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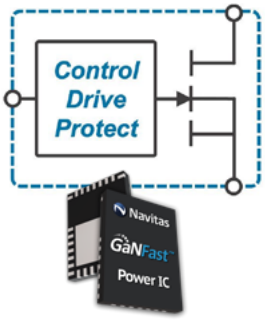
Navitas

GaNFast™

The Future is GaNFast™



GaNFast power ICs enable up to 3x more power or 3x faster charging, with up to 40% energy savings and up to 20% lower system costs in half the size and weight of legacy silicon.

Gallium nitride (GaN) is a next-generation semiconductor technology that runs up to 20x faster than legacy silicon (Si) chips. GaNFast™ power ICs integrate power, drive and control, with additional autonomous protection and lossless current sensing to deliver the smallest, fastest, most reliable power conversion performance for mobile fast chargers, consumer electronics, solar power and storage, data centers and EVs.

Navitas is the only pure-play next-gen power semiconductor company, with over 250 patents issued or pending.

Mobile

- 3x faster charging
- 50% smaller
- 50% lighter

20-300 W

Consumer

- 3x smaller and lighter
- Low-profile

<1 kW

Data Center

- <10% reduction in datacenter electrical consumption
- Saving >15 TWh / $1.9B/yr

<20 kW

Solar

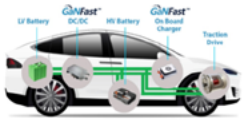
GaNFast™ Micro-inverters

GaNFast™ Energy Storage

- 25% cost reduction of micro-inverters
- 40% energy savings
- Improve payback by 10%+

<50 kW

EV



- 3x faster charging
- 70% energy savings
- 5% longer range / lower battery cost

<100 kW

200 Mpcs Shipped

Proprietary, 400% production testing includes multi-temperature, extensive high-frequency hard- and soft-switching to ensure consistent, robust and high-quality performance for every device delivered. GaNFast ICs have a 6x-lower FIT (failures-in-time) rate than legacy silicon.

As of Sep 2024: total units shipped

20-Year Limited Warranty

Unprecedented, industry-first 20-year limited warranty: 10x longer than typical silicon, SiC or discrete GaN power semiconductors, and a critical accelerator for GaN's adoption in data center, solar and EV markets. Founded on Navitas' holistic approach to product reliability through design, testing, characterization & certification.

See Navitas terms and conditions for details

Electrify Our World™

Every GaN IC saves 4 kg CO_2. GaN supports global carbon 'net-zero' ambitions by reducing Navitas' customers' CO_2 footprints and accelerating the evolution from fossil fuels to renewable energy sources and electricity-based applications. GaN will save up to 2.6 Gton/yr CO_2 by 2050

See www.navitassemi.com for details

Navitas

GaNFast™ Power ICs

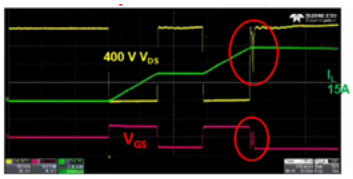
Integration of power and drive

Easy to drive with low component count

Discrete GaN FETs have weak, exposed gates and no electro-static discharge (ESD) capability, causing erratic system behavior and device failures. GaNFast power ICs eliminate gate overshoot and undershoot, while zero inductance on chip ensures no turn-off loss. No ringing or overshoot makes tight control of deadtime easy in high-frequency switching circuits.

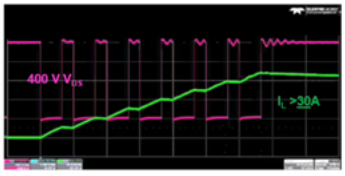
Monolithic Drive and Power Stage

Unprotected GaN



- Exposed gate
- Faulty switching
- Dangerous ringing and glitching
- Significant reliability risks

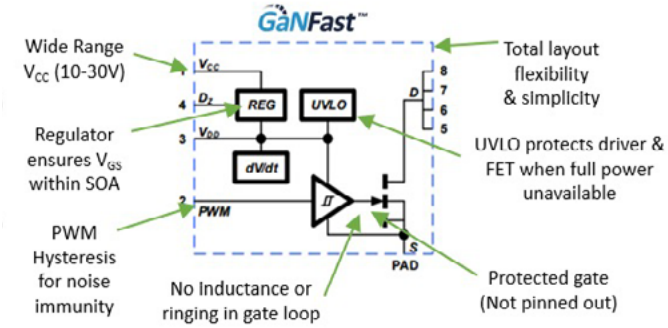
Navitas GaN Power IC



- Integrated gate drive
- Clean switching
- Safe, robust and reliable performance

Reliability by design

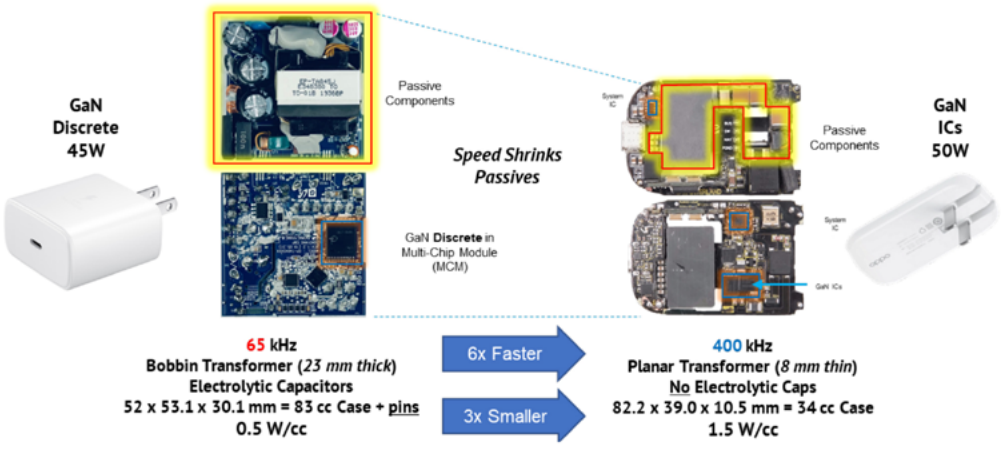
GaNFast power ICs have been designed to maximize performance whilst maintaining the highest level of reliability. A key feature is the 800 V peak capability for robust operation during transient events. The GaN gate is fully protected and the whole device is rated at an industry-leading electrostatic discharge (ESD) specification of 2 kV. Combining a wide input voltage range with programmable turn-on dV/dt and under-voltage lockout (UVLO), GaNFast power ICs are packaged in industry-standard, low-inductance, low-cost QFN packages measuring 5x6, 6x8 and 8x8 mm.



Integration of power and drive - higher efficiencies and miniaturization

Implementing a GaNFast power IC solution enables 6x higher switching frequency, reduction of external components and 3x smaller passives compared to a discrete GaN solution.

GaN Discrete > GaN Power IC = 6x faster, 3x smaller



Navitas

GaNFast™

GaNFast™ with GaNSense™

GaNFast power ICs with GaNSense technology integrate critical, real-time, autonomous sensing and protection circuits which further improve Navitas' industry-leading reliability and robustness. This technology also enables a patent-pending, lossless current sensing capability, which improves energy savings by up to an additional 10% compared to prior generations, as well as further reducing external component count and shrinking system footprints.

Silicon FET

- Old, slow
- High Q_g
- High C_{oss}
- F_{sw} < 100 kHz

Discrete GaN

- Exposed gate
- External gate Drive
- dV/dt sensitivity
- Layout sensitivity
- ESD sensitivity
- Unknown reliability
- Unknown robustness

GaNFast™ 200-300 kHz

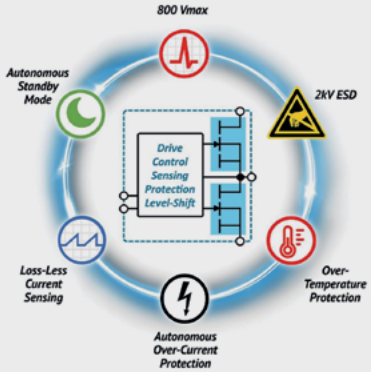
- ✓ Internal gate
- ✓ Integrated gate drive
- ✓ dV/dt immunity
- ✓ Layout insensitive
- ✓ 2 kV ESD rating
- ✓ Proven reliability
- ✓ Proven robustness

GaNSense™ 500 kHz

GaNFast plus:

- ✓ Autonomous standby
- ✓ Autonomous protection
- ✓ Lossless current sensing
- ✓ High precision
- ✓ High efficiency

GaNSense™ Half-Bridge 1 MHz

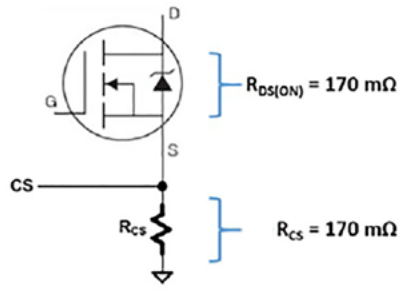


GaNSense plus:

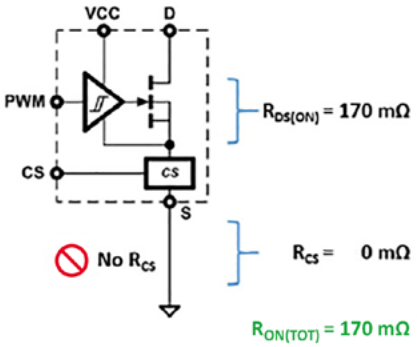
- ✓ Highest integration
  - ✓ Integrated HS and LS FETs
  - ✓ Integrated level-shift isolation
  - ✓ Integrated boot-strap
  - ✓ Shoot-through protection
  - ✓ Enlarged cooling pads
- ✓ Fastest switching
- ✓ Highest efficiency

Lossless current sensing

External Resistor Sensing



GaNSense™

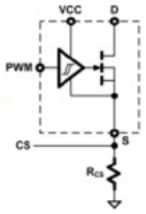


Autonomous over-current protection

GaNFast™

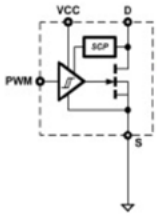
Uses QR controller OCP function

T_{OCP} = 180 ns



- Discrete solutions use external R_{CS}
- Filter and controller delay slow

GaNSense™

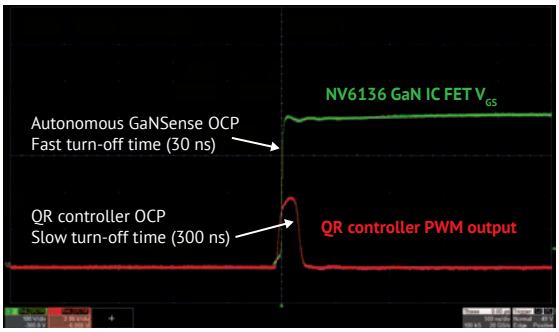


Integrated SCP function

T_{OCP} = 30 ns

- Autonomous OCP
- Fast-acting self protection
- Cycle-by-cycle protection
- Excellent robustness

6x faster protection

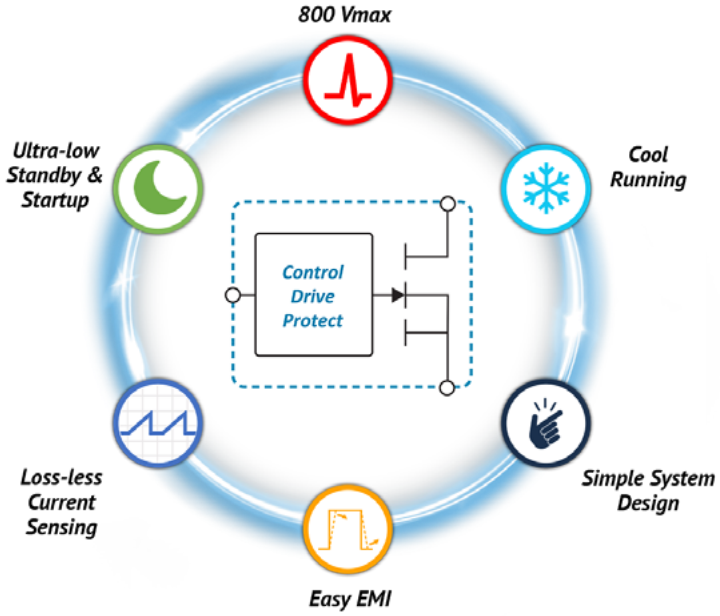


Navitas

GaNFast™

GaNSlim™ Simple. Fast. Integrated

GaNSlim™ is the next generation of Navitas' GaNSense family. It offers the simplest, easiest, and fastest system design by integrating drive, control and protection, with autonomous EMI control and lossless current-sensing, all within a 4-pin, high thermal performance industry standard package. Target applications include chargers for mobile devices and laptops, TV power supplies, lighting, etc. up to 500 W.

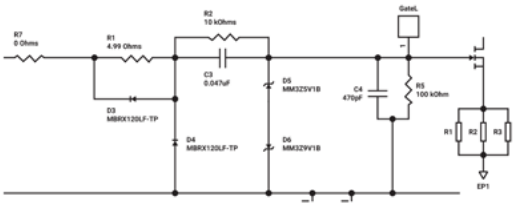


Simplicity through integration

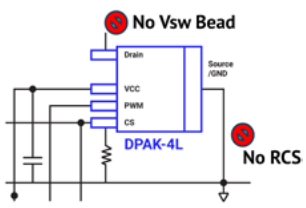
- Easy EMI with turn on/off integrated control
- Loss-less programable current sensing
- 4 pin, high-performance thermal package
- Integrated gate drive
- Over-temperature protection
- Fewer external components

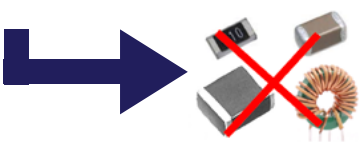
GaNSlim™ has a programmable built-in turn-on/off to maximize efficiency and power density, while reducing external component count, system cost and lowering EMI.

Discrete GaN Solution

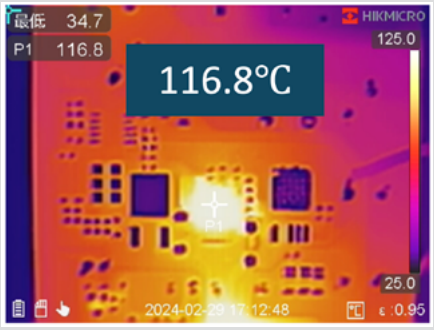


GaNSlim™

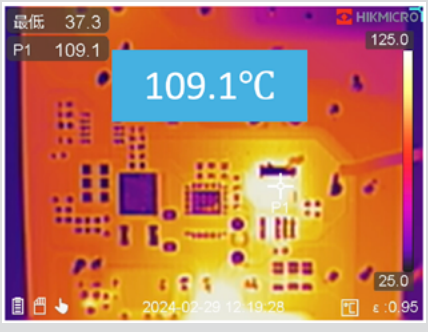




- Fewer external components
- Eliminates high voltage ceramic or bead
- 3-5db EMI improvement



PQFN 6x8 Package



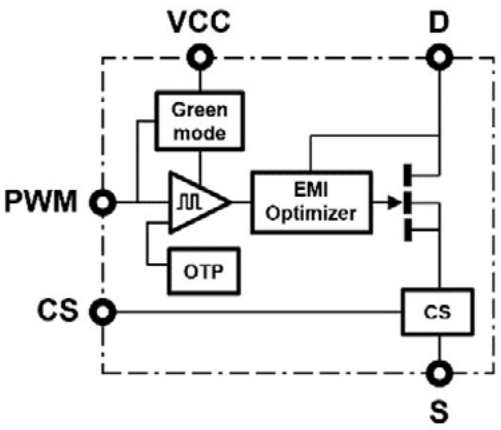
DPAK-4L

High thermal performance DPAK-4L reduces operating temperate by 7°C

Navitas

GaNFast™

GaNSlim™ Simple. Fast. Integrated

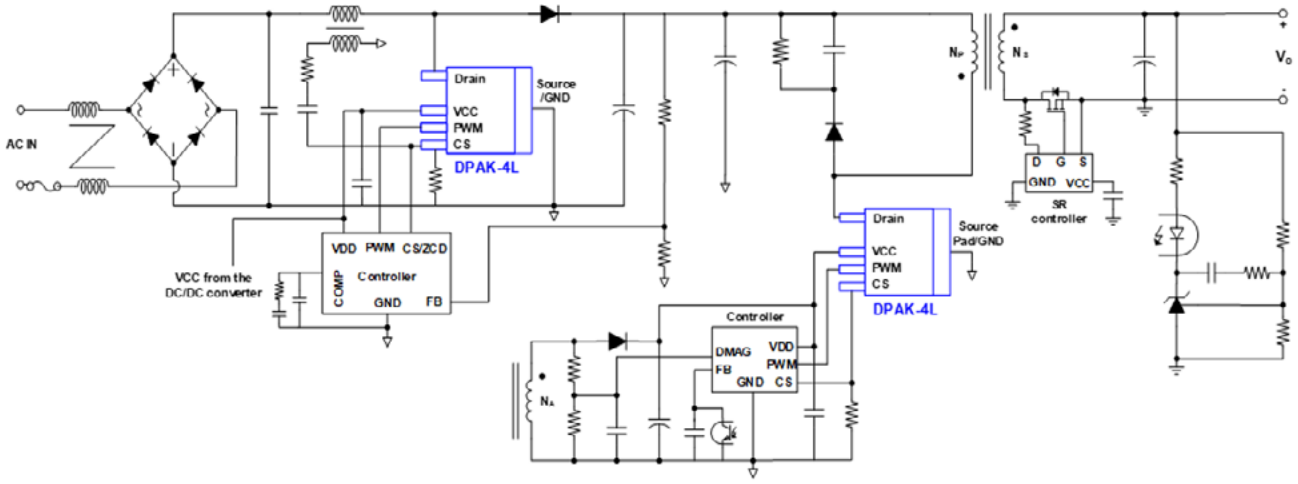


Ultra-low start up current allows compatibility with industry standard SOT23-6 controllers

IC Spec	Value
PWM	30 V
$Vcc_{(max)}$	24 V
$Vcc_{(ON)typ}$	8.5 V
$UVLO_{(max)}$	6.2 V
$I_{QCC\_Standby\ (typ)}$	50 uA
$I_{QCC\_Sleep\ mode\ (max)}$	10 uA
$OTP+_{(typ)}$	160°C

Applications
Mobile chargers
Adaptors
TV power supplies
LED lighting
PFC
HQFR Flyback

Typical application schematic (HFQR flyback and PFC)



Portfolio

Broad portfolio optimized for isolated and non-isolated technologies

Part #	Package	$R_{DS(ON)}$ (typ) (mΩ)	ID (A)	Power (W)	Topology	Samples
NV6143C	DPAK-4L	330	6	30	Isolated & non-isolated	Now
NV6144C		260	8	45		
NV6145C		210	10	70		
NV6146C		170	12	100		
NV6148C		120	14	140		

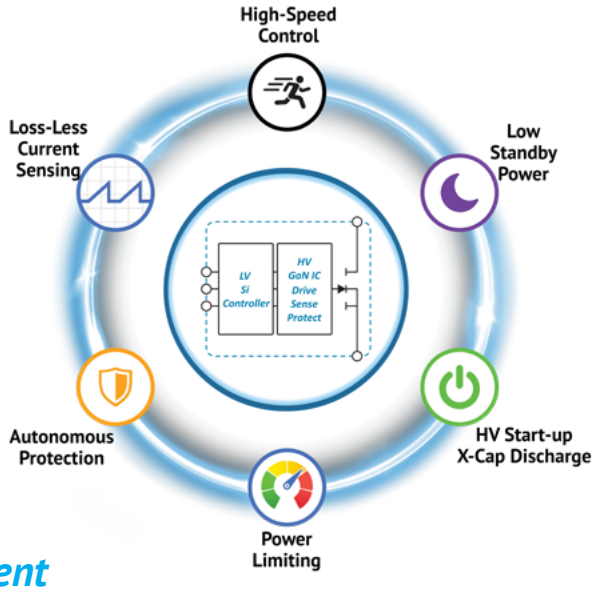
Navitas

GaNFast™

GaNSense™ Control

The GaNSense Control family combines next-generation gallium nitride (GaN) power with high-frequency control functionality. Unlike competing systems, GaNSense Control has all the benefits of the monolithically-integrated GaN power FET and GaN drive, plus control and protection circuits in a single surface-mount package for high-density charger, adapter and auxiliary power applications.

Applications
Mobile Fast Chargers
Home Appliance
Data Center Auxiliary
Industrial Auxiliary
Consumer
Point-of-Sale



Easy-to-use, flexible, efficient

A comprehensive, easy-to-use portfolio of co-packaged and standalone solutions offers ultimate flexibility to the power designer. NV958x high-frequency quasi-resonant (HFQR) flyback controllers with GaNSense power ICs support QR, DCM, CCM and multiple-frequency, hybrid-mode operations. A choice of frequency ranging from 82 to 225 kHz provides flexible design for both planar or wire-wound transformers, offering highly-efficient, and most-compact charger solutions. On the secondary side, NV97xx synchronous rectifier (SR) controllers with power FETs provide maximum efficiency at any load condition compared to conventional rectifiers.

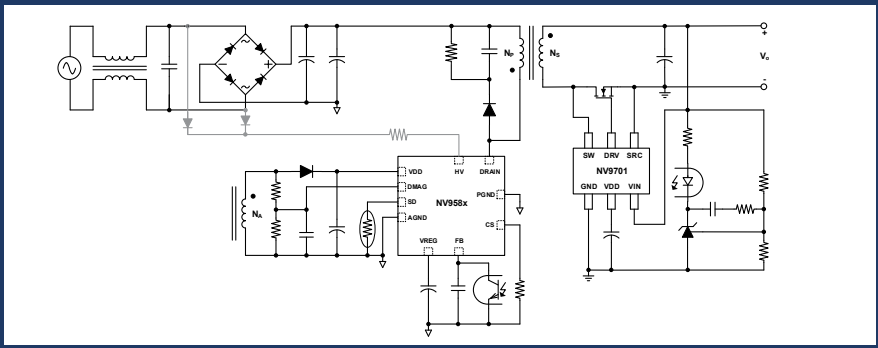
World-class performance

GaNSense Control enables the highest-frequency operation to minimize system size and weight. Integrated features such as lossless current sensing, high-voltage start-up, and elimination of V_{DD} inductor reduce component count and increase system efficiency. With transient voltage breakdown up to 800 V and no PCB hotspots, Navitas' GaNSense Control delivers best-in-class efficiency in the smallest form-factor.

Feature	Competitor A	Competitor B	Navitas	Navitas Benefit
Max frequency (kHz)	175	150	225	Higher efficiency, power density
Package	PQFN 6x8	InSOP 10x14	PQFN 5x6	
HV startup	Internal	Internal	Internal	
Lossless current sensing	No	Yes	Yes	
V_{DD} range (V)	7.9 - 40	4 – 6	6.2 - 80	
External V_{DD} regulator	Boost	Linear	Not required	
External components	+11	+18	+9	
PCB footprint (mm^2)	85	90	50	
Thermal pad	Yes	No	Yes	
Standby loss (mW)	50	<30	<20	
Hotspot	Yes	No	No	Higher reliability
V_{DS} (cont./trans.)	650 / 750	650 / 750	700 / 800	

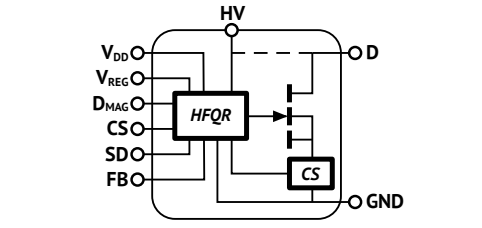
GaNSense™ Control

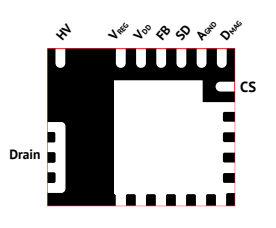
Typical Application Circuit: 20 W - 65 W, 20 V



HFQR Flyback Primary | Synchronous Rectifier

Internal Schematic and Pin-out (PQFN 5x6)





Description	Part Number	Status	Target Application	Power (W)	Voltage (cont./trans.) (V)	$R_{DS(ON)}$ (mΩ)	V_{DD} (V)	No-Load (mW)	Package
HFQR Controller + GaNSense Co-pak	NV9580x	Active	Consumer/ Industrial/ Appliance	70	700/800	170	6.8-77	<20	QFN 5x6
	NV9581x			70		210			
	NV9582x			50		260			
	NV9583x			45		330			
	NV9573x			40		330			ESOP-7
	NV9584x			35		450			QFN 5x6
	NV9574x			35		520			ESOP-7
	NV9586x			30		600			QFN 5x6
	NV9576x			30		600			ESOP-7
HFQR Flyback Controller	NV9510x			150	700	-			10-Lead, SOIC
SR Controller + GaNSense Co-pak	NV9750x			50	100	12		-	QFN 5x6
SR Controller	NV9701x			150	-	-			SOT-23-6

Navitas

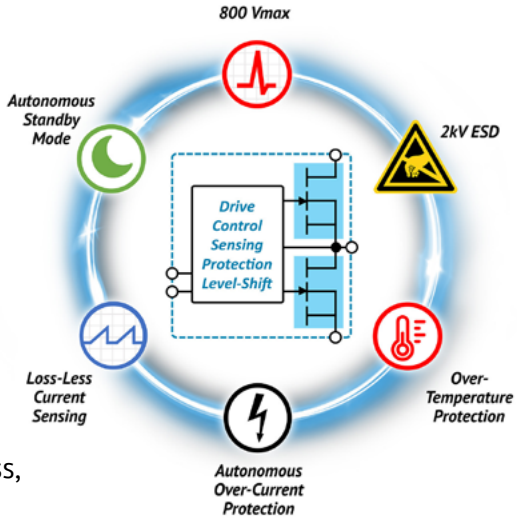
GaNFast™

GaNSense™ Half-Bridge ICs

The next stage of the high-frequency revolution in power electronics

New GaNFast Half-Bridge ICs with GaNSense technology integrate two GaN FETs with drive, control, sensing, autonomous protection, and level-shift isolation, to create a fundamental power-stage building block for power electronics. This revolutionary single-package solution reduces component count and footprint by over 60% compared to existing discretes, cutting system cost, size, weight, and complexity.

- The most integrated solution in the power semiconductor industry
- Feature-rich, in low-profile, low-inductance, industry standard 6x8 mm PQFN
- Enables simpler, more flexible system designs
- Autonomous protection and lossless sensing for increased reliability, robustness, and efficiency

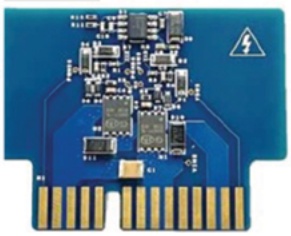


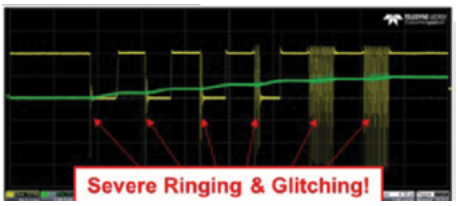
- Fast time-to-prototype and time-to-revenue
- Designed to enable the next generation of soft-switching topologies and exploit GaN's high-speed, fast-switching capability
- Next generation power systems can now operate in the MHz, not kHz switching range!

Highest integration, fewest components, smallest footprint, and most robust

Discrete GaN Half-Bridge

- ✗ 33 components
- ✗ 250 mm² footprint
- ✗ External HB driver HVIC
- ✗ External HV bootstrap
- ✗ 2x HV bypass diodes
- ✗ 2x external gate drives
- ✗ Exposed gates



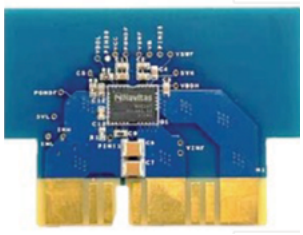


61% fewer components

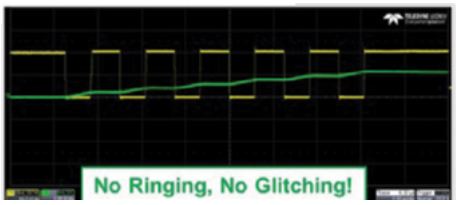
64% smaller footprint

Complete integration

GaNSense Half-Bridge IC



- ✓ 13 components
- ✓ 90 mm² footprint
- ✓ Level shifters
- ✓ Bootstrap
- ✓ Gate drivers
- ✓ No exposed gates



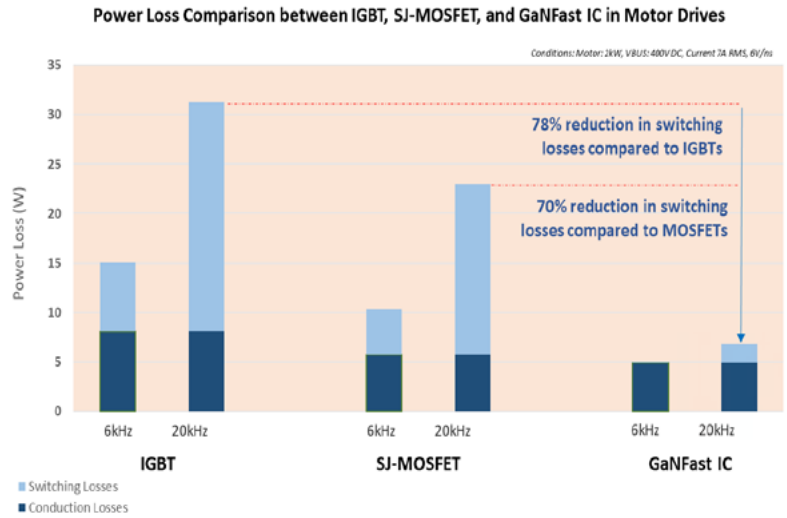
Fastest Switching, Highest Efficiency & Power Density with Soft-Switching

GaNFast™

Ultra-fast mobile chargers continue to transition to higher power in order to support faster charging times for increasingly power-hungry smartphones. New charging protocols such as USB PD 3.1 now support up to 240 W. For these higher power levels, soft-switching half-bridge topologies provide the fastest switching frequency, highest power density and maximum efficiency.

Soft-Switching Topology	QR Flyback (Silicon)	QR Flyback (GaNFast)	Active-Clamp Flyback (ACF) (GaNSense)	Asynchronous Half-Bridge + Totem Pole (GaNSense HB)
System Power (W)	≤65	≤65	≤65	200 - 300
F_{sw} (kHz)	100	200	500	500 - 1 MHz
Efficiency (%)	90	92	93	94.5
Power Density (W/cc)	0.5	0.8	1.2	1.6

Enabling compact size and integration in motor drives



GaNSense Half-Bridge ICs provide up to a 78% reduction in total power losses compared to legacy silicon IGBTs or MOSFETs. This translates to a significant reduction in cost, weight and size of thermal management.

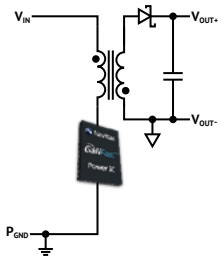
This enables next-generation motors to incorporate the inverter stage into the motor chassis itself. More details can be found in our dedicated whitepapers and application note AN018.

Fewest components, highest integration, highest efficiency, and smallest footprint

	Comp.1	Comp.2	Comp.3	Navitas	
Monolithic GaN logic, drive, power	No	No	Yes	Yes	Complete integration
Internal bootstrap	Yes	No	No	Yes	
Lossless current sensing	No	No	No	Yes	
Propagation delay (ns)	47	46	Not stated	35	24% faster
δV/δt (V/ns)	100	300	Not stated	200	
Short-circuit response time (ns)	300	300	Not stated	50	6x faster
Package (PQFN)	9x9	8x8	6x8	6x8	
External components required	16	22	18	10	60% fewer
R_{thJC} (°C/W)	2.9	2.8	1.9	1.8	
PCB footprint (incl. controller) mm^2	104	148	135	84	24% smaller

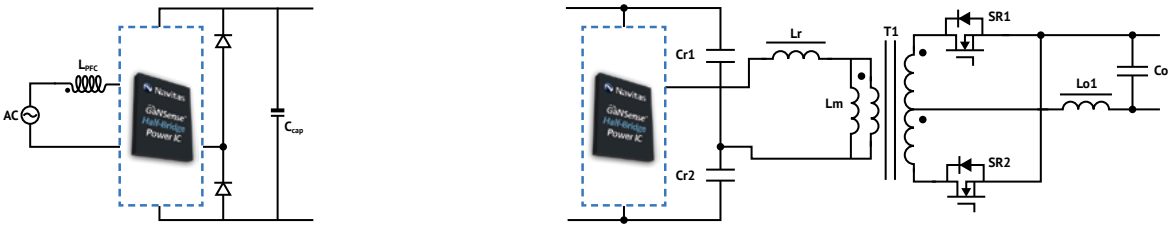
Typical Applications

Fast Charger (QR Flyback) using GaNFast IC

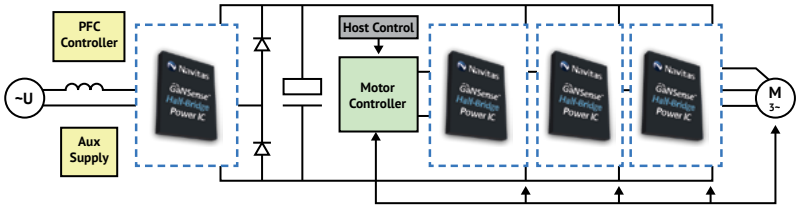


Fast Charger (Totem Pole + Asymmetric Half-Bridge) using GaNFast ICs and GaNSense Half-Bridge IC

AC-DC Converter (Totem Pole + LLC + SR) using GaNSense Half-Bridge ICs



Motor Drive (3-Phase) Schematic using GaNSense Half-Bridge ICs



Product portfolio

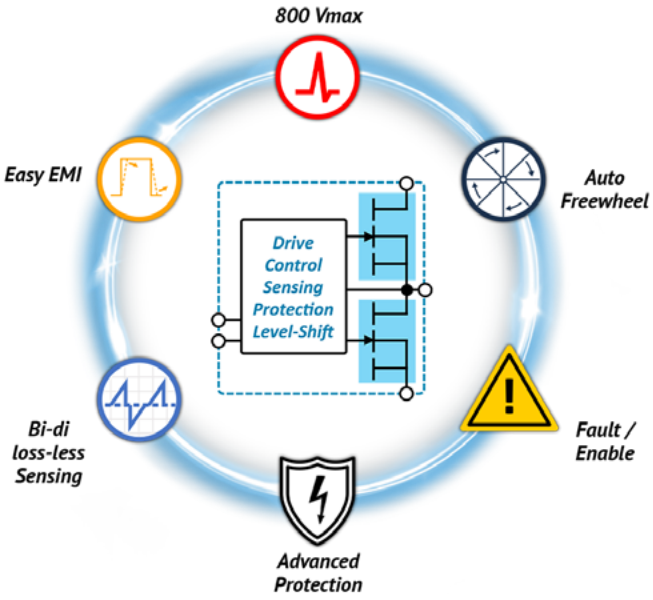
Family	Part Number	Type	$V_{DS(CONT)}$ (V)	$V_{DS(TRAN)}$ (V)	$R_{DS(ON)}$ (mΩ, typ)	Package
GaNFast™	NV6117	Single	650	800	120	PQFN 5 x 6
	NV6115				170	
	NV6113				300	
	NV6128C				70	PQFN 6 x 8
	NV6127C				125	
	NV6125C				175	
GaNSense™	NV6138C	Single	700		120	PQFN 6 x 8
	NV6136C				170	
	NV6135C				210	
	NV6134C				260	
	NV6133C				330	
	NV6132C				450	
	NV6169				45	PQFN 8 x 8
GaNSense™ Half-Bridge	NV6269C	Half-Bridge	650		70 / 70	PQFN 8 x 10
	NV6247C				160 / 160	PQFN 6 x 8
	NV6245C				275 / 275	

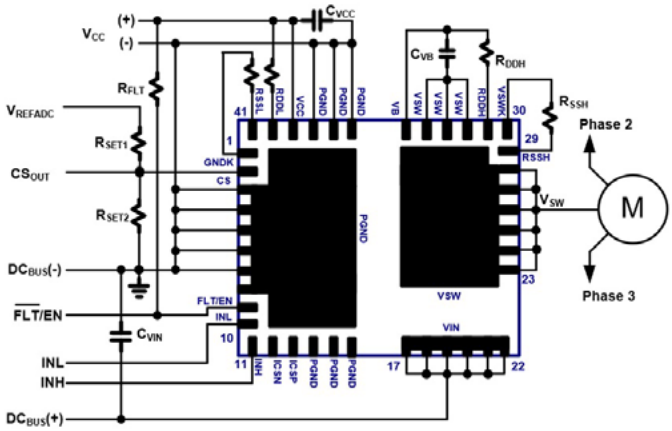
GaNSense™ Motor Drive ICs for Home Appliance and Industrial

GaNFast™

The new GaNSense™ Motor Drive ICs integrate high performance eMode GaN FETs with integrated gate drive, control and protection to achieve unprecedented high-frequency and high efficiency operation. GaNSense motor drive technology is also integrated which enables real-time, accurate sensing of voltage, current and temperature to further improve performance and robustness not achieved by any discrete GaN or discrete silicon device.

High efficiency and integration with full robustness





GaNSense motor drive enables integrated bidirectional loss-less current sensing which eliminates external current sensing resistors and increases system efficiency. GaNSense motor drive also enables short circuit and over-temperature protection to increase system robustness. For applications up to 700W.

Features	Benefits
Highest integration	15% smaller system size, higher reliability through less components, less design complexity and faster time to market
Bi-directional loss-less current sensing	0.2% lower losses, no hotspot
Full HS/LS short-circuit protection	Robust operation without catastrophic failure
Full slew rate control	20% smaller EMI filter, no motor damage
Automatic freewheeling	0.1% lower losses, no controller loading
Fault communication and HW enable	Full power stage control, less field failures

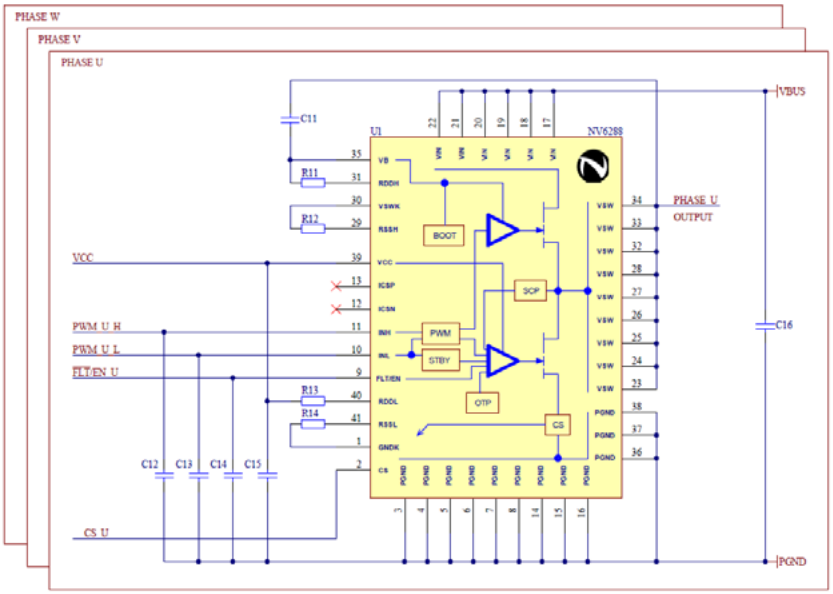
PQFN 6x8

PQFN 8x10

GaNSense™ Motor Drive ICs for Home Appliance and Industrial

GaNFast™

Typical application schematic (one phase shown):



Reduced system cost and complexity:

- No more shunt resistors, avoid hot spot and power dissipation
- Less external components for lower system cost and improved reliability
- Full protection against output short-circuits
- Lower, adjustable EMI for smaller filter size and higher motor reliability

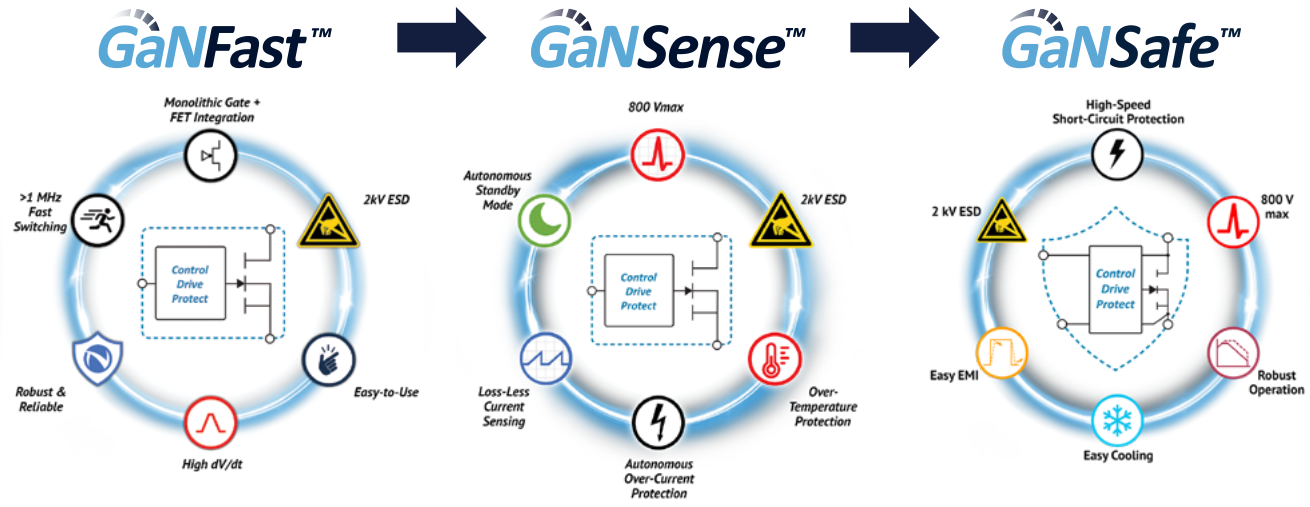
Segment	Application
Home appliance	Air conditioner, heatpump, washing machine, dryer, dishwasher, refrigerator, air purifier, hair dryer
Low power industrial	Circulators, water pumps, cooling pumps, HVAC systems, exhaust fans, cooling fans, home and building automation, material handling, window and door openers

Product portfolio:

Part number	Family	$R_{DS(ON)}$	Package	Integrated driver / protections	dV/dt control	HW disable
NV6245M	GaNSense™ Half-Bridge	2x 275mΩ	QFN 6x8	Y	Y	-
NV6247M		2x 150mΩ	QFN 6x8			
NV6269M		2x 70mΩ	QFN 8x10			
NV6257		2x 170mΩ	QFN 6x8		Fully adjustable	Y
NV6287		2x 170mΩ	QFN 8x10			
NV6288		2x 120mΩ	QFN 8x10			

High Power GaNSafe™: The World's Safest GaN

The GaNSafe family has been specifically created to serve demanding, high-power applications, such as AI data centers, solar/energy storage, and industrial markets. Navitas 4th generation integrates control, drive, sensing, and critical protection features that enable unprecedented reliability and robustness.

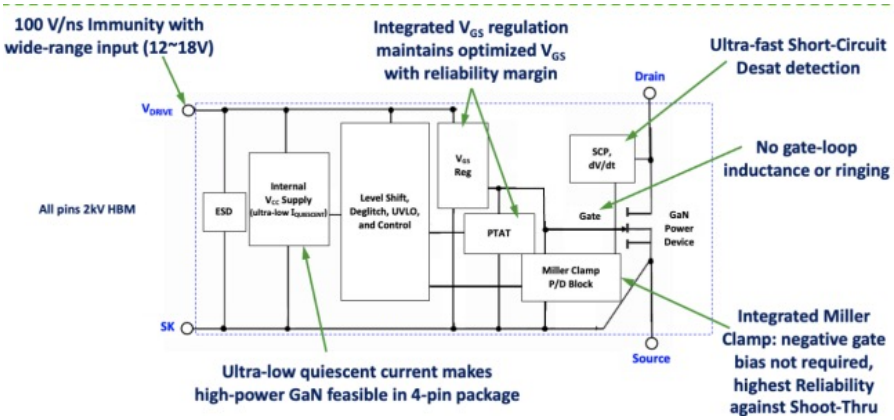


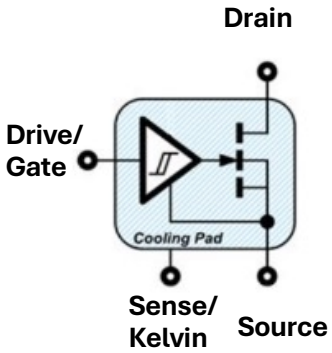
- High-speed short-circuit protection, with autonomous 'detect and protect' with ultra-fast 350 ns / 50 ns latency.
- Protected, regulated, integrated gate-drive control, with zero gate-source loop inductance for reliable high-speed 2 MHz switching capability
- Electrostatic discharge (ESD) protection of 2 kV
- 650 V continuous, 800 V transient voltage capability for extraordinary conditions.
- Integrated Miller Clamp (no negative gate bias, higher 3rd quadrant efficiency)
- Programmable turn-on and turn-off speeds (dV/dt) to simplify EMI requirements.
- Simple 4-pin device, allowing the package to be treated like a discrete GaN and requiring no additional V_{CC} pin

GaNSafe™

TOLL

TOLT



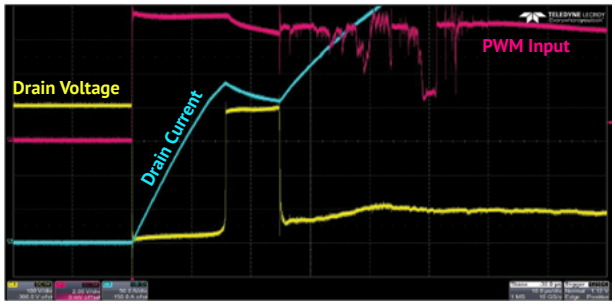


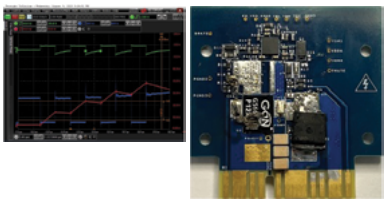
4-pin Performance

High Power GaNSafe™: The World's Safest GaN

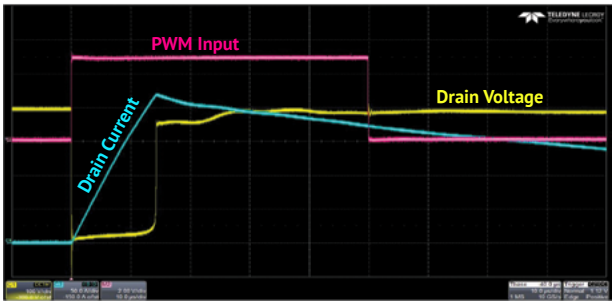
GaNSafe is the world's safest GaN with short-circuit protection (350 ns max latency), 2 kV ESD protection on all pins, elimination of negative gate drive, and programmable slew rate control. All these features are controlled with 4-pins, allowing the package to be treated like a discrete GaN FET, requiring no V_{CC} pin.

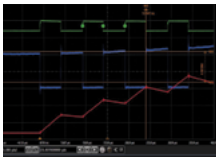
Short-circuit current test





GaN discrete
650 V, 25 mΩ type
Fails short-circuit





Navitas GaNSafe
650 V, 25 mΩ max (NV6514)
Survives short-circuit

'Double-pulse' test (400 V, 30 A, R_{SERIES} = 11 mΩ)

GaN discrete 650 V, 42 mΩ max
Spikes, t_{ON} ringing & 250 V undershoot

GaNSafe 650 V, 45 mΩ max (NV6513)
Smooth, safe, reliable operation

Broad portfolio with top- and bottom-cooled options addresses topologies from 1 kW to 100 kW+. Application-specific features increase efficiency, power density and reliability, and reduce component count and system cost.

Family	Part number	$V_{DS(CONT)}$ (V)	$V_{DS(TRAN)}$ (V)	$R_{DS(ON)}$ (max, mΩ)	$I_{DS(CONT)}$ (A)	Package
GaNSafe™ 20-YEAR WARRANTY GaNFast™	NV6511	650	800	98	22	 TOLL-4L, 10x10 mm
	NV6512C			55	34	
	NV6513			45	48	
	NV6515			35	57	
	NV6514C			25	80	
	NV6522			55	34	 TOLT-16L, 10x15 mm
	NV6523			45	48	
	NV6525			35	57	
	NV6524			25	80	

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Navitas Semiconductor
3520 Challenger Street,
Torrance, CA 90503, USA
Navitas +1 844-654-2642, info@navitassemi.com
www.navitassemi.com

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