

NOVOSENSE

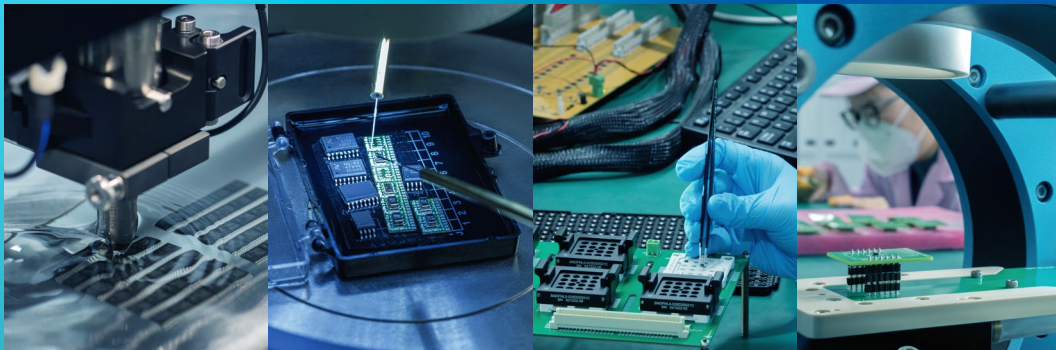
NOVOSENSE Gate Driver IC Guide Book



www.novosns.com

NOVOSENSE: A highly robust & reliable analog and mixed signal chip company

NOVOSENSE Microelectronics (NOVOSENSE, SSE Stock Code 688052) is a highly robust & reliable analog and mixed signal chip company. Since its establishment in 2013, the company has been focusing on sensor, signal chain, and power management, providing comprehensive semiconductor products and solutions, which are widely used in automotive, industrial, information communication and consumer electronics markets.



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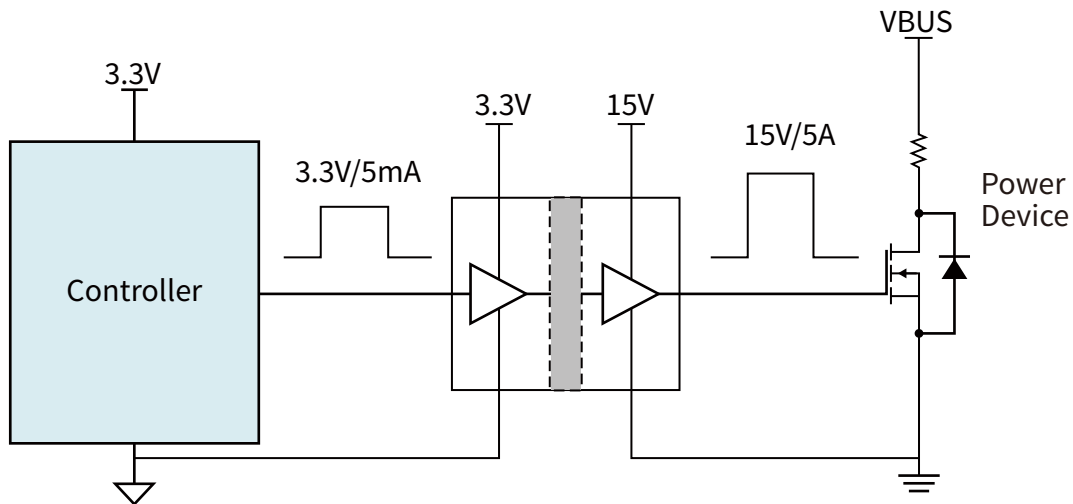


NOVOSENSE
Gate Driver IC Products



Overview

Gate driver IC is designed to control and switch power devices such as MOSFETs, IGBTs, SiC MOSFETs, and GaN HEMTs. It amplifies control signals from the control unit, to provide sufficient current and voltage slew rate to the gate of these power devices. This capability facilitates precise timing control, high-speed switching operations, and minimizes switching losses, thereby enhancing overall system efficiency and reliability.



Block diagram of gate driver ICs

Key Features

1

Signal Amplification

Amplify the current of control signals from the microcontroller or driver circuit to a suitable level, to rapidly charge and discharge the gate capacitance of power devices.

2

Voltage Conversion

Convert the control signal voltage levels from the logic level to higher voltages required to drive the gates of power devices in order to ensure fast switching and low conduction losses.

3

Isolation

Ensure that the control signals from the input side are transmitted to the output side without direct electrical connection, thereby protecting sensitive control circuitry from high voltage spikes or transients that may occur in the power circuit.

4

Protection

Integrate protective functions such as undervoltage lockout (UVLO), Miller Clamp, and desaturation protection (DESAT) to ensure the reliability and safety of power devices.

Each power device requires a corresponding driver ICs. The appropriate driver ICs can simplify system design complexity and save R&D time. NOVOSENSE offers a wide range of gate driver ICs with different **voltage ratings, package options, isolation levels, and protective functions** for users to choose from as needed.



Key parameters

Gate driver IC has many key parameters. A thorough understanding of these parameters can help engineers find the best fit for driver IC spec requirements in different application scenarios.

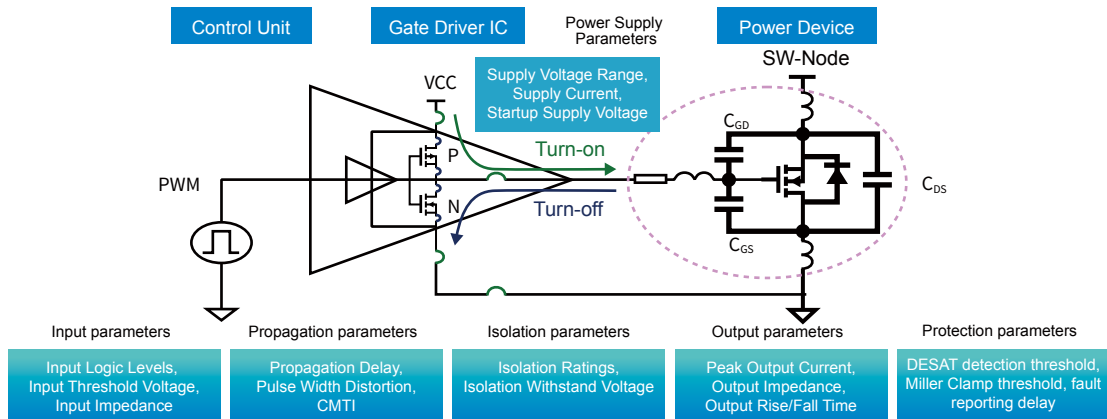


Diagram of gate driver IC's key parameters

Power supply parameters

- 1 Absolute Maximum Rating of Supply Voltage** indicates the highest positive or negative transient voltage that each driver ICs can withstand. Once the voltage goes beyond this range, irreversible damages may occur in the chip.
- 2 Recommended Operating Condition of Supply Voltage** indicates the voltage range that the driver ICs can withstand during long-time operation. Operation beyond the maximum voltage may shorten the expected lifetime of the chip.
- 3 Quiescent Supply Current (IQ)** consumed by the gate driver ICs when it is not switching any loads or performing any active functions.

Input parameters

- 1 Logic High Input Threshold** refers to the minimum voltage considered as a logic high level input.
- 2 Logic Low Input Threshold** refers to the maximum voltage considered as a logic low level input.
- 3 Input Impedance** refers to the impedance seen by the source providing the input signals to the gate driver ICs, influencing signal quality and transmission efficiency.



Output parameters

- 1 Peak Output Current** refers to the maximum instantaneous current that the gate driver ICs can supply to charge or discharge the gate capacitance of a power device.
- 2 Output Impedance** refers to the impedance of the gate driver IC's output when driving the gate of a power device, influencing signal integrity and stability.
- 3 Output Rise/Fall Time** refers to the time required for the output voltage to transition from a low to a high state (or from a high to a low state). These parameters characterize the switching speed of the gate driver ICs.

Isolation parameters

Safety certifications

VDE, UL, CQC certifications

Isolation ratings

VDE and CQC certifications typically classify isolation ratings into basic isolation and reinforced isolation. Meanwhile, UL certification categorizes isolation ratings into single isolation and double isolation.

Isolation withstand voltage

It typically includes maximum operating isolation voltage, maximum transient isolation voltage, maximum surge voltage, and maximum impulse voltage.



Transmission parameters

- 1 Propagation delay** refers to the time delay between the input signal switching and the corresponding output signal change, indicating how quickly the gate driver responds to control signals.
- 2 Power up delay** refers to the delay period during which the device initializes its internal circuits, stabilizes its operating parameters, and ensures all internal components are ready to function correctly.
- 3 Pulse width distortion** refers to the difference between the input pulse width and the output pulse width due to varying propagation delays or non-uniform response times within the device. Minimizing pulse width distortion is critical to ensuring precise and reliable operation of the overall system, especially in high-frequency switching applications where timing accuracy is crucial.
- 4 Common Mode Transient Immunity (CMTI)** indicates the maximum rate of change of the common-mode voltage that the device can tolerate while still maintaining specified performance levels. Common-mode noise refers to voltage fluctuations that occur simultaneously on both input terminals of the device relative to a common reference point, such as ground. CMTI is typically specified in volts per microsecond ($V/\mu s$) and is an important parameter to consider when designing gate driver circuits for applications requiring high noise immunity and robust performance in industrial, automotive, and power electronics systems.

Protection parameters

- 1** Key parameters in the DESAT protection function include desaturation detection threshold, leading edge blank time, and deglitch filter time, etc.
- 2** Key parameters in the Miller Clamp function include clamp threshold, and clamp delay, etc.
- 3** Key parameters in the fault reporting function include fault delay, fault mute time, and fault output voltage, etc.

Categories of NOVOSENSE gate driver ICs

NOVOSENSE offers a comprehensive range of gate driver ICs products accommodating various power devices such as MOSFETs, IGBTs, SiC, GaN, and covering the majority of automotive and industrial applications including EVs, photovoltaics, energy storage, industrial automation, and power supplies, etc.



Classifications of NOVOSENSE gate driver IC products

1 Isolation method

By isolation methods, gate driver ICs products can be divided into galvanic isolated driver ICs and non-isolated driver ICs. Isolated driver ICs can meet the basic or reinforced isolation requirements, and have passed the isolation certifications such as VDE/UL/CQC. Non-isolated driver ICs do not have isolation safety certifications, but can meet functional isolation between high side and low side output by PN junction isolation or capacitive isolation technology.

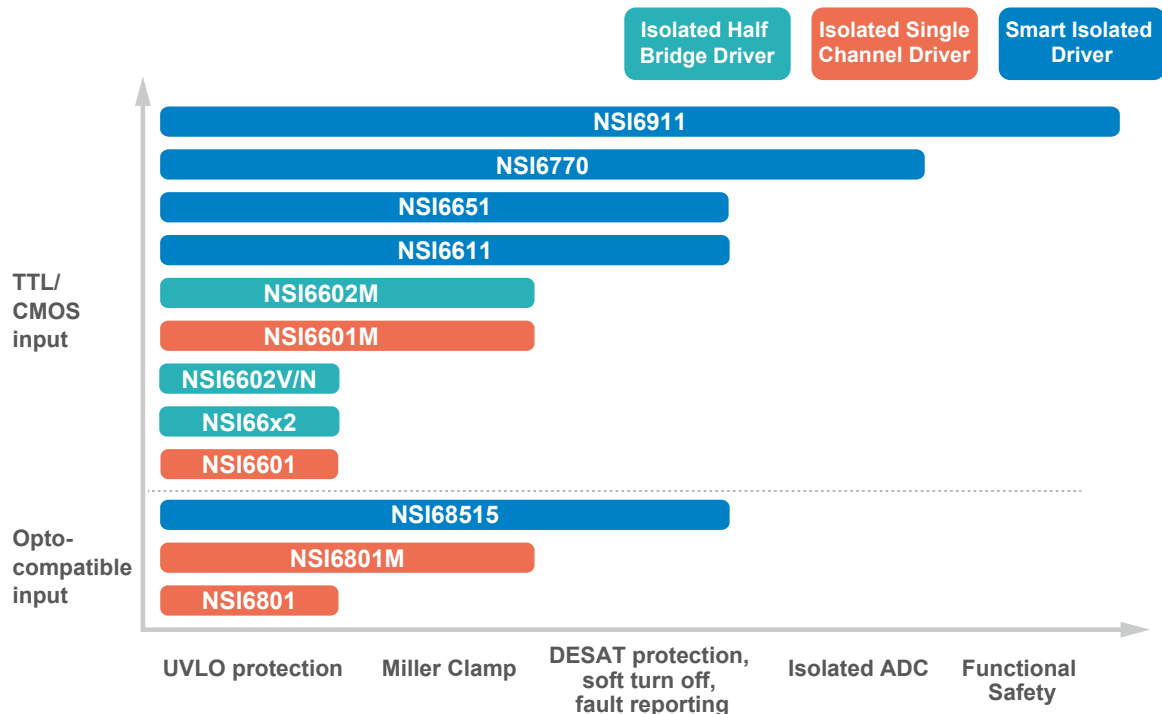
2 Application architecture

By the number of driver channels, gate driver ICs products can be divided into single-channel driver ICs and dual-channel driver ICs. By application architecture, they can be divided into low-side driver ICs and half-bridge driver ICs, etc. Especially, NOVOSENSE's 3rd generation semiconductor GaN series products cover not only gate driver ICs, but also integrated power stage ICs.

3 Protection function

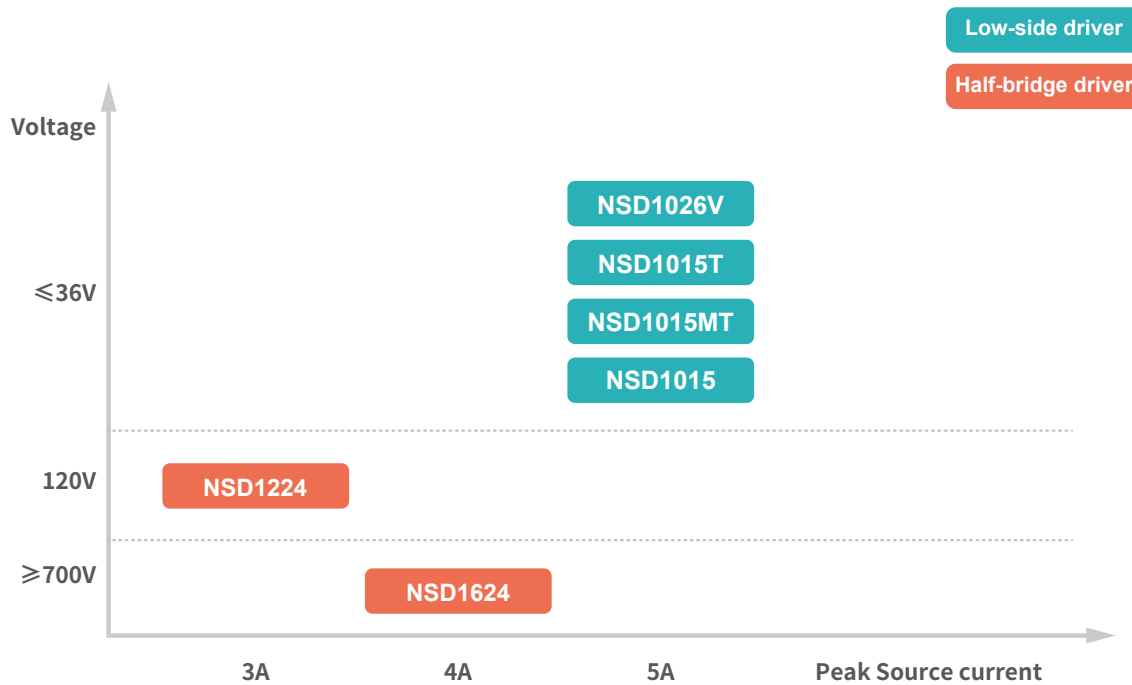
By protection functions, gate driver ICs products can be divided into general driver ICs and smart driver ICs. NOVOSENSE driver ICs integrate multiple optional protection functions. General gate driver ICs only provide UVLO function, and dead time protection, etc., while smart gate driver ICs integrate complicated protection functions such as DESAT protection, soft turn off, isolated ADC and fault reporting.

Isolated Driver

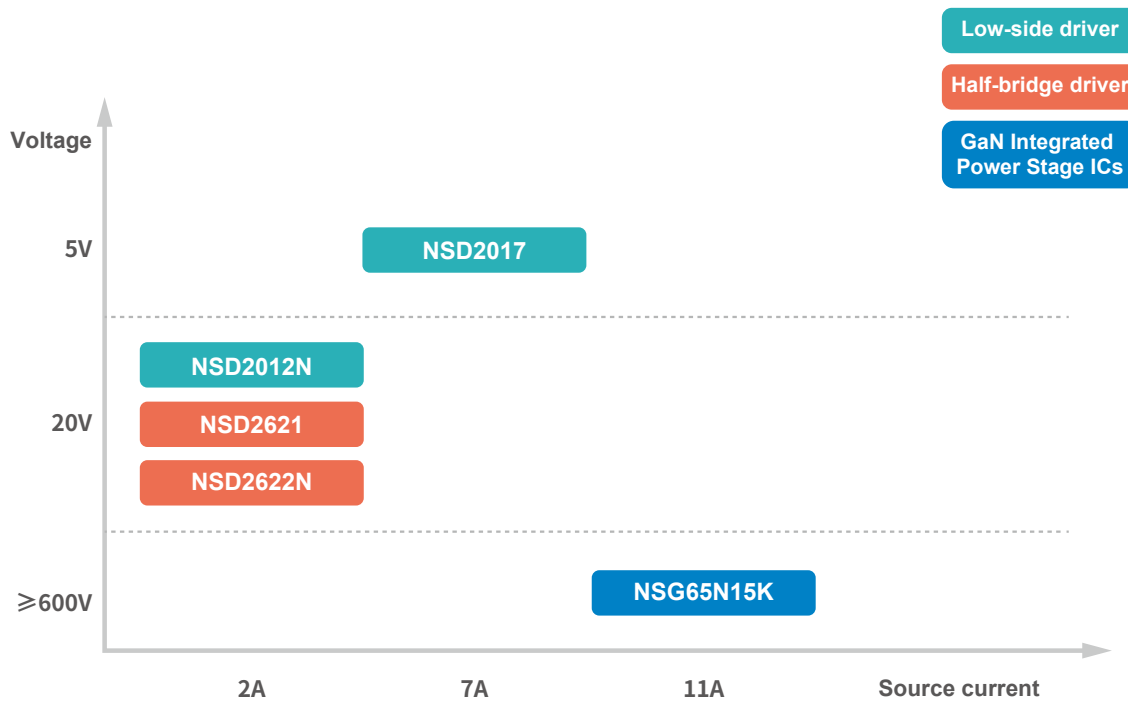




● Non-isolated Driver



● GaN Integrated Power Stage & Gate Driver



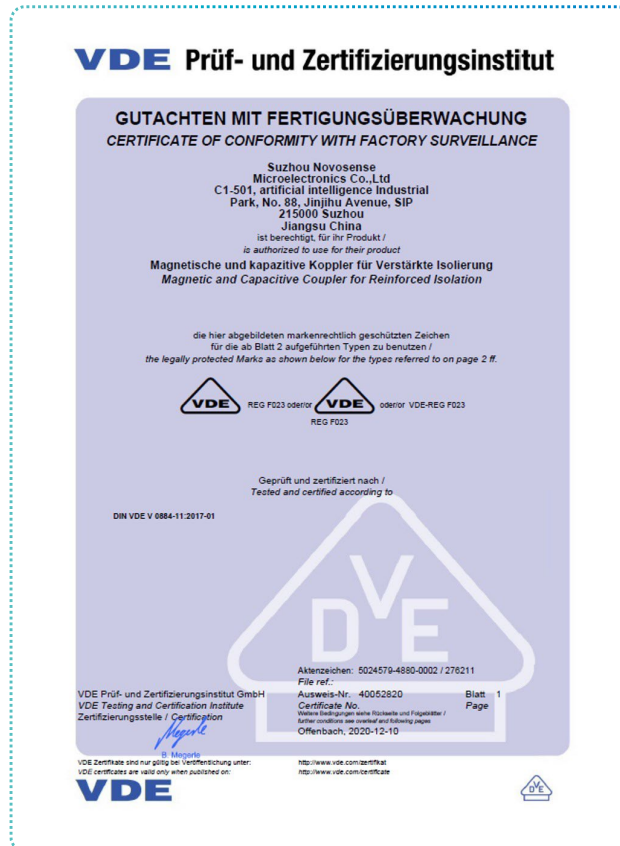
A microscopic view of a semiconductor wafer with a probe station. The wafer is covered in a complex pattern of circular and rectangular structures. A probe station is positioned above the wafer, with its probe tips touching the surface. The background is a gradient of blue and green.

NOVESENSE Gate Driver Technologies



Enhanced capacitive isolation technology withstanding surge voltage exceeding 10 kV

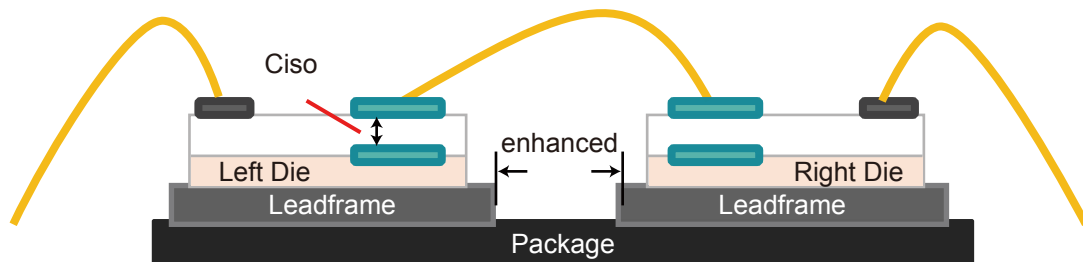
Currently, there are three mainstream isolation technologies in the market: opto-coupler isolation, magnetic coupling isolation, and capacitive coupling isolation. All isolated driver IC products from NOVOSENSE are designed with capacitive coupling isolation technology.



NOVOSENSE DIN VDE V 0884-11 reinforced isolation certificate

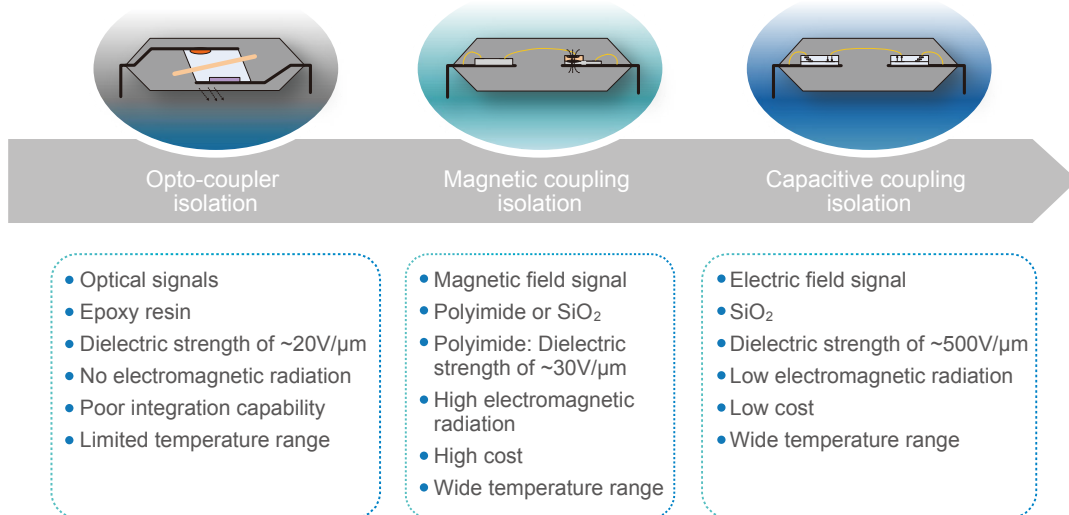
Series-connected SiO₂ isolation capacitors achieve reinforced insulation

NOVOSENSE uses enhanced capacitive isolation technology. The isolation medium utilizes silicon dioxide (SiO₂), renowned for its high dielectric strength exceeding 400V per micron, surpassing epoxy resin typically used in optocouplers by 5-6 times.

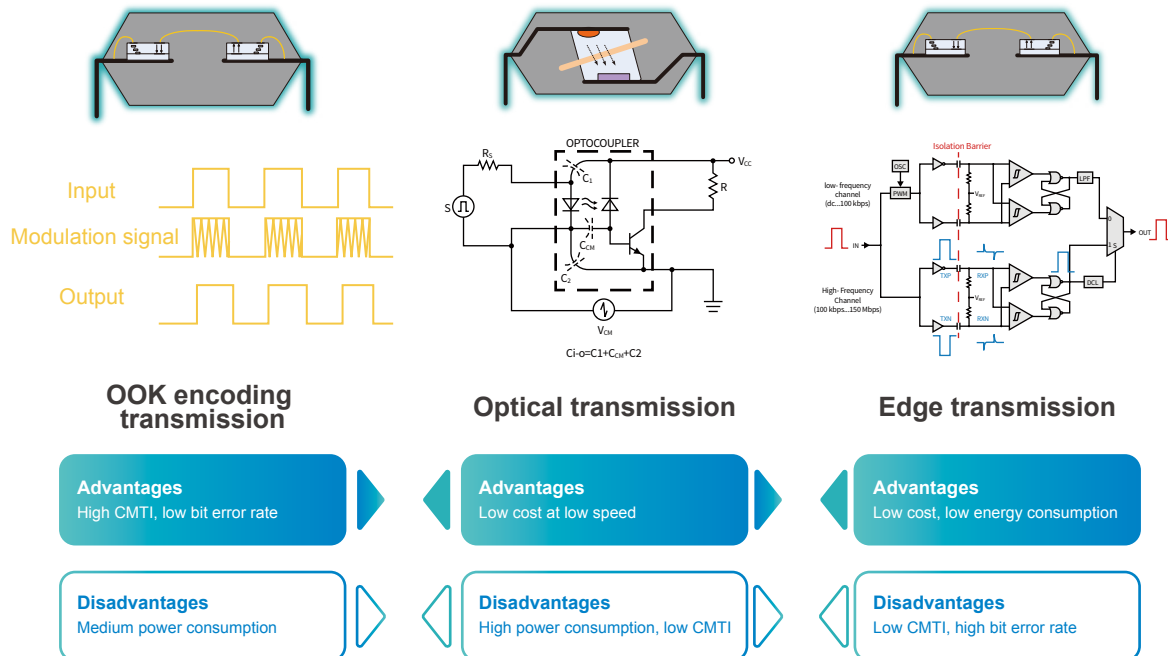




Comparison of different isolation methods



Signal modulation technology for high CMTI



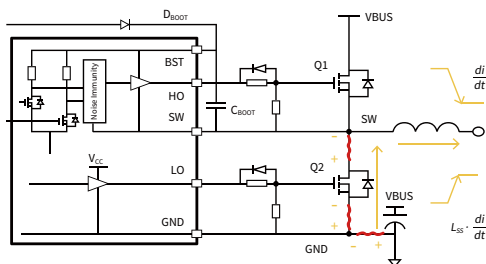


NOVOSENSE's Adaptive OOK® transmission technology

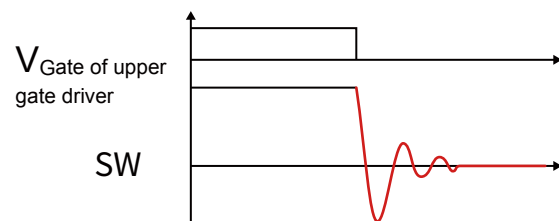
- 1 NOVOSENSE's Adaptive OOK technology utilizes advanced signal modulation to bolster the anti-interference capability and stability of digital isolation chips, enabling them to excel in high-speed switching and strong interference environments.
- 2 NOVOSENSE employs differential signal transmission per channel, which coupled with a dual-isolation capacitor architecture further suppresses the common-mode interference.
- 3 CMTI performance of NOVOSENSE isolated gate driver ICs: Typical CMTI >150kV/μs, and actual measurement up to 200kV/μs.

High-reliability half-bridge driver ICs: galvanic isolation or Level Shift technology

- 1 NOVOSENSE innovatively applies isolation technology to high-voltage half-bridge driver ICs, enabling the high-side to withstand up to 1200V DC voltage, while the SW pin meets the requirements of 150kV/μs dv/dt and high negative voltage spike tolerance. This solution addresses the pain points of high-voltage and high-frequency systems, therefore it is suitable for various high-voltage half-bridge, full-bridge, and LLC power supply topologies.
- 2 NOVOSENSE low-voltage half-bridge driver ICs employ the Level Shift technology, allowing the high-voltage output side to withstand up to 100V DC voltage. Additionally, to address the easy occurrence of negative voltage at the switching point of the half-bridge, the chip incorporates a unique internal circuit design to ensure that the SW pin can withstand negative voltage and operate reliably for a long time.



Effects of PCB trace parasitic inductance on switching behavior of SW pin



When the upper gate driver is turned off, SW will experience severe negative pressure

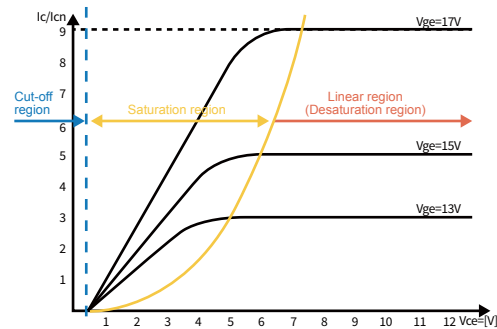


Integration of comprehensive protection functions

Selecting a right gate driver ICs can greatly enhance system reliability, simplify system design, and reduce R&D costs. NOVOSENSE smart gate drivers are integrated with a variety of protection functions to meet the specific requirements of different applications.

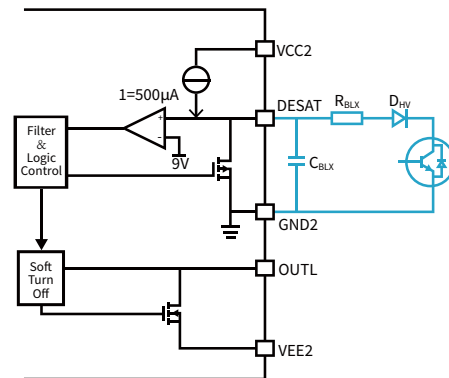
1 DESAT protection

Normally, the IGBT operates in the saturation region, where the collector-emitter voltage increases linearly with the collector current. However, when a short circuit occurs in the system, the collector-emitter voltage continues to rise without a corresponding increase of the collector current. This indicates that the IGBT has entered the linear region (also desaturation region). In the linear region, power dissipation in the IGBT increases significantly, leading to severe heating and a high risk of overheating failure.



Typical output characteristic curves of IGBT

Desaturation protection could protect the IGBT by detecting the short-circuit faults through the voltage of DESAT pin and promptly turning off the gate voltage of the IGBT. The peripheral circuit of DESAT pin, as shown in the figure on the right, mainly comprises a capacitor, a resistor, and a high-voltage diode. Under normal operation of the IGBT, the DESAT pin continuously source a $500\mu\text{A}$ current from inside circuit. This current will generate a relatively low voltage which clamped by collector-emitter voltage of the IGBT. As a short circuit fault occurs in the system, the V_{CE} of the IGBT rises rapidly, then the high-voltage diode cuts off in reverse bias, and a $500\mu\text{A}$ constant current source starts charging the capacitor CBLX. When the capacitor voltage reaches to the DESAT threshold, the desaturation protection mechanism of the driver ICs will be triggered, which turns off the gate voltage softly by a small sink current. At the same time, the FLT pin on the primary side is pulled low, signaling the short-circuit fault to the MCU. In addition, the internal MOSFET of the DESAT pin will be turned on to discharge the DESAT capacitor.

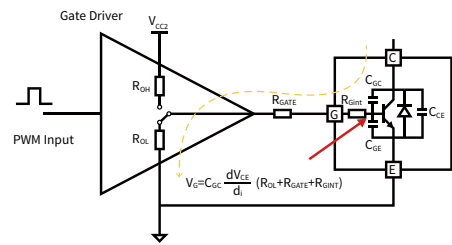


Description of the peripheral circuit of DESAT function



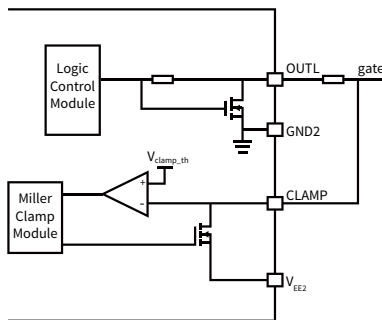
2 Miller Clamp

Miller Clamp is designed to address the challenge in half-bridge applications where the rapid change in dv/dt at the switching node during the turn-on of one power device inadvertently raise the gate voltage of the other power device, causing it to turn on as well. This leads to both power devices being on simultaneously, resulting in a short circuit. This phenomenon is known as the Miller effect. The figure below illustrates the path of the current under the Miller effect and the theoretical calculation formula for the erroneous increase in the gate voltage of power devices. When the voltage exceeds the power device's gate turn-on threshold, unintended turn-on of the power device will occur. For example, SiC/IGBT devices have a typical gate turn-on threshold voltage of 4-5V, while GaN devices have a lower threshold, making it more susceptible to unintended turn-on.

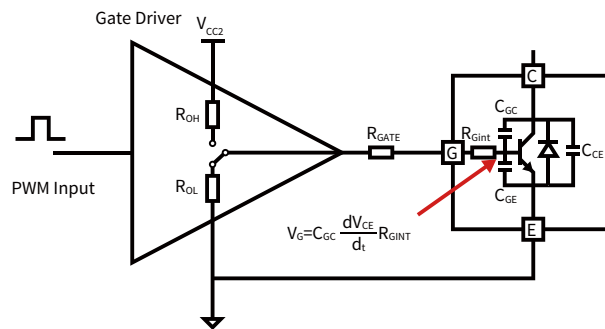


Schematic diagram of Miller effect in power devices

This is how the Miller Clamp function of a driver ICs works: the gate voltage of the power device will be detected, and once the gate voltage drops below the threshold of the internal comparator, the gate voltage of the power device will be directly pulled down through a low-impedance path. In this way, the effect of the Miller current on the gate circuit will be reduced and the gate voltage of the power device will be clamped to V_{EE} .



Block diagram of CLAMP function in NSI6611





ASIL D functional safety

1 Technical principle

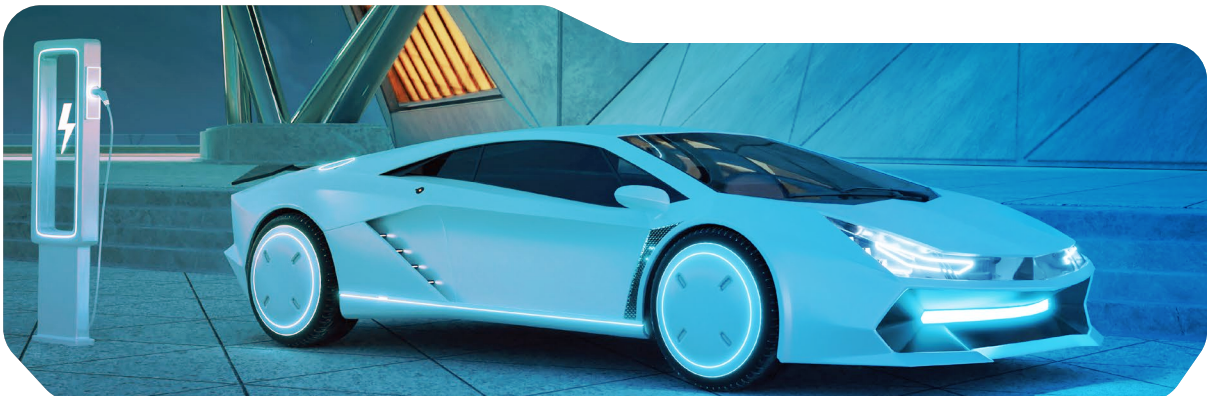
Functional safety gate drivers are applied in power module drive systems that require high-voltage isolation and safety requirements. Typical applications include IGBT/SiC power devices used in xEV traction inverters. The gate driver ICs identifies failure modes within the driver ICs itself, the power module, and the drive system. Working in tandem with the intrinsic safety mechanisms and the system-level safety control logic, the chip ensures the system to enter into a safe state within the fault tolerance time interval (FTTI), thereby preventing serious harm to personal safety caused by faults.

In the chip design and development process, methods such as project management, functional safety management, Change Control Board (CCB), configuration management, functional safety analysis (FTA, DFA, DFMEA, FMEDA), and functional safety verification measures have been adopted to reduce the probability of random hardware failures and avoid systemic failures.



2 System value

Using intelligent analog front-end (AFE) chips that meet the functional safety standards for development of functional safety components, can greatly simplify the system development process, reduce the complexity of hardware and software design, lower the failure risks, and improve the reliability and robustness. Functional safety gate driver ICs from NOVOSENSE could not only achieve all the benefits as mentioned above but also support software-based intelligent configuration, enabling differentiated configuration development for various applications and power devices.





3 Product features

- **Rigorous development process:** NOVOSENSE's functional safety drivers follow the semiconductor functional safety product development process (with ISO26262 ASIL-D process system certification), and meet the ASIL-C or D system-level functional safety requirements based on SEooC (Safety Elements out of Context) at all stages of development and manufacturing, including definition, design, verification, and production.
- **Well-designed diagnostic mechanisms:** They have independent safety architecture and redundant design which can avoid common cause failures and cascading failures, and various self-check measures including voltage and current diagnostics, communication diagnostics, configuration diagnostics, gate status diagnostics, and ICs overheat alarm.
- **Robust fault protection:** They provide fault protection mechanisms, such as DESAT, overtemperature, overcurrent, short circuit, Miller Clamp, V_{CE} overshoot, and shoot-through protection, as well as two-level turnoff and soft turnoff protection actions.
- **Flexible parameter configuration:** They support configuring different parameters such as thresholds, gate voltage, filter time, and protection activation time by SPI. The chips can enter the ASC state through a separate fail-safe pin.
- **Reliable drive capability:** The low-voltage side supports 5-12V power supply, and 3.3/5V level logic; the high-voltage side supports positive and negative voltage supply, adjustable gate driver voltage, and drive current of over 15A; CMTI of more than 150kV/μs, and isolation withstand voltage V_{iso} of more than 5kVrms.
- **Rich extended functions:** The high-voltage side integrates an LDO that can output 5V@20mA externally, a 12-bit high-precision isolated ADC, and functions such as temperature sampling and DC Link voltage sampling.



NOVOSENSE ISO26262 functional safety system certificate



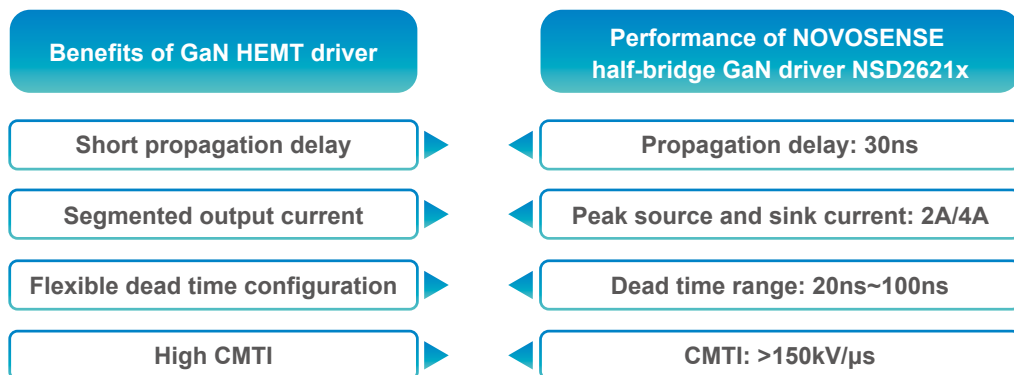
GaN driver technology

1 Features of GaN drivers technology

GaN HEMT features low threshold voltage, low gate charge, high switching frequency, low on-resistance by driver side. Currently, GaN HEMTs are mainly classified into Depletion Mode (D-mode) and Enhancement Mode (E-mode). Specifically, D-mode GaN HEMT typically involves a Cascade (common source common gate) structure by cascading low-voltage Si MOSFET devices. E-mode GaN HEMT has a simple structure and lower switching losses, and can be turned off directly at zero voltage. Undoubtedly, E-mode GaN HEMT also has certain disadvantages, such as extreme sensitivity to parasitic parameters in high-frequency applications, which can easily cause gate oscillation and overvoltage during hard switching. In response to the characteristics of E-mode GaN HEMT, such as low gate voltage and sensitivity to parasitic parameters, NOVOSENSE GaN HEMT drivers use an LDO for stable voltage output, and employ segmented switches to regulate the turn-on and turn-off speed of GaN HEMT, thereby reducing the drain-source voltage stress and gate oscillation voltage of GaN HEMT.

2 Benefits of NOVOSENSE GaN drivers

- NOVOSENSE GaN HEMT driver employs an LDO for stable voltage output. This allows the ability to output stable driving voltage and avoid output voltage fluctuations caused by system noise or power supply voltage fluctuations, which otherwise can lead to gate overvoltage failure of the GaN HEMT.
- Segmented switches can effectively regulate the switching speed of GaN HEMT, reducing the drain-source voltage stress of GaN HEMT and gate oscillation, and improving EMI.
- Separate source and sink currents allow flexible configuration of drive resistance and easy system design.
- QFN package design results in smaller parasitic inductance.
- Based on capacitive isolation technology provides higher CMTI and ability to withstand voltage change rate of more than 150kV/μs.





Typical Applications

Leveraging a deep understanding of application systems, NOVOSENSE gate driver IC products can provide comprehensive solutions and support for various applications.





Automotive electronics



NOVOSENSE automotive-grade gate driver ICs are extensively utilized in the electric powertrain and thermal management system of xEVs. Certified under rigorous safety standards, these products offer a range of protection features and functional safety capabilities. They enable our customers to design more reliable and secure automotive systems.

Key considerations for product selection

xEV electric powertrain system is crucial for the performance and safety of automotives. The key considerations in selection of a gate driver are as follows:



Ensure safety and reliability by AEC-Q100 qualified



Appropriate UVLO and drive current parameters for power devices



Isolated driver IC meeting safety certification requirements



Intelligent driver IC integrating multiple protections

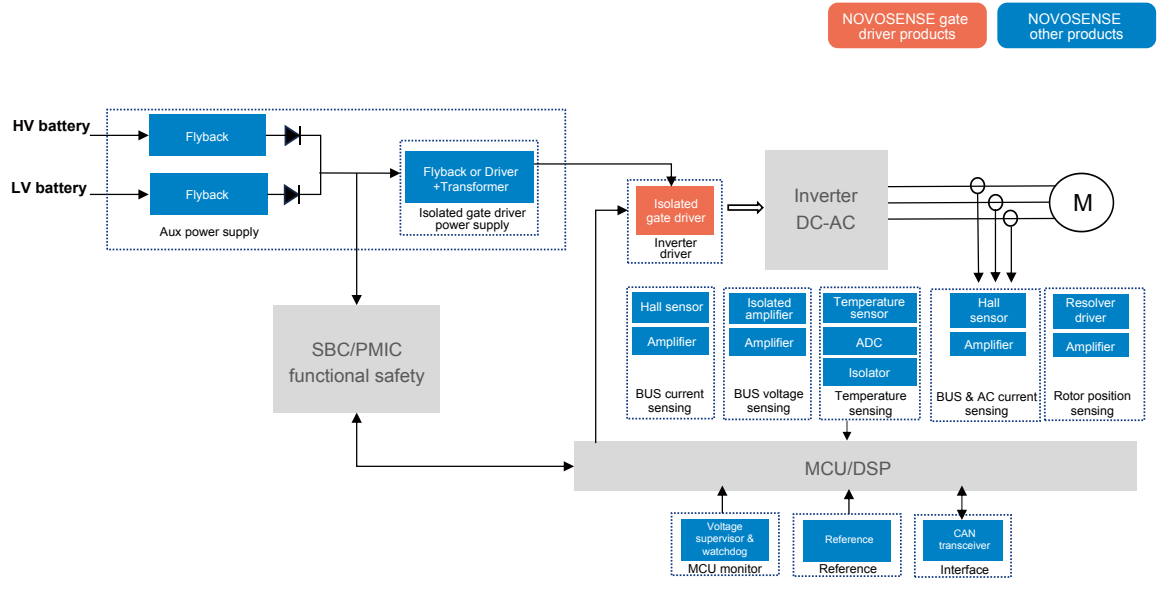


Compliance with functional safety requirements per ISO 26262

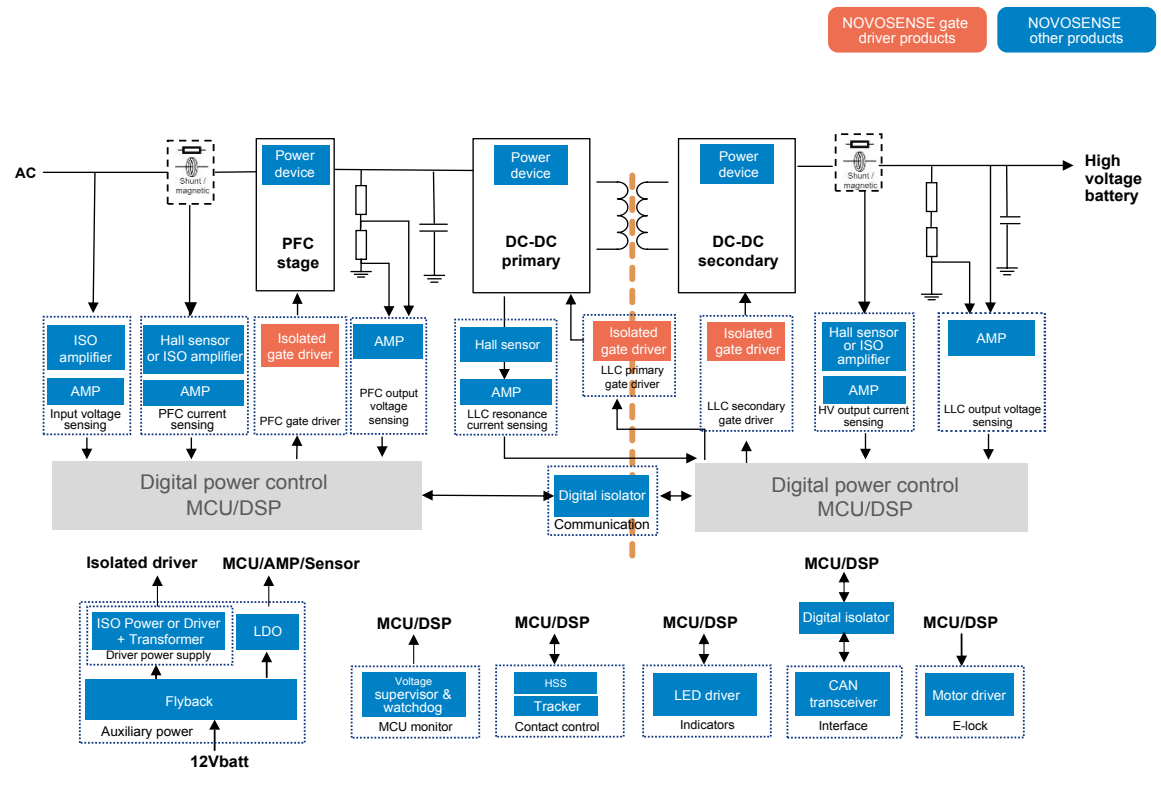


xEV automotive electric powertrain

Traction Inverter

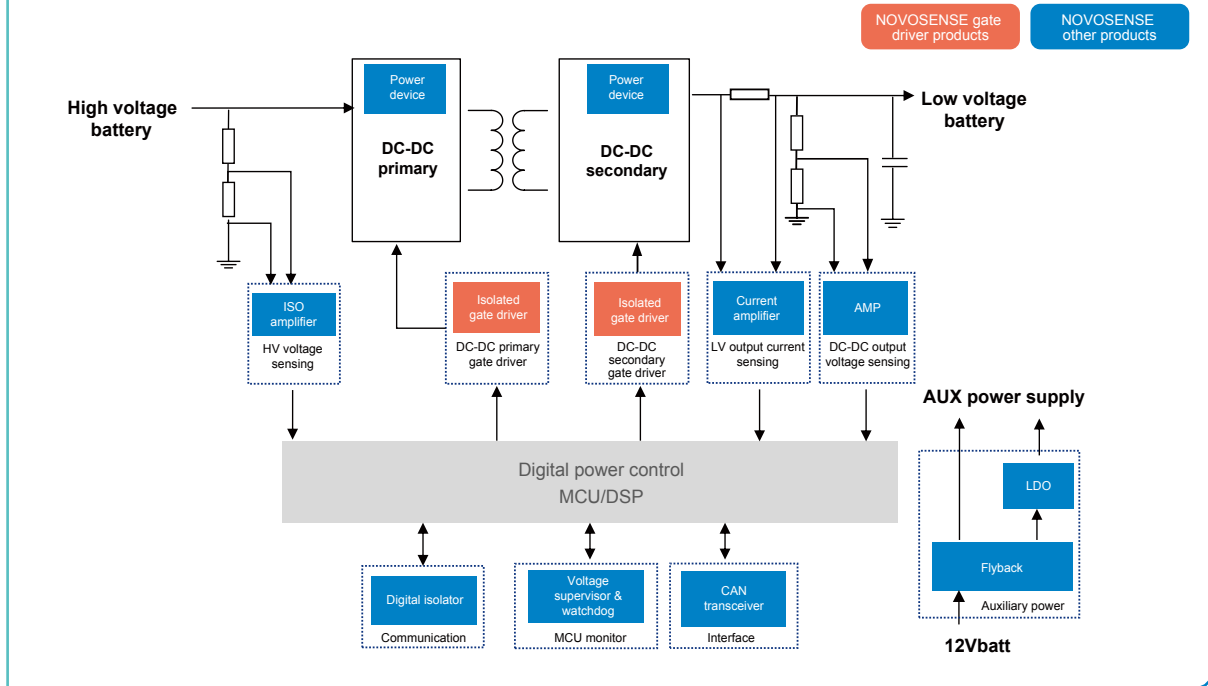


OBC





DC-DC Converter



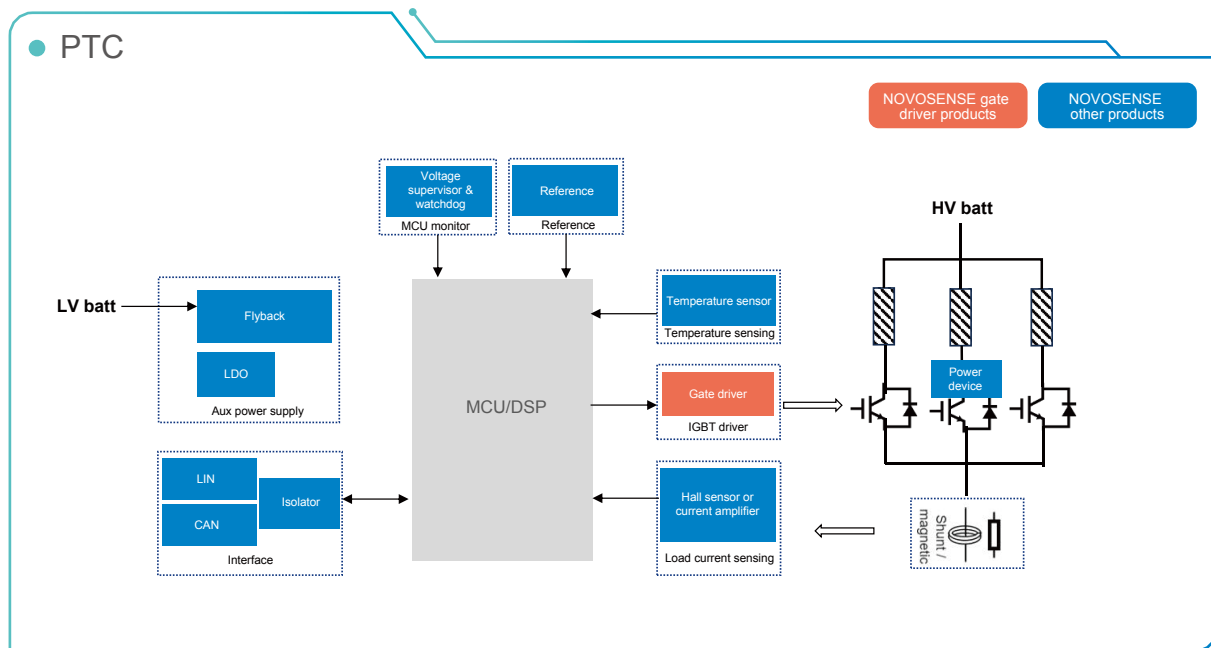
Product recommendations

Application	Recommended product category	Part number of recommended product	Recommended package	Product description	Application description
Traction inverter	Functional safety driver	NSI6911-Q1	SSOW32	Single-channel isolated gate driver integrated with functional safety and multiple protective functions	Functional safety driver, supporting SiC/IGBT
	Smart isolated driver	NSI6611-Q1	SOW16	10A Single-channel isolated gate driver integrated with ASC and multiple protective functions	Non-functional safety driver, supporting SiC/IGBT
		NSI6651-Q1	SOW16	10A Single-channel isolated gate driver integrated with multiple protective functions	Non-functional safety driver, supporting SiC/IGBT
		NSI6770-Q1	SOW16	10A Single-channel isolated gate driver integrated with Isolated Analog Sensing and multiple protective functions	Non-functional safety driver, supporting SiC/IGBT
Low-side driver	NSD1026V-Q1	HSOP8/SOP8/HMSOP8	High-speed dual-channel low-side gate driver	Collaborate with transformer to provide power for the isolated driver	
OBC/DC-DC	Isolated single-channel driver	NSI6601-Q1	SOP8/SOW8	Single-channel isolated gate driver	OBC&DCDC primary-side driver, supporting SiC/IGBT/MOSFET
		NSI6601M-Q1	SOP8/SOW8	Single-channel isolated gate driver integrated with Miller Clamp	OBC&DCDC primary-side driver, supporting SiC/IGBT/MOSFET
		NSI68010-Q1	SOW6	Opto-compatible single-channel isolated gate driver	OBC&DCDC primary-side driver, supporting SiC/IGBT/MOSFET



Application	Recommended product category	Part number of recommended product	Recommended package	Product description	Application description
OBC/DC-DC	Isolated half-bridge driver	NSI6602V-Q1	SOP16/SOW16/ SOP14/SOW14	High-performance dual-channel isolated gate driver	OBC&DC-DC primary-side driver, supporting SiC/IGBT/MOSFET
		NSI6622V-Q1	SOP16/SOW16/ SOP14/SOW14	Dual-channel isolated gate driver without dead time configuration	OBC&DC-DC primary-side driver, supporting SiC/IGBT/MOSFET
		NSI6602U-Q1	SOP16/SOW16/ SOP14/SOW14	Dual-channel isolated gate driver integrated with UVLO alarm	OBC&DC-DC primary-side driver, supporting SiC/IGBT/MOSFET
	Low-side driver	NSD1026V-Q1	HSOP8/SOP8/ HMSOP8	High-speed dual-channel low-side gate driver	DC-DC secondary-side synchronous rectification driver, collaborate with the transformer to provide power for the isolated driver

Automotive thermal management systems

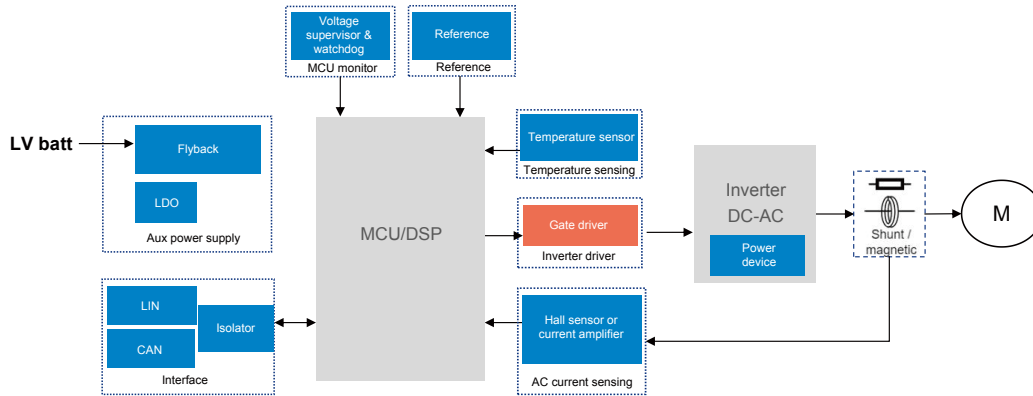




E-compressor

NOVOSENSE gate driver products

NOVOSENSE other products

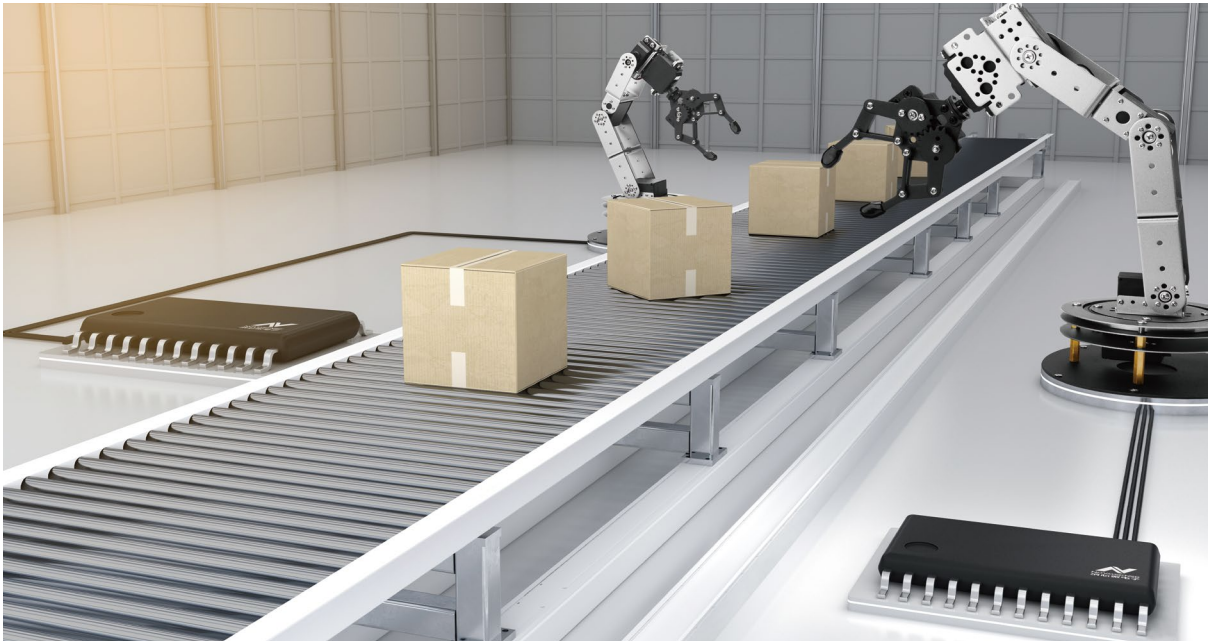


Product recommendations

Application	Recommended product category	Part number of recommended product	Recommended package	Product description	Application description
PTC & E-compressor	Isolated single-channel driver	NSI6601-Q1	SOP8/SOW8	Single-channel isolated gate driver	Driver for PTC application, supporting SiC
		NSI6601M-Q1	SOP8/SOW8	Single-channel isolated gate driver integrated with Miller Clamp	Driver for PTC application, supporting SiC
	Isolated half-bridge driver	NSI6602V-Q1	SOP16/SOW16/ SOP14/SOW14	High-performance dual-channel isolated gate driver	Driver for E-Compressor, supporting SiC/IGBT
	>600V half-bridge driver	NSD1624-Q1	SOP8/ SOP14	Half-bridge gate driver supporting above +/-700V	Driver for E-Compressor, supporting SiC/IGBT
	Low-side driver	NSD10151-Q1	SOT23-6	High-speed single-channel low-side gate driver	Driver for PTC application, supporting SiC/IGBT
		NSD1015MT-Q1	SOP8	Single-channel low-side gate driver integrated with DESAT protection	Driver for PTC application, supporting SiC/IGBT
		NSD1026V-Q1	HSOP8/SOP8/ HMSOP8	High-speed dual-channel low-side gate driver	Driver for PTC application, supporting SiC/IGBT



Industrial automation



NOVOSENSE gate drivers are extensively used in industrial automation applications, such as industrial drives, stepper motor controllers, servo drives, and battery formation and capacity grading. The products equipped with NOVOSENSE gate driver ICs have achieved stable mass production in many leading customers in the industrial automation industry, and their reliability and stability have been well proved by the market and customers.

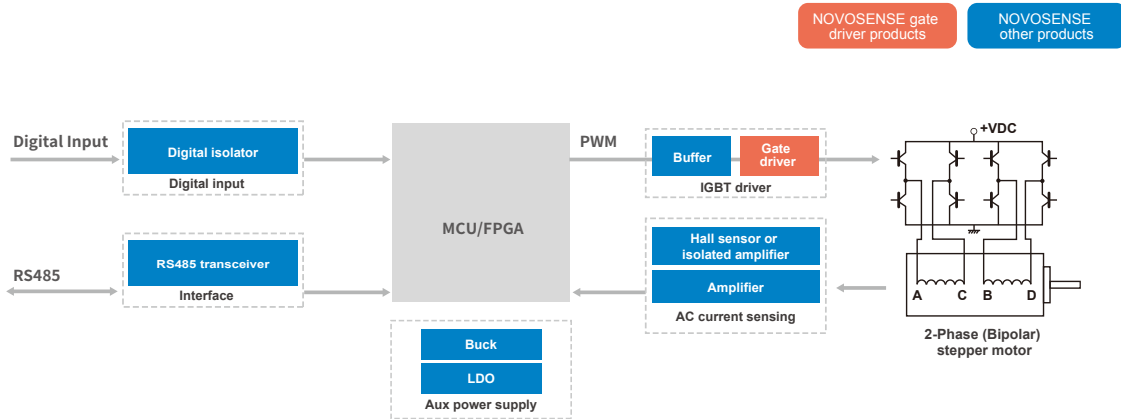
Key considerations for product selection

In the application scenario of industrial automation, it usually has the harsh electromagnetic compatibility (EMC) and high voltage conditions. To find the best fit gate driver, special considerations need to be taken into account:

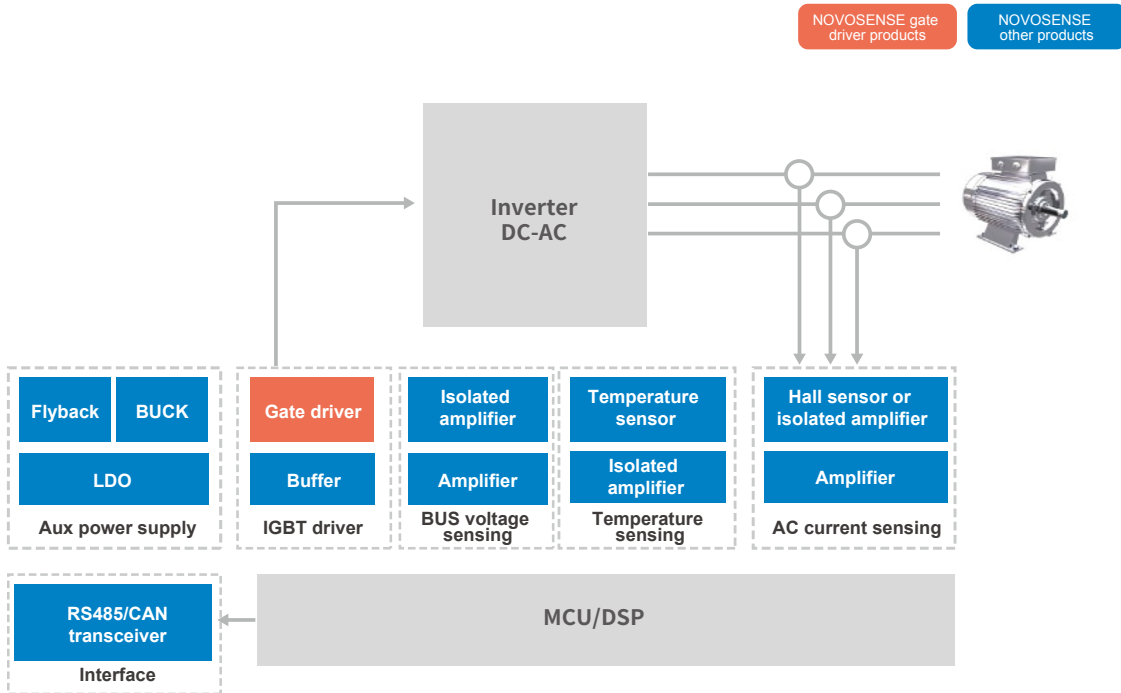
- 1 Is it compatible with opto-coupler drivers?
- 2 Does it meet the requirements of safety standards?



Stepper motor driver

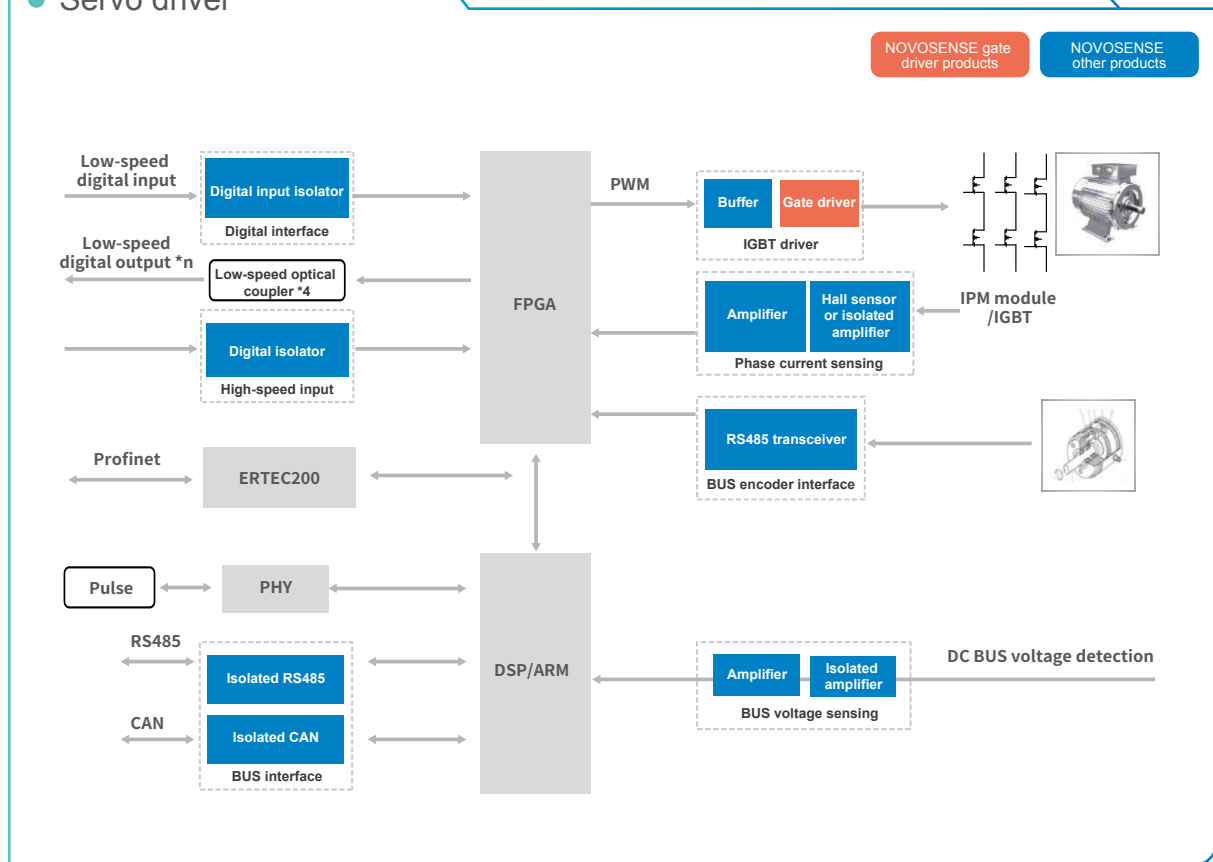


Industrial frequency converter

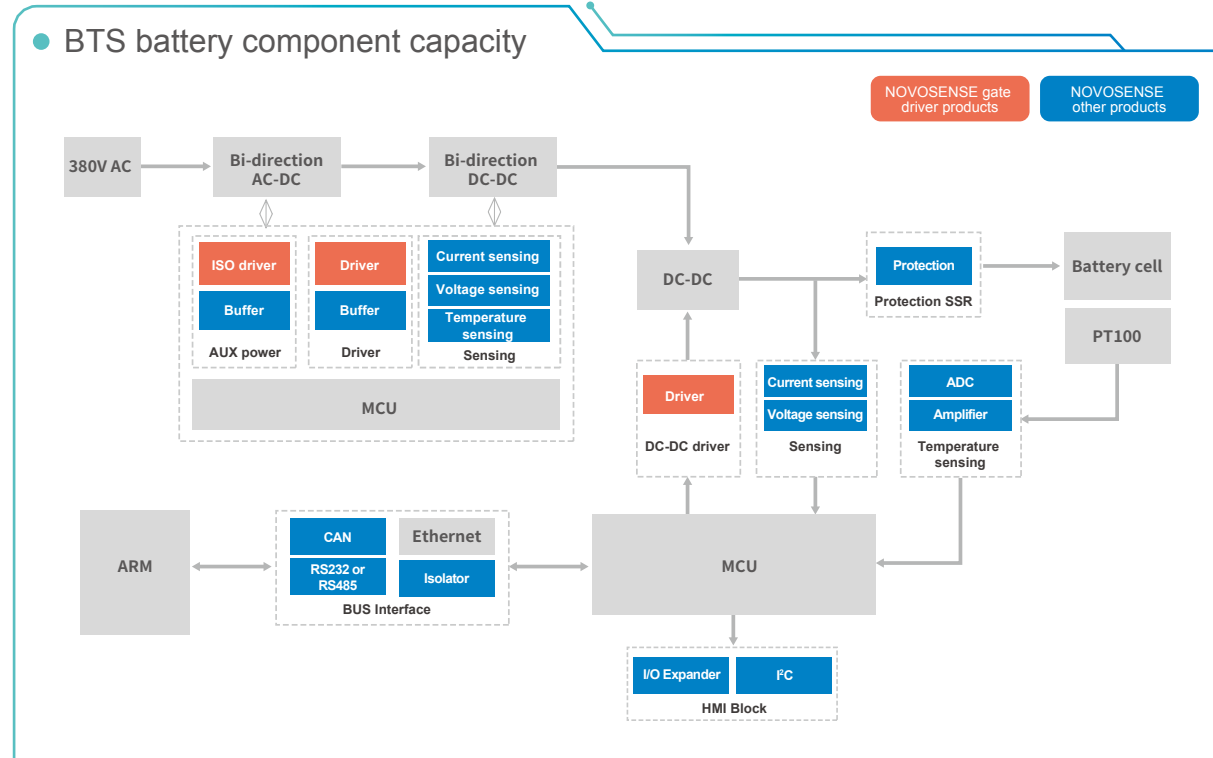




Servo driver



BTS battery component capacity





Product recommendations

Application	Recommended product category	Part number of recommended product	Recommended package	Product description	Application description
Stepper motor driver & industrial frequency converter & servo driver	Isolated single-channel driver	NSI6801E	SOW6/DUB8/SOL6/SOWW8	5A single-channel opto-compatible isolated gate driver	Motor driver
		NSI68010/1	SOW6	1A/2A single-channel opto-compatible isolated gate driver	Motor driver
		NSI6801M	SOP8/SOW8	5A single-channel opto-compatible isolated gate driver integrated with Miller Clamp	Motor driver, especially suitable for applications with high interference
	Smart isolated driver	NSI68515	SOW16	5A single-channel opto-compatible isolated gate driver integrated with multiple protection	Motor driver, especially suitable for upper gate drivers in high-power motors
	Low-side driver	NSD1015MT	SOP8	Single-channel low-side gate driver integrated with DESAT protection	Motor drive for hot ground solutions, especially suitable for high-power motor driver
BTS battery component capacity	Isolated half-bridge driver	NSI6602VD	SOP16/SOW16/SOP14/SOW14	High-performance dual-channel isolated gate driver integrated with 4V UVLO	GaN driver
	GaN half-bridge driver	NSD2621	QFN15	Half-bridge GaN gate driver supporting +/-700V and above	High-voltage LLC-stage GaN driver
		NSD2622N	QFN 5*7	Half-bridge GaN gate driver supporting +/-700V and above and integrated with negative voltage output	High-voltage LLC-stage GaN driver
<200V half-bridge driver	NSD1224	DFN10/SOP8/HSOP8/DFN8	Half-bridge gate driver supporting 100V and above	Low-voltage driver for BUCK	



Renewable energy and power supply



Power intensity and reliability represent consistent pursuits in the energy and power applications. NOVOSENSE can provide highly reliable gate driver solutions that provide enhanced interference immunity and protective functions to ensure system safety and stability.

Key considerations for product selection



Isolated drivers meeting safety certification requirements:

Meeting electrical isolation requirements and enhanced interference immunity

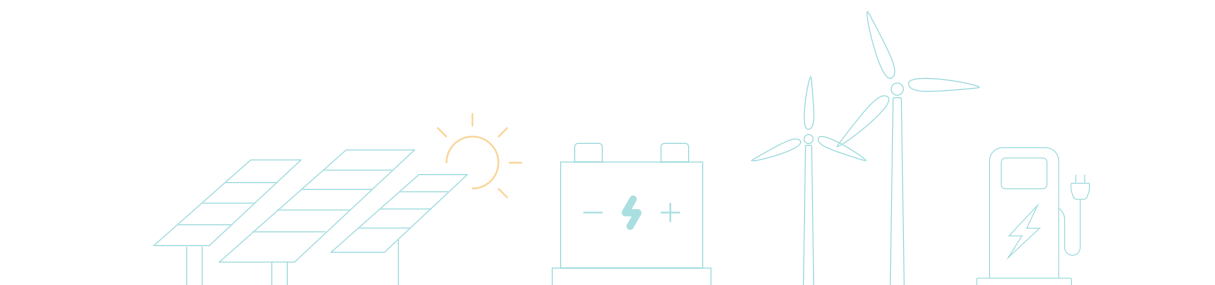


Appropriate UVLO and drive current parameters:

Suitable for characteristic parameters of power devices



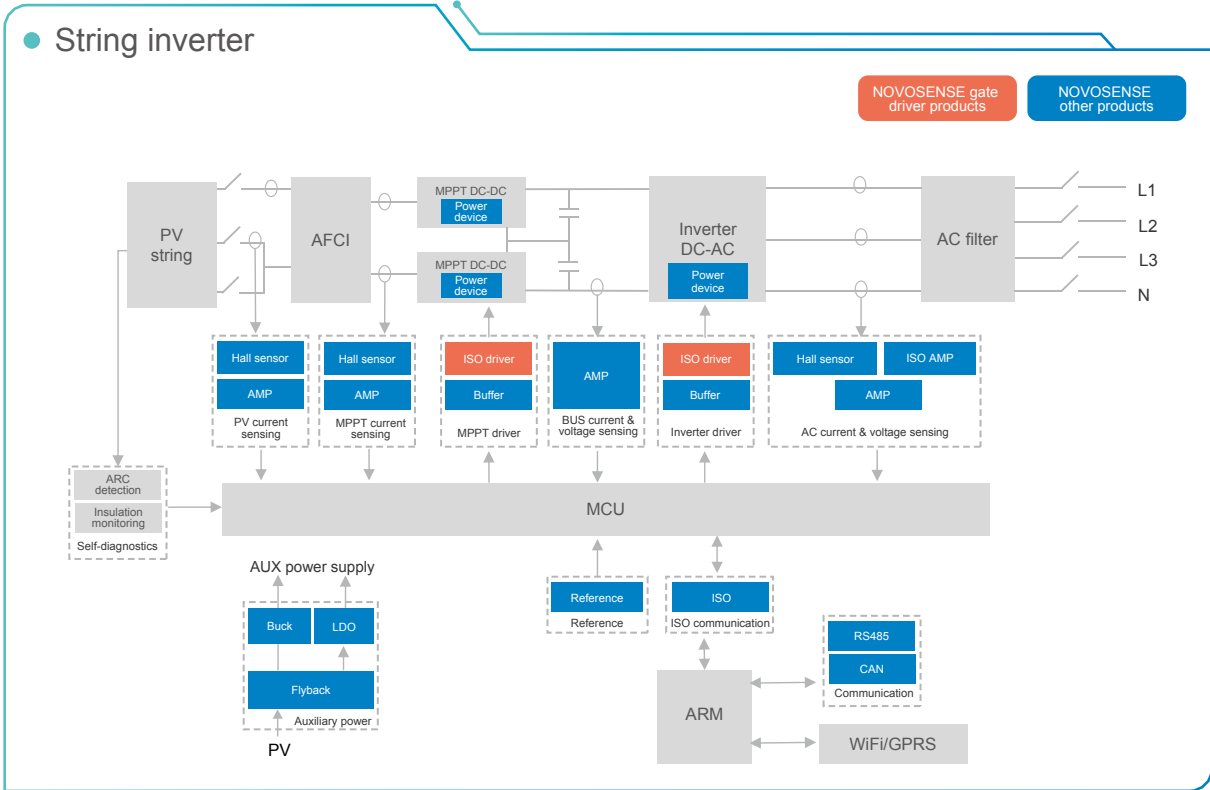
Package selection ensuring right creepage distance



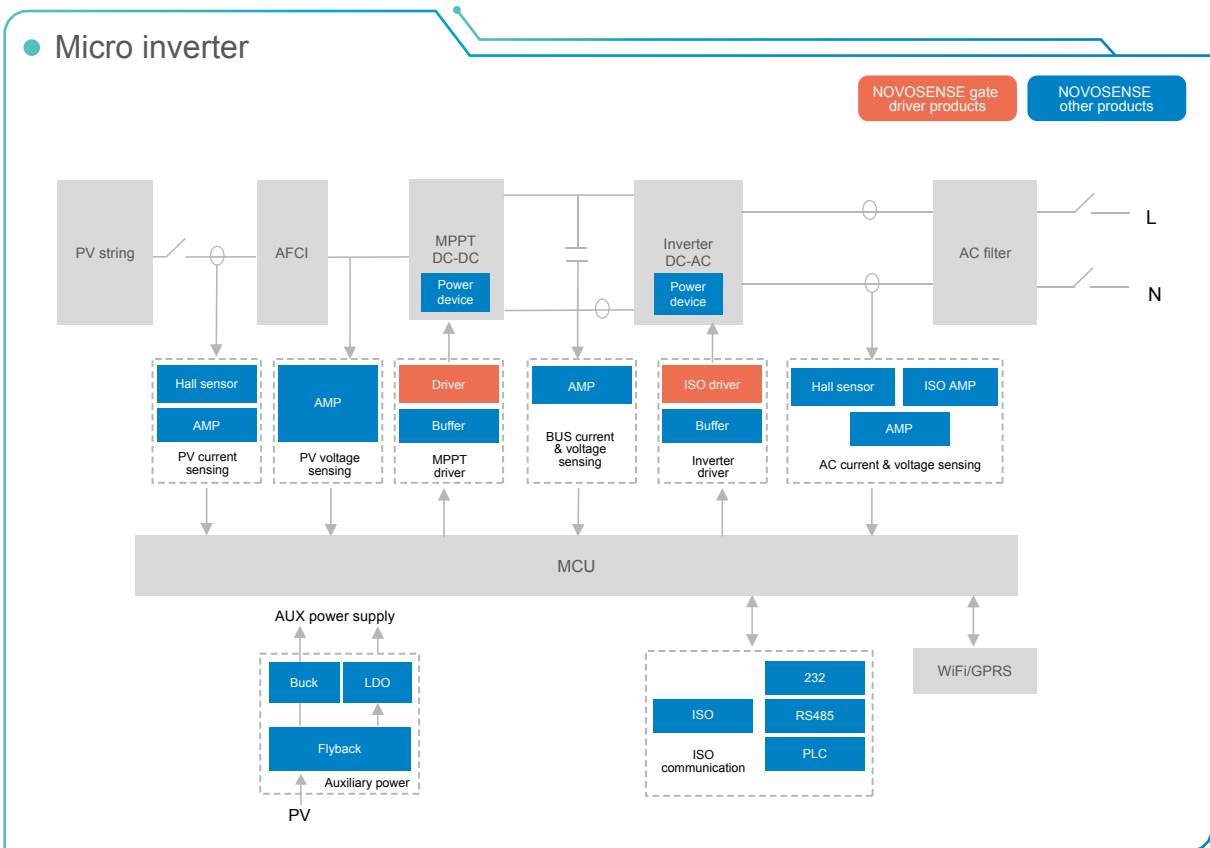


PV, energy storage and charging applications

String inverter

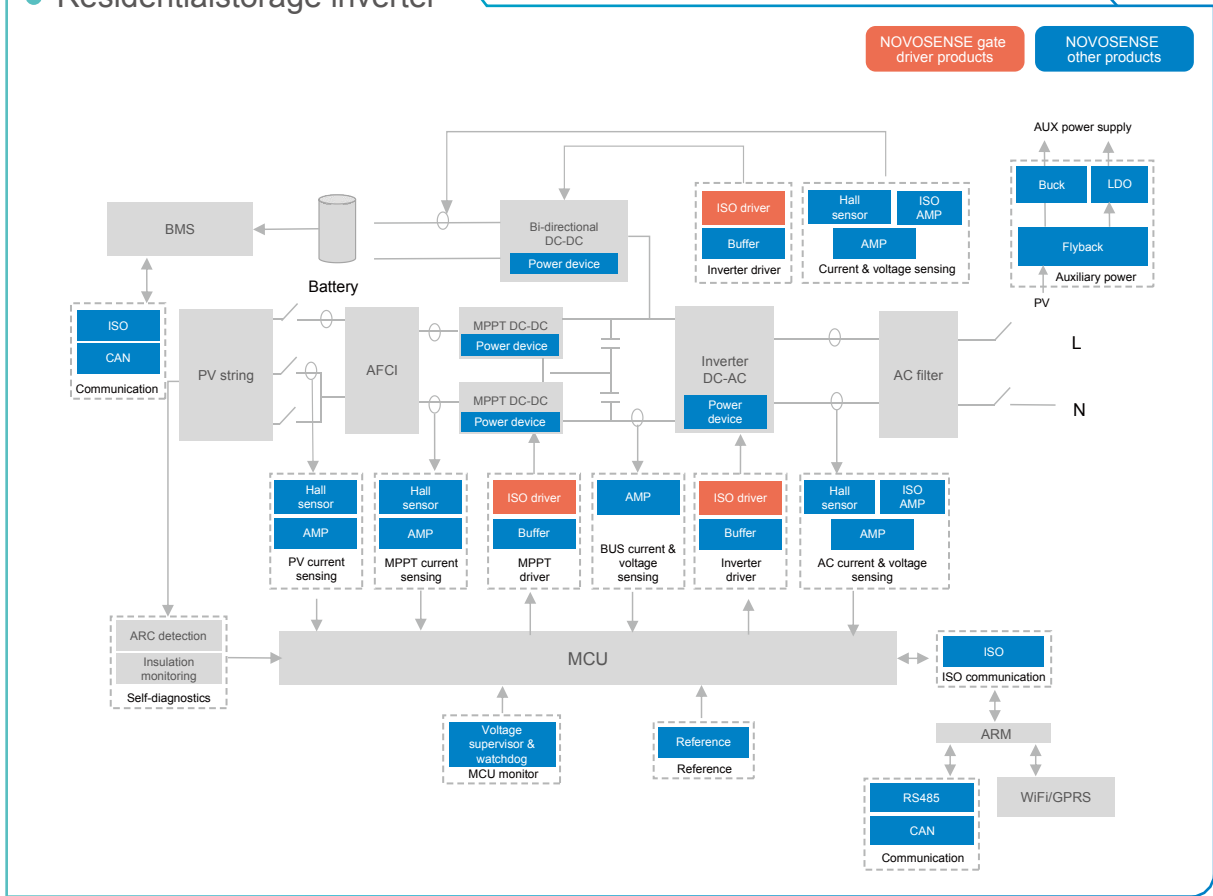


Micro inverter

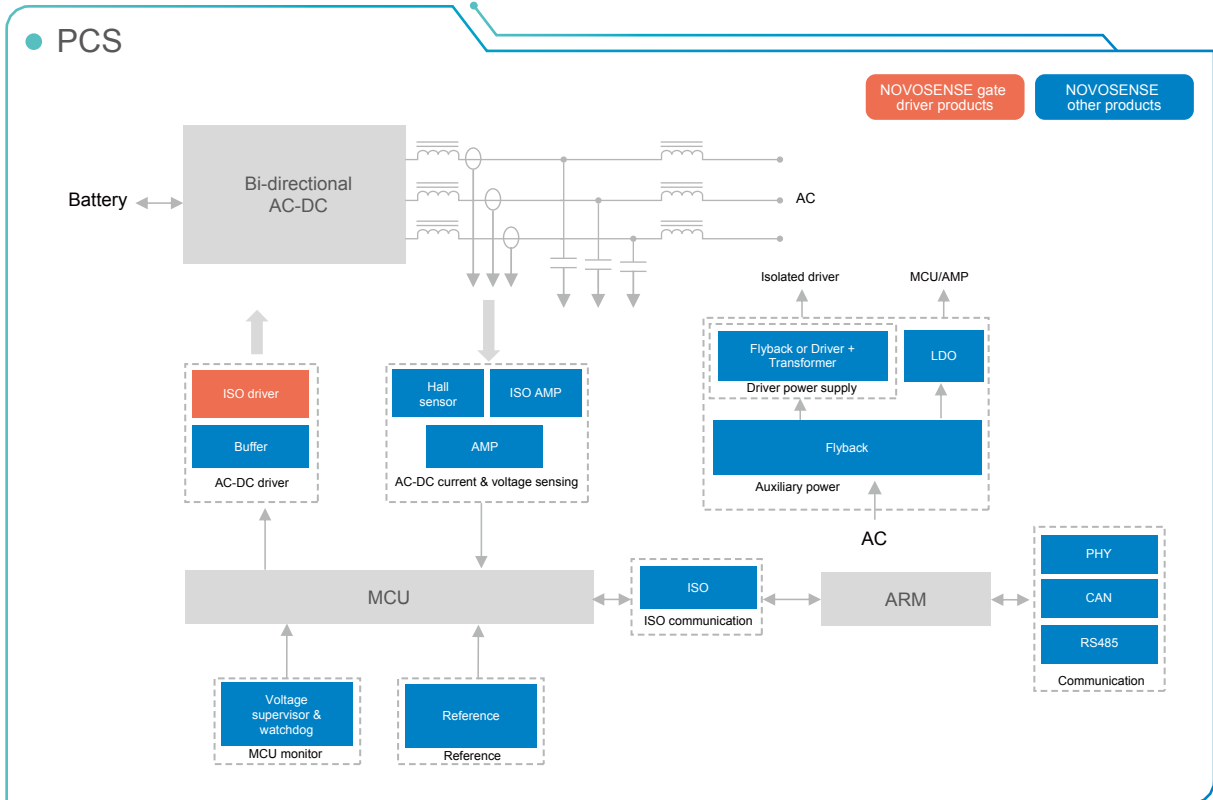




Residential storage inverter

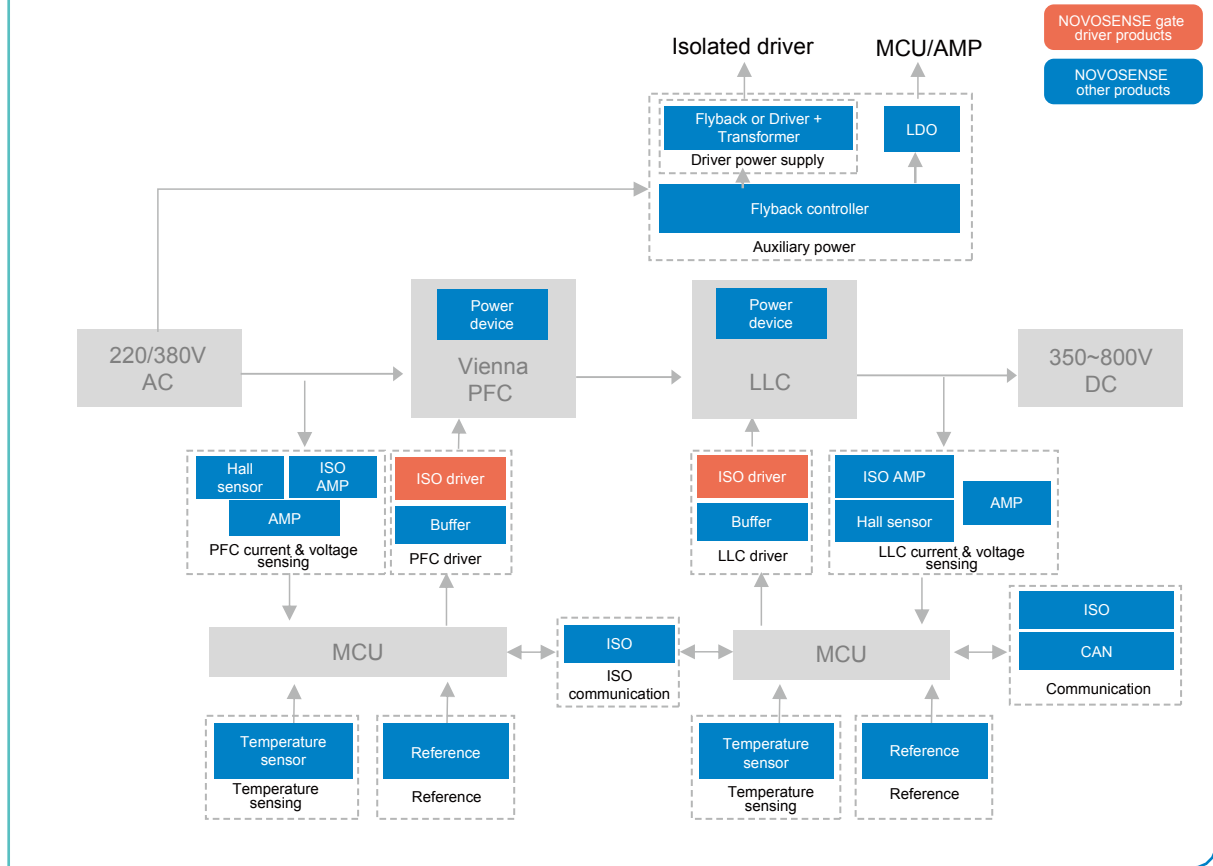


PCS





Power module



Product recommendations

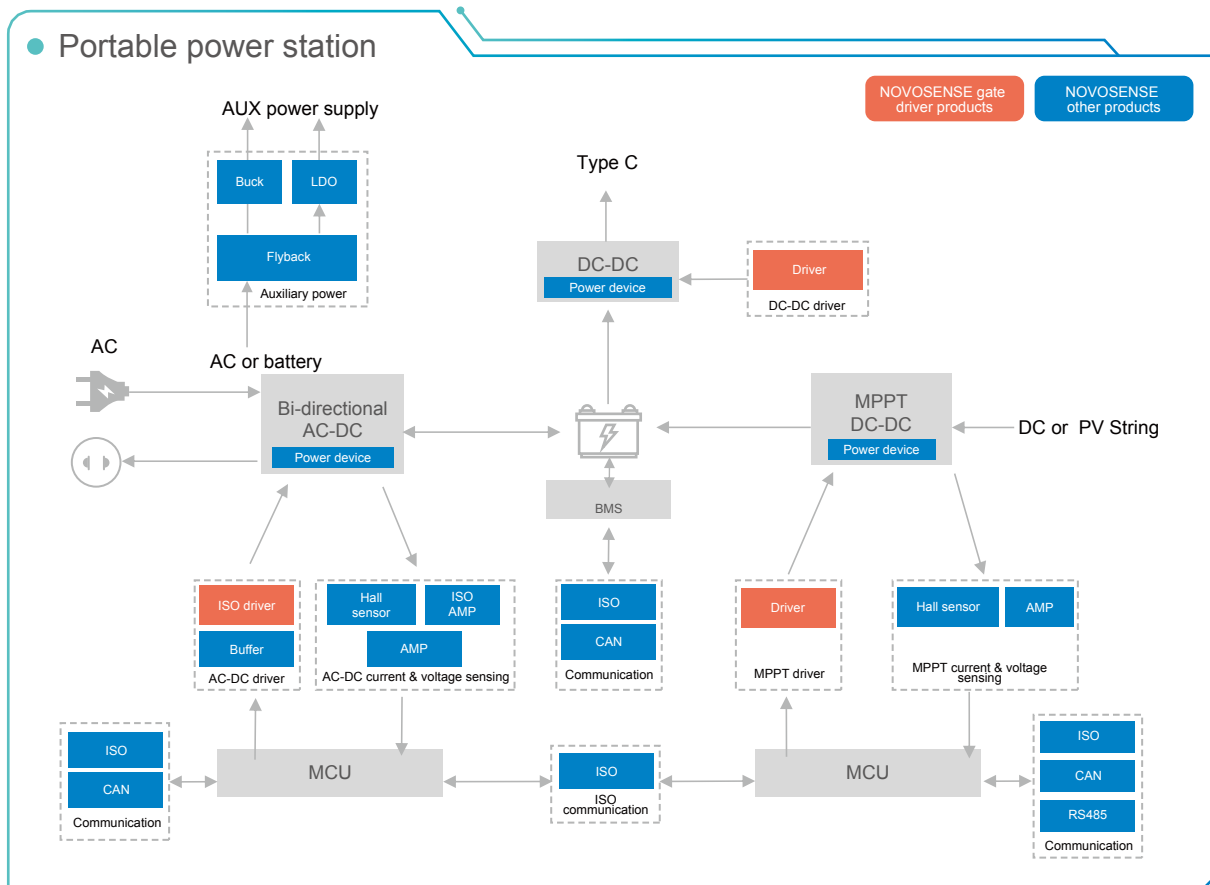
Application	Recommended product category	Part number of recommended product	Recommended package	Product description	Application description
String inverter & micro inverter & residential storage inverter & PCS & power module	Isolated single-channel driver	NSI6601	SOP8/SOW8	5A Single-channel isolated gate driver	MOSFET/IGBT/SiC driver
		NSI6801E	SOW6/DUB8/SOWW8/SOL6	5A single-channel opto-compatible isolated gate driver	MOSFET/IGBT/SiC driver
		NSI6601M	SOP8/SOW8	Single-channel isolated gate driver integrated with Miller Clamp	MOSFET/IGBT/SiC driver, especially suitable for applications with high interference
		NSI6801M	SOP8/SOW8	5A single-channel opto-compatible isolated gate driver integrated with Miller Clamp function	MOSFET/IGBT/SiC driver, especially suitable for applications with high interference
	Smart isolated driver	NSI6611	SOW16	10A Single-channel isolated gate driver integrated with ASC and multiple protective functions	MOSFET/IGBT/SiC driver, especially suitable for high-power applications
		NSI6651	SOW16	10A Single-channel isolated gate driver integrated with multiple protective functions	MOSFET/IGBT/SiC driver, especially suitable for high-power applications



Application	Recommended product category	Part number of recommended product	Recommended package	Product description	Application description
String inverter & micro inverter & residential storage inverter & PCS & power module	Smart isolated driver	NSI6770	SOW16	10A Single-channel isolated gate driver integrated with Isolated Analog Sensing and multiple protective functions	MOSFET/IGBT/SiC driver, especially suitable for high-power applications
		NSI68515	SOW16	5A single-channel opto-compatible isolated gate driver integrated with multiple protective functions	MOSFET/IGBT/SiC driver, especially suitable for high-power applications
	Isolated half-bridge driver	NSI6602V	SOP16/SOW16/SOP14/SOW14	High-performance dual-channel isolated gate driver	Bidirectional DC-DC converter driver for energy storage, supporting MOSFET/IGBT/SiC
	<200V half-bridge driver	NSD1224	DFN10/SOP8/HSOP8/DFN8	Half-bridge gate driver supporting 100V and above	MOSFET driver for micro inverter
	GaN half-bridge driver	NSD2621	QFN15	Half-bridge GaN gate driver supporting +/-700V and above	GaN driver for micro inverter and household energy storage inverter
		NSD2622N	QFN 5*7	Half-bridge GaN gate driver supporting +/-700V and above and integrated with negative voltage output	GaN driver for micro inverter and household energy storage inverter
Low-side driver	NSD1026V	SOP8/HMSOP8/DFN8	High-speed dual-channel low-side gate driver	Driver used in EV-charger	

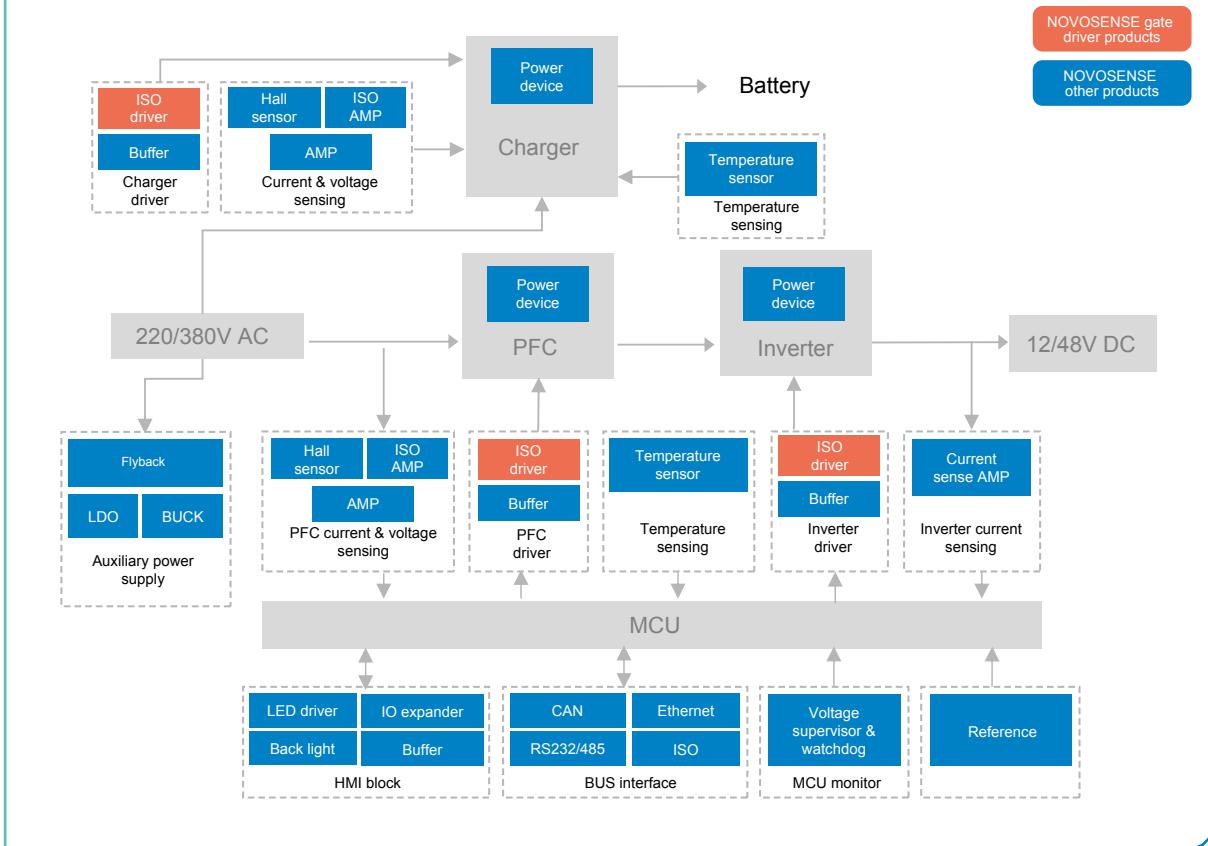
Power supply

Portable power station

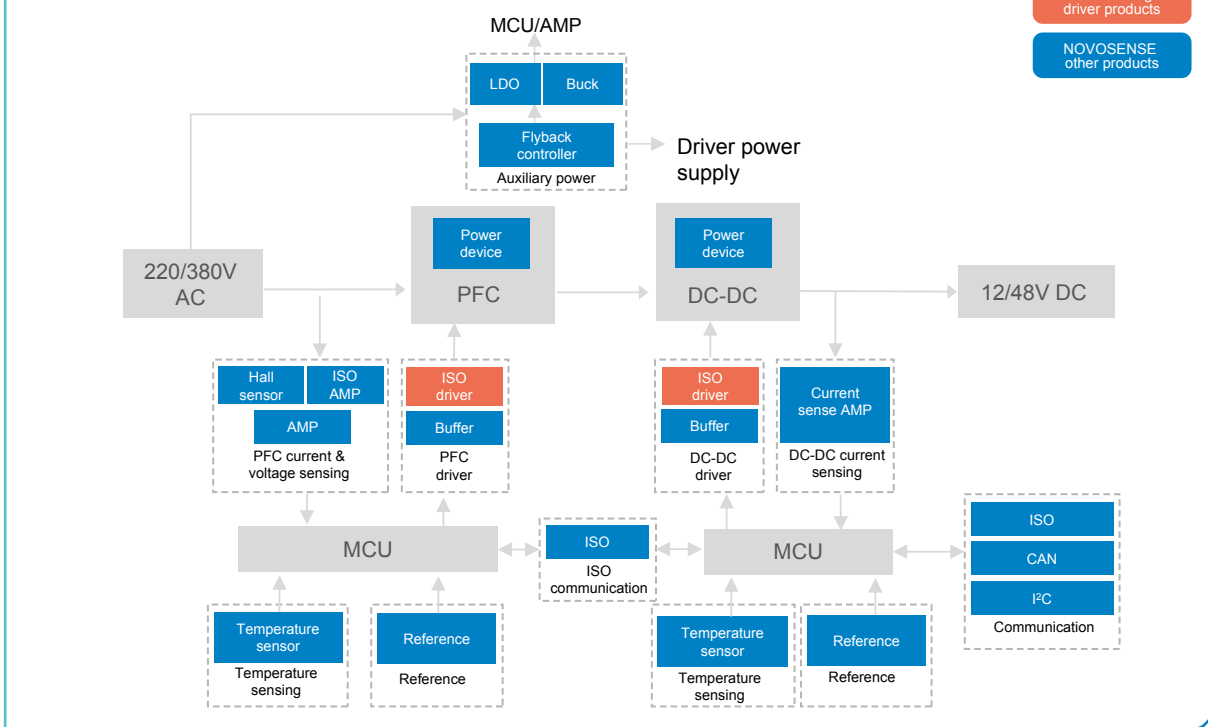




• UPS



• AC-DC power supply (communication & server power supply)

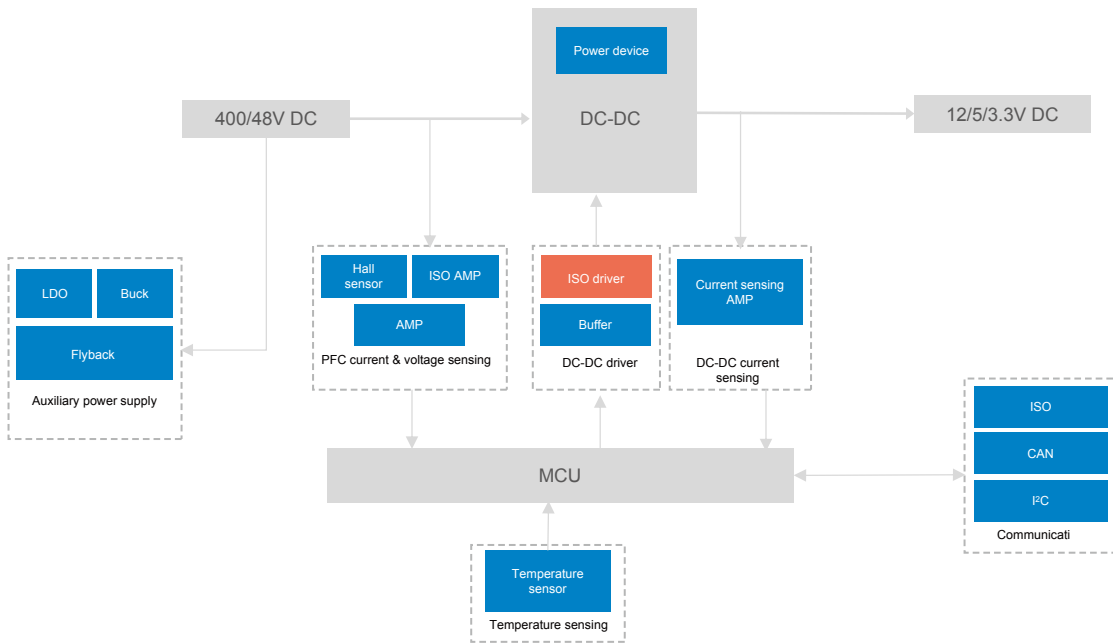




DC-DC power supply (industrial power supply & power module)

NOVOSENSE gate driver products

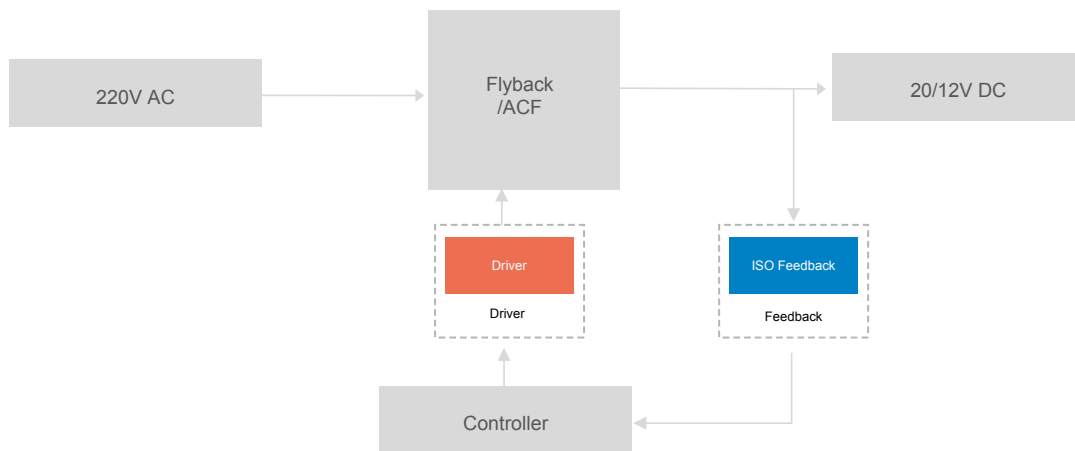
NOVOSENSE other products



Adapter power supply

NOVOSENSE gate driver products

NOVOSENSE other products





Product recommendations

Application	Recommended product category	Part number of recommended product	Recommended package	Product description	Application description
Portable power station & UPS	Isolated single-channel driver	NSI6601	SOP8/SOW8	Single-channel isolated gate driver	MOSFET/IGBT/SiC driver
		NSI6601M	SOP8/SOW8	Single-channel isolated gate driver integrated with Miller Clamp	MOSFET/IGBT/SiC driver, especially suitable for applications with high interference
		NSI6801M	SOP8/SOW8	5A single-channel opto-compatible isolated gate driver integrated with Miller Clamp	IGBT driver, especially suitable for applications with high interference
		NSI6801E	SOW6/DUB8/SOL6/SOWW8	5A single-channel opto-compatible isolated gate driver	MOSFET/IGBT/SiC driver
	Isolated half-bridge driver	NSI6602V	SOP16/SOW16/SOP14/SOW14	High-performance dual-channel isolated gate driver	Driver suitable for mobile energy storage
	>600V half-bridge driver	NSD1624	LGA10/SOP8/SOP14	Half-bridge gate driver supporting +/-700V and above	Driver suitable for mobile energy storage
	<200V half-bridge driver	NSD1224	DFN10/SOP8/HSOP8/DFN8	Half-bridge gate driver supporting 100V and above	MOSFET driver for low-voltage Buck circuit
	GaN half-bridge driver	NSD2621	QFN15	Half-bridge GaN gate driver supporting +/-700V and above	GaN driver suitable for PFC totem-pole
		NSD2622N	QFN 5*7	Half-bridge GaN gate driver supporting +/-700V and above and integrated with negative voltage output	GaN driver suitable for PFC totem-pole
	Low-side driver	NSD1026V	SOP8/HMSOP8/DFN8	High-speed dual-channel low-side gate driver	MOSFET driver suitable for PFC BOOST circuit
AC-DC power supply & DC-DC power supply & adapter power supply	Isolated single-channel driver	NSI6601	SOP8/SOW8	Single-channel isolated gate driver	Upper tube driver for totem-pole PFC, supporting MOSFET/IGBT/SiC
	Isolated half-bridge driver	NSI6602V	SOP16/SOW16/SOP14/SOW14	High-performance dual-channel isolated gate driver	Full-bridge driver suitable for totem-pole PFC, LLC and DC-DC, supporting MOSFET/GaN/IGBT/SiC
	>600V half-bridge driver	NSD1624	LGA10/SOP8/SOP14	Half-bridge gate driver supporting +/-700V and above	Driver suitable for totem-pole PFC, supporting MOSFET/IGBT/SiC
	GaN half-bridge driver	NSD2621	QFN15	Half-bridge GaN gate driver supporting +/-700V and above	Half-bridge GaN driver suitable for totem-pole PFC, LLC and DC-DC
		NSD2622N	QFN 5*7	Half-bridge GaN gate driver supporting +/-700V and above and integrated with negative voltage output	Half-bridge GaN driver suitable for totem-pole PFC, LLC and DC-DC
	<200V half-bridge driver	NSD1224	DFN10/SOP8/HSOP8	Half-bridge gate driver supporting 100V and above	Driver suitable for bridge rectifier
	Low-side driver	NSD1026V	SOP8/HMSOP8/DFN8	High-speed dual-channel low-side gate driver	Driver suitable for synchronous rectification



White goods and consumer electronics



NOVOSENSE gate driver IC products are extensively used in indoor and outdoor air conditioner units, washing machines, and food delivery robots, covering many different application scenarios.

Key considerations for product selection

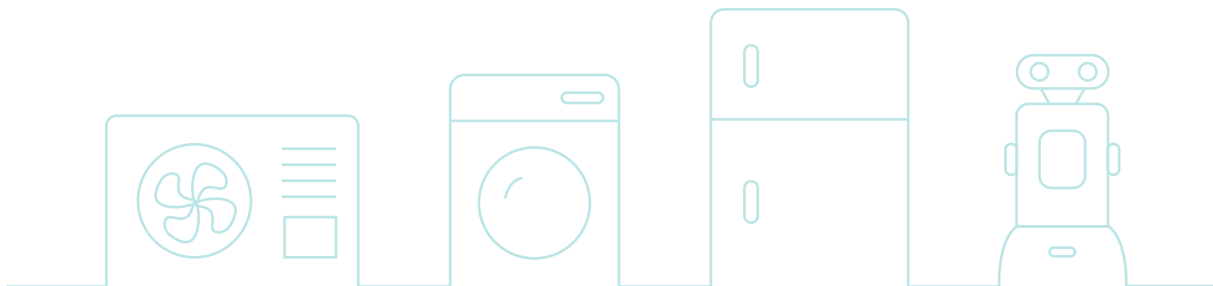


Isolated driver IC meeting safety certification requirements:

Meeting electrical isolation requirements and enhanced interference immunity

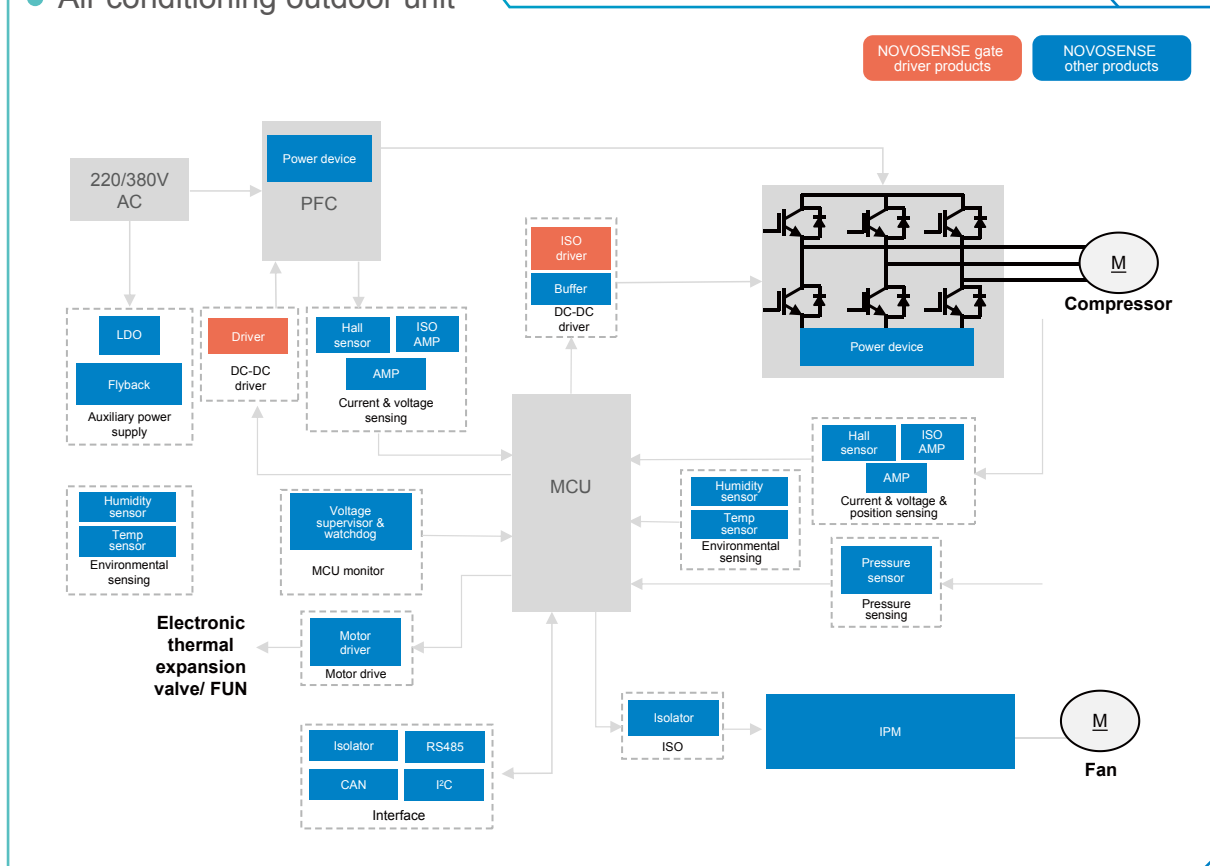


Suitable Package

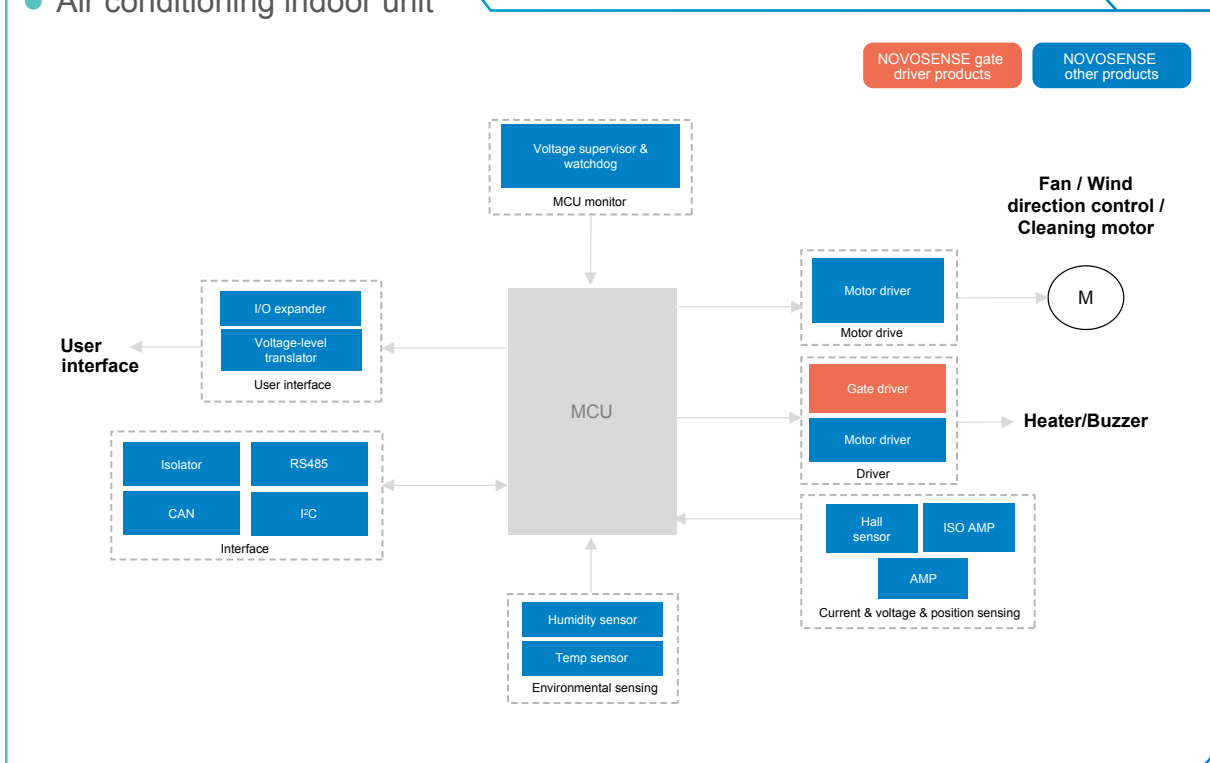




Air conditioning outdoor unit

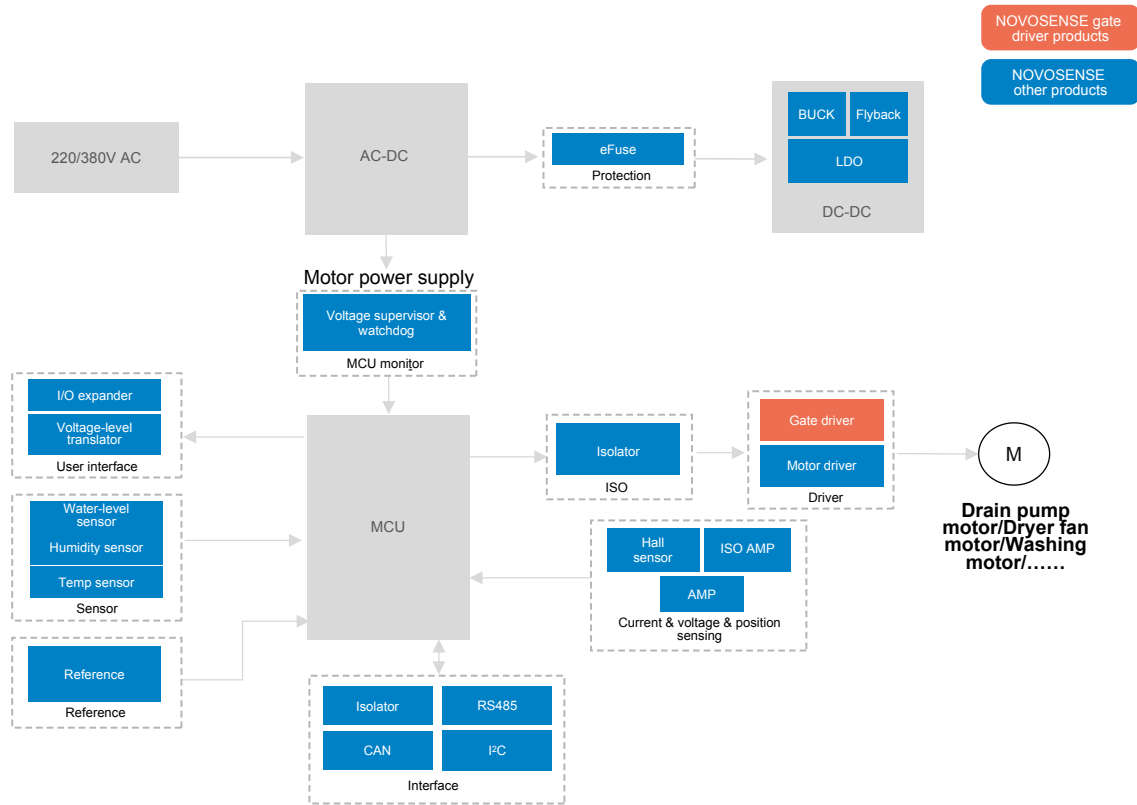


Air conditioning indoor unit

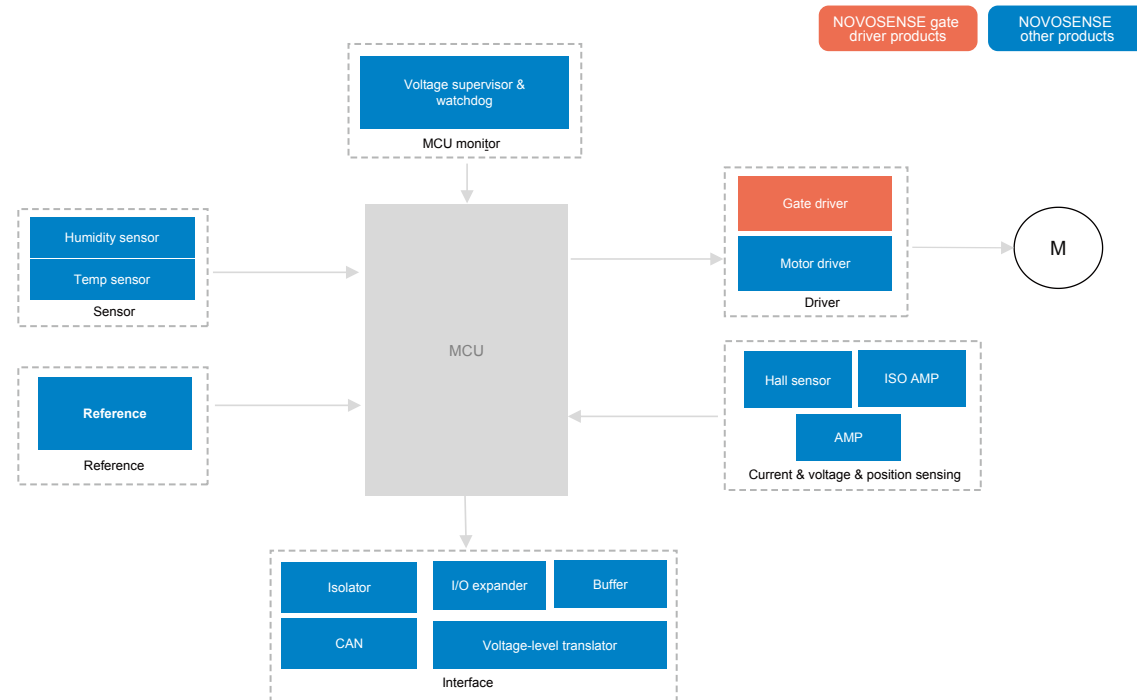




Washing machine



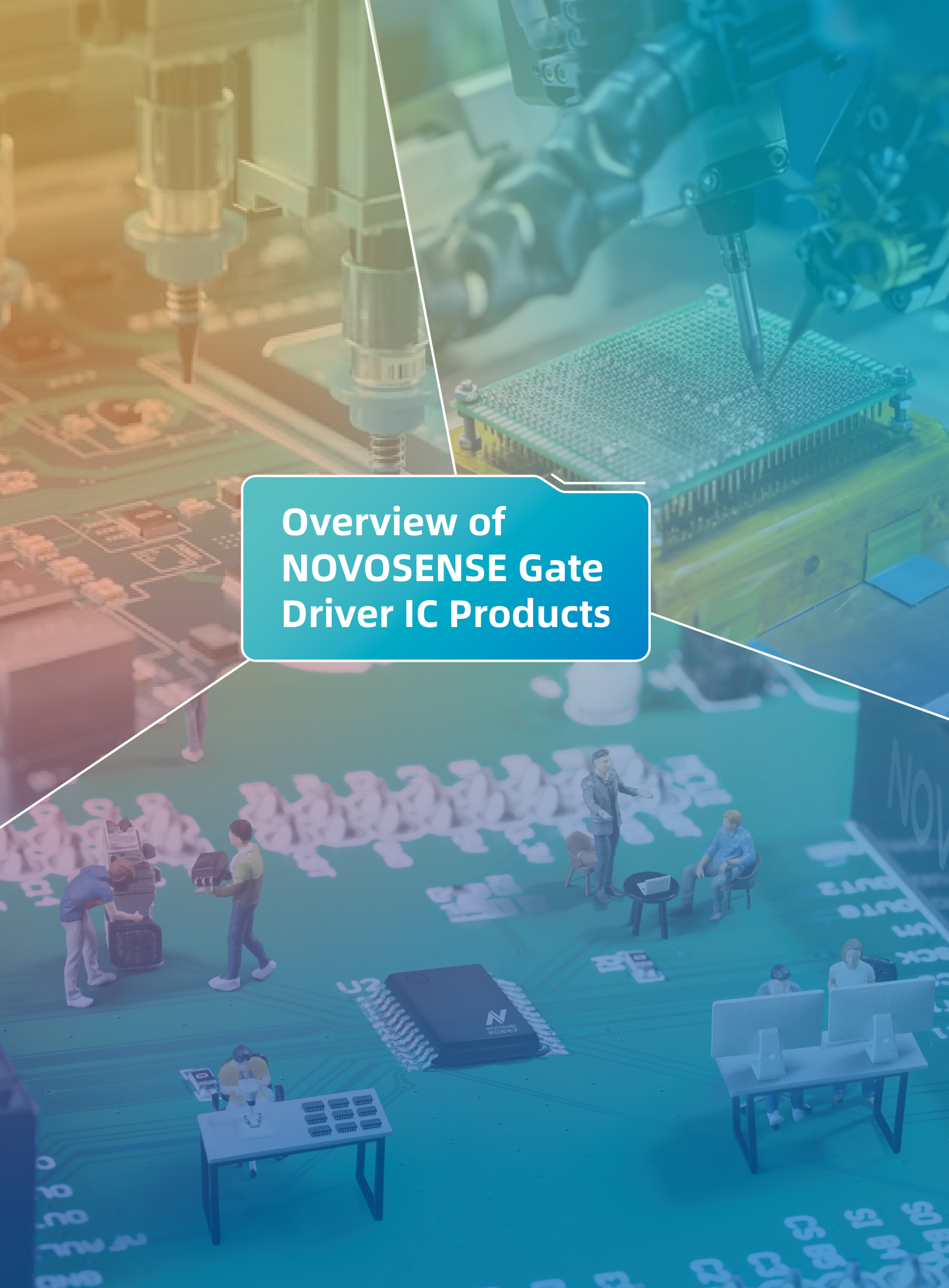
Food delivery robot





Product recommendations

Application	Recommended product category	Part number of recommended product	Recommended package	Product description	Application description
Air conditioning outdoor unit & Air conditioning indoor unit & washing machine & food delivery robot	Isolated single-channel driver	NSI6601	SOP8/SOW8	Single-channel isolated gate driver	Motor driver
		NSI6801E	SOW6/DUB8/SOL6	5A single-channel opto-compatible isolated gate driver	Motor driver
		NSI6601M	SOP8/SOW8	Single-channel isolated gate driver integrated with Miller Clamp	Motor driver, especially suitable for applications with high interference
		NSI6801M	SOP8/SOW8	5A single-channel opto-compatible isolated gate driver integrated with Miller Clamp	Motor driver, especially suitable for applications with high interference
	Smart isolated driver	NSI6611	SOW16	10A Single-channel isolated gate driver integrated with ASC and multiple protective functions	Motor driver, especially suitable for high-power applications
		NSI6651	SOW16	10A Single-channel isolated gate driver integrated with multiple protective functions	Motor driver, especially suitable for high-power applications
		NSI6770	SOW16	10A Single-channel isolated gate driver integrated with Isolated Analog Sensing and multiple protective functions	Motor driver, especially suitable for high-power applications
		NSI68515	SOW16	5A single-channel opto-compatible isolated gate driver integrated with multiple protective functions	Motor driver, especially suitable for high-power applications
	>600V half-bridge driver	NSD1624	LGA10/SOP8/SOP14	Half-bridge gate driver supporting +/-700V and above	Motor driver
	Low-side driver	NSD1015T	SOP8	Single-channel low-side gate driver integrated with DESAT protective function	Lower tube driver for motor, especially suitable for high-power applications
		NSD1026V	SOP8/HSOP8/DFN8	High-speed dual-channel low-side gate drive	Lower tube driver for motor

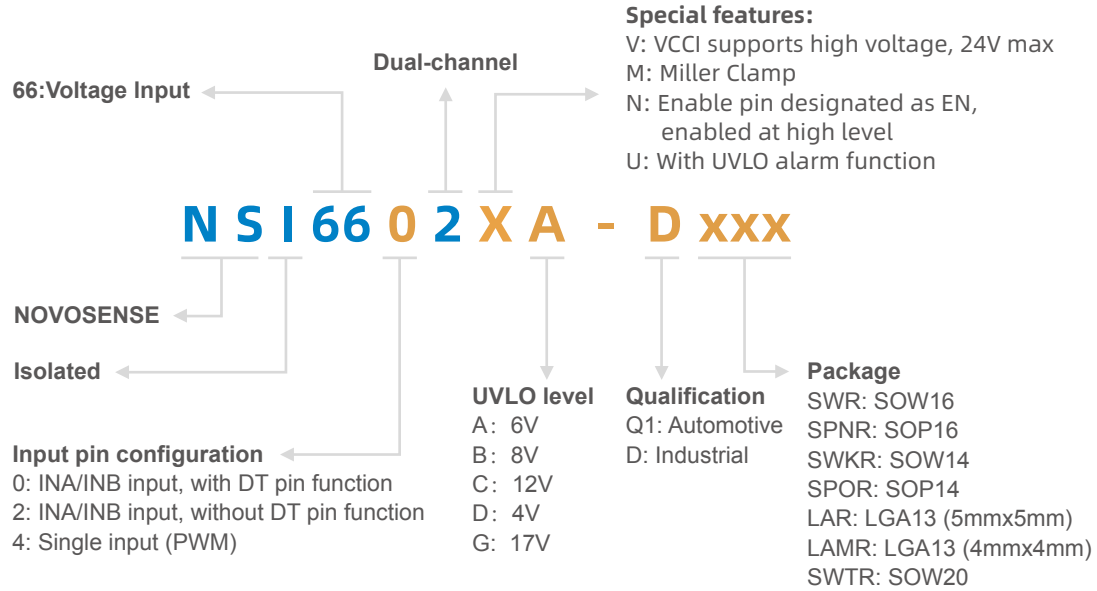


Overview of NOVOSENSE Gate Driver IC Products



Name Code for gate driver IC products

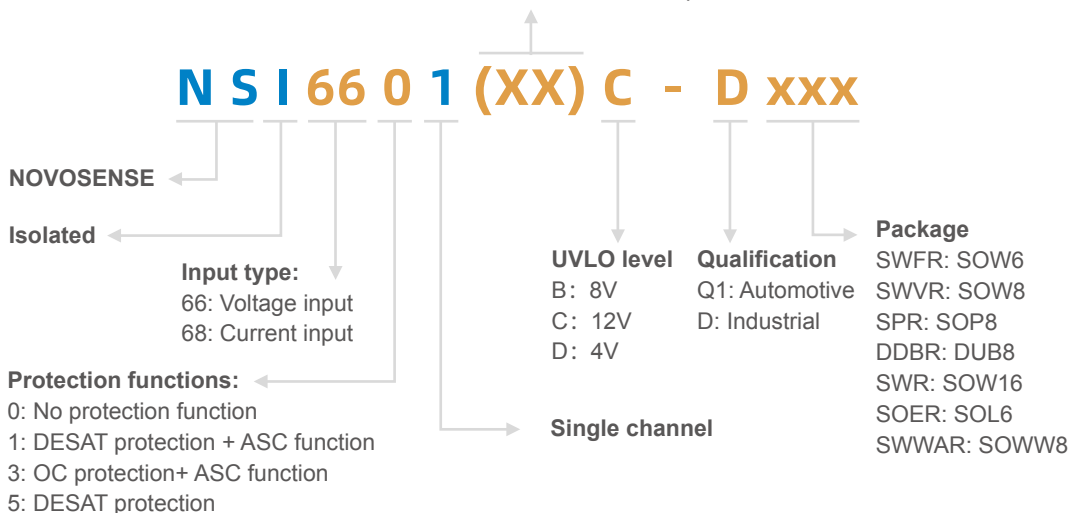
• Dual-channel isolated gate driver



• Single-channel isolated gate driver

The first X represents the size of the driver's source current:
 If this position is blank, it means 5A by default.
 0: 0.8A
 1: 1.5A
 A: 10A
 E: Enhance version

The second X represents the output method:
 If this position is blank, it means no Miller Clamp by default.
 M: Miller Clamp
 S: Split Output + Miller Clamp
 L: Single Output + Miller Clamp
 T: Two Output





● Non-isolated driver

The number of power device that single chip can drive

- 1: 1 power device
- 2: 2 power devices
- 6: 6 power devices

Maximum current output

- 4: 4A
- 5: 5A
- 10: 10A

NSD1624 (XX) - xx

NOVOSENSE

D: Driver

G: GaN Power Stage IC

- 1: Non-isolated MOSFET driver**
- 2: Non-isolated GaN driver**

To distinguish between half-bridge and low-side drivers
 0: Low-side driver; >0: Half-bridge driver

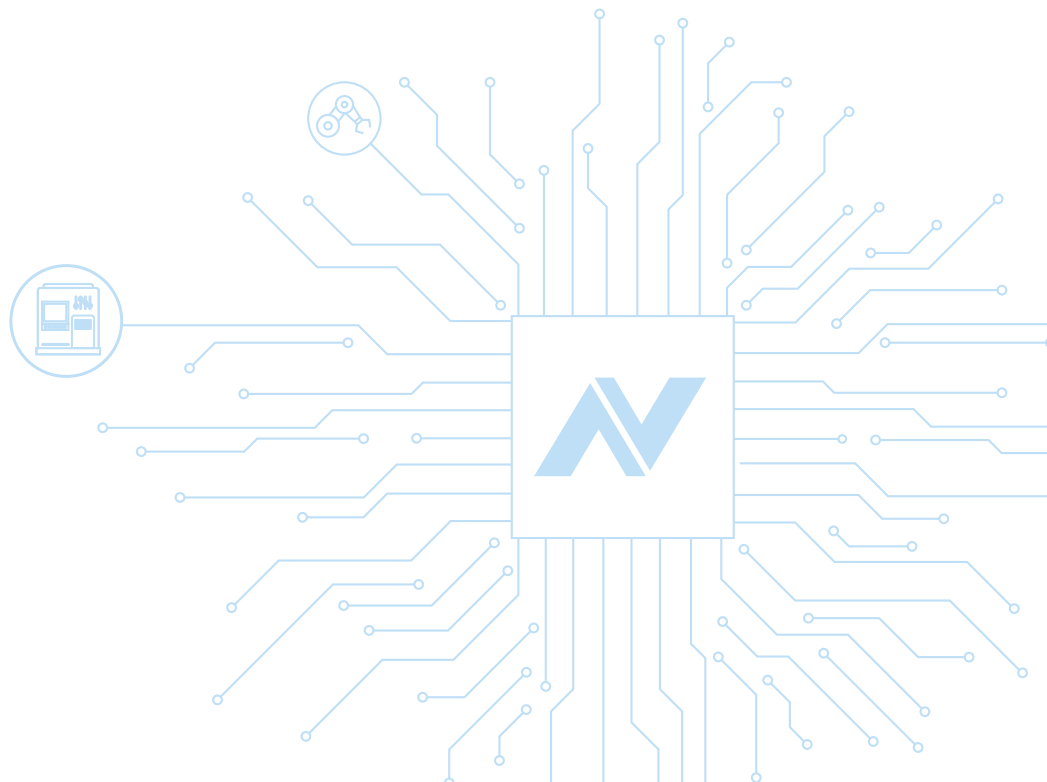
- 1: $V_{max} < 100V$
- 2: $V_{max} = 100V - 180V$
- 6: $V_{max} >= 600V$

The first X represents the special functions

- V: Higher VCC withstand voltage, >30V, for example: NSD1026V
- F: Logic inverse output, for example: NSD1026VF
- T: DESAT, for example: NSD1015T
- M: Miller Clamp, for example: NSD1015MT
- L: Interlock, for example: NSD1224LA
- C: OC protection
- S: Split output
- N: Integrated with negative voltage output

The second X represents the UVLO level:

- Half-bridge: If this position is blank, it means 8V by default.
- Low-side: If this position is blank, it means 4V by default.
- A: 4V
- B: 8V
- C: 13V



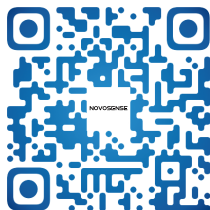


Selection guide for NOVOSENSE gate drivers

Category	Architecture	Input type	Voltage level	Output current	Protective functions	Part Number
Non-isolated driver	Low-side	CMOS/TTL	>30V	+3A/-4A	UVLO	NSD1015
			>30V	5A/-5A	UVLO/DESAT	NSD1015T
			>30V	5A/-5A	UVLO/Miller Clamp/DESAT	NSD1015MT
			>30V	5A/-5A	UVLO	NSD1026V
	Half-bridge	CMOS/TTL	>100V	3A/-4A	UVLO	NSD1224
			>600V	4A/-6A	UVLO	NSD1624
Isolated driver	Single-channel	CMOS	3~5.7KV	5A/-5A	UVLO	NSI6601
				5A/-5A	UVLO/Miller Clamp	NSI6601M
		Opto-compatible	3~5.7KV	5A/-5A	UVLO	NSI6801E
				1.5A/-2A	UVLO	NSI68010
	Half-bridge	CMOS/TTL	3~5.7KV	4A/-6A	UVLO	NSI66x2
				6A/-8A	UVLO	NSI66x2V
				10A/-10A	UVLO/Miller Clamp	NSI6602M
	Smart	CMOS	3~5.7KV	10A/-10A	UVLO/Miller Clamp/DESAT/Soft turn off	NSI6651
				10A/-10A	UVLO/Miller Clamp/DESAT/Soft turn off/ASC	NSI6611
				10A/-10A	UVLO/Miller Clamp/DESAT/Soft turn off/Isolated ADC	NSI6770
		Opto-compatible	3~5.7KV	5A/-5A	UVLO/Miller Clamp/DESAT/Soft turn off	NSI68515
		CMOS/TTL	3~5.7KV	20A/-20A	UVLO/Miller Clamp/DESAT/Soft turn off /Isolated ADC/Functional safety	NSI6911
GaN integrated power stage & gate driver	Half-bridge	CMOS/TTL	>600V	2A/-4A	UVLO/Miller Clamp	NSD2621
				2A/-4A	UVLO/Miller Clamp/Negative voltage output	NSD2622N
	Power stage ICs	CMOS/TTL	650V	11.5A	UVLO	NSG65N15K
	Low-side	CMOS/TTL	5V	7A/-5A	UVLO	NSD2017
			20V	2A/-4A	UVLO/Miller Clamp/Negative voltage output	NSD2012N



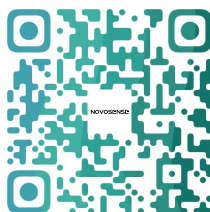
• Technical supporting



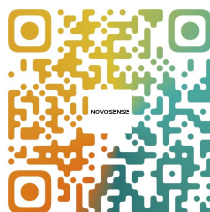
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Product Selection Guide



Cross-reference Search



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Automotive Solution



NOVOSENSE
Renewable Energy &
Power Supply Application
Solution



NOVOSENSE
Industrial
Control Solution

 NOVOSENSE Microelectronics

 NOVOSENSE Microelectronics



Robust

Reliable

Keep Learning

Persist in Long-term Value

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Release Date: September 2024