal to the device controls the colour temperature of light emitted.



Technology Update

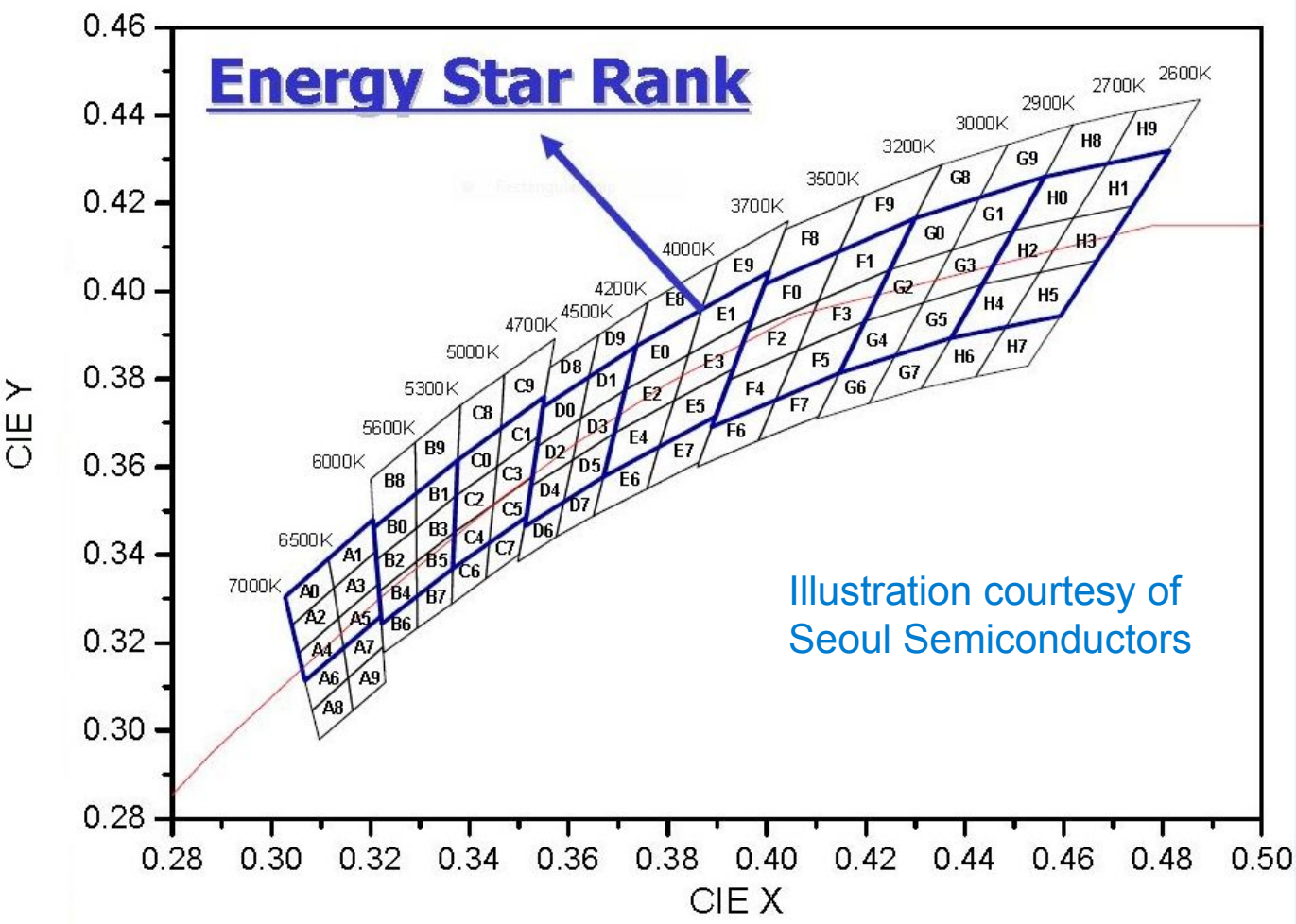
- LED technology has progressed rapidly in recent years.
- Efficacy levels of 140 lm/W are now being achieved.



- This compares to 15 lm/W for halogen and 90 lm/W for fluorescent.

Technology Update

- Colour rendering has improved from 65-70 to 85.
- Colour temperature control has improved radically.



Technology Benefits

- Long service life:
  - When used in conjunction with an optimally designed thermal solution and well designed drive electronics, LED solutions can offer 100,000 hours to the point of 70% initial lumen output.
  - This compares to 3000 hours life for halogen and 20,000 hours life for optimally driven triphosphor fluorescent technology.

Technology Benefits

- Significant Energy Savings:

- The high luminous efficacy level results in significant energy savings compared to traditional incandescent, halogen and fluorescent light sources.

- A typical LPA-Excil LumiMatrix solution would offer around a 40% power saving compared to a conventional fluorescent system.

- A typical LPA-Excil LumiSpot down light solution would offer an 80% power saving compared to a conventional halogen down light solution.

Technology Benefits

- Full control of ambient lighting levels via dimming and ambient light responsive control systems. This further increases life expectancy.

- Total freedom from infra-red and ultraviolet content in the light beam resulting in a cool to touch light source which does not degrade polycarbonate diffusers.

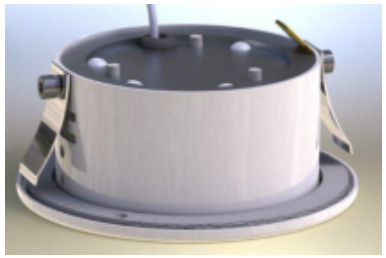
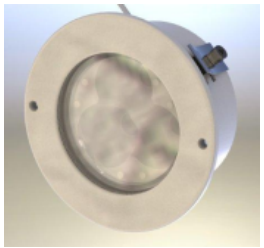
- Environmentally friendly, no lamp disposals.

Application of LED Technology

Down lights

- Down lights typically utilise one or three high power LEDs.

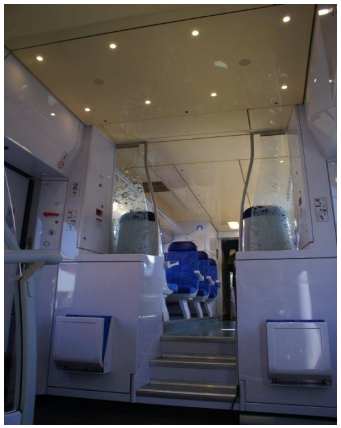


- Replacement for halogen types.
- 100,000 hours to 70% initial lumen output.
- 80% energy saving compared to halogen.
- Drive electronics may be integrated or central.


Application of LED Technology

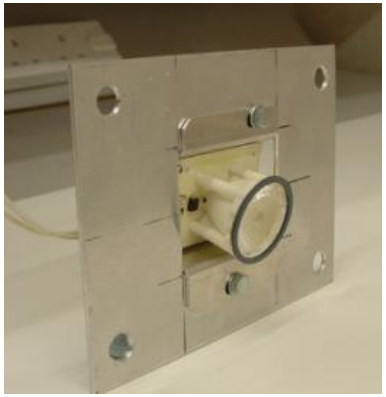
Down lights-Applications

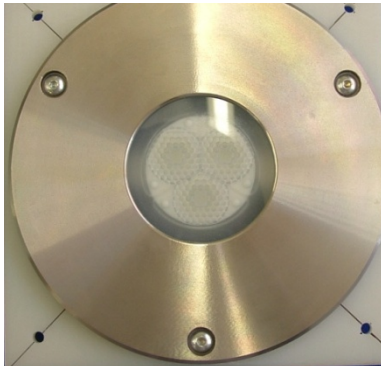


Application of LED Technology

Step Lights and Reading Lights

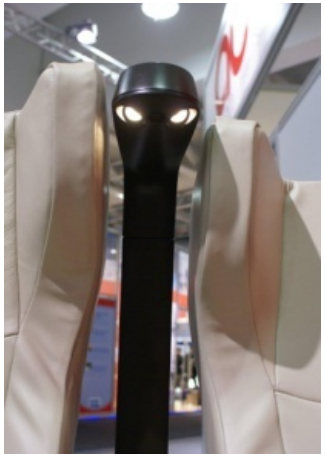
- Utilise essentially the same technology as down lights packaged specifically for the application:





Application of LED Technology

Step and Reading Applications



Application of LED Technology

Saloon Lighting

Application of LED Technology

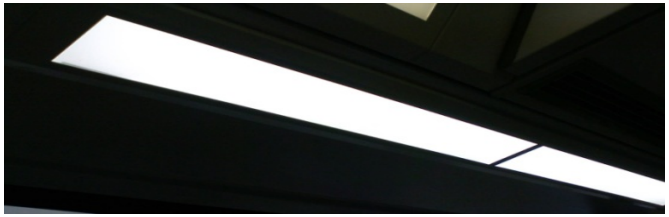
Saloon Lighting-LumiStrip

Long Life Reliability
does not cost the earth

- Fluorescent tube alternative.
- Connects directly to the vehicle control supply.
- Fixes to the gear tray.
- Utilises existing diffuser; inverter and lamp end caps become redundant.
- Typically 17 years service life.
- Offers up to 25% energy saving compared to fluorescent.

Application of LED Technology

LumiStrip-Applications



Non-rolling stock

Application of LED Technology

Saloon Lighting-LumiPanel

Long Life Reliability
does not cost the earth

- Luminaire just 20 mm thick.
- Built in drive electronics, connects directly to the vehicle power supply.
- 17 years service life.
- Up to 40% energy saving.
- Vandal resistant IK10 rated.
- Fully rolling stock compliant.
- BS6853 cat 1a fire compliance.

Application of LED Technology

LumiPanel-Applications

Application of LED Technology

Saloon Lighting-LumiMatrix

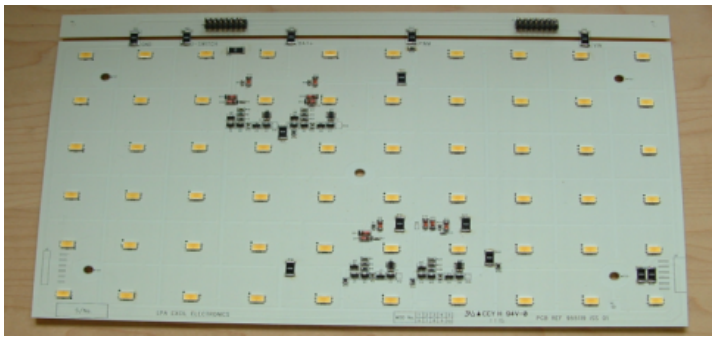
Long Life Reliability
does not cost the earth

- Luminaire just 30 mm thick.

•Uses hundreds of chip LEDs achieving extremely high levels of uniformity.

•Flexible LED pitch and light output to meet specific illumination requirements.

•The high quantity of LEDs operated at low power levels ensures freedom from spotting.

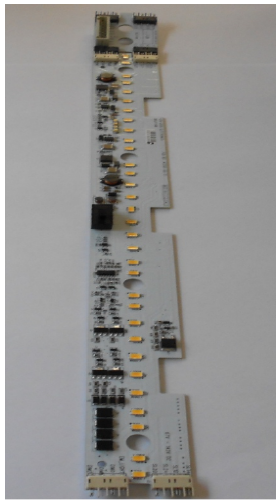


Application of LED Technology

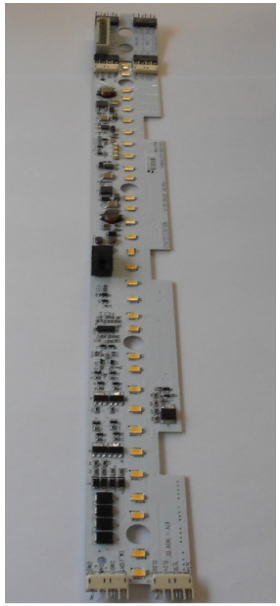
Saloon Lighting-LumiMatrix

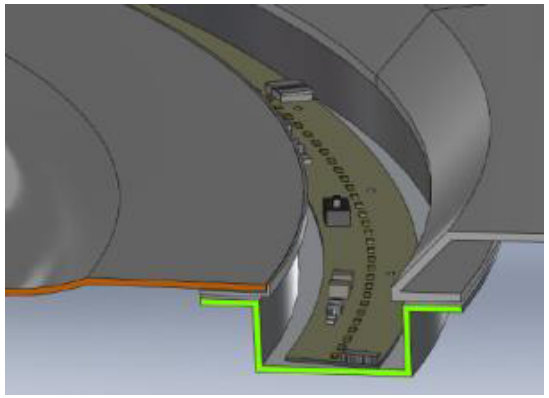
Long Life Reliability
does not cost the earth

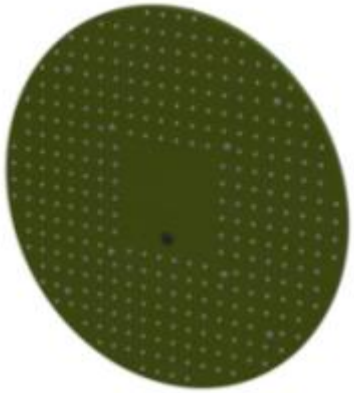
- Built in drive electronics & optional emergency battery back-up.
- Connects direct to the vehicle power supply.
- Typically 15 years service life.
- Up to 40% energy saving.
- Fully Railway compliant.



Configuration Flexibility







Application of LED Technology

LumiMatrix-Applications

Siemens Inspiro Platform-
Warsaw Metro

• Utilises LumiMatrix technology with LEDs and drive technology integrated onto a common circuit board.

• Achieves highly uniform lighting with circuit boards connected end to end.

• Multiple dimming levels are available which are set under the control of the train computer.

• Built in emergency mode and multiple circuit redundancy.

Application of LED Technology

LumiMatrix-Applications

Siemens Inspiro Platform-
Munich Metro

• Utilises LumiMatrix technology based on straight and curved circuit boards to achieve an unconventional, refreshing and highly effective lighting scheme.

• Achieves highly uniform strip lighting with circuit boards connected end to end even in the rotunda and curved features.

• The system is designed to produce continuous and seamless illumination

LED Dimming

- LEDs offer complete control of lumen output.
- Dimmable down to 10% of full output (0% for LumiMatrix).
- May be controlled in a stepped or continuously variable manner.
- Dimming may be utilised to maximise energy savings.
- Dimming improves lumen maintenance resulting in extended system life.
- Provides a more pleasant passenger environment.

Ambient Light Responsive Control

- LED lumen output is adjusted in response to ambient lighting conditions.
- Several ambient light sensors (phototransistors) are mounted within the vehicle.
- An intelligent control system averages the sensor outputs and applies a processing algorithm in order to attain the correct response characteristics.
- The algorithm must reject regular undulations but yet provide a quick response to sudden darkness i.e. tunnel entry.
- Ambient light responsive systems significantly extend LED life and save significant amounts of energy as the LEDs are only fully driven in the complete absence of daylight.

Case Study

LED versus Fluorescent

- Based on a single car over a 15 year period.
- Assumes a single centre row of sixteen, 1200mm length luminaires.
- The LED solution is LumiMatrix containing 300 x chip LEDs and integrated drive electronics.
- The Fluorescent solution utilises 2 x 36W, T8 lamps with inverters.
- The usage duty is 16 hours per day, 365 days per year.

Case Study

Note: For back up data, please see appendix after final slide.

	LED-LumiMatrix	Fluorescent
Luminaire lumen output	2700lm	2574 lm
Illuminance at 0.8m above floor	565 lux	535 lux
Illumination requirement	150 lx	150 lx
Lumen maintenance (time to 70% initial lumen output)	88,000 hours	----
Life expectancy	----	20,000 hours
Luminaire power	48W	80W
Lighting power for one car	768W	1280W
Energy consumption over 15 years	67 Mwhr	112 Mwhr
Energy saving over 15 years	45 Mwhr – Per single car	----
Number of lamp changes over 15 years	Zero	128
Labour saving over 15 years	896 minutes - Per single car	----

Conclusions

- LED solutions offer:
  - Ultra high reliability, long service life and hence significantly reduced operating costs.
  - Substantial energy savings.
  - Low temperature lumen output as the light beam is free from ultraviolet and infrared content.
  - Enhanced emergency lighting performance.
  - Total control flexibility.
  - Reduced environmental impact (no lamp disposals).

Thank You

Any Questions?

LPA EXCIL ELECTRONICS
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Appendix

Case study supplementary information

	LED-LumiMatrix	Fluorescent
Luminaire lumen output	2700lm **(Note 1)**	2574 lm **(Note 2)**
Illuminance at 0.8m above floor	565 lux	535 lux
Illumination requirement	150 lx	150 lx
Lumen maintenance (time to 70% initial lumen output)	88,000 hours	----
Life expectancy	----	20,000 hours
Luminaire power	48W **(Note 3)**	80 **(Note 3)**
Lighting power for one car	768W	1280W
Energy consumption over 15 years	67 Mwh **(Note 4)**	112 Mwh **(Note 4)**
Energy saving over 15 years	45 Mwhr – Per single car	----
Number of lamp changes over 15 years	Zero	128 **(Note 5)**
Labour saving over 15 years	896 minutes - Per single car **(Note 6)**	----

Appendix

Case study supplementary information

- Note 1: LED lumens x LED qty x diffuser factor (15 x 300 x 0.6).
- Note 2: Lamp lumens x lamp qty x luminaire factor x diffuser factor (3300 x 2 x 0.65 x 0.6).
- Note 3: Driver and inverter efficiency taken as 90%.
- Note 4: Power for one car x 16 hours x 365 days x 15 years.
- Note 5: A fluorescent lamp lasts (20,000/8760)(24/16)=3.4 yrs. Changes over 15 years =15/3.4 = 4.

  4 changes over 16 luminaires x 2 lamps = 128.
- Note 6: Assuming 7 minutes average lamp change time.