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# Two-Wheelers and Three-Wheelers EV Charging Solutions

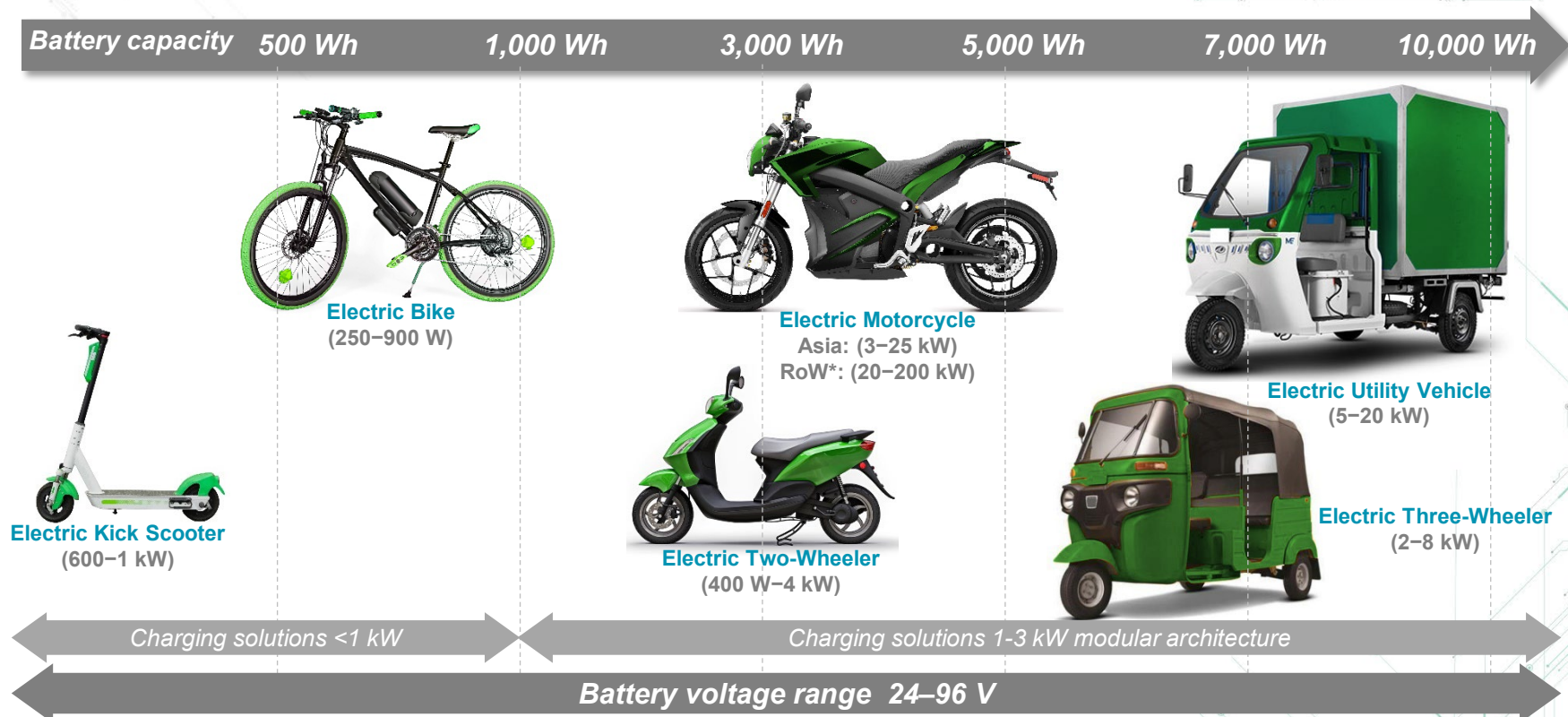
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EV Infrastructure

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# By fulfilling zero-emission mandates, electric two-wheelers and three-wheelers help improve air quality



# Electric two-wheelers and three-wheelers market trends and drivers

## Market trends and drivers

The global electric two-wheeler and three-wheeler market is projected to grow from 1.05M units in 2021 to 19.11M units by 2031, at a CAGR of ~34%

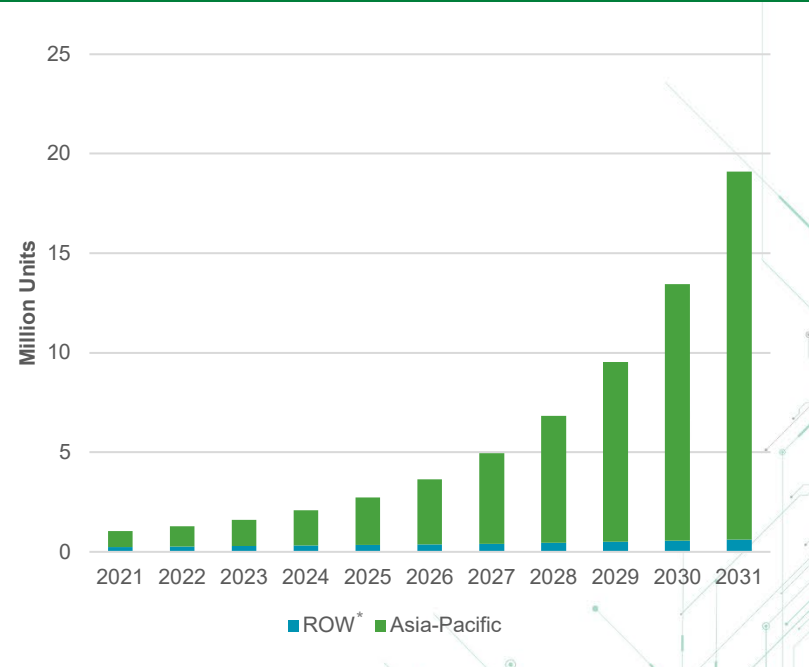
The double-digit growth of lithium-ion battery packs in the global electric two-wheelers and three-wheelers market is driving the need for charging infrastructure

Asia Pacific is expected to be the largest market. China spent approximately \$2.4 billion by 2020 to improve its charging facility infrastructure

The Indian government has undertaken initiatives such as FAME-II, offering subsidies and tax exemptions to encourage buyers to change from ICE bikes to electric two-wheelers and three-wheelers to reduce Carbon emission

27 European countries have imposed taxes on carbon dioxide emissions related to vehicles

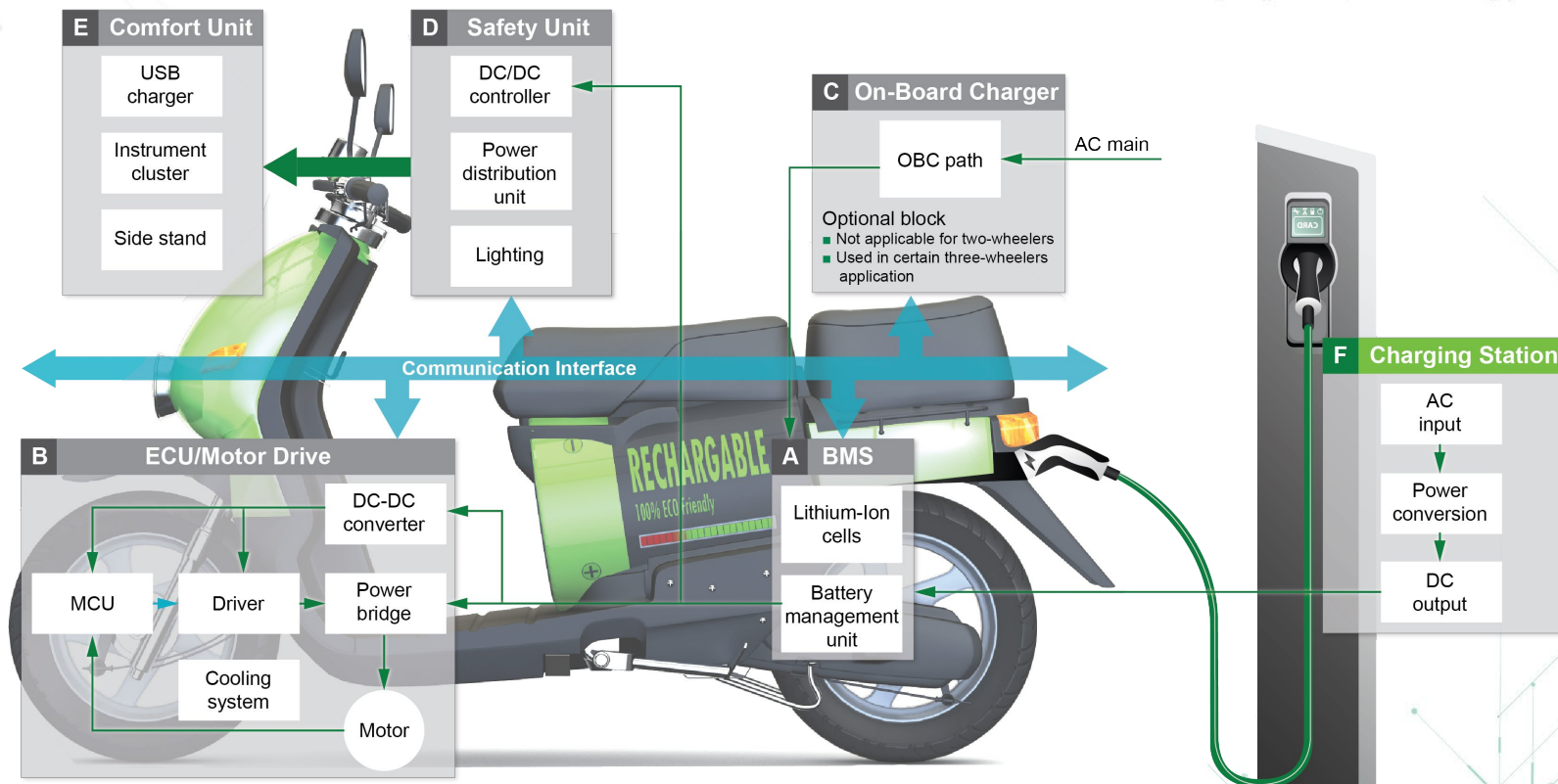
## Rapid growth of electric two-wheelers and three-wheelers



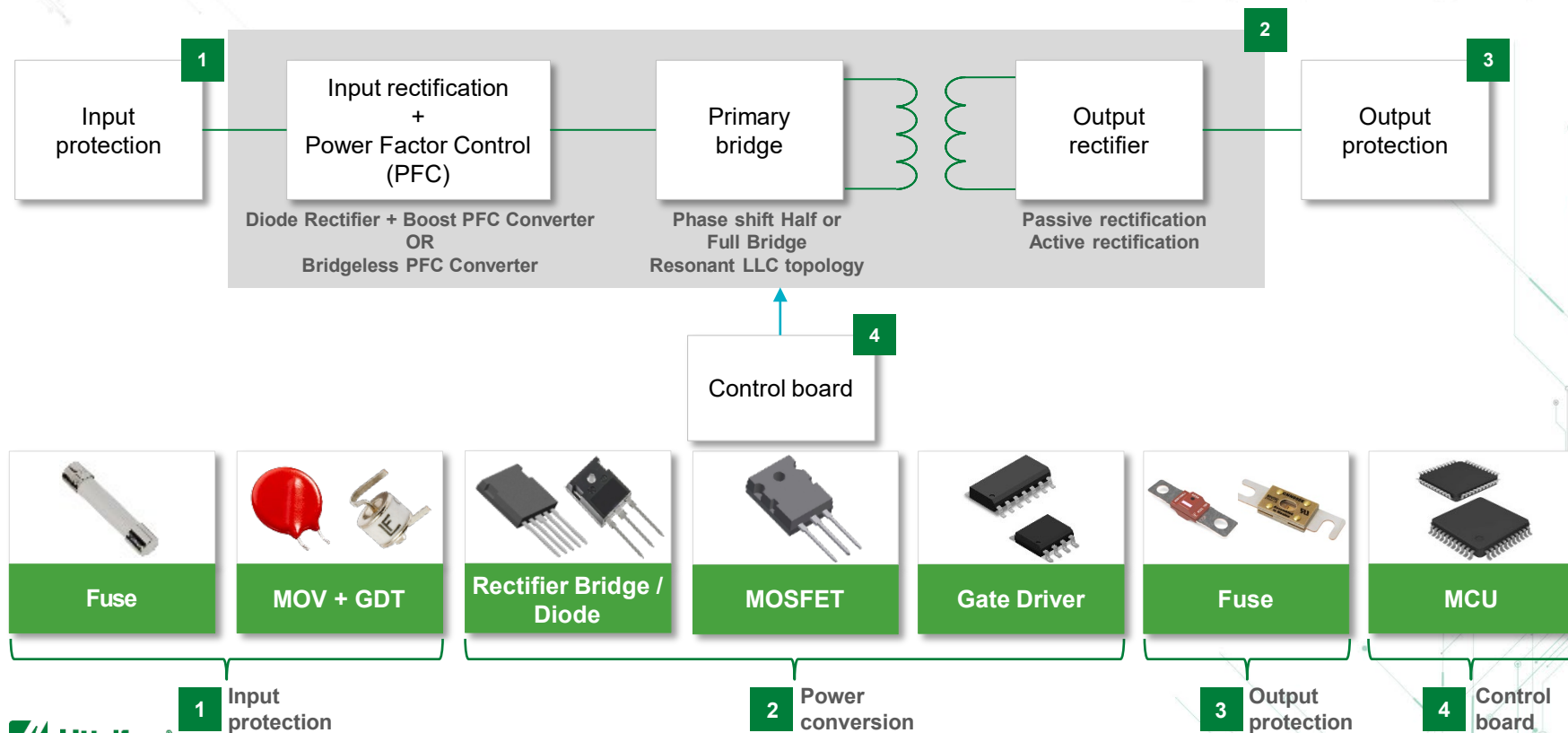
Source: [CEEW](#), Littelfuse estimates (Does not include Kick Scooter, Electric Bike, and China electric two-wheeler forecast)

\* Rest of the World

# Electric two-wheelers and three-wheelers system architecture



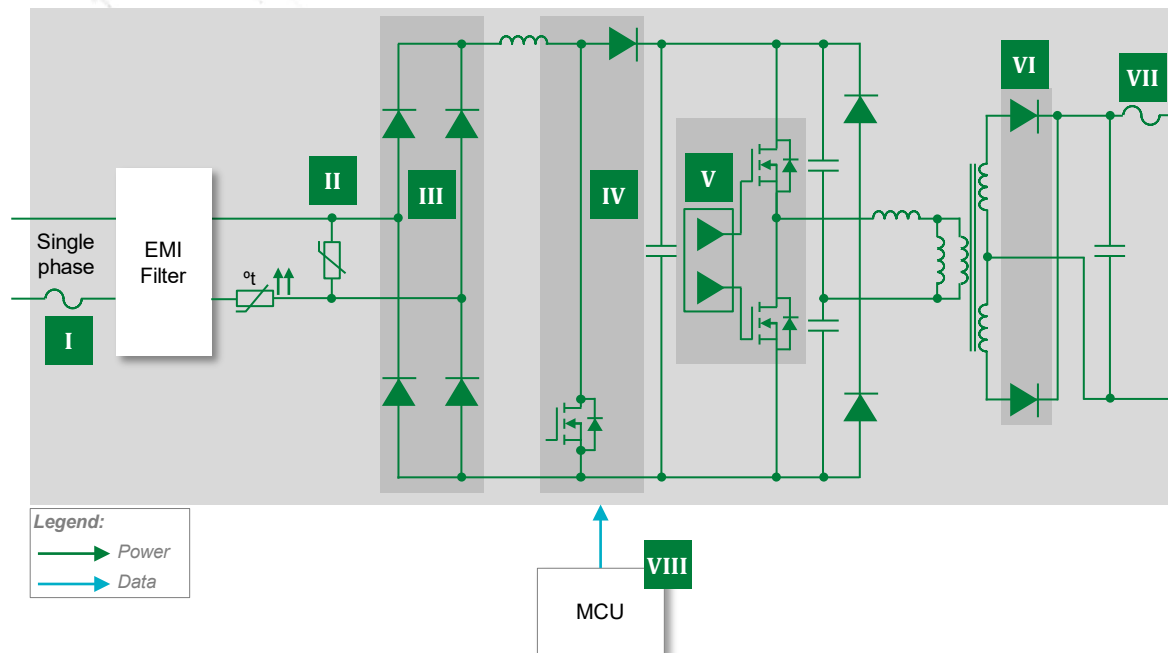
# Two-wheelers and three-wheelers charging application block diagram



# Typical charging solutions for electric kick scooters and electric bikes (<1 kW)



Click on the product series in  
the table below for more info



	Technology	Series
I	Fuse	<a href="#">216</a> , <a href="#">215</a> , <a href="#">314</a>
II	MOV + GDT	<a href="#">TMOV</a> , <a href="#">Xtreme</a>
		<a href="#">CG2</a> , <a href="#">CG3</a>
III	Rectifier Bridge	<a href="#">FBO40-12N</a>
IV	MOSFET	<a href="#">X2-Class</a> , <a href="#">X3-Class</a>
	Gate Driver	<a href="#">IX4340</a> , <a href="#">IXD60x</a>
	Si Diode OR SiC Diode	<a href="#">DUR</a> , <a href="#">LSIC2SD065</a>
	Power MOSFET with HiPerDyn™ FRED	<a href="#">FMD 15-06KC5</a>
V	MOSFET	<a href="#">X2-Class</a> , <a href="#">X3-Class</a>
	Gate Driver	<a href="#">IX4340</a> , <a href="#">IXD60x</a>
VI	Diode	<a href="#">DSEK 60</a> , <a href="#">DSEP</a> , <a href="#">DPG</a>
VII	Fuse	<a href="#">688</a> , <a href="#">midi-70</a> , <a href="#">CNN</a> , <a href="#">CNNE</a> , <a href="#">BF1 58</a>
VIII	MCU	<a href="#">Z8F3224</a>





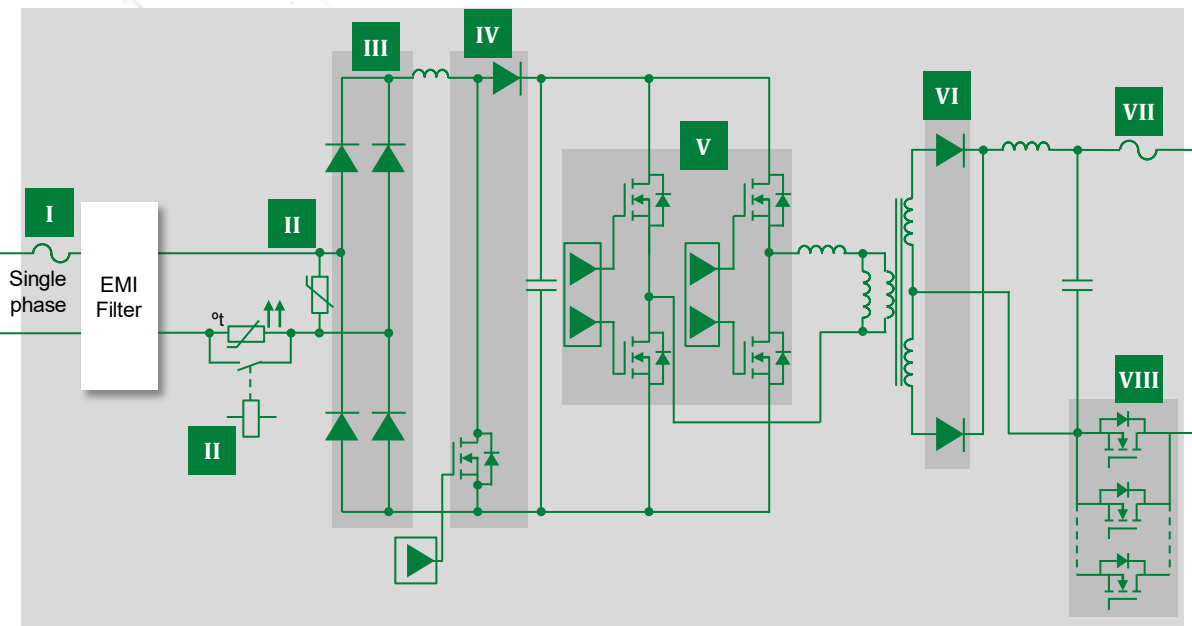
# Features and benefits of Littelfuse components

	Technology	Function in application	Product Series	Benefits	Features
I	Fuse	Protects and isolate subunit in case of short circuit	<a href="#">216</a> , <a href="#">215</a> , <a href="#">314</a>	Reduces customer qualification time by complying with third-party safety standards, such as UL/IEC	Compliance with third-party safety standards, such as UL/IEC
II	MOV + GDT	Protects from temporary over voltage event and transient surges; meets requirements for common mode protection	<a href="#">TMOV</a> , <a href="#">Xtreme</a>	Reduces customer qualification time by complying with third-party safety standards, such as UL/IEC	High energy absorption capability: 40–530 J (2 ms); integrated thermal protection
			<a href="#">CG2</a> , <a href="#">CG3</a>	Surge protection in a smaller size	Rugged ceramic metal construction
III	Rectifier Bridge	Converts AC voltage to DC voltage	<a href="#">FBO40-12N</a>	Very low leakage current and forward voltage drop; improved thermal behavior	1200 V single-phase standard rectifier bridge in i4-Pac
IV	MOSFET	Primary side of the DC-DC converter	<a href="#">X2-Class</a> , <a href="#">X3-Class</a>	Optimized for high-frequency applications	Ultra-low 2.3 A / 1.9 A on-resistance $R_{DS(ON)}$ and gate charge $Q_g$ ; dv/dt ruggedness
	Gate Driver	Efficient switching of MOSFETs and IGBTs	<a href="#">IX4340</a> , <a href="#">IXD60x</a>	Ultra-fast turn-on and turn-off of MOSFET; extremely robust device	1.5 A to 30 A peak source/sink drive current; wide operating voltage range: -40 °C to +125 °C; low propagation delay times
	Si Diode OR SiC Diode	High-frequency switching and rectification	<a href="#">DUR</a> , <a href="#">LSIC2SD065</a>	Reduces switching losses; increases efficiency	High surge capability; negligible $I_{RR}$ ; $T_J$ 175 °C
	Integrated PFC Boost	Integrated switching for PFC (power factor correction)	<a href="#">FMD 15-06KC5</a>	High power density; reduces component count; PCB space savings	Integrated MOSFET with FRED diode in single package
V	MOSFET	Primary side of the DC-DC converter	<a href="#">X2-Class</a> , <a href="#">X3-Class</a>	Optimized for high-frequency applications	Ultra-low 2.3 A / 1.9 A on-resistance $R_{DS(ON)}$ and gate charge $Q_g$ ; dv/dt ruggedness
	Gate Driver	Efficient switching of MOSFETs and IGBTs	<a href="#">IX4340</a> , <a href="#">IXD60x</a>	Ultra-fast turn-on and turn-off of MOSFET; extremely robust device	1.5 A to 30 A peak source/sink drive current; wide operating voltage range: -40 °C to +125 °C; low propagation delay times
VI	Diode	Secondary side output rectification of DC-DC converter	<a href="#">DSEK 60</a> , <a href="#">DSEP</a> , <a href="#">DPG</a>	Reduces switching losses; increases efficiency	High surge capability; negligible $I_{RR}$ ; $T_J$ 175 °C
VII	Fuse	Short circuit protection and overload circuit protection	<a href="#">688</a> , <a href="#">midi-70</a> , <a href="#">CNN</a> , <a href="#">CNNE</a> , <a href="#">BF1 58</a>	Provides safety protection in high-voltage environments; quicker reaction time	Bolt down form factor; fast-acting; high breaking capacity; qualified to ISO 8820 standard
VIII	MCU	Controlling specific function on control board	<a href="#">Z8F3224</a>	Simplifies design; low power consumption; board space saving compared to 32-bit MCU	8-bit MCU with a fast core, an efficient register-oriented architecture and a wide range of integrated peripherals supporting up to 5 V

# Typical charging solutions for electric motorcycles and three-wheelers (1–3 kW modular architecture)

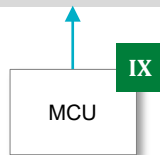


Click on the product series in the table below for more info



## Legend:

→ Power  
→ Data



	Technology	Series
I	Fuse	<a href="#">216</a> , <a href="#">215</a> , <a href="#">314</a>
II	MOV + GDT	<a href="#">TMOV</a> , <a href="#">Xtreme</a>
		<a href="#">CG2</a> , <a href="#">CG3</a>
II	SIDACTor®	<a href="#">Pxxx0FNL</a> , <a href="#">Pxxx0S3N</a>
	AC Relay	SC0x*
III	Rectifier Bridge	<a href="#">FBO40-12N</a>
IV	MOSFET	<a href="#">X2-Class</a> , <a href="#">X3-Class</a>
	Gate Driver	<a href="#">IX4340</a> , <a href="#">IXD60x</a>
IV	Si Diode OR SiC Diode	<a href="#">DJR</a> , <a href="#">LSIC2SD065</a>
	Integrated PFC Boost	<a href="#">FMD 47-06KC5</a>
V	MOSFET	<a href="#">X2-Class</a> , <a href="#">X3-Class</a>
V	Gate Driver	<a href="#">IX4340</a> , <a href="#">IXD60x</a>
VI	Diode	<a href="#">DSEK 60</a>
VII	Fuse	<a href="#">Mega-120</a> , <a href="#">midl-70</a> , <a href="#">CNN</a> , <a href="#">CNNE</a>
VIII	MOSFET	<a href="#">X4-Class</a> , <a href="#">MMIX</a>
IX	MCU	<a href="#">Z8F3224</a>

\* Contact Littelfuse Sales for details



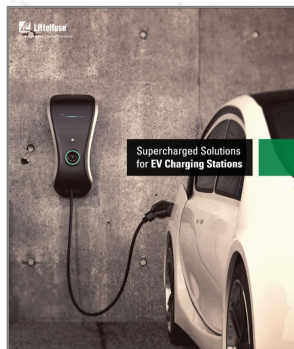


# Features and benefits of Littelfuse components

	Technology	Function in application	Product Series	Benefits	Features
I	Fuse	Protects and isolates subunit in case of short circuit	<a href="#">216, 215, 314</a>	Reduces customer qualification time by complying with third-party safety standards, such as UL/IEC	Compliance with third-party safety standards, such as UL/IEC
	MOV	Protects from temporary over voltage event and transient surges; meets requirements for common mode protection	<a href="#">TMOV, Xtreme</a>	Reduces customer qualification time by complying with third-party safety standards, such as UL/IEC	High energy absorption capability: 40–530 J (2 ms); integrated thermal protection
II	SIDACtor®	Enhancing surge protection for auxiliary power supply; improves AC input voltage immunity	<a href="#">CG2, CG3</a>	Surge protection in a smaller size	Rugged ceramic metal construction
	AC Relay	Safety cutoff on the grid (power network) to prevent abnormal current supply	<a href="#">Pxxx0FNL, Pxxx0S3N</a>	Good clamping and fast response time for high-energy transient protection	3 kA, 8/20 $\mu$ s surge capability to help protect AC lines from harmful transient surges
III	Rectifier Bridge	Improves AC input voltage immunity	SC0x*	PCB mount capable; higher flexibility for designers; compact design	Low heat generation and low coil power consumption; performance to meet regulatory UL/IEC compliance
IV	MOSFET	Primary side of the DC-DC converter	<a href="#">FBO40-12N</a>	Very low leakage current and forward voltage drop; improved thermal behavior	1200 V single-phase standard rectifier bridge in i4-Pac
	Gate Driver	Efficient switching of MOSFETs and IGBTs	<a href="#">X2-Class, X3-Class</a>	Optimized for high-frequency applications	Ultra-low on-resistance $R_{DS(ON)}$ and gate charge $Q_g$ ; dv/dt ruggedness
	Si Diode OR SiC Diode	High-frequency switching and rectification	<a href="#">IX4340, IXD60x</a>	Ultra-fast turn-on and turn-off of MOSFET; extremely robust device	1.5 A to 30 A peak source/sink drive current; wide operating voltage range; -40 °C to +125 °C; low propagation delay times
	Integrated PFC Boost	Integrated switching for PFC (power factor correction)	<a href="#">DUR, LSIC2SD065</a>	Reduces switching losses; increases efficiency	High surge capability; negligible $I_{RR}$ ; $T_J$ 175 °C
V	MOSFET	Primary side of the DC-DC converter	<a href="#">FMD 47-06KC5</a>	High power density; reduces component count; PCB space savings	Integrated MOSFET with FRED diode in single package
	Gate Driver	Efficient switching of MOSFETs and IGBTs	<a href="#">X2-Class, X3-Class</a>	Optimized for high-frequency applications	Ultra-low 2.3 A / 1.9 A on-resistance $R_{DS(ON)}$ and gate charge $Q_g$ ; dv/dt ruggedness
VI	Diode	Secondary side output rectification of DC-DC converter	<a href="#">IX4340, IXD60x</a>	Ultra-fast turn-on and turn-off of MOSFET; extremely robust device	1.5 A to 30 A peak source/sink drive current; wide operating voltage range; -40 °C to +125 °C; low propagation delay times
VII	Fuse	Short circuit protection and overload circuit protection	<a href="#">DSEK 60</a>	Reduces switching losses; increases efficiency	High surge capability; negligible $I_{RR}$ ; $T_J$ 175 °C
VIII	MOSFET	Output reverse polarity protection	<a href="#">Mega-120, midi-70, CNN, CNNE</a>	Provides safety protection; quicker reaction time	Bolt down form factor; fast-acting; high breaking capacity; qualified to ISO 8820 standard
IX	MCU	Controlling specific function on control board	<a href="#">X4-Class, MMIX</a>	Fast response time and lower heat signature	Low $R_{DS(ON)}$ , dv/dt ruggedness
			<a href="#">Z8F3224</a>	Simplifies design; low power consumption; board space saving compared to 32-bit MCU	8-bit MCU with a fast core, an efficient register-oriented architecture, and a wide range of integrated peripherals supporting up to 5 V

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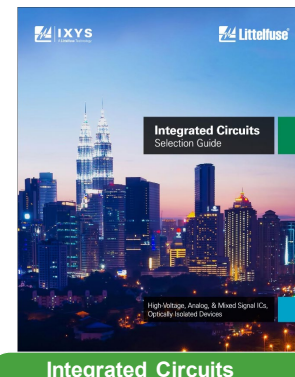
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Application Guide



Circuit Protection  
Selection Guide



Sensing Products  
Selection Guide



Integrated Circuits  
Selection Guide

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Catalog



Two-/Three-Wheeler  
Solutions Spotlight

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