

Reliability and Cost-of-Ownership Optimization in Industrial Power Supplies

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Industrial power supplies

Continuous operation in demanding conditions

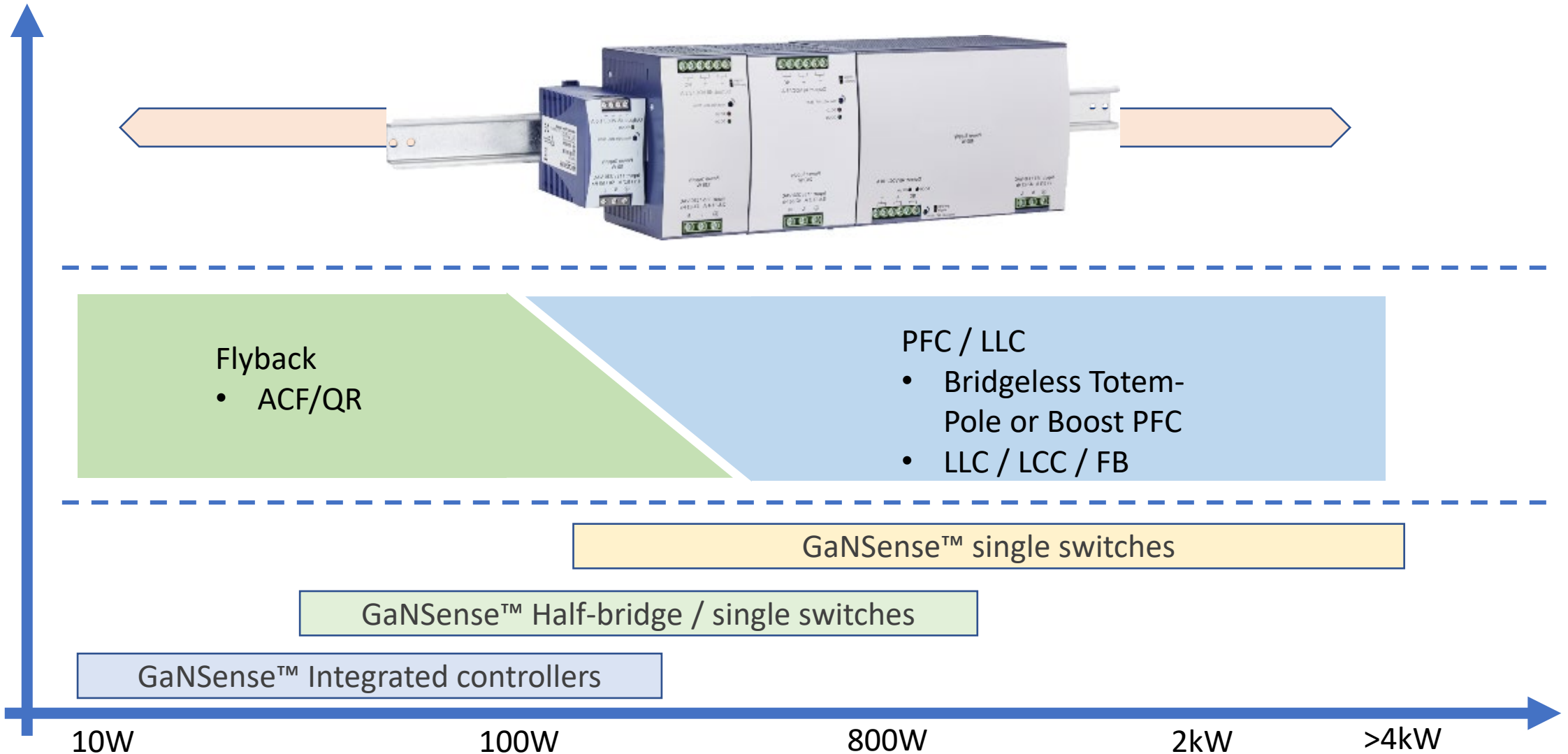


- **Reliability** – Continued uninterrupted operation with no failures
- **Robustness** – Demanding ambient conditions and harsh line / load conditions
- **Efficiency** – Lowest losses to optimize operational cost and cabinet cooling
- **Power density** – Save system cost and cabinet space in challenging installations

... all affecting cost of ownership!

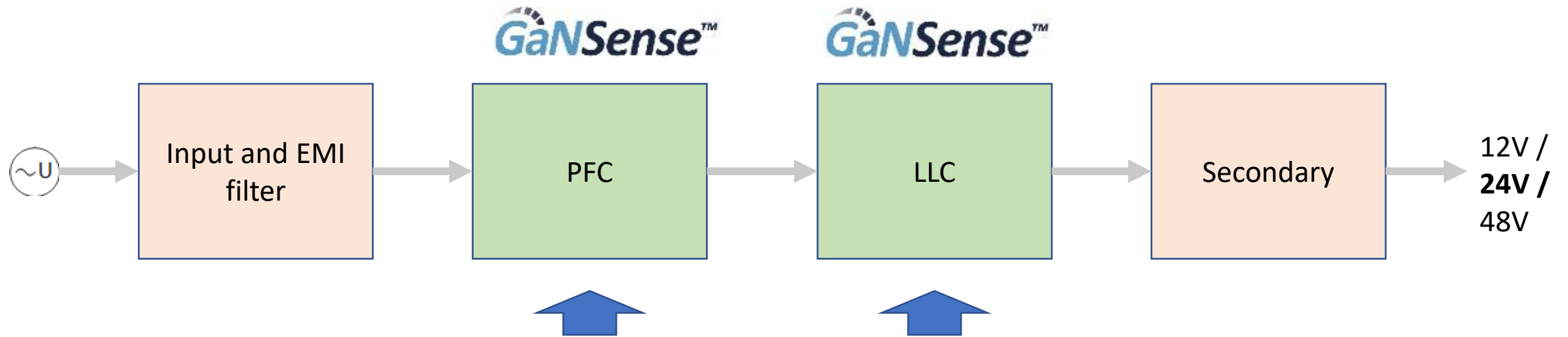
Industrial power supplies

Scalable solution portfolio



Industrial power supplies

Application block diagram – key benefits



- Massive reduction of switching losses → much smaller / no heatsink → improve efficiency by ~1...2%
- High switching frequency now easy to do → much smaller PFC inductor (size and losses) → smaller, easier EMI filter
- Bridgeless totem pole PFC → remove input rectifier and improve efficiency by ~2...3%

- Optimum ZVS operation with lowest losses → much smaller / no heatsink → improve efficiency by ~1...2%
- High frequency now easy → much smaller inductor / transformer (size and losses) → enable planar inductors
- Very small and linear output cap → improved resonant operation and control loop performance

Navitas GaN power ICs unlock the next level of performance

Feature
Very low switching losses,
Very high switching frequency possible
Precise switch timing with low latency and dead time
High voltage ratings
Integrated gate driver and voltage regulator
Integrated lossless current sensing and temperature sensor
High level of integration – less components on PCB

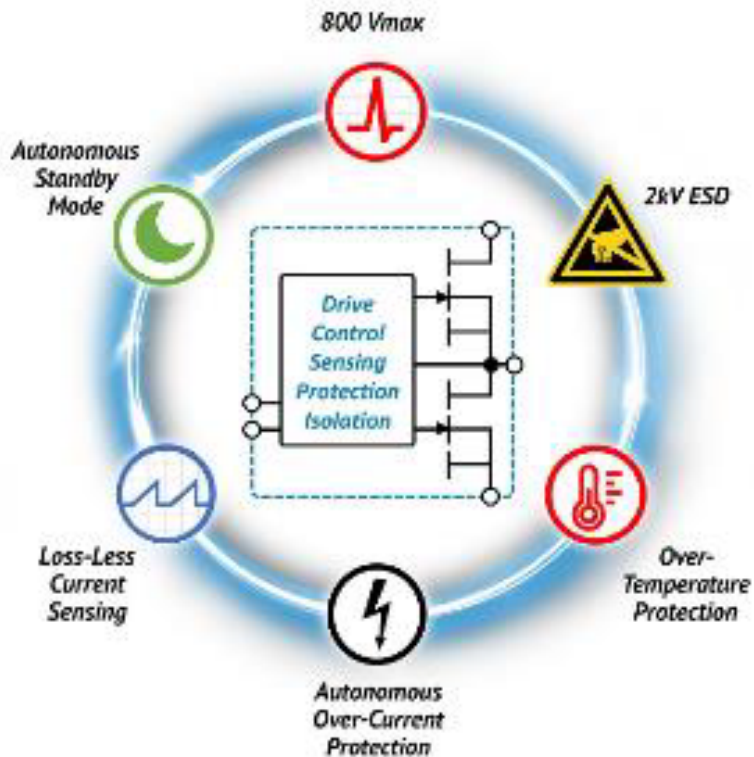
Impact
Reduce losses by >20% over SiC, >50% over Si
Very small / planar magnetic components
Improved control loop performance, low EMI
High robustness against transient over-voltages
Excellent reliability through precise gate drive conditions
Excellent robustness through very fast and precise action
Very compact size and higher reliability



Benefit
Small / no heatsink, easier thermal design, higher reliability
Reduced size and system cost
Smaller EMI filter → system cost improvement
Lower field failure rate
Improved lifetime and low field failure rate
Robust, protected application and low failure rate
Reduced system size and cost, and very easy to use

GaNSense™ Half-bridges / Single switches

Key benefits for industrial power supplies



- **High, stable and repeatable performance** → reduce design margins
 - Very low prop delay for best control loop performance
- Controlled gate drive conditions enable **outstanding reliability**
- **Much reduced component count** → system size and cost reduced, increasing power density
- Easy to use → **fast time to market**
- Lossless current sensing **removes shunt resistors** → cost, size, reliability and performance improvement
- Fast and precise overcurrent protection → improved **system robustness**
- On-chip temperature sensing for better thermal design margin
- Precise overtemperature turn-off → improved **system robustness**

GaNSense™ offers highest performance, integration, robustness

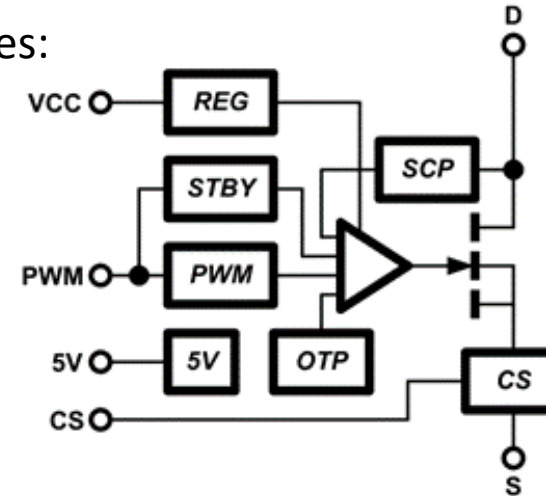
Industrial power supplies

GaNSense™ Product Family

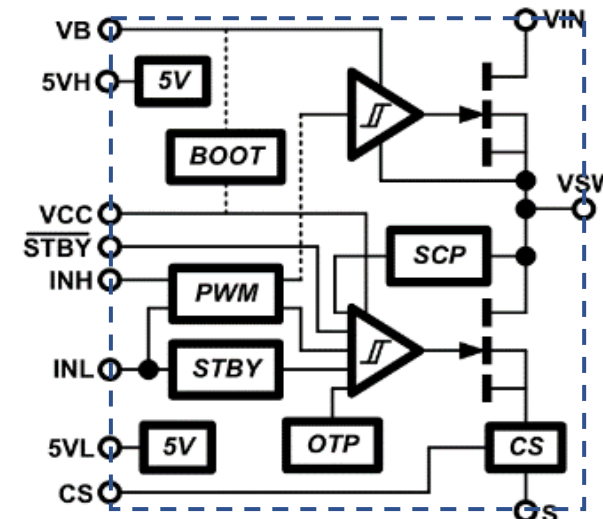


- Many family members
 - From 45 to 450mohm R_{dson}
 - Singles and half-bridges
- 650V continuous voltage rating
 - 800V transient, tested at 900V
- Monolithically-integrated gate drive
 - Lateral GaN process to minimize EMI
 - Full ESD protection 2kV
- Very low switching losses
 - Zero reverse recovery charge
 - Negligible parasitic capacitance
- **GaNSense** features
 - Integrated loss-less current sensing
 - Short-circuit protection
 - Over-temperature protection
 - Autonomous low-current standby mode
 - Auto-standby mode input
 - UVLO function
- Suitable for all topologies

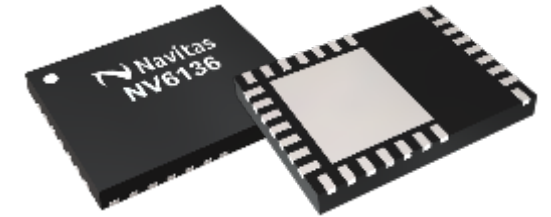
Singles:



Half-bridges:

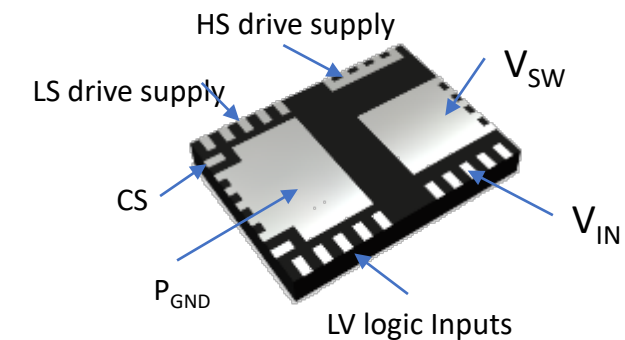


GaNSense™



QFN 5x6 / 6x8 / 8x8

PQFN 6x8



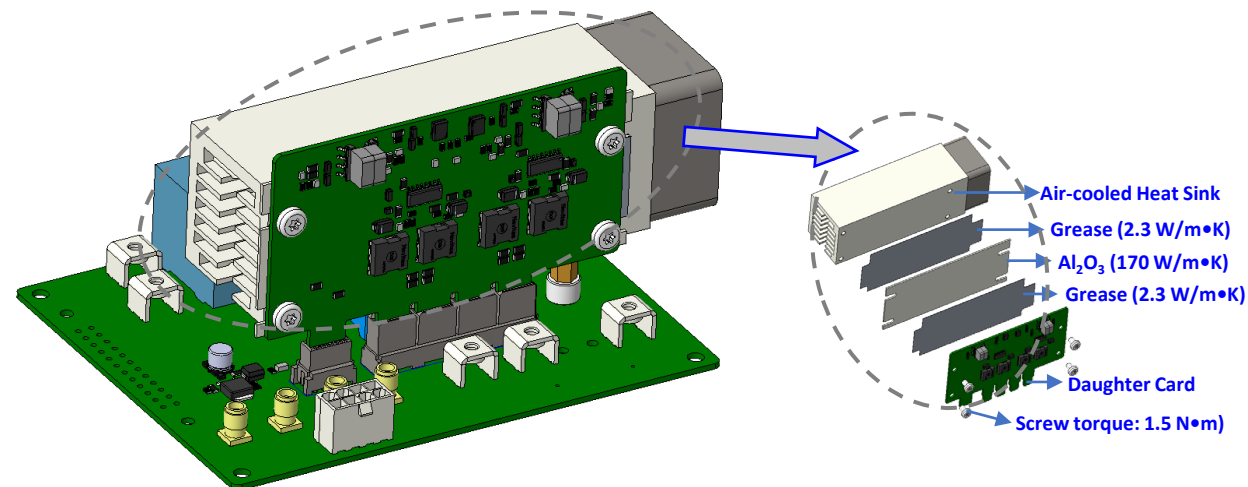
Industrial power supplies GaNSafe™ Product Family

Part#	V _{DS} (Cont, Max) (V)	V _{DS} (Dyn, Max) (V)	R _{DS(ON)} (Max 25°C) (mΩ)	I _D (Max) (A)	Package	Evaluation Kit
NV6515	650	800	35	57	TOLL 10x10 Bottom-cool	Power Board, Full Bridge Daughter Card, and FanSink/TIM ~ configurable for DPT or Half-Bridge testing
NV6513			45	48		
NV6512			55	34		
NV6511			98	22		

DIM	TOL
A ₁	10.00 ±0.10
B ₁	13.10 ±0.10
K ₁	2.70 ±0.10

TnR Ordering

Mini-Reel (7" dia)	Qty500 Pcs "-MR" suffix
Standard (13" dia)	Qty2,000 Pcs



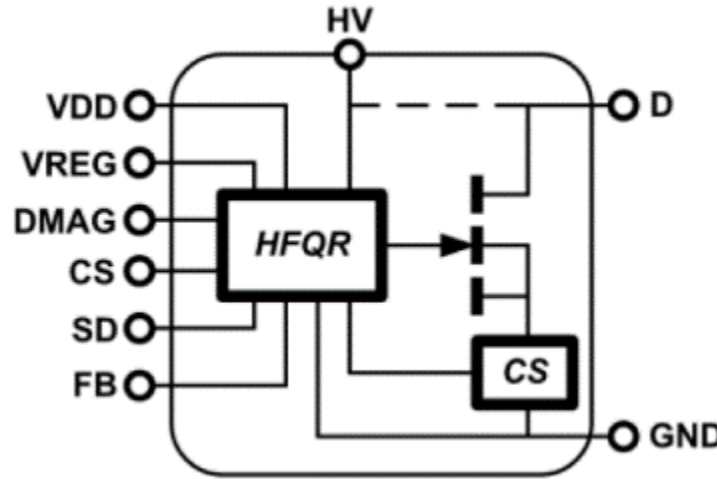
1. Samples and collateral available immediately to qualified customers

GaNSense™ Control product family

Highest power density and lowest component count

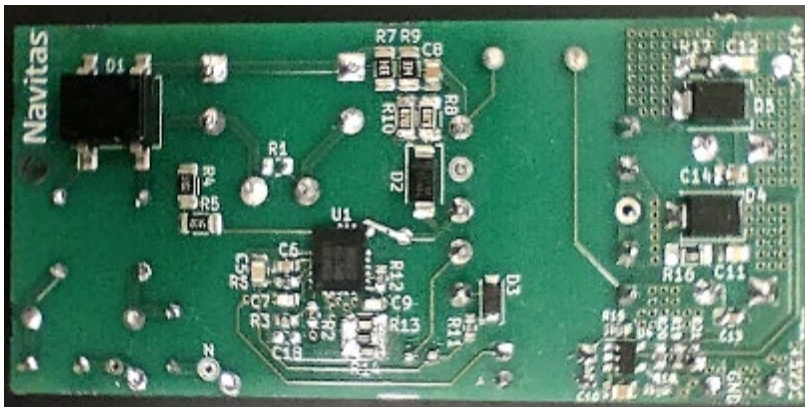
HFQR Control

- HFQR controller
- CCM and QR hybrid mode
High-frequency, up to 300kHz
- High-voltage startup
- Frequency-hopping for EMI reduction
- X-cap discharge
- SCP, OCP, OTP, LPS protection

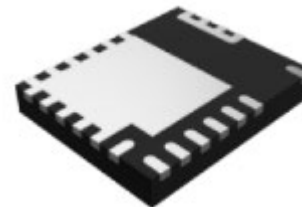


GaN Power FET

- 170mΩ, 260mΩ, 450mΩ
- Ultra-low gate charge
- Zero reverse-recovery charge
- Low output charge
- 650 / 800 V continuous / transient voltage rating
- Integrated current sense



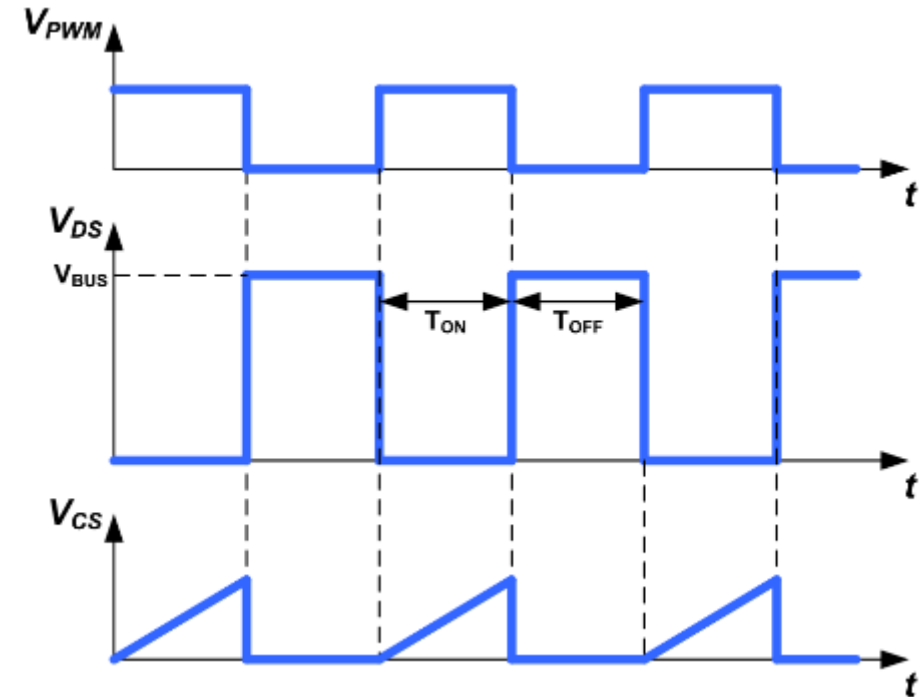
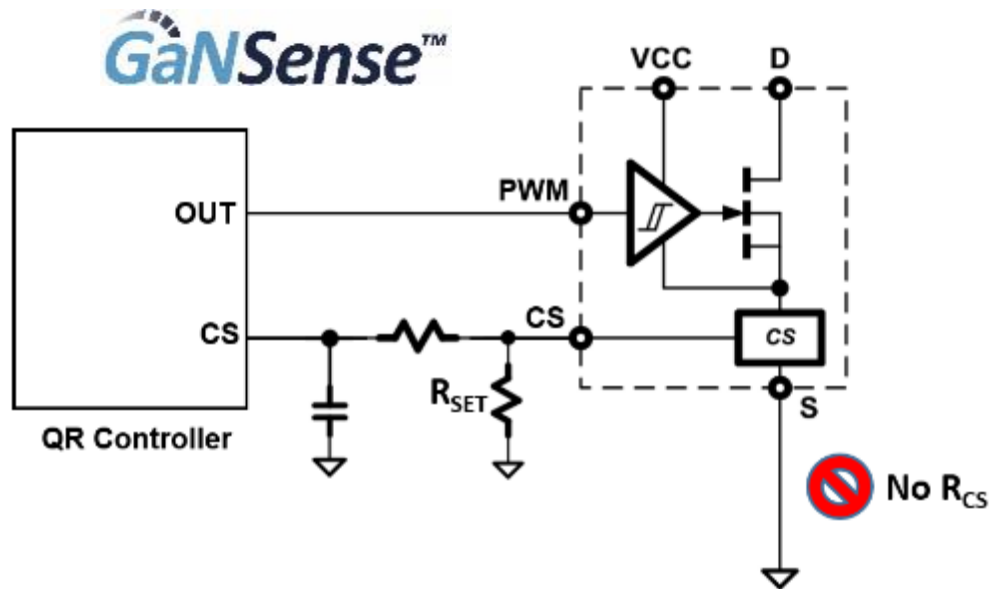
Ultracompact aux PSU 12V/3A



Small, low-profile SMT PQFN

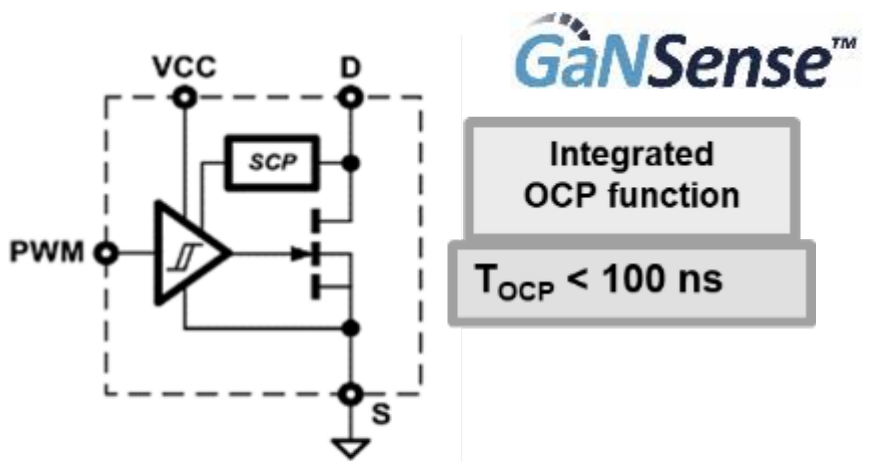
- 5x6 mm footprint
- Minimized package inductance
- Large cooling pad

Programmable Current Sensing Using R_{SET}

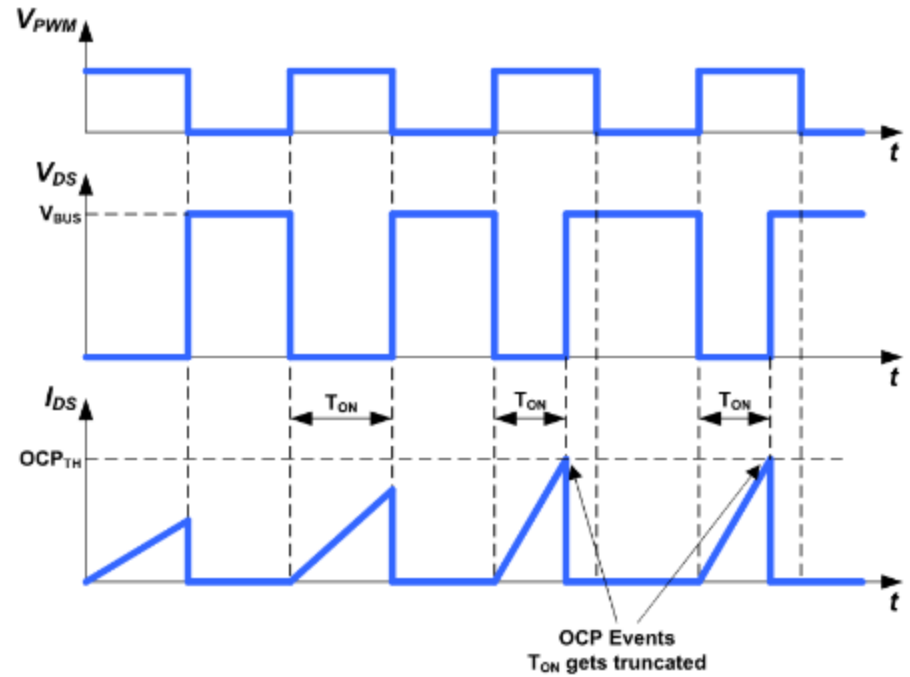


- No need for external current sensing resistor
 - High efficiency, lower component count, better reliability
- Adjust system OCP level using R_{SET}

Autonomous Over Current Protection (OCP)

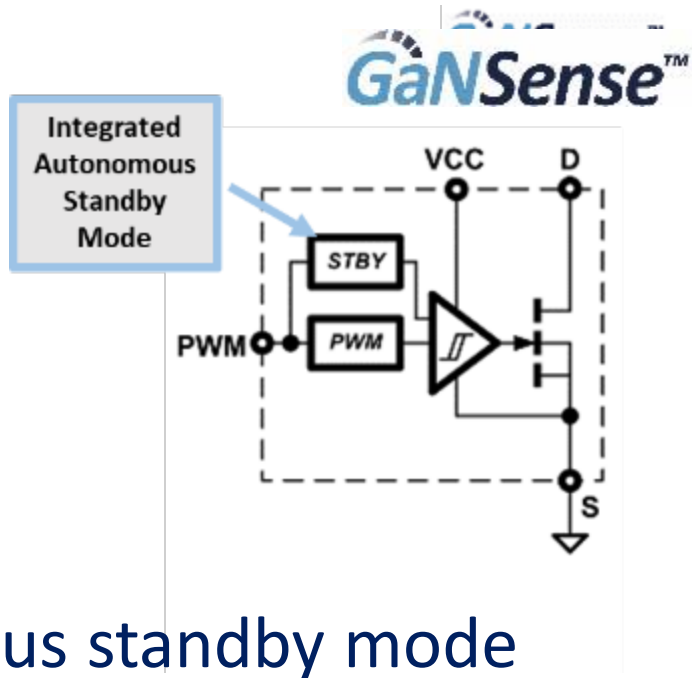


- Autonomous OCP
- Fast-acting self-protection
- Cycle-by-cycle protection
- Excellent robustness
- GaN FET on-time gets truncated at each OCP event
- OCP latch gets reset at next PWM rising edge

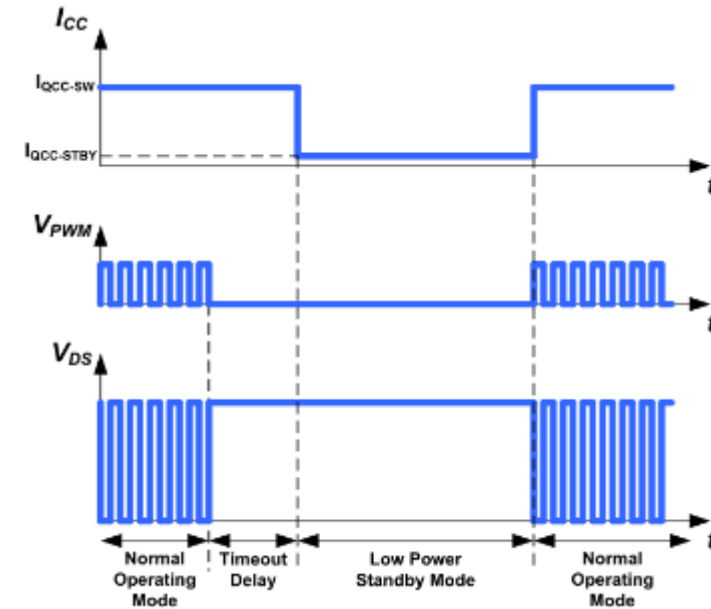


Industrial power supplies

Autonomous Standby Mode



- Autonomous standby mode
- Enters STBY after no PWM for 75usec
- Fast wake-up at next PWM edge (15nsec)
- Reduces system standby power (-17%)

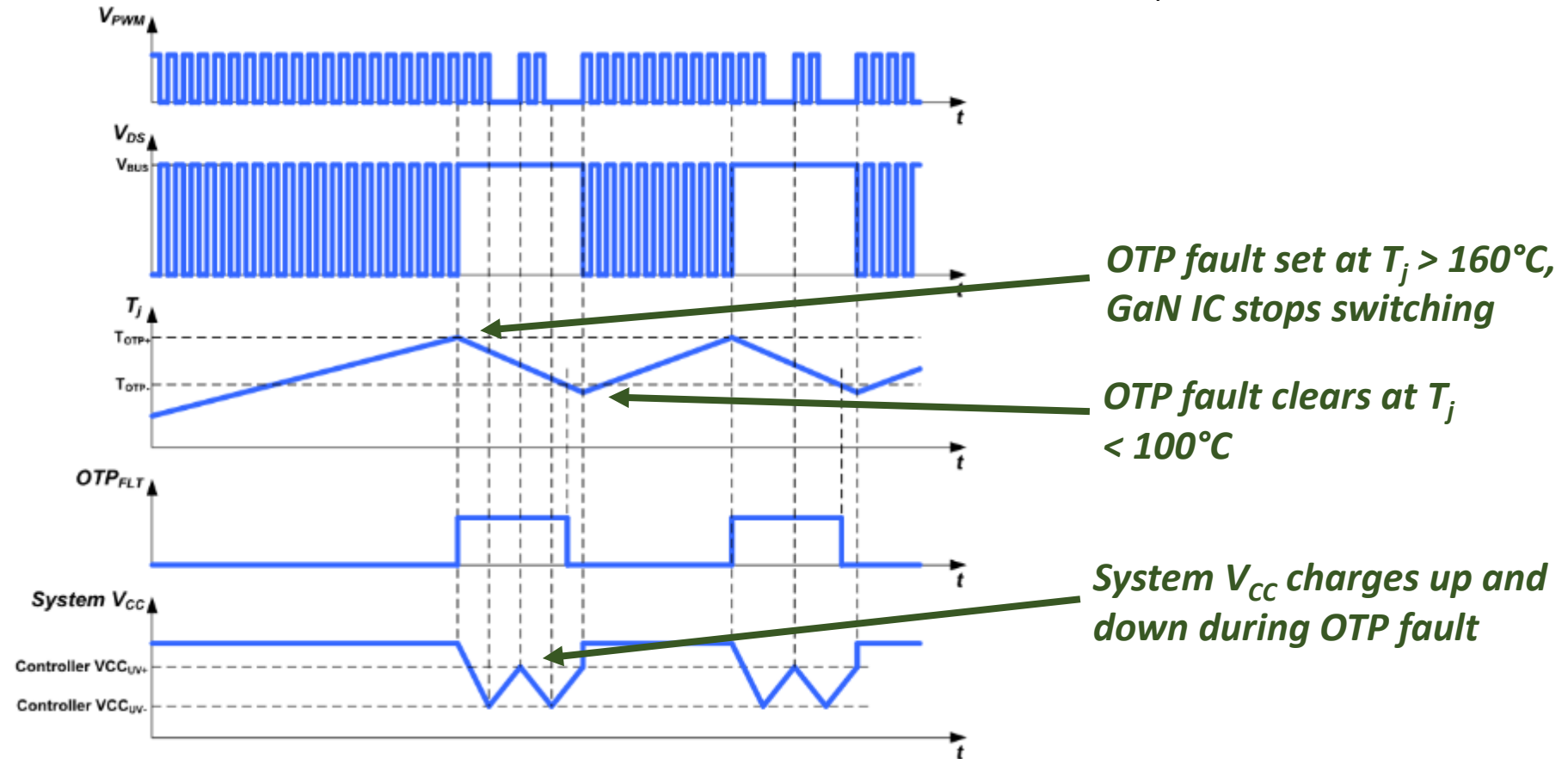


P_{IN} (no load)	115 V _{AC}	230 V _{AC}
NV6136	33 mW	33 mW

Industrial power supplies

Over-Temperature Protection (OTP)

Over-Temperature Protection						
T_{OTP+}	OTP Shutdown Threshold		160		$^{\circ}\text{C}$	
T_{OTP_HYS}	OTP Restart Hysteresis		60		$^{\circ}\text{C}$	



- Trends in industrial power supplies:
 - Improved energy efficiency
 - System cost and TCO reduction
 - Meet EMI regulations
 - Lowest no-load consumption
 - Size and weight reduction
 - Improved performance and reliability
- Challenge to reduce design time / effort



Navitas' GaNSense™ and GeneSiC™ offer convincing solutions for industrial power supplies – the next level of performance and integration

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