






Auxiliary Power Supply

- Industrial
- Datacenter and Cloud
- Renewable Energy
- EV Infrastructure

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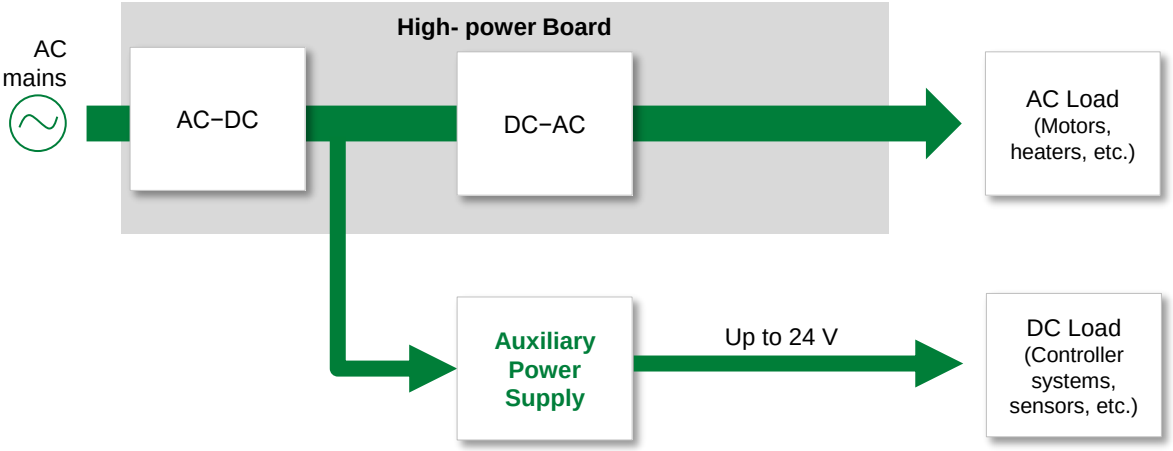
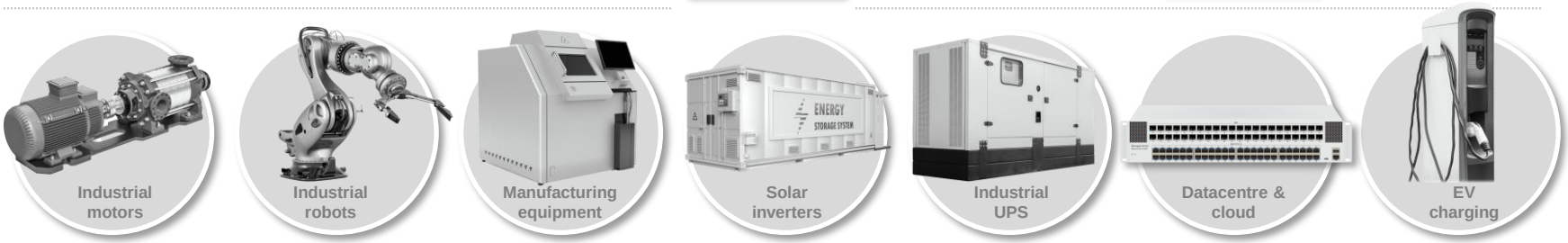
Every high-power application such as industrial, datacenter, solar, etc. needs an auxiliary power supply

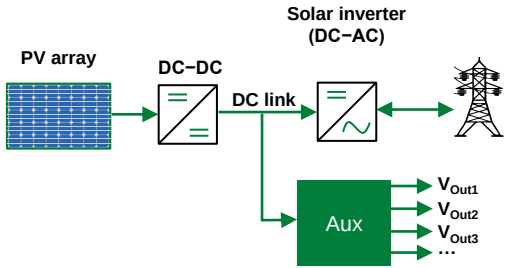




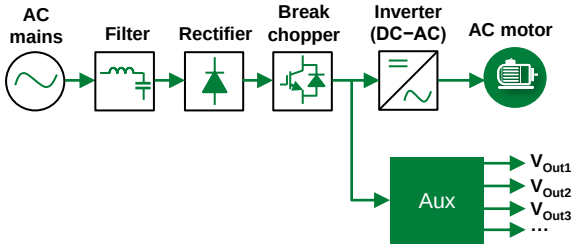
Auxiliary power supply is used to power the internal control electronics, voltage- & current-sensing electronics of the PSU

Auxiliary power supply used in different applications

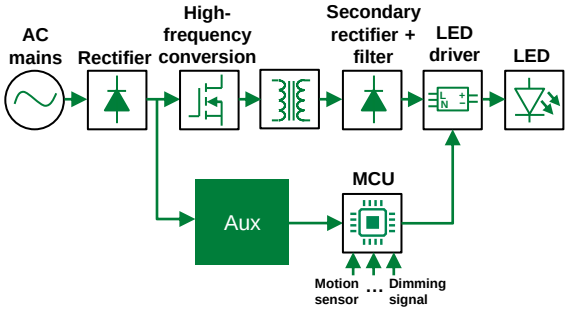
Solar inverter



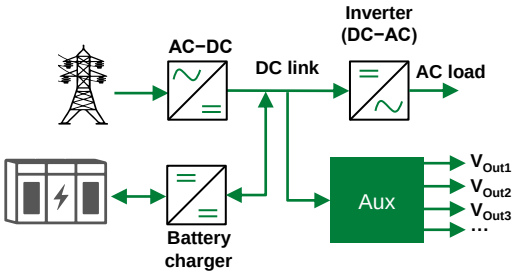
Industrial motor drive



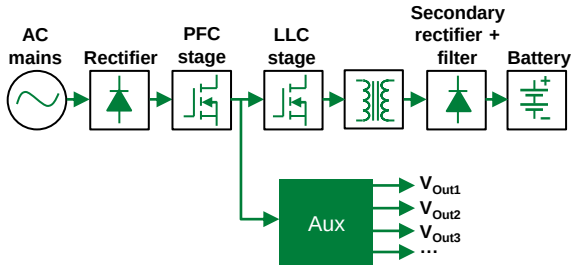
LED lighting



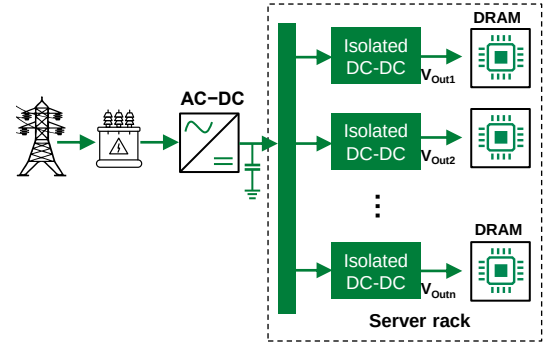
UPS



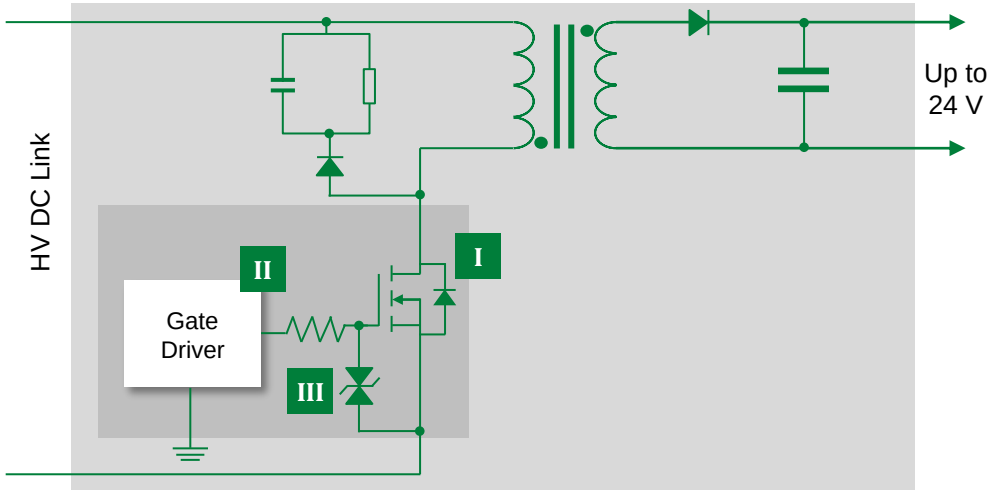
EV charging



Datacenter Server Tray



Example schematics (flyback topology) of auxiliary power supply and recommended Littelfuse solutions



	Technology	Function in application	Product series	Benefits	Features
I	Si/SiC MOSFET ***OR*** IGBT	High-frequency switching	HV MOSFET , LSIC1MO, ***OR*** HV IGBT	Higher switching frequency; higher efficiency; increased robustness; smaller die size per voltage/current rating	Optimized for high-frequency applications; extremely low gate charge and output capacitance; ultra-low on-resistance
II	Gate Driver	Drives SiC MOSFETs and high-power IGBTs	IX4310T, IX4352NE, IX_609	Eliminates the need for separate negative supply; quick turn-on and turn-off of power SiC MOSFET and IGBT	Separate 9 A peak source and sink outputs; internal negative charge pump regulator for selectable negative gate drive bias
III	TVS Diode	Protects SiC MOSFET from voltage transient	SMF, SMFA	Improves system reliability by clamping the voltage at safe levels during transients	200 W peak pulse power capability; excellent clamping capability; low profile

TVS Diode for SiC MOSFET Gate Protection

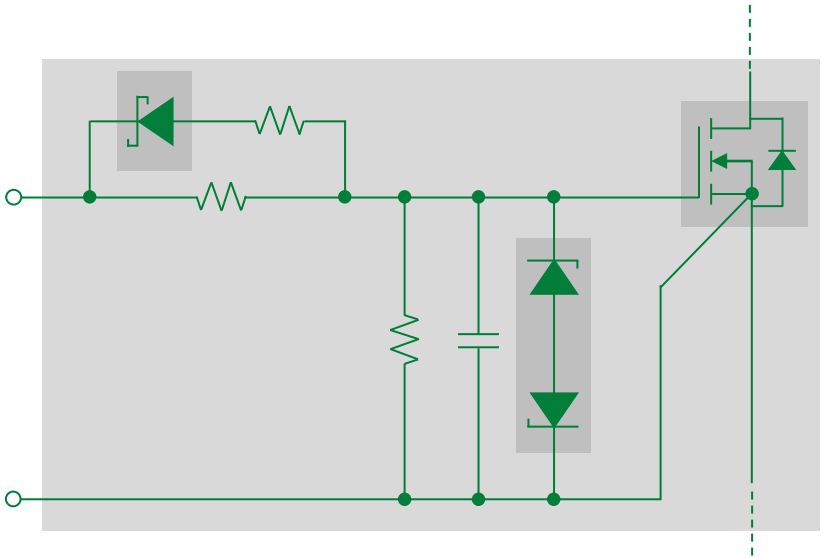
Commonly used SiC MOSFETs (V_{DS} and V_{GS} max ratings) in auxiliary power supply

Competition name	V_{DS}	V_{GS}
Littelfuse	1200 V	+22 V / -6 V
	1700 V	+22 V / -6 V
Competition A	650 V	+19 V / -8 V
	1200 V	+19 V / -8 V
	1700 V	+25 V / -10 V
Competition B	650 V	+23 V / -5 V
	1200 V	+23 V / -7 V
	1700 V	+20 V / -10 V
Competition C	650 V	+22 V / -8 V
	1200 V	+22 V / -10 V or +25 V / -15 V
	1700 V	+25 V / -15 V
Competition D	650 V	+23 V / -10V
	1200 V	+23 V / -10 V
	1700 V	+20 V / -10 V

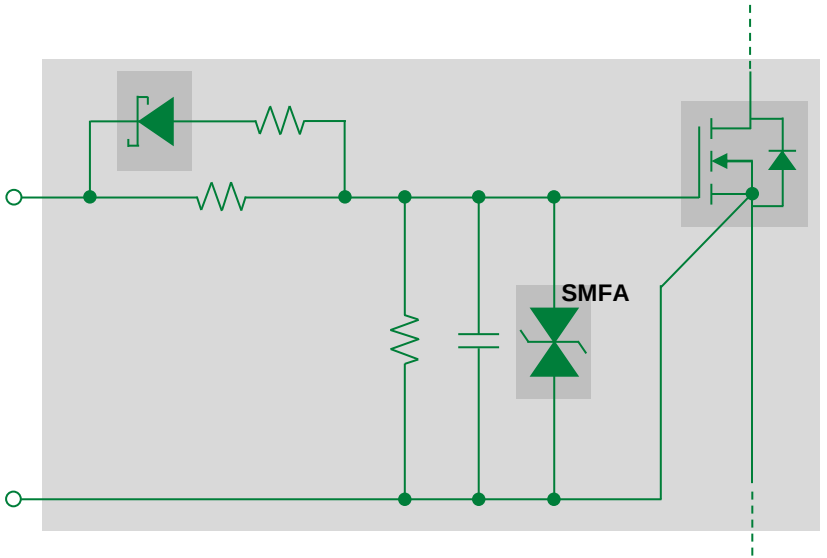
Two most popular SiC MOSFET driver range are +15V/-3V and +20V/-3V

Advantages of asymmetric TVS Diode for SiC MOSFET gate protection

Gate protection using 2 bi-directional Zener or TVS Diodes



Gate protection with single asymmetric TVS Diode



- Single component SiC MOSFET gate protection with asymmetrical gate voltage protection.
- Compact, 1 mm low profile, SOD123-FL package.

SMFA Series asymmetrical TVS Diode for SiC MOSFET gate protection

Problem/Solution

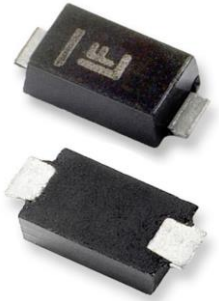
The SMFA Series are Asymmetrical TVS diodes designed specifically to protect SiC MOSFETs gates from overvoltage events. The faster switching speeds of SiC MOSFETs (as compared to Silicon MOSFETs and IGBTs) combined with layout and parasitic elements causes ringing and overshoot phenomena on the gate drive circuit that can be mitigated by the SMFA Series.

As SiC MOSFETs have a different negative gate voltage rating from the positive one, the asymmetrical SMFA Series is ideal in offering a single component solution.

Technical resources *(Click on below icons to learn more)*

Series Page | Datasheet | Tech Info | Product Brief | Application Note





Benefits

- Reduced part-count
- Reduced PCB-space
- Lower complexity, paired with higher reliability
- Precisely defined voltage levels

Features

- Single component SiC MOSFET gate protection with asymmetrical gate voltage protection
- Low clamping voltage for negative gate drive, VC < 8 V @ 2 A (10/1000 µs)
- Variety of positive standoff voltages, VBR 15~20 V compatible with popular SiC MOSFETS
- Stable capacitance over wide range of operating frequency (2 MHz) compatible with SiC MOSFET applications
- Compact, 1mm low profile, SOD123-FL package

Markets/Applications

- AI/data center server power supplies
- High-efficiency power for EVI
- High-reliability semiconductor/industrial power supplies

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SMFA Series compared to LF existing series

Parameters	New SMFA	SMF	SMF4L
Asymmetical V_R	Yes	No	No
V_{R1} (Positive Polarity)	15 ~ 20 V	5.0 ~ 85 V	9.0 ~ 51 V
V_{C3} @ 2 A (8/20 µs)	18.57 ~ 26.40 V	-	-
V_{C1} @ I_{pp1} (8/20 µs for SMFA, 10/1000 µs for SMF/SMF4L)	24.05 ~ 31.85 V	9.2 ~ 137 V	15.4 ~ 82.4 V
V_{R2} (Negative Polarity)	5.5 V	-	-
V_{C4} @ 2 A (8/20 µs)	7.85 V	-	-
V_{C2} @ I_{pp2} (8/20 µs)	10.5 V	-	-
Capacitance @ 1 MHz 0 V	440 ~ 565 pF	1100 ~ 800 pF	800 ~ 120 pF
Change in Capacitance 0~2 MHz	< 10 pF	-	-

Note:
V_{C1} and V_{C2}: Maximum Clamping Voltage.
V_{C3} and V_{C4}: Typical Clamping Voltage.

Comparison of SMFA series with competition

Parameters	New SMFA		
Asymmetical V_R	Yes		
V_{R1} (Positive Polarity)	15 ~ 20 V		
V_{C3} @ 2 A (8/20 µs)	18.57 ~ 26.40 V		
V_{C1} @ I_{pp1} (8/20 µs for SMFA, 10/1000 µs for SMF/SMF4L)	24.05 ~ 31.85 V		
V_{R2} (Negative Polarity)	5.5 V		
V_{C4} @ 2 A (8/20 µs)	7.85 V		
V_{C2} @ I_{pp2} (8/20 µs)	10.5 V		
Capacitance @ 1 MHz 0V	440 pF		
Change in Capacitance 0~2 MHz	< 10 pF		

Single source, no direct drop in replacement

Gate Driver to control SiC MOSFET

Gate Driver requirements for SiC MOSFET

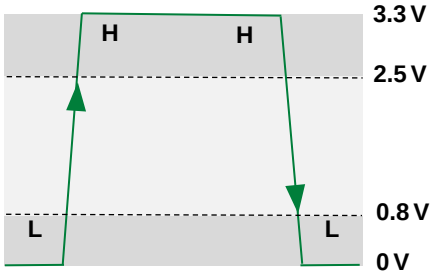
General Gate Driver features

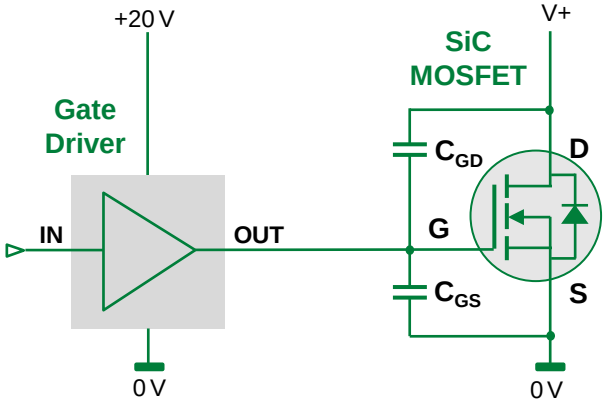
- It is an interface IC with a power amplifier
- It accepts logic level input from a controller IC
- It produces the required high-voltage and high-current output to drive the gate of the SiC MOSFET

SiC Gate Driver requirements

- +15 V to +20 V turn-on gate voltage
- −3 V to −5 V turn-off gate voltage
  - Ensure noise robustness
  - Improve turn on/off switching speed
- Ensure safe operation

Controller Output Logic Level Signal (V_{DD} = 3.3 V)





IX4352NE low-side SiC MOSFET and IGBT Driver

Problem/Solution

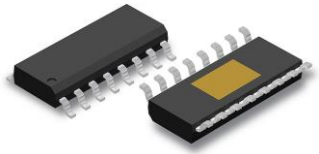
The IX4352NE is specifically designed to drive SiC MOSFETs and high-power IGBTs. Separate 9 A source and sink outputs allow for tailored turn-on and turn-off timing while minimizing switching losses. An internal negative charge regulator provides a selectable negative gate drive bias for improved dV/dt immunity and faster turn-off. Various built-in features, such as DESAT detection, UVLO, thermal shutdown, and Fault output, protect the driver and the power device.

Technical resources *(Click on below icons to learn more)*

Series Page | Datasheet | Tech Info


Benefits

- Negative voltage gate drive for improved dV/dt immunity, eliminates the need for separate negative supply
- Can drive a broad range of SiC-MOSFETs or IGBTs
- Protects driver and power device
- No input logic level shifter required



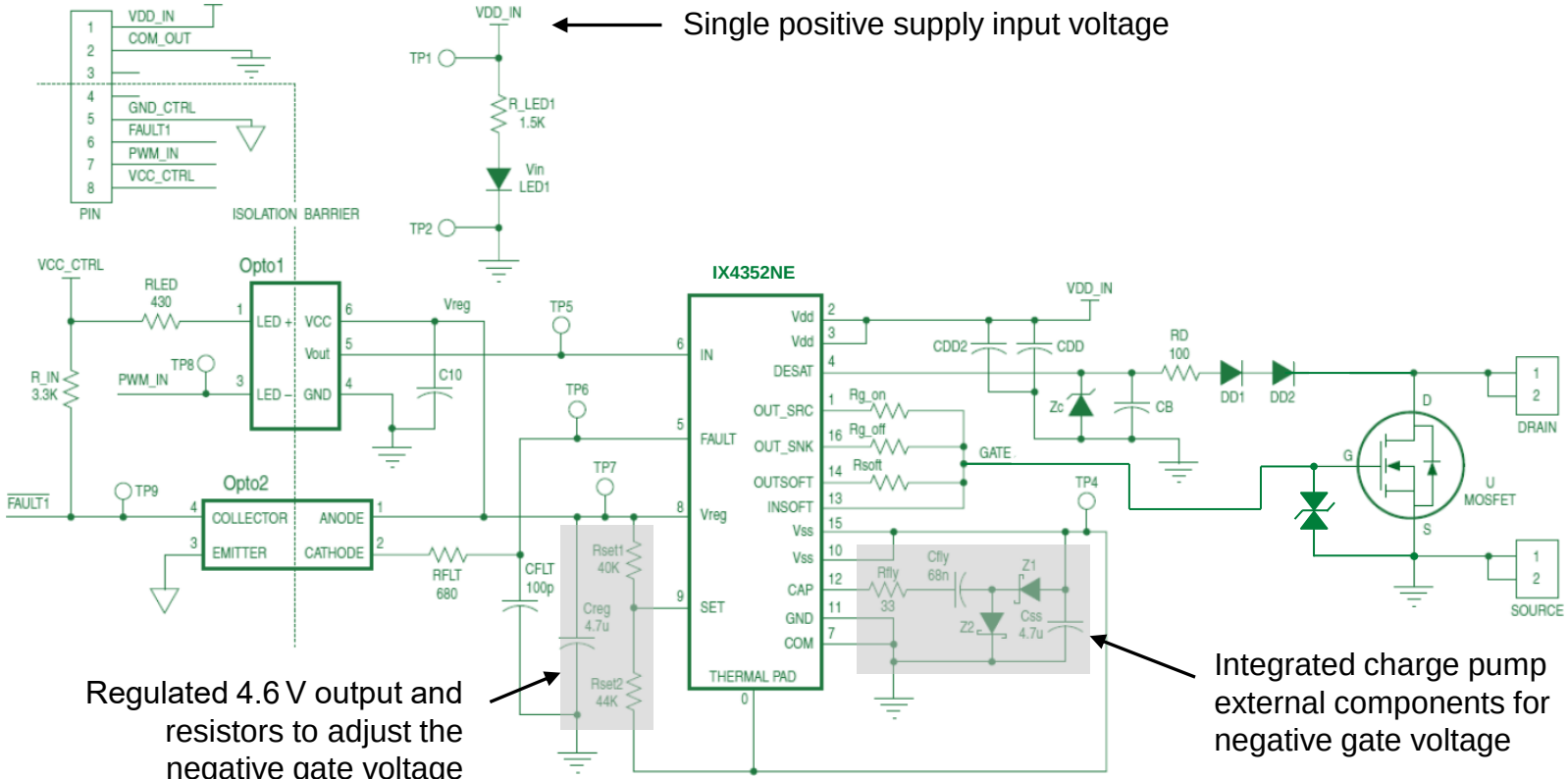
Features

- Internal charge pump regulator for selectable negative gate drive bias down to −10 V
- +13 V to +25 V supply voltage range
- DESAT detection, UVLO, thermal shutdown, fault output
- TTL/CMOS compatible logic input with integrated level shifter

Markets/Applications

- EV infrastructure/DC charging stations
- Datacenter/power supplies and UPS
- Light industrial/PFC, AC−DC and DC−DC converters
- Alternate energy/solar converters

Advantages of IX4352NE for SiC MOSFET



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IX4352NE compared to existing series

Parameter	New IX4352NE	IX4351NE	IXDN609SI
Gate drive voltage range	−10 V to +25 V	−10 V to +25 V	0 V to +35 V
Output peak drive current	±9 A	±9 A	±9 A
Integrated charge pump for negative bias voltage	Yes	Yes	No
DESAT with soft shutdown*	Yes	Yes	No
UVLO and TSD	Yes	Yes	No
Regulator output to supply discrete optocoupler	Yes	Yes	No
FAULT output	Yes	Yes	No
Safe DESAT initiated soft turn-off transition	Yes	No	-
High Thermal Shutdown Temperature (TSD) threshold accuracy	Yes	No	-
Charge pump operates during thermal shutdown	Yes	No	-

* *DESAT function needs to be matched with the power semiconductor device selected.*

Comparison of IX4352NE series with competition

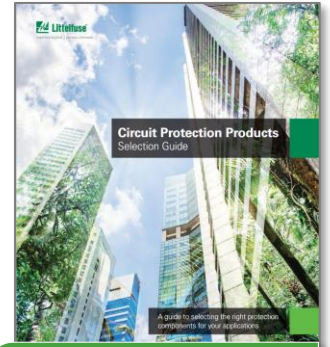
Parameter	New IX4352NE	-	-
Supply voltage range	−10 V to +25 V		
Output peak drive current	±9 A		
Integrated charge pump for negative bias voltage	Yes		
DESAT with soft shutdown*	Yes		
UVLO and TSD	Yes		
Regulator output to supply discrete optocoupler	Yes		
FAULT output	Yes		
Safe DESAT initiated soft turn-off transition	Yes		
High Thermal Shutdown Temperature (TSD) threshold accuracy	Yes		
Charge pump operates during thermal shutdown	Yes		

Single source, no direct drop in replacement

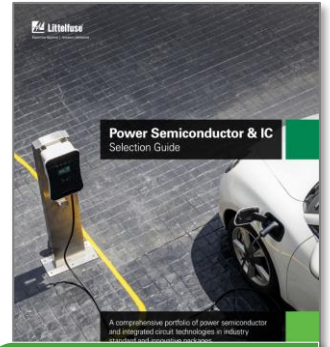
* *DESAT function needs to be matched with the power semiconductor device selected.*

Additional information can be found on Littelfuse.com

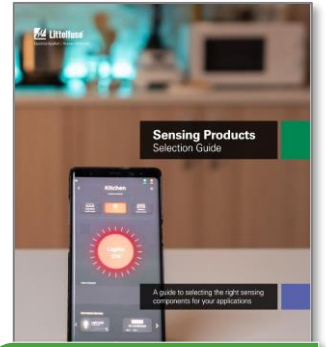
Explore the world of Littelfuse with the electronics eCatalogs (ecatalogs.littelfuse.com)



Circuit Protection Selection Guide



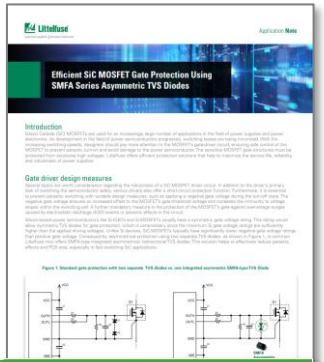
Power Semiconductor Product Catalog



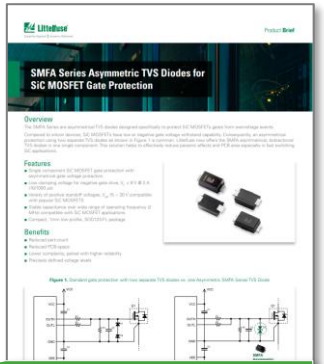
Sensing Products Selection Guide

Integrated Circuit Selection Guide

Click the images for more information



SiC MOSFET Gate Protection Application Note



SMFA Series Product Brief

Scan the code to learn more!

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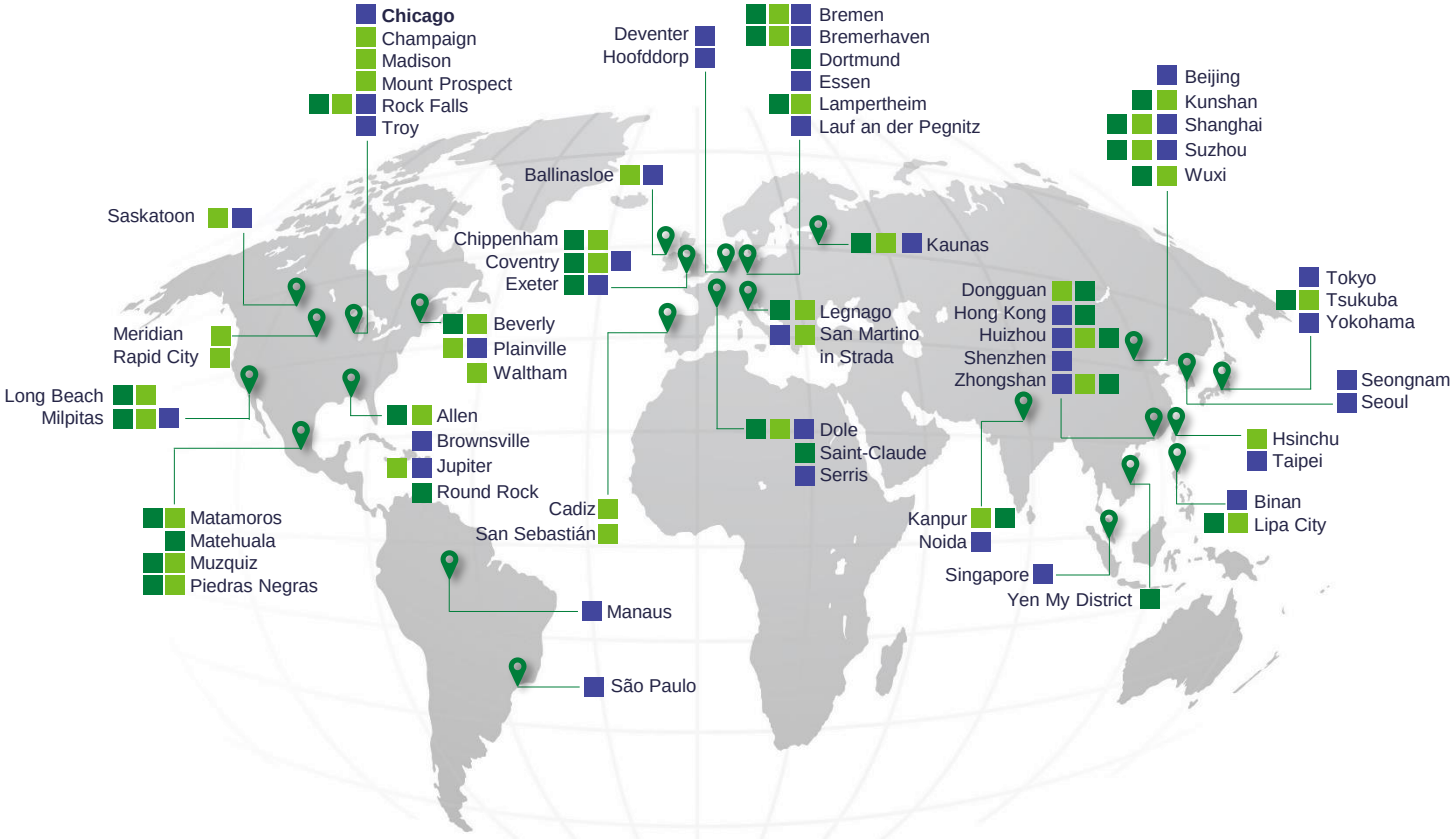
Local resources supporting our global customers



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