Littelfuse®

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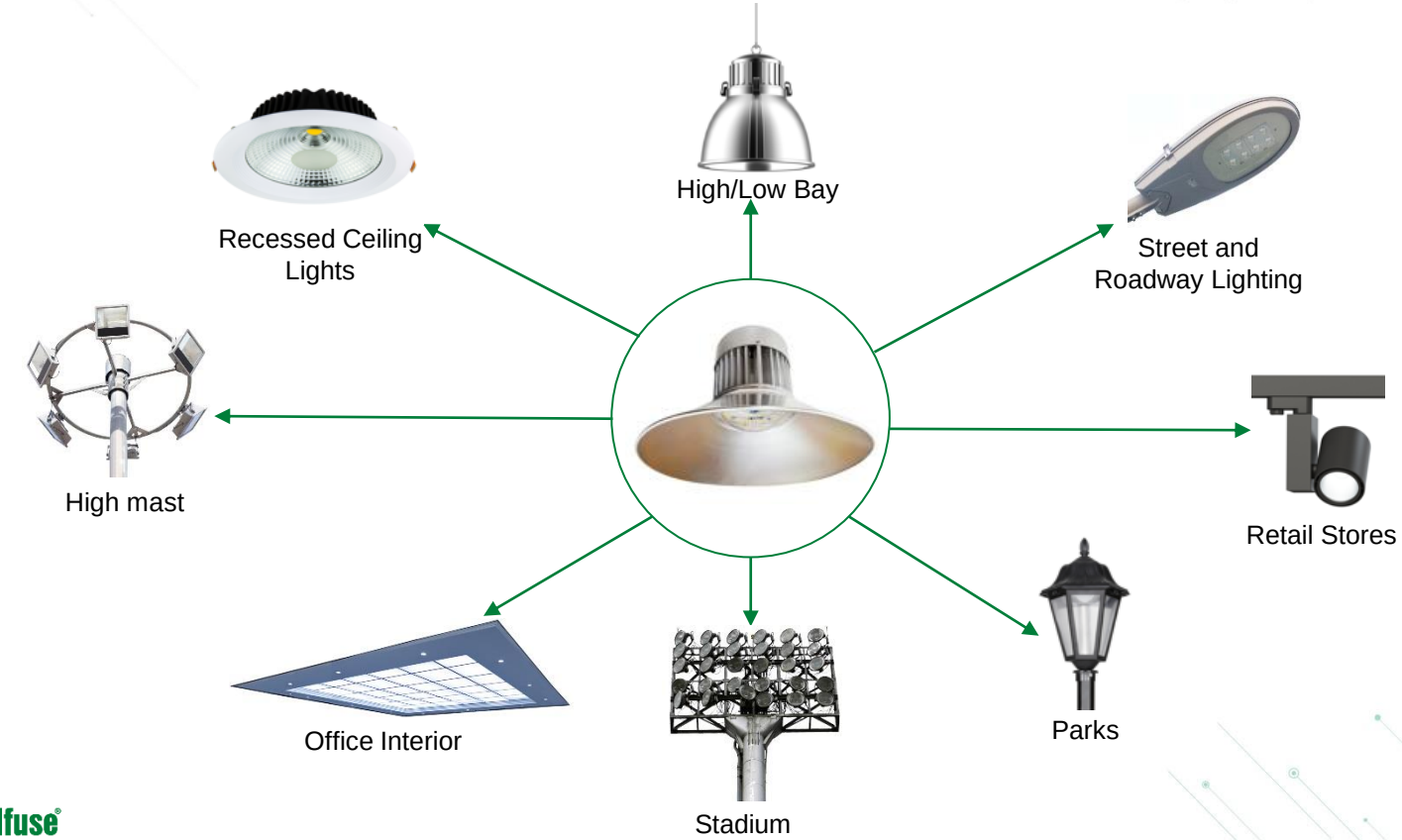
Smart LED Lighting

Illuminating the path to our future

LED Lighting

REV0619

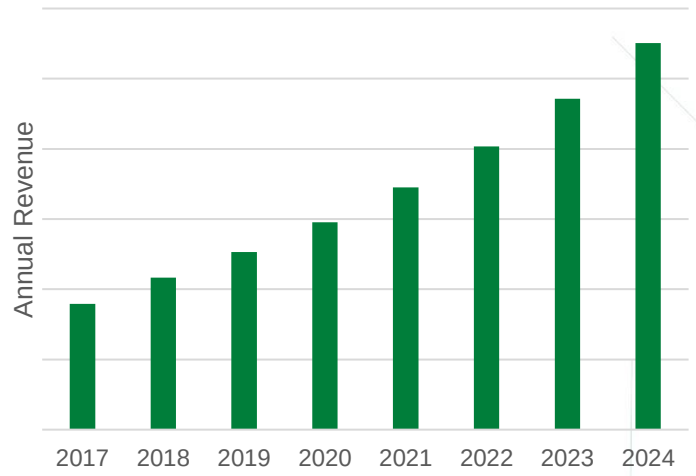
Various lighting applications now include smart features



Smart LED lighting market trends and drivers

Market trends and drivers
Integral component of smart cities and buildings
Includes many types of features: dimming, color tuning, occupancy sensing, communications, and more
Increasing adoption globally, led by USA, UK, and China
Intelligent controls are being used in commercial, residential, outdoor, indoor farming, and industrial lighting

Rapid growth at ~17% CAGR



Source: *BIS Research*

Industrial and commercial luminaires

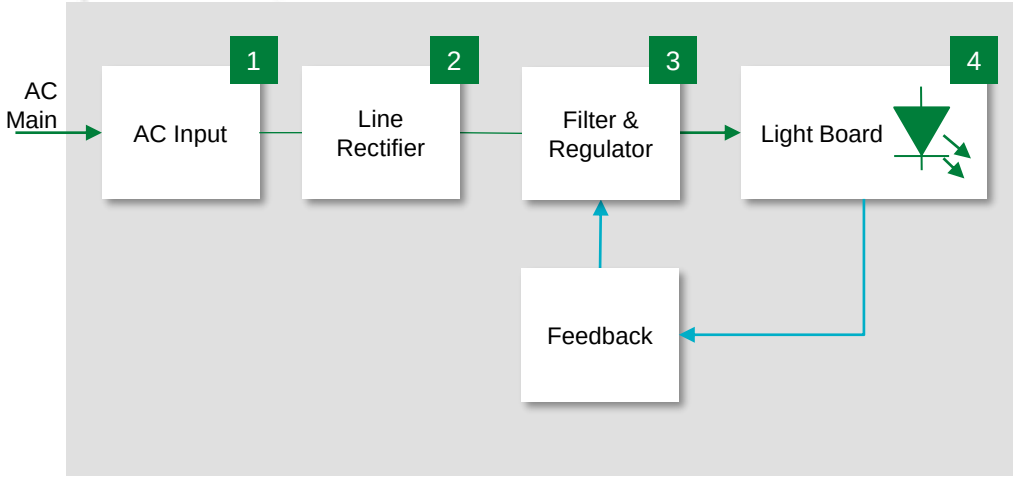
AC Input
- Fuse
- MOV

Line Rectifier
- SIDCAtor® + MOV
- Rectifier Diode

Filter and Regulator
- MOSFET
- LED Driver IC

Light Board:
- TVS Diode
- LED Protector

Industrial and commercial luminaire block diagram



Legend:
Power
Data

	Technology	Product Series
1	Fuse [I]	209, 392, 383, or 476
	MOV	UltraMOV
2	SIDACtor + MOV [II]	P3500SCLRP + LA
	Rectifier diodes	Schottky Gen² Diodes
3	LED Driver	IX9908
	MOSFET	N-Channel Ultra Junction
4	TVS Diode	SMBJ, 1.5KE
	LED Protectors	PLED

Notes:

I. Many different fuse options available based on current, voltage, mounting method, and surge withstand required

II. For protection in more harsh environments and when enhanced reliability is critical

Industrial and commercial luminaire solution details

	Technology	Function in Application	Product Series	Benefits	Features
1	Fuse	Overcurrent protection	209, 392, 383, or 476	Avoid nuisance tripping Multiple mounting options	Up to 300 Vac High I^2t rating
	MOV	Primary surge protection	UltraMOV	Pass appropriate surge level testing	Up to 10 kA Imax Up to 125°C operating temp
2	SIDACtor + MOV[I]	Transient voltage suppression	P3500SCLRP + LA	Enhanced system reliability	Low Peak let-thru voltage
	Rectifier diodes	Converting AC to DC	Schottky Gen[2] Diodes	Efficient energy conversion	I_{FAV} 10 to 300A
3	LED Driver	Constant current driver with dimming and PFC	IX9908	Energy efficient Built in power factor correction	Up to 600V operating > 90% efficiency
	MOSFET	Power conversion	N-Channel Ultra Junction	High power density	400V - 1,000V Class
4	TVS Diode	Transient protection for LEDs	SMBJ, 1.5KE	Better protected light board	600W or 1,500W Peak pulse rating
	LED Protectors	Bypass LEDs failed-open	PLED	Higher % of light output when LED fail-open	6, 9, 13, or 18V_{DRM}

LED driver

AC Input

- Fuse
- MOV

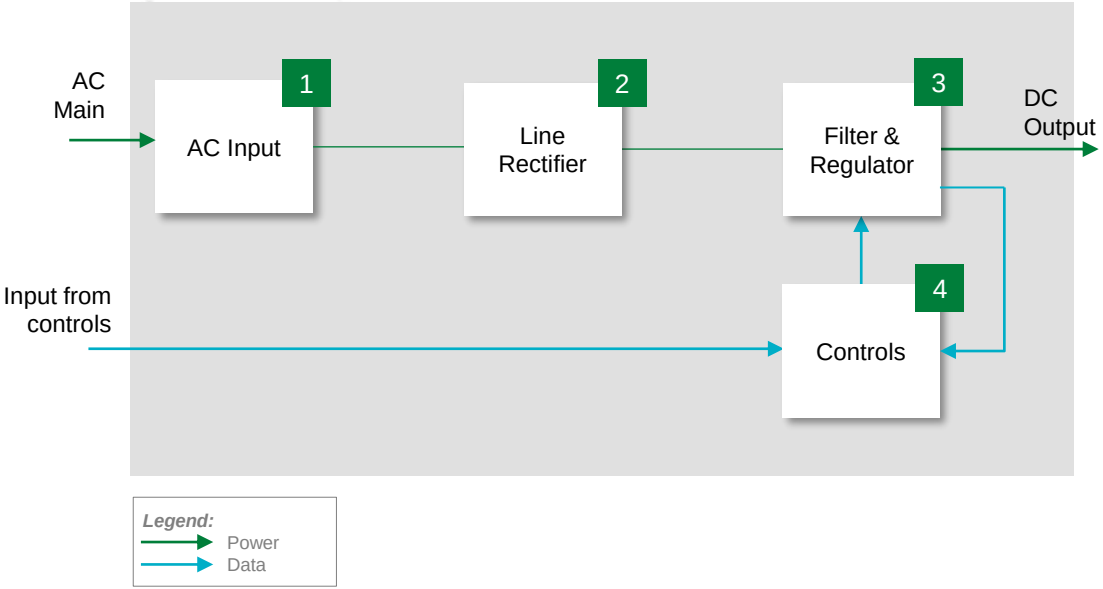
Line Rectifier

- SIDCAtor® + MOV
- Rectifier Diode

Filter and Regulator

- MOSFET
- LED Driver IC

LED driver block diagram



	Technology	Product Series
1	Fuse [I]	369
	MOV	UltraMOV
2	SIDACtor + MOV [II]	P3500SCLRP + LA
	Rectifier Diode	Schottky Gen² Diodes
3	LED Driver	IX9908
	MOSFET	N-Channel Ultra Junction
4	LED Protectors	PLED

Notes:

I. Many different fuse options available based on current, voltage, mounting method, and surge withstand required

II. For protection in more harsh environments and when enhanced reliability is critical

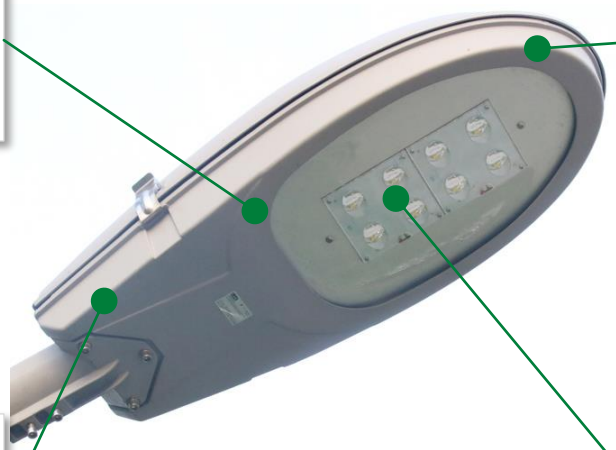
LED driver solution details

	Technology	Function in Application	Product Series	Benefits	Features
1	Fuse	Overcurrent protection	209, 392, 383, or 476	Avoid nuisance tripping Multiple mounting options	Up to 300 Vac High I^2t rating
	MOV	Primary surge protection	UltraMOV	Pass appropriate surge level testing	Up to 10 kA Imax Up to 125°C operating temp
2	SIDACtor + MOV[I]	Transient voltage suppression	P3500SCLRP + LA	Enhanced system reliability	Low Peak let-thru voltage
	Rectifier Diode	Converting AC to DC	Schottky Gen[2] Diodes	Efficient energy conversion	I_{FAV} 10 to 300A
3	LED Driver	Constant current driver with dimming and PFC	IX9908	Energy efficient Built in power factor correction	Up to 600V operating > 90% efficiency
	MOSFET	Power conversion	N-Channel Ultra Junction	High power density	400V - 1,000V Class
4	LED Protectors	Bypass LEDs failed-open	PLED	Higher % of light output when LED fail-open	6, 9, 13, or 18V_{DRM}

Street and outdoor LED luminaire

Photocontrol
- MOV

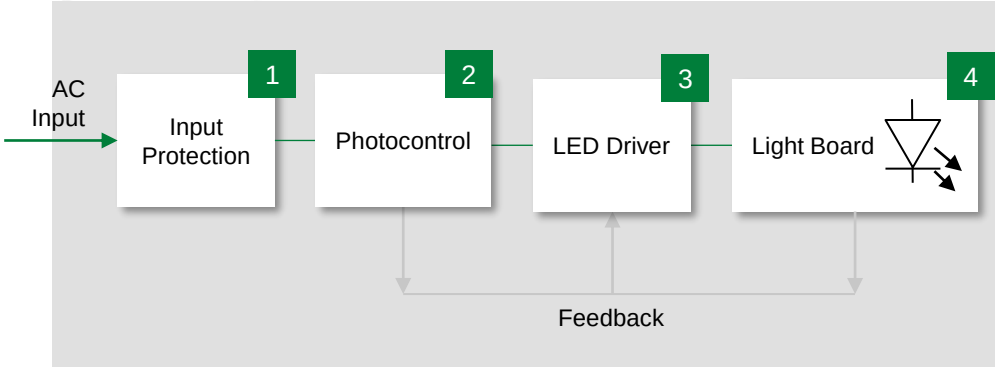
AC Input
- Fuse
- Surge protection module



LED Driver:
- Multiple control products
- Multiple protection products

Light Board:
- MOSFET
- TVS Diode
- LED Protector

Street & outdoor LED luminaire block diagram



	Technology	Product Series
1	Fuse	328
	Surge protection module	LSP
2	MOV	UltraMOV
3	See LED driver block diagram	
4	MOSFET	N-Channel Depletion Mode
	TVS Diodes	SMBJ
	LED Protector	PLED

Notes:

I. Many different fuse options available based on current, voltage, mounting method, and surge withstand required

II. For protection in more harsh environments and when enhanced reliability is critical

Street & outdoor LED luminaire solution details

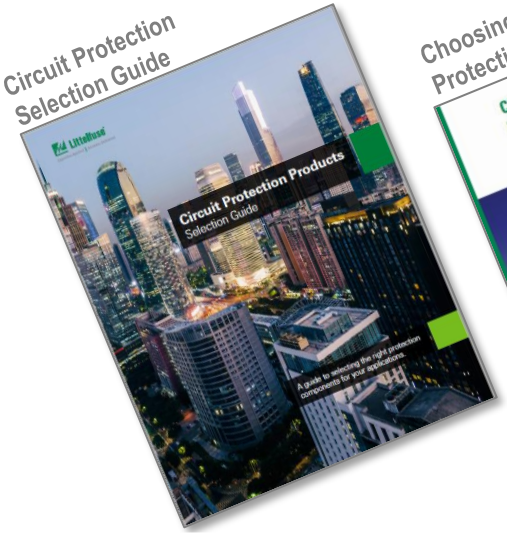
	Technology	Function in Application	Product Series	Benefits	Features
1	Fuse	Overcurrent protection	328	High transient surge withstand	4,800 A^2s 300 Vac
	Surge protection module	Lightning surge protection	LSP	Coordinated protection with Driver & Photocontrols	Up to 20 kA Imax UL 1449 Type 4
2	MOV	Surge protection	UltraMOV	Longer photocontrol life	Up to 10 kA Imax Up to 125°C operating temp
3	See LED driver block diagram				
4	MOSFET	Filtering	N-Channel Depletion Mode	Current regulation	350V - 800V Class
	TVS Diodes	Transient voltage protection	SMBJ	Better protected light board	600W Peak pulse capable
	LED Protector	Bypass failed-open LEDs	PLED	Helps maintain long-term reliability as required by “L70” and “B10” standards	6, 9, 13 or 18 V_{DRM}

Standards for LED lighting equipment

Standard	Title	General Scope	Region
DOE MSSSLC	Department of energy municipal solid-state street lighting consortium	First organization to write a specification for LED Streetlighting	North America
IEEE C62.41.2-2002	Recommended practice on characterization of surges in low-voltage AC power circuits	Provides standard waveforms for testing which is often referenced in other lighting standards.	Global
ANSI C136.2-2018	Roadway and area lighting equipment – dielectric withstand and electrical transient	Luminaires and control devices classified for up to 600V operation and intended for use in roadway and area lighting applications.	North America
ANSI C82.77-5-2017	Standard for lighting equipment – voltage surge requirements	All types of lighting equipment used for general illumination.	North America
IEC/EN 61000-4-5	Part 4-5: Testing and measurement techniques – Surge immunity test	Referenced within many standards	Global
UL 1598	Luminaires	Non-hazardous location luminaires classified for up to 600V operation	North America
IEC 60598	Luminaires	All luminaires up to 1,000V	Global
IEC 62560	Self-ballasted LED-lamps for general lighting services > 50V	Self-ballasted LED-lamps up to 60W	Global
UL 8750	LED equipment for use in lighting products	LED Drivers	North America
IEC 61347	Lamp control-gear	LED Drivers	Global
UL 1449	Surge Protection Devices	All devices used to limit and protect against surge	North America
IEC 61643-11	Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods	All devices used to limit and protect against surge	Global
UL 773	Plug-in locking type photocontrols for use with area lighting	Photocontrols for area lighting	North America
ANSI C136.41	Dimming control between an external locking type photocontrol and ballast or driver	Photocontrols	North America

Additional information can be found on Littelfuse.com

Circuit Protection Selection Guide



Choosing Right Circuit Protection for LEDs

LED Design Guide

Click on images to open the catalog

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Partner for tomorrow’s electronic systems

Broad product portfolio

A global leader with a broad product portfolio, covering every aspect of protection, sensing, and control

Application expertise

Our engineers partner directly with customers to help speed up product design and meet their unique needs

Global customer service

Our global customer service team is with you to anticipate your needs and ensure a seamless experience

Compliance & regulatory expertise

We help customers in the design process to account for requirements set by global regulatory authorities

Testing capabilities

We help customers get products to market faster, we offer certification testing to global regulatory standards

Global manufacturing

We offer high-volume manufacturing that is committed to the highest quality standards

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