



onsemi SmartFET's Solutions SmartFET车身(区)域控制器的配电方案

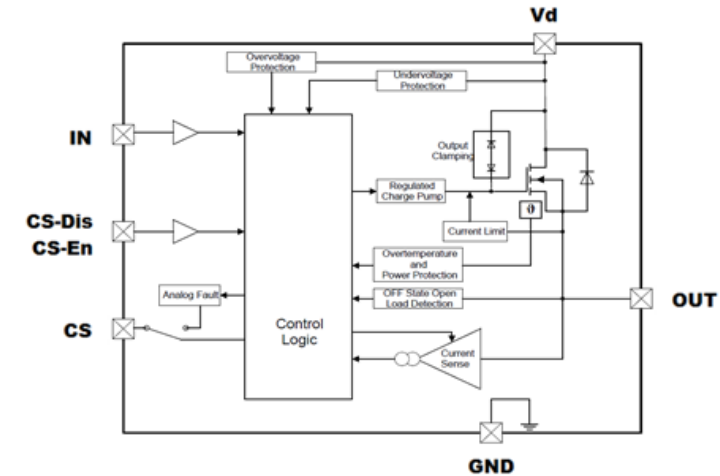
Contents

- Application Overview
- Latest Developments

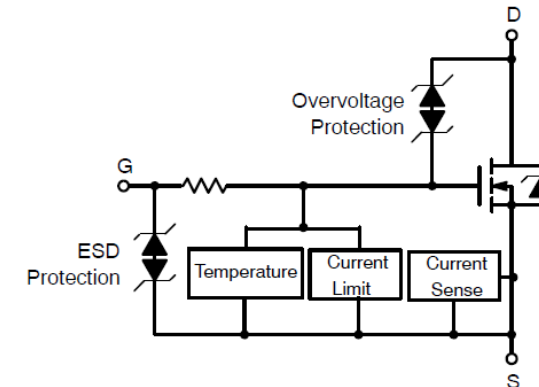
Application Overview

- A SmartFET consists of Two Main Components

- Power Stage- FET which delivers current to the load
- Control Stage- Control and monitoring circuitry which turns the FET on and off, and prevents damage to the FET

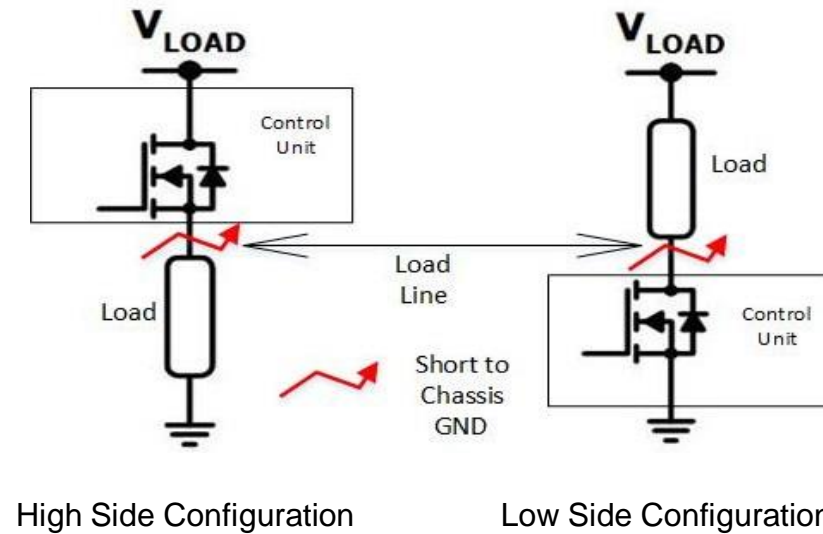


High Side SmartFET



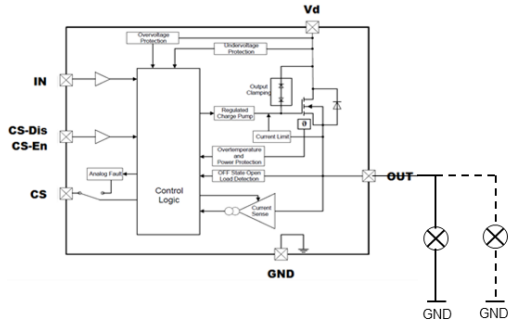
Low Side SmartFET

Application Overview



- SmartFETs Have Two Configurations
- High Side SmartFETs are Between Battery and the Load
- Low Side SmartFETs are Between the Load and GND

Application Overview

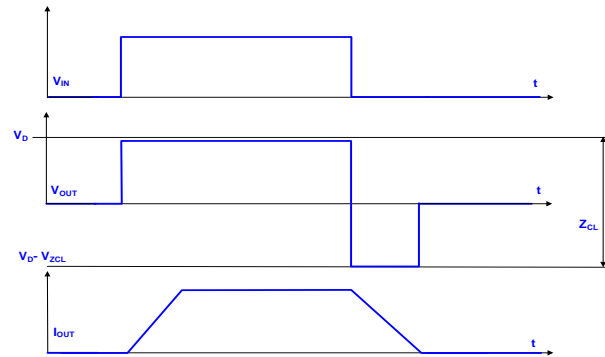
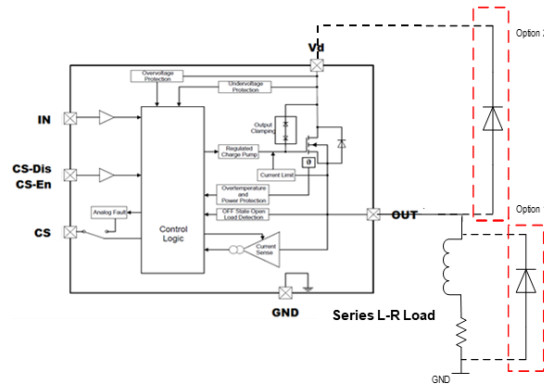


S.No	Application	Rated Wattage
1	Front Light (High Beam and Low Beam)	51W; 55W; 60W; 65W; 60/55W*
2	Parking Light	Front: 4W; 5W; 6W Rear: 10W; 21/5W*; 21/4W*
3	Turn Signal Lights	Door Integrated: 4W; 5W Front and Rear: 21W
4	Reverse Lights	16W; 21W
5	Warning Lights	21W
6	Brake Lights	CHM: 5W; 16W Rear: 21W; 21/4W*; 21/5W*
7	Trunk Light	5W
8	Fog Lights	Front: 55W; 35W Rear: 21W
9	Interior Lights	3W; 5W; 10W; 15W; 18W
10	License Plate Lights	4W; 5W
11	Daytime Running Light	35W; 55W

* Two Filament Bulbs

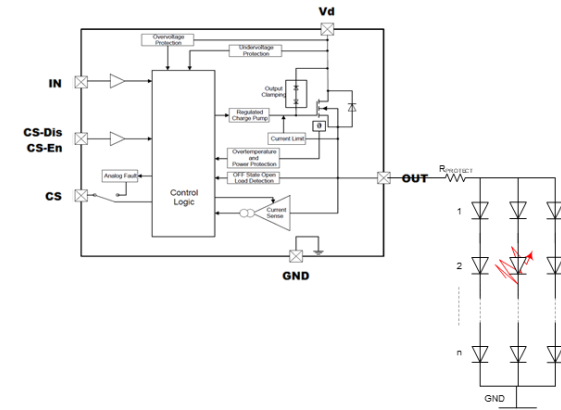
Bulb and Capacitive Loads

- Interior and Exterior lighting applications
- Capacitive loads include powering modules
- Requires ability to handle in-rush currents



Inductive Loads

- Example: Motors and relays for wipers, starters, door modules, HVAC, fuel injectors, electric power steering, throttle control etc.
- Effective Resistance and line resistance affect energy capability



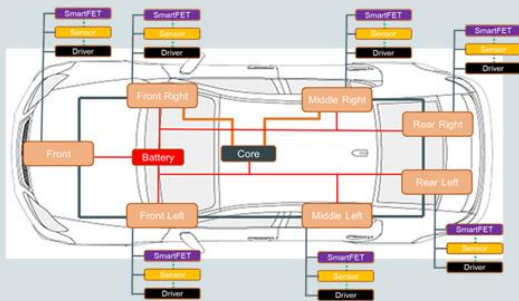
Location	Application	Drive Current (Low/Med/High)
Exterior	Center High Mount Stop Lamp	Low (<100mA)
	Side View Mirror	Low (<100mA)
	Side Markers	Low (<100mA)
	License Plate Lamp	Low (<100mA)
	Rear Combination Lamps	Med (200~500mA)
	Turn Signal	Med (200~500mA)
	DRL	Med (200~500mA)
	Head Lights	High (>500mA)
Interior	Fog Lights	High (>500mA)
	Colored RGB Lighting (Including ambient lighting, instrument cluster lighting, LCD Backlighting, Switches, Front Panel (Clock etc.))	Low (<100mA)
	Map/Dome Lights	Med (200~500mA)

Resistive Loads

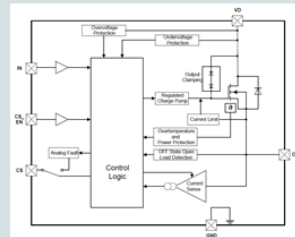
- LED's, Heating Elements, Transmission and Engine Mgmt Systems
- Example shows LED application and possible LED loads in vehicle
- This example shows one LED in a string failing
- The change in load current will be reflected in the change in sense current

Latest Developments

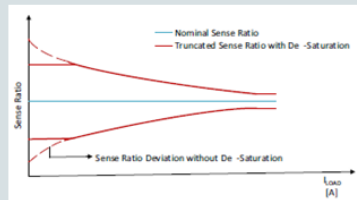
Market Trends



High Side SmartFET's

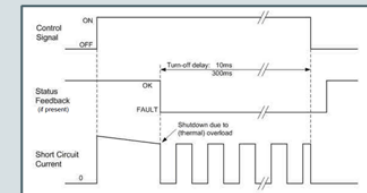


Expansion of Single Channel Family With Current Sense

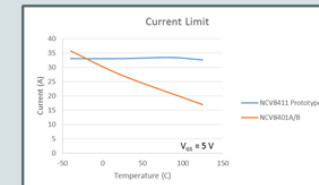


High Accuracy Current Sense

Low Side SmartFET's



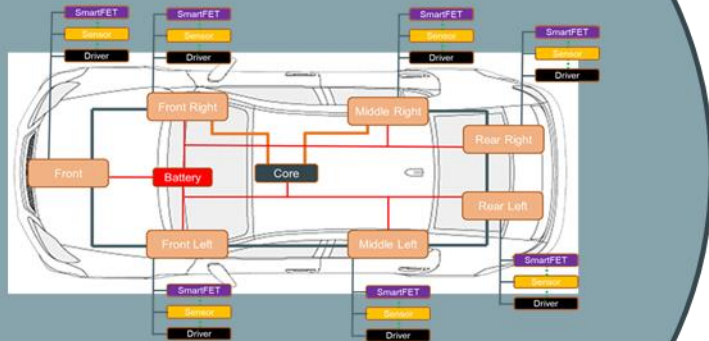
Best in Class RSC Performance



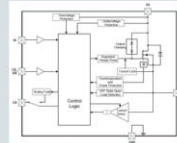
Elimination of Current Limit TC

Latest Developments

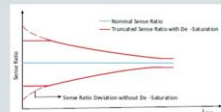
Market Trends



High Side SmartFET's

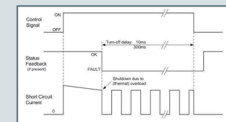


Expansion of Single Channel Family With Current Sense

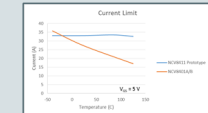


High Accuracy Current Sense

Low Side SmartFET's

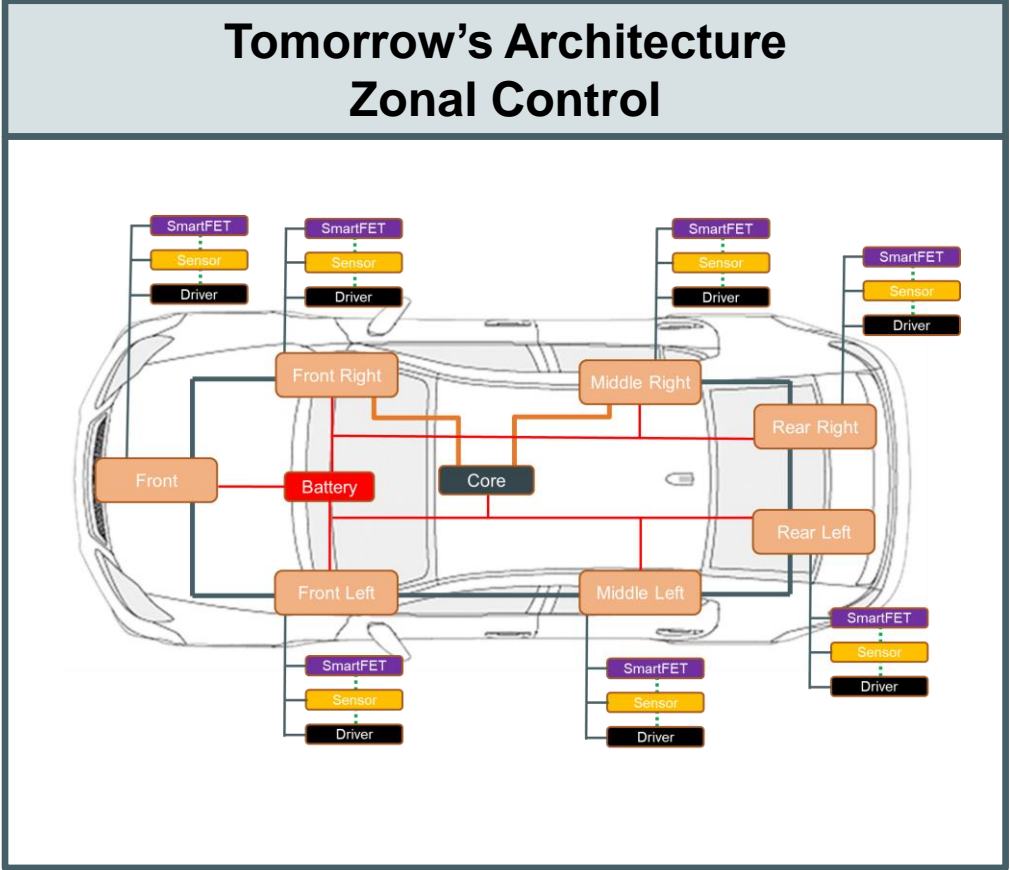
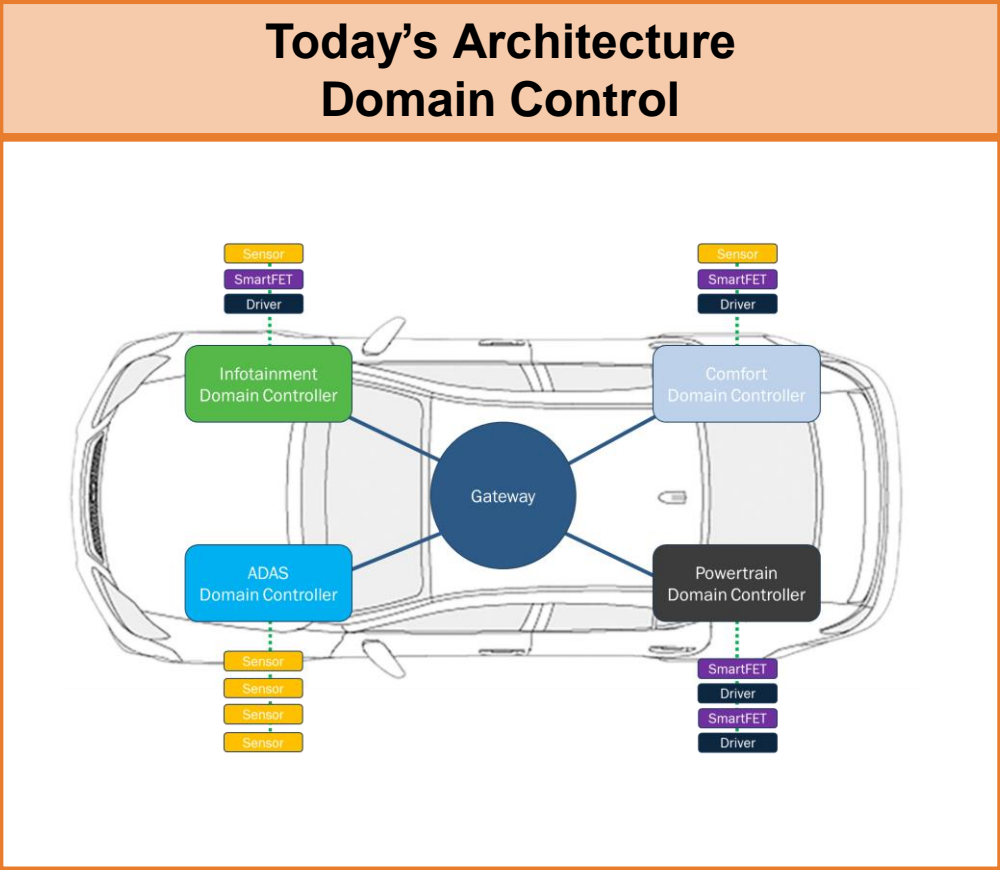
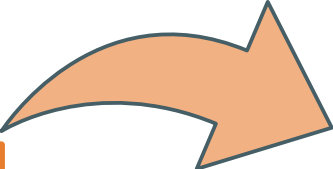


Best in Class RSC Performance



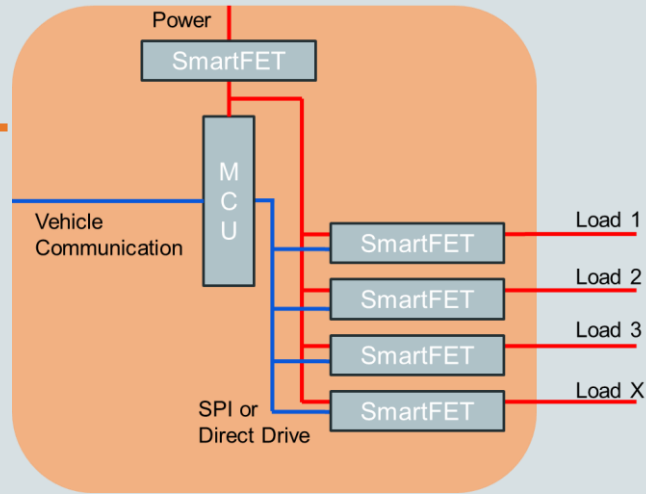
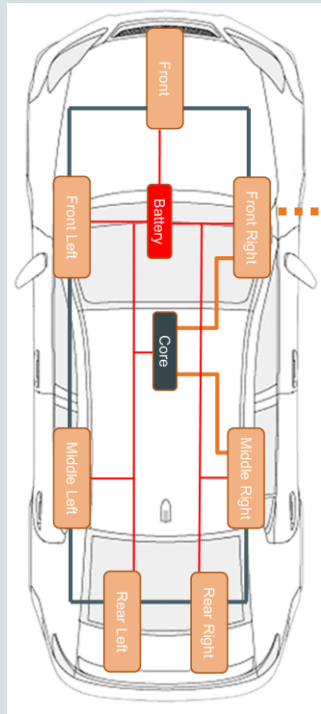
Elimination of Current Limit TC

Shift to Zonal Networks: Supports Transition to EV, while Maintaining ICE Compatibility



Cost Effective- Wires Currently 3rd Heaviest and 3rd Most Expensive Component
Simpler Architecture- Faster and More Complex Communication
Scalability- Zones Can Expand Based on Need

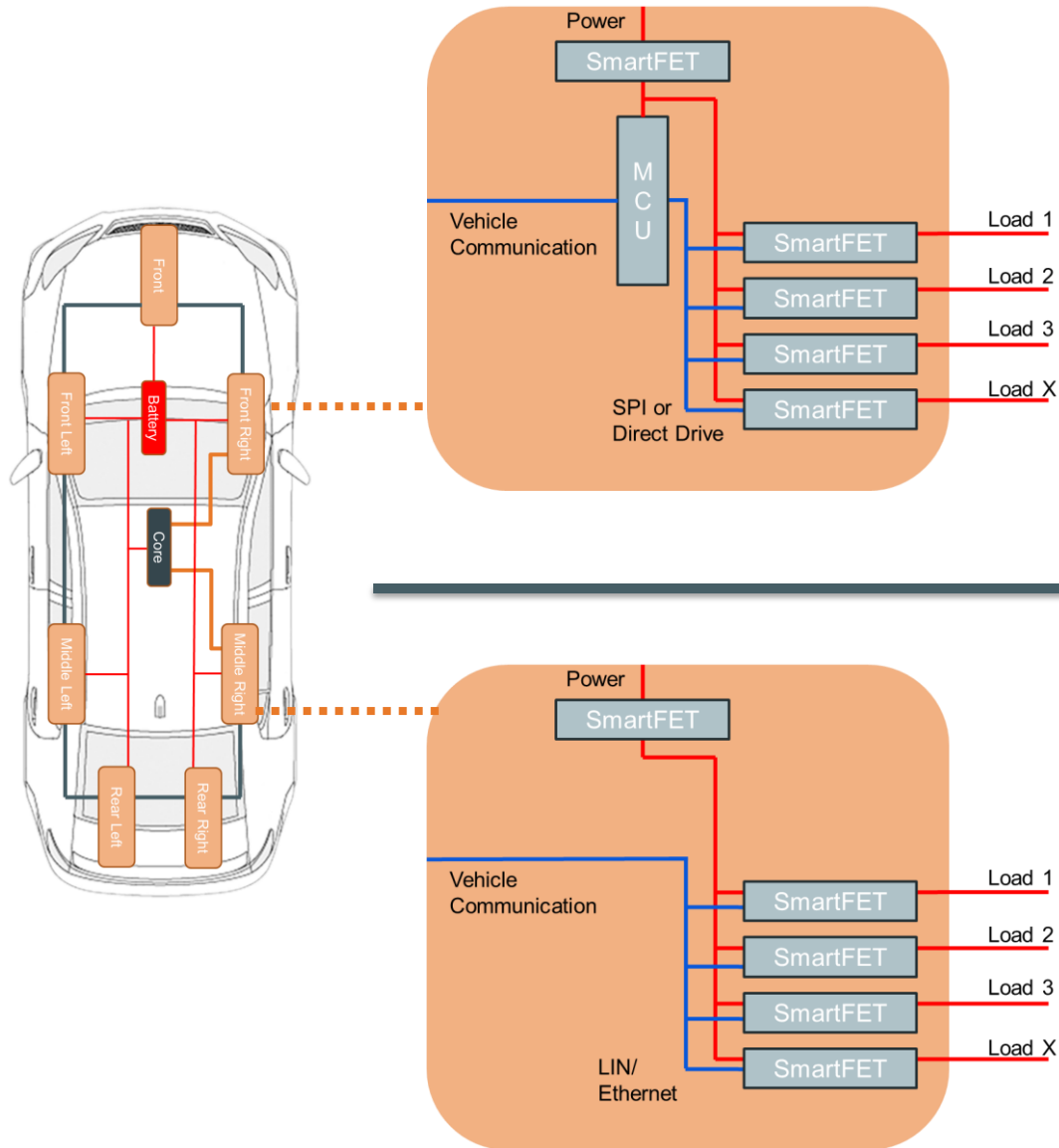
SmartFETs Supporting Zonal Applications



Zoom In to Zonal Controller

- SmartFETs Performing Multiple Functions
 - Used as Smart Fuse, Protected Power in Zone Controllers
 - Provides Protected Power for all Loads Driven by the Zone Controller
 - Target Single Family from 1 mΩ to 60 mΩ
 - Common Footprint
 - Common Command Structure
 - Reliable Performance

SmartFETs Supporting Zonal Applications



Direct Drive

- Controlled by Micro
- Basic turn on/off control of outputs and protections
- Hard Wired Protection

SPI Control

- Controlled by Micro
- Serial Communication Protocol
- On the Fly Protection Adjustments

LIN Control

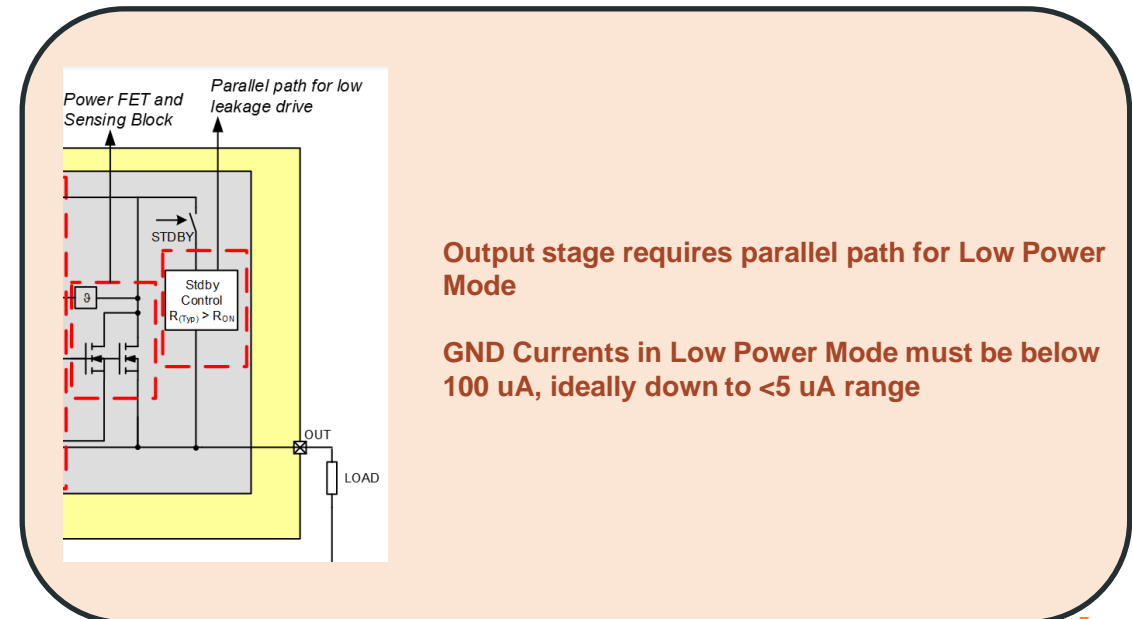
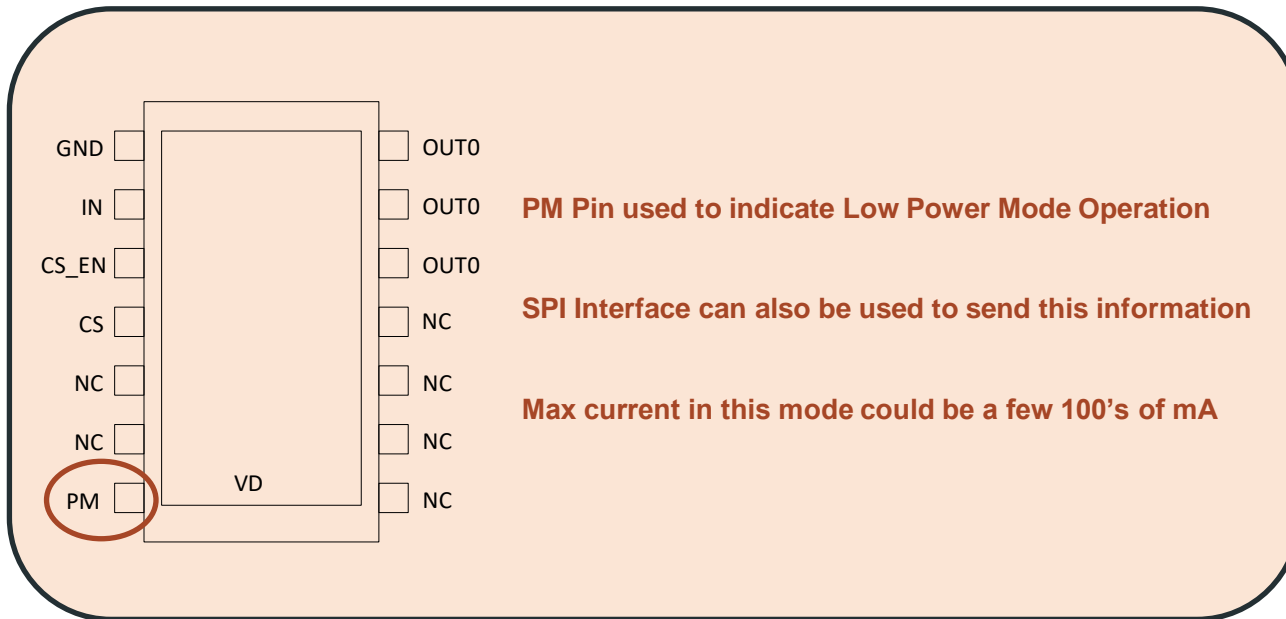
- No Micro Required
- Serial Communication Protocol
- On the Fly Protection Adjustments
- Ideal for module w/o Micro

Ethernet Control

- No Micro Required
- High Speed Communication
- Serial Communication Protocol
- On the Fly Protection Adjustments

Low Power Mode/ Sentry Mode

- Allows Off Mode Operation of Keep Alive Circuitry
- Support Overnight Software Updating or Powering of Monitoring Circuitry
- Low Current Operation (~300 mA)
- Low Leakage Operation (less than 50 uA)



What is an eFuse?

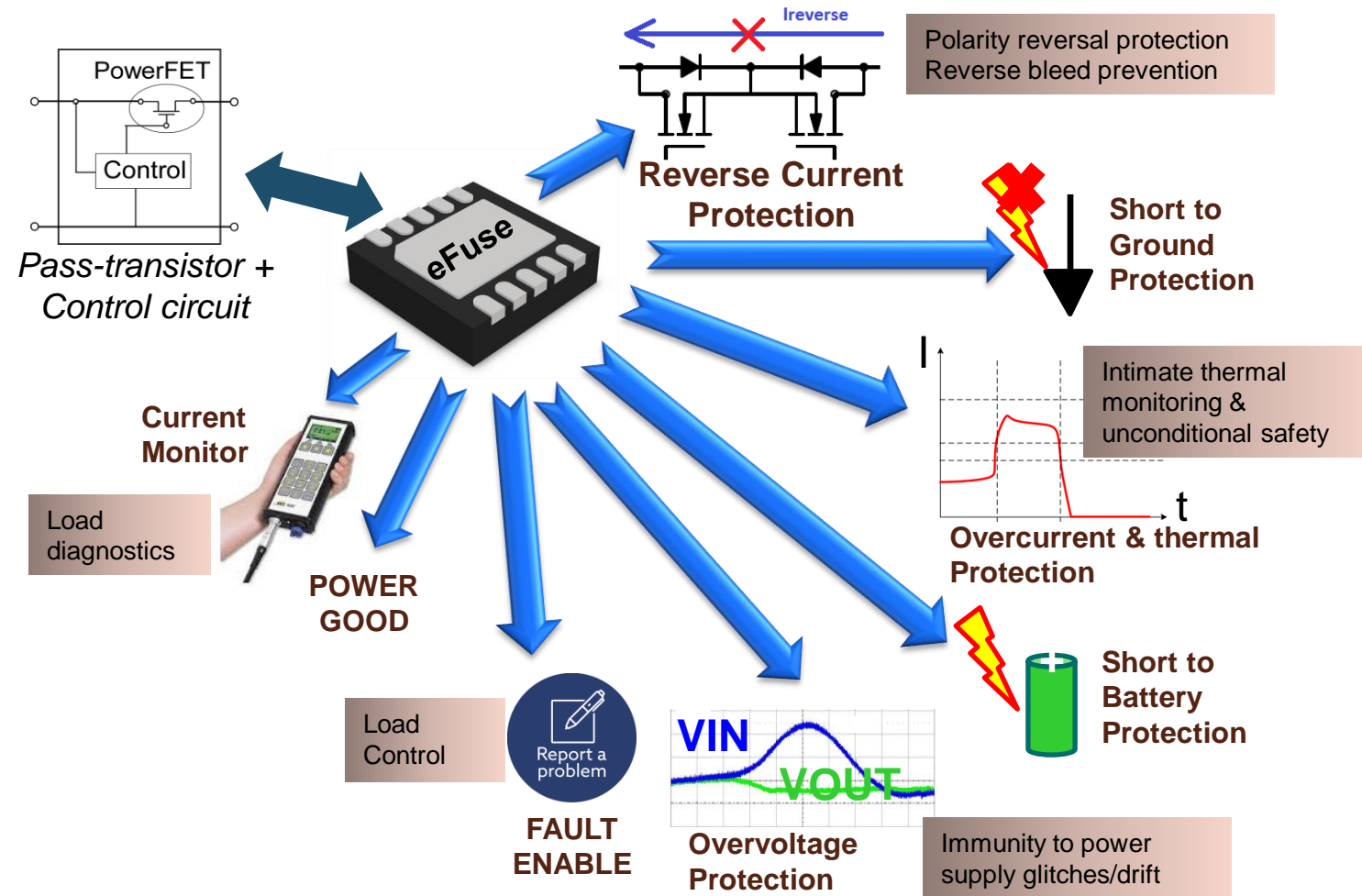
An eFuse is a lot more than a fuse!

Integrated Overcurrent, thermal & Overvoltage protection solution

Protects by preventing damage to connectors, PCB traces and downstream components



Used in hot-plug situations and applications where power glitches or load faults are common, & in any system requiring inrush/outrush current limiting



eFuse Portfolio

ONPN	Operating Voltage	Max Voltage (Tolerance)	Max Current (DC)	RCP	TSD	EN	UVLO	OVP	Fault Flag	dV/dt adjust	ILIM adj.	IMON	PG	Pkg
NIS6350	4-6V	10V	3A	O	O	O	O	O	O	X	O	O	X	WDFN 3x3mm
NIS6150	4-6V	10V	1A	O	O	O	O	O	O	X	O	O	X	WDFN 3x3mm
NIS64x2	3-5V	14V	5A	O	O	O	O	O	O	O	O	O	X	WQFN 2x3mm
NIS5420	7-15V	18V	4.6A	X	O	O	O	O	O	O	O	O	X	WDFN 3x3mm
NIS5112	3-12V	15V	5.3A	X	O	O	O	O	O	O	O	O	X	SOIC 5x4mm
NIS6420	3-15V	16V	5A	O	O	O	O	O	O	O	O	O	X	WQFN 2x3mm
NIS4461	9-30V	30V	5A	X	O	O	O	O	O	O	O	O	X	WDFN 3x3mm
NIS3071	8-58V	60V	10A	X	O	O	O	X	O	O	O	O	X	WQFN 6x5mm

For more information:

onsemi.com/products/power-management/protection/current-protection

RCP: Reverse Current Protection
 TSD: Thermal Shutdown
 EN: Enable
 UVLO: Undervoltage Lockout
 OVP: Output Voltage Protection

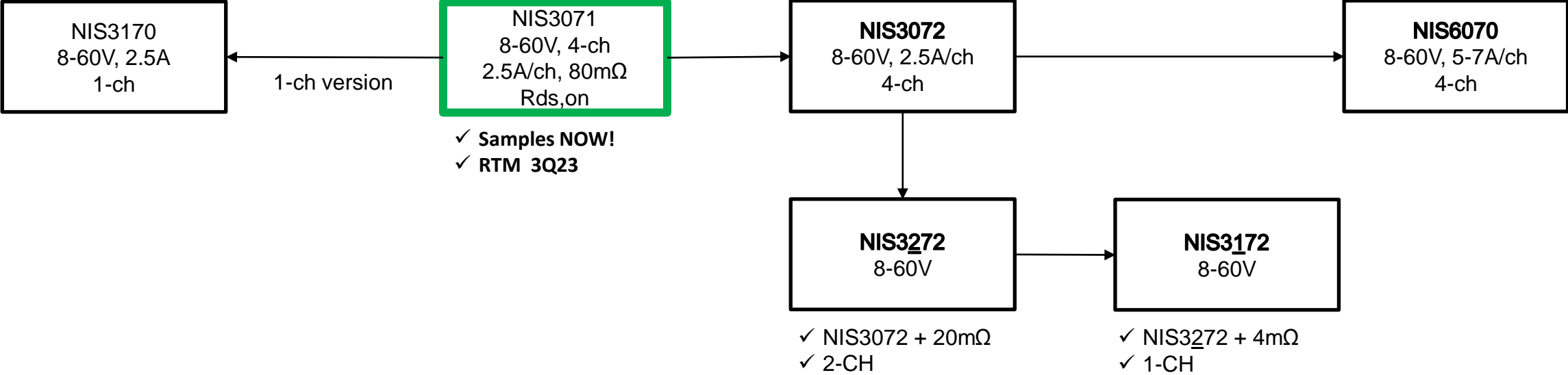
dvdt: Adjustable Slew Rate Control
 ILIM: Adjustable Current Limitation
 IMON: Current Monitoring Output
 PG: Power Good Indicator Output

8V to 60V eFuse Family: NIS3071 & Derivatives

- ✓ Adj I_{LIM}
- ✓ Adj dv/dt
- ✓ Independent EN/DIS
- ✓ 1 common current limit
- ✓ 1 common Fault reporting
- ✓ 1.5ms turn-on

- ✓ 50mΩ
- ✓ I_{mon}
- ✓ Open load detect
- ✓ SPI
- ✓ PG? or PG/FLT?

Higher current
SPI/telemetry



Die size optimized

Performance optimized

NIS3071 60V_{AbsMax}, 10-A, 4-Channel Integrated eFuse

Value Proposition

- NIV3071 is a 60V, eFuse integrating 4 independent channels in one package. The eFuse support up to 10-A continuous output current. Each integrated eFuse has a fixed soft start time. Configurable current limit common for all channels. The device also has control and status monitoring pins targeting wide range of industrial and automotive applications from 12V to 48V.

Features

- 8V to 60V DC operating input voltage range
- 4 Independent integrated eFuses in one package
- 2.5A Continuous current operation for each channel
- 80 mΩ R_{DSon} TYP @ 25 °C (at 1 A); each channel
- 7.0V (max) rising undervoltage Lockout
- 40 to 150°C T_J operating range

Other Features

- Configurable current limit (common for all channels)
- Output Voltage Clamp
- Digital output FLAG pin to indicate fault condition
- Configurable ITRIP time
- Built-in fixed soft-start of 1 ms
- ESD protection: 2 kV HBM

Engineering samples NOW!
RTM 3Q-2023

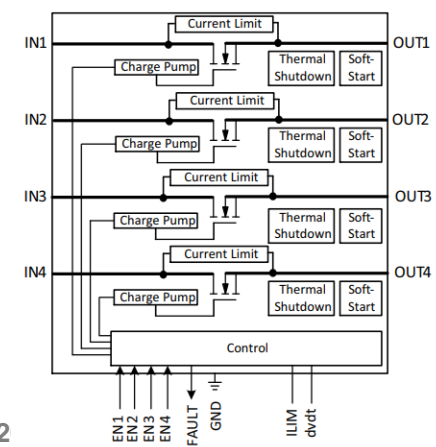
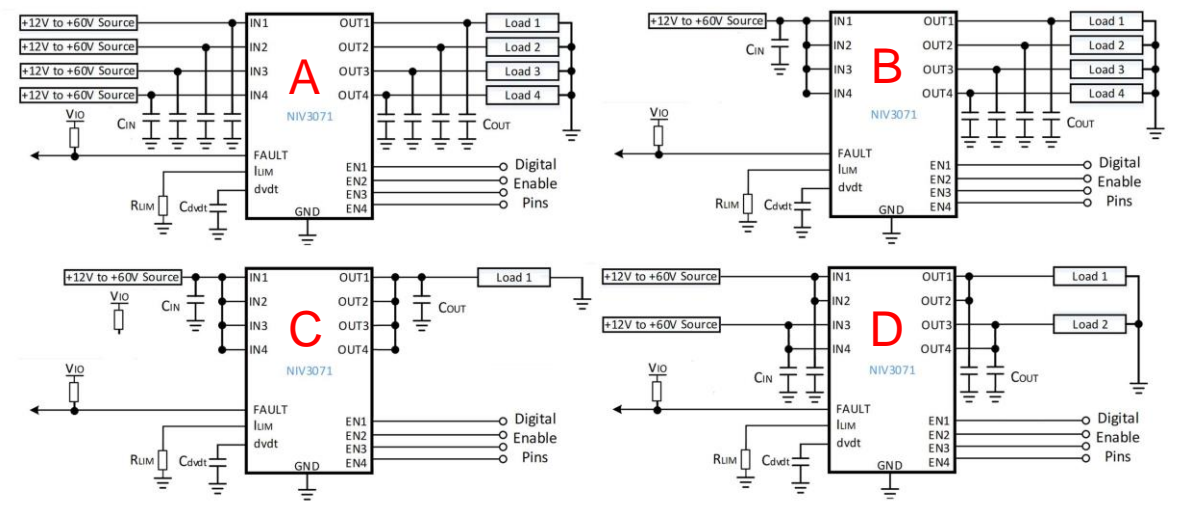
Market, Applications, & Package Information

- Auto**
- 8-60V operation in ICE, mHEV, BEV
 - Automotive HSD
 - Load/harness protection (Body Control Modules)
- Industrial**
- Computer Numerical Control (CNC machine)
 - Telecom
 - Industrial Transport
 - 48V servers

WQFN16, WQFNW16 5x6mm



Applications & Configurations, Block Diagram

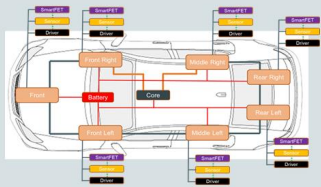


With NIS3071, it is possible to run any of the above combinations, combining inputs, outputs or running multiple rails through one device.

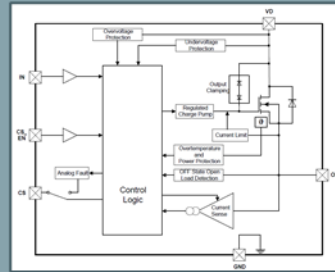


Latest Developments

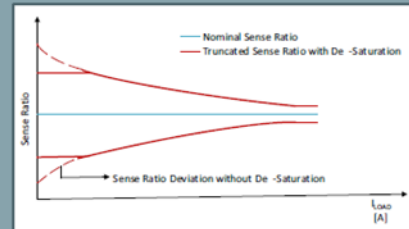
Market Trends



High Side SmartFET's

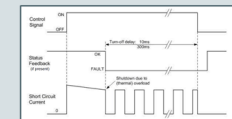


Expansion of Single Channel Family With Current Sense

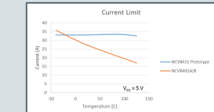


High Accuracy Current Sense

Low Side SmartFET's



Best in Class RSC Performance



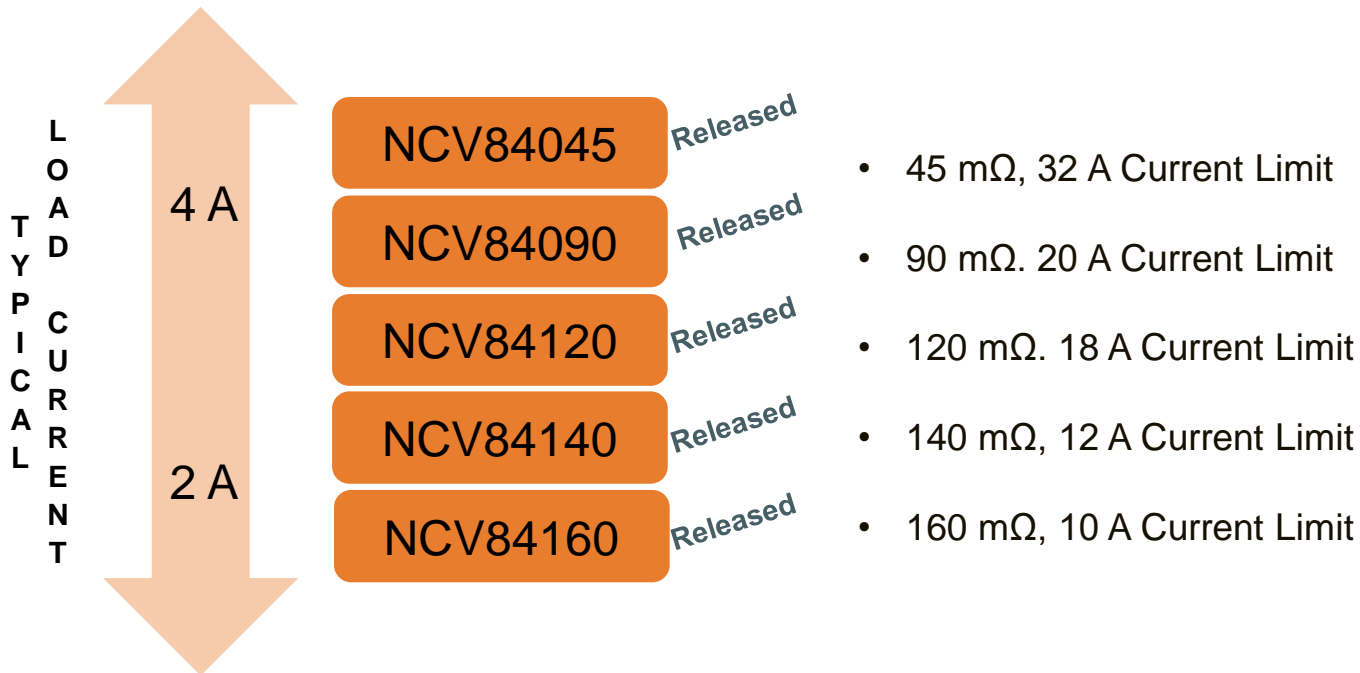
Elimination of Current Limit TC

NCV84xxx High Side SmartFET Family

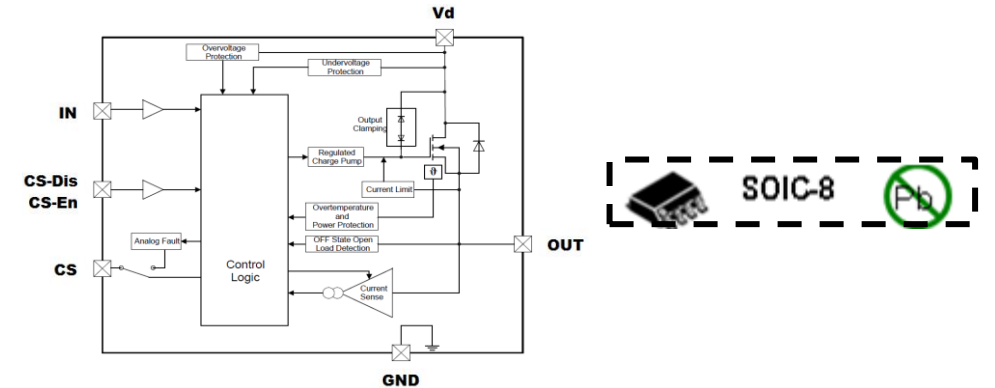
Value Proposition

Fully protected High Side Driver Family, targeted for bulbs, inductive, capacitive, and resistive loads in Automotive and Industrial applications.

Device Family



Block Diagram and Package



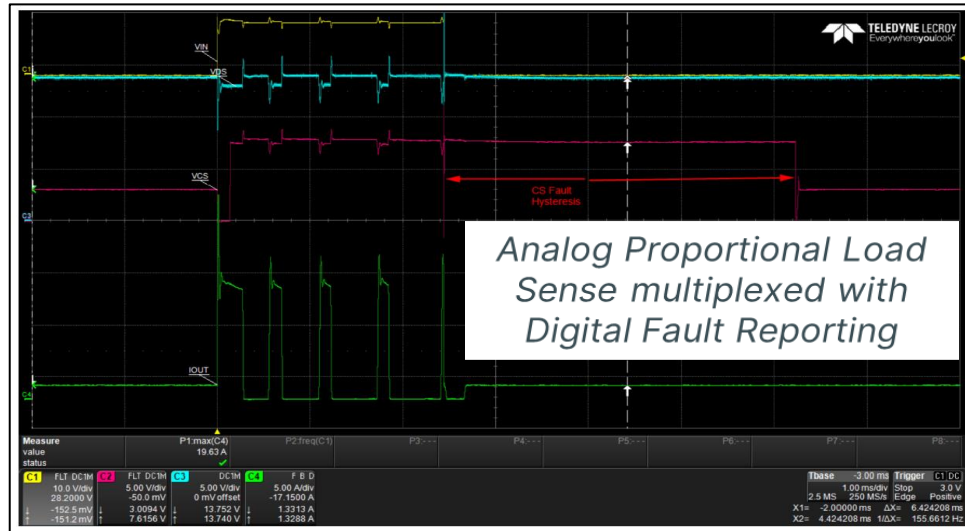
Feature Set

- Direct Drop-In for VN5/VN7 Series Devices
- Short Circuit Protection with Inrush Current Handling
- Thermal Shutdown with Auto Restart
- Integrated Clamps for Over-voltage protection and Inductive Load Switching
- CS Output multiplexing proportional load current and diagnostic feedback
- Low Quiescent current
- Loss of Ground and Loss of VCC Protection

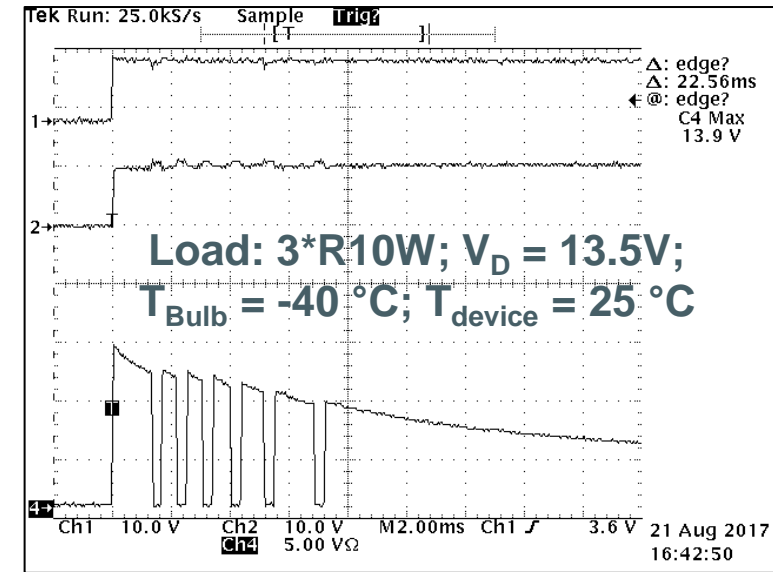
Note NCV84xxx-xxx represents typical RDSOn level in mΩ at 25 C

Accurate Current Monitoring and Protection

Accurate Current Monitoring and Diagnostic Feedback



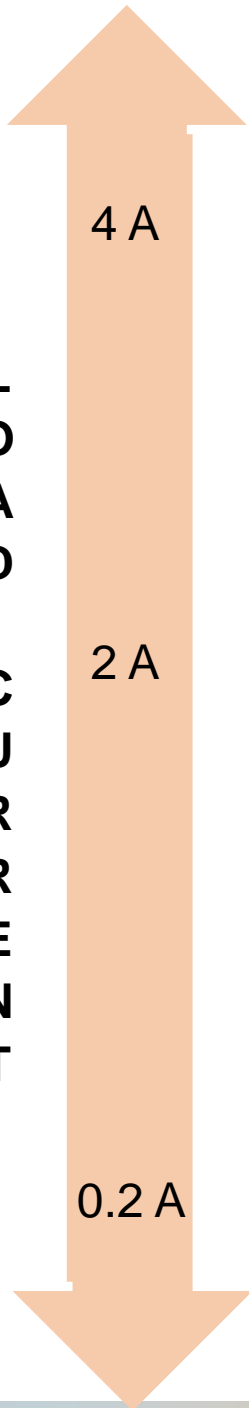
Active Inrush Handling



- Improved Performance over Temperature vs Competition
- Accurate Load Monitoring Feedback
- Performance enhancement with recommended in-circuit calibration
- Optimal CS response to transient fault reporting

- Fast response regulation on low~med current devices
- Fold-back limits power dissipation in a sustained short
- Optimized for inrush handling
- Accurately powers the desired load

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No Diagnostics

Digital Diagnostics

Current Sense Drop Ins

NCV8452

NCV8445

NCV84045

NCV8460A

NCV84090

NCV84120

NCV84140

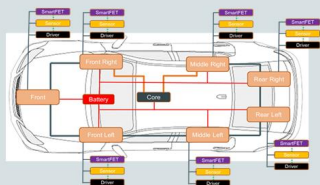
NCV8461

NCV84160

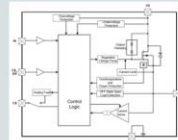
NCV8450A

Latest Developments

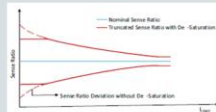
Market Trends



High Side SmartFET's

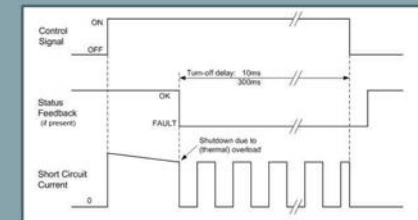


Expansion of Single Channel Family With Current Sense

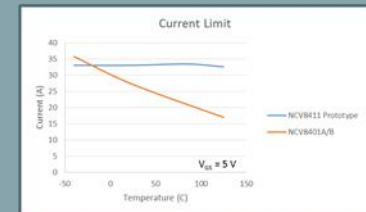


High Accuracy Current Sense

Low Side SmartFET's



Best in Class RSC Performance



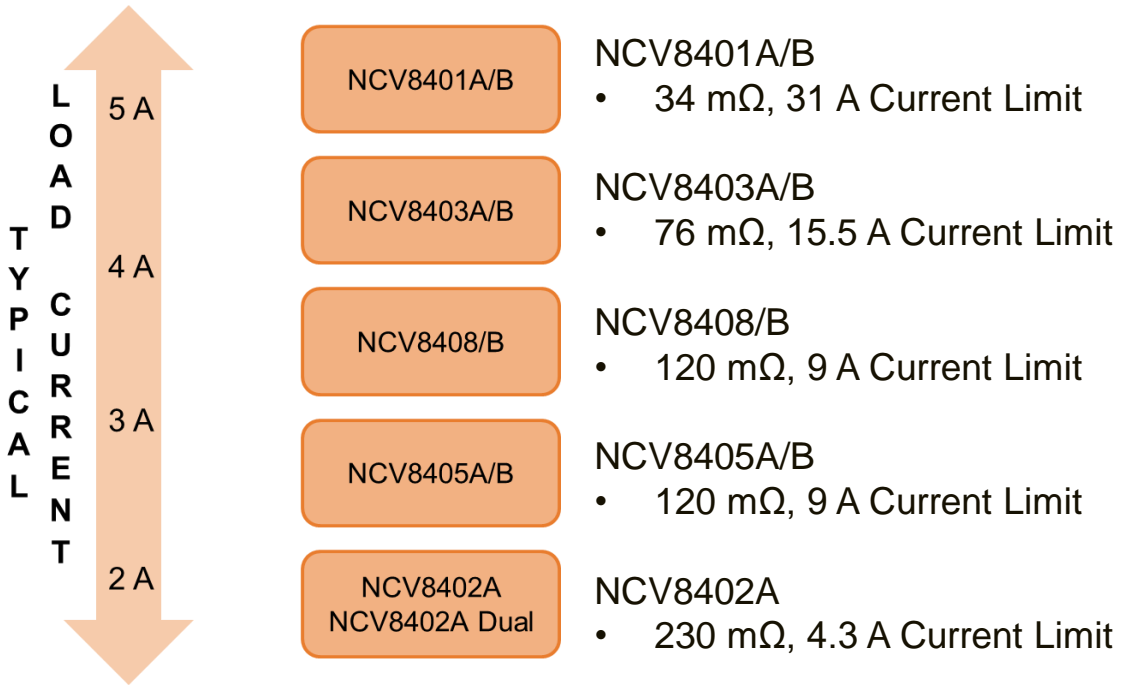
Elimination of Current Limit TC

NCV840x Low Side SmartFET Family

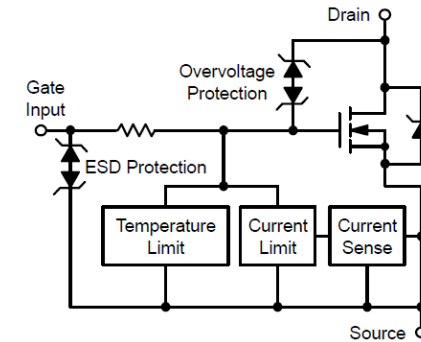
Value Proposition

Fully protected Low Side Driver Family targeted for bulbs, inductive, capacitive, and resistive loads in Automotive and Industrial applications.

Device Family



Block Diagram



Feature Set

- Short Circuit Protection
- Current Limit
- Thermal Shutdown
- ESD Protection
- Overvoltage Clamping Protection
- Can be used to switch a variety of resistive, capacitive and inductive loads

- SOT223, DFN, or DPAK Packages available (device dependent)

NCV841x Low Side SmartFET Family

Value Proposition

Fully protected Low Side Driver Family targeted for bulbs, inductive, capacitive, and resistive loads in Automotive and Industrial applications.

Device Family

NCV8411

NCV8411- NCV8401B Redesign
 • 34 mΩ, 31 A Current Limit

NCV8413

NCV8413- NCV8403B Redesign
 • 76 mΩ, 15.5 A Current Limit

NCV8415

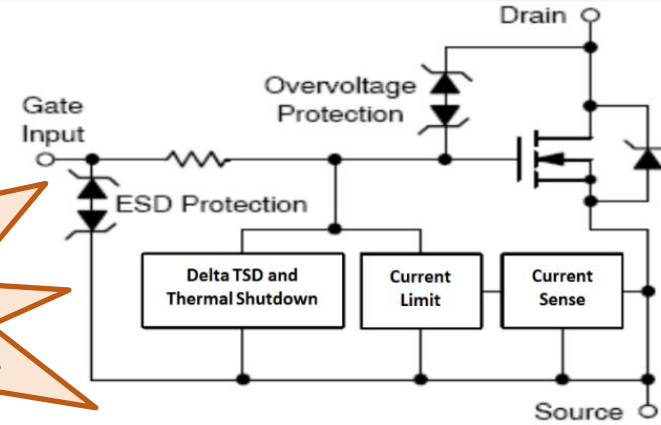
NCV8415- NCV8405B Redesign
 • 120 mΩ, 9 A Current Limit

NCV8412

NCV8412- NCV8402B Redesign
 • 230 mΩ, 4.3 A Current Limit

Harness cost and weight reduction!

Block Diagram



Pin for Pin compatible with NCV840x family

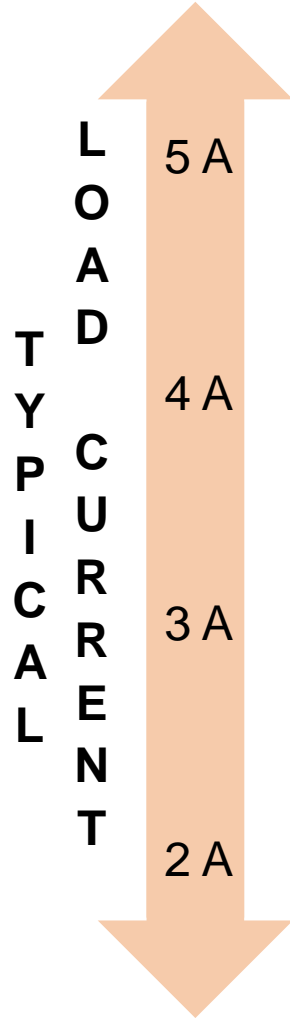
Feature Set

Feature	Benefit
Differential TSD	Improved RSC Performance
Grade A RSC Performance	Increased Module Reliability
Flattened ILIM Temp Coeff	Smaller Wire Size
Gate Current Fault Indication	Fault Monitoring

- SOT223, DFN, or DPAK Packages available (device dependent)

NCV840X
Standard RSC Performance

NCV841X
Best In Class RSC Performance



NCV8401A/B

NCV8411

NCV8403A/B

NCV8413

NCV8408/B

42 V Breakdown

NCV8405A/B

NCV8415

NCV8402A
NCV8402A Dual

NCV8412

NCV8406A/B

65 V Breakdown

Released

In Planning

In Development

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