Automotive

HVAC E-Compressor

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Contents

1. Introduction

An e-compressor (electric compressor) is a critical subsystem in the thermal management architecture of modern electrified vehicles, providing precise and efficient temperature control for traction batteries, power electronics, cabin comfort, and auxiliary systems. Its key advantage is electrical independence, because it is powered directly from the vehicle's high-voltage (HV) supply and can therefore operate whenever thermal demand exists, regardless of the propulsion state. This enables active cooling or heating during driving, fast charging, pre-conditioning, or idle states, which is essential for both passenger comfort and battery safety in battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).

Traditionally, automotive air-conditioning compressors in Internal Combustion Engine (ICE) vehicles were belt-driven from the crankshaft, so compressor speed and cooling capacity were tightly coupled to engine RPM. This linkage caused air-conditioning performance to fluctuate with driving conditions, reduced efficiency at low engine speeds, and imposed parasitic mechanical losses that increased fuel consumption. Moreover, because these mechanical units could not run when the engine was off, they offered limited support for functions such as cabin pre-cooling, stop-start comfort, or maintaining stable battery temperatures in early hybrid architectures.

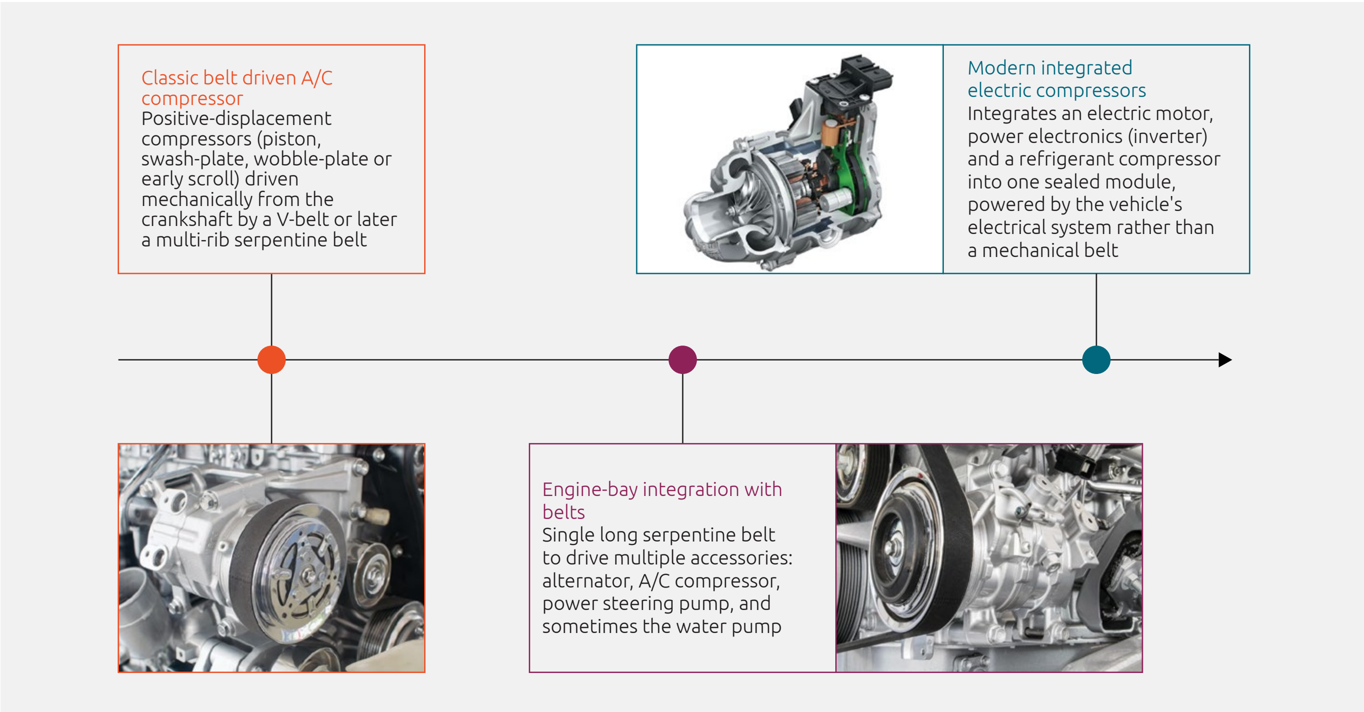

Fig. 1 Evolution of compressor systems in vehicles over the decades

Figure 1 shows how the compressor technologies transformed from belt-driven compressors to electrically driven ones over the years. Electrification accelerated this shift, making e-compressors the standard solution for BEVs and PHEVs due to their superior controllability, energy efficiency, and integration flexibility. E-compressors eliminate mechanical load on the engine, provide variable-speed operation, and enable sophisticated thermal strategies essential for battery longevity and fast-charging performance.

An e-Compressor integrates three major components into a compact, sealed assembly:

- High-speed electric motor: a Brushless DC (BLDC) or Permanent Magnet Synchronous Motor (PMSM).
- Inverter stage: a compact 3-phase power module, implemented using MOSFETs or IGBTs, responsible for motor control under high switching frequencies and harsh thermal conditions.
- Mechanical compression stage: usually scroll or rotary type, optimized for low NVH (Noise, Vibration, Harshness) and high efficiency in both cooling and heat pump operation.

Together, these subsystems deliver fast dynamic response, controllable displacement, and high thermodynamic efficiency. This techbook provides a technical overview of e-compressor operation, electrical architecture, key design challenges, and Nexperia's product offerings.

2. Application description

The significance of thermal management in electric vehicles directly impacts vehicle range, performance, battery longevity, and occupant safety. This section introduces core thermal management concepts, highlighting the pivotal role of the e-compressor in regulating temperatures across the most critical EV components such as traction batteries, power electronics, electric motors, and cabin spaces. It describes sophisticated multi-loop architecture designed to maintain thermal equilibrium under diverse operating conditions, from subzero winter charging to high-load summer drives.

2.1 Multi-loop system integration

EV thermal management typically relies on three primary interconnected loops as shown in Figure 2, with the e-compressor enabling the refrigerant circuit loop.

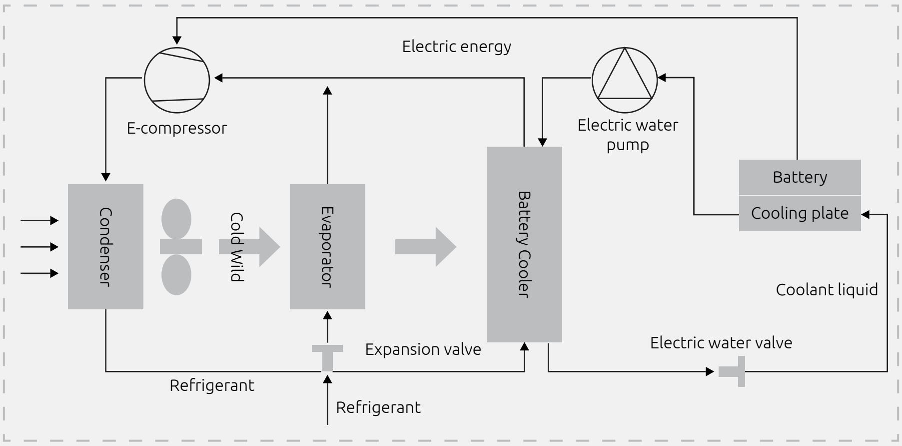

Fig. 2 Example multi-loop systems in thermal management of EVs

Each circuit loop serves a specific role to maintain optimal operating conditions across the vehicle.

The refrigerant circuit:
This loop is driven by the electric compressor, which compresses refrigerant, increasing its pressure and temperature. The refrigerant then flows through the condenser, where it dissipates heat to the outside air, and through expansion valves before reaching evaporators or chillers that absorb heat from the coolant or cabin air. The electric compressor is the core component here, enabling active cooling by circulating refrigerant dynamically to maintain desired temperatures, whether by cooling the battery, power electronics, or cabin air.

The water/coolant circuit:
The coolant circuit circulates a liquid coolant, typically a glycol-water mix through jackets around heat-generating components like the battery, electric motor, inverter, and DC/DC converter. Pumps drive the coolant flow to transfer heat away from these components to radiators or heat exchangers, where heat is released to the ambient. The coolant loop often interfaces with the refrigerant loop via chillers, which cool the liquid coolant further when ambient conditions or component heat loads require it.

Air conditioning (AC) circuit:
The cabin AC system uses portions of the refrigerant loop (evaporator and expansion valve) combined with cabin air blowers and heating elements (such as electric heaters or heat pumps) to regulate passenger comfort. The electric compressor modulates refrigerant flow to provide cooling, while heating functions may use waste heat or dedicated heaters for warming.

2.2 Types of e-compressors

E-compressors serve as the high-pressure heart of the refrigerant loop in EV thermal management systems, delivering precise, variable-speed compression that decouples cooling capacity from propulsion state and enables seamless heat transfer across interconnected coolant, refrigerant, and cabin HVAC loops. Designing and selecting an e-compressor requires balancing key performance parameters including power density (typically 2 - 12 kW), maximum speed, volumetric capacity, overall efficiency, physical footprint, weight, and integration constraints such as high-voltage bus compatibility (400-800 VDC) and CAN/IVN communication. These units must also withstand automotive extremes: -40°C to +120°C ambient, vibration, IP67 sealing, and durability targets. Figure 3 illustrates a typical e-compressor, it is compact and has both mechanical and electrical functions integrated into one unit.

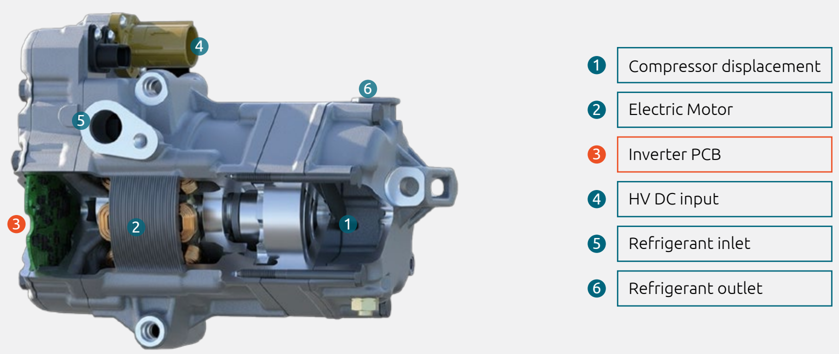

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Fig. 3 Illustrative image of an e-compressor

E-compressors are classified primarily by the mechanical compressions stage, each optimized for trade-offs in efficiency, cooling capacity, size, power and cost. Different types of compressors mechanisms exist as shown in table below.

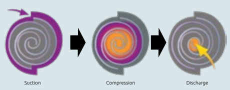
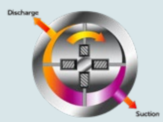
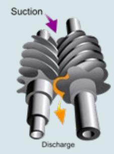
	Scroll	Rotary (Vane)	Piston	Screw
				
Mechanism	Uses two interleaved spirals scrolls with one fixed and one orbiting to trap and compress refrigerant pockets progressively.	Use and eccentric rotor with sliding vane in a cylindrical bore to create varying chamber volumes.	Multi-cylinder wobble-plate designs convert rotary motor input to axial pistons, supporting electronic displacement control (EDC) for fine COP optimization	Meshing helical rotors provide continuous compression with near-zero clearance
Use case	Common in BEVs and PHEVs	Prevalent in cost-sensitive BEV models	Less common in modern EVs.	Ideal for heavy-duty or high-capacity EV trucks

Table 1 Types of compressor mechanisms commonly used in automotive

The mechanical parts in the e-compressors are coupled to an electric motor. The electric motor converts electrical power from the high-voltage AC supply into mechanical torque to drive the compression mechanism. Primary motor types used in e-compressors include permanent magnet synchronous motor (PMSM), Brushless DC (BLDC) motors and interior permanent magnet (IPM) motors.

- BLDC: This is the most common motor type, and its characteristics includes three phase power supply design and can have very high rotational speed, up to 30 kRPM with power up to 5 kW.
- PMSM: It is also extremely common and tends to have better efficiency and smooth torque compared to BLDC motors. Typical power range is 6 – 8 kW and typically used in premium EVs.
- IPM: It is an electric machine where magnets are buried inside the rotor. These kinds of motors have high torque density and are typically used in 800 V high-speed compressors.

The inverter stage is the electronic heart of an e-compressor, serving as the vital interface between the vehicle's high-voltage DC bus and the high-speed electric motor that drives the compressor mechanism. While the mechanical compression system determines how refrigerant is circulated, it is ultimately the inverter that dictates the precision, efficiency, and dynamic responsiveness of the entire e-compressor unit. Thermal management demands fluctuate rapidly in EVs with battery load, fast-charging events, and cabin comfort requirements, the inverter must deliver an uncompromising combination of power density, switching efficiency, protection intelligence, and electromagnetic cleanliness.

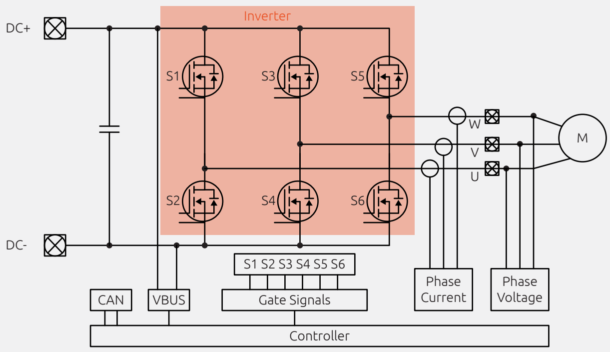


Fig. 4 Circuit diagram of an e-compressor inverter

At its core, the inverter converts the vehicle's 400 - 800 V DC supply into a finely modulated, three-phase AC waveform as shown with the circuit schematic in Figure 4. This conversion is performed through a series of Si/SiC MOSFETs or IGBT half-bridges, switching at frequencies typically ranging from 8 to 20 kHz. Advanced control algorithms such as Field-Oriented Control (FOC) are facilitated and deployed by the controller to command motors with exceptional smoothness, enabling whisper-quiet operation. The power switching devices in the inverter should be able to handle RMS current and maximum DC voltage to drive the compressor motor. Table 2 below gives a summary of bus voltage inputs for various vehicle classes and power levels for the compressor.

Typical DC input voltage for different vehicle classes				
	EV Type			
Function	MHEV	HEV/PHEV	BEV	BEV (premium)
HV DC input (typical)	48 V	~400 V	~470 V	800 V
Typical compressor power	1-3 kW	3 – 8 kW	8 – 15 kW	15 + kW
Component cooling scope	Air conditioning	Air conditioning, Battery, Power Electronics	Air conditioning, Battery, Power Electronics	Air conditioning, Battery, Power Electronics

Table 2 Typical bus voltages and compressor power for different vehicle classes

3. Block diagram

Figure 5 below shows a generic functional block diagram of an automotive e-compressor with products catalogues that are supported by Nexperia. All highlighted products offered by Nexperia are automotive grade qualified.

Block Diagram – Automotive HVAC e-compressor

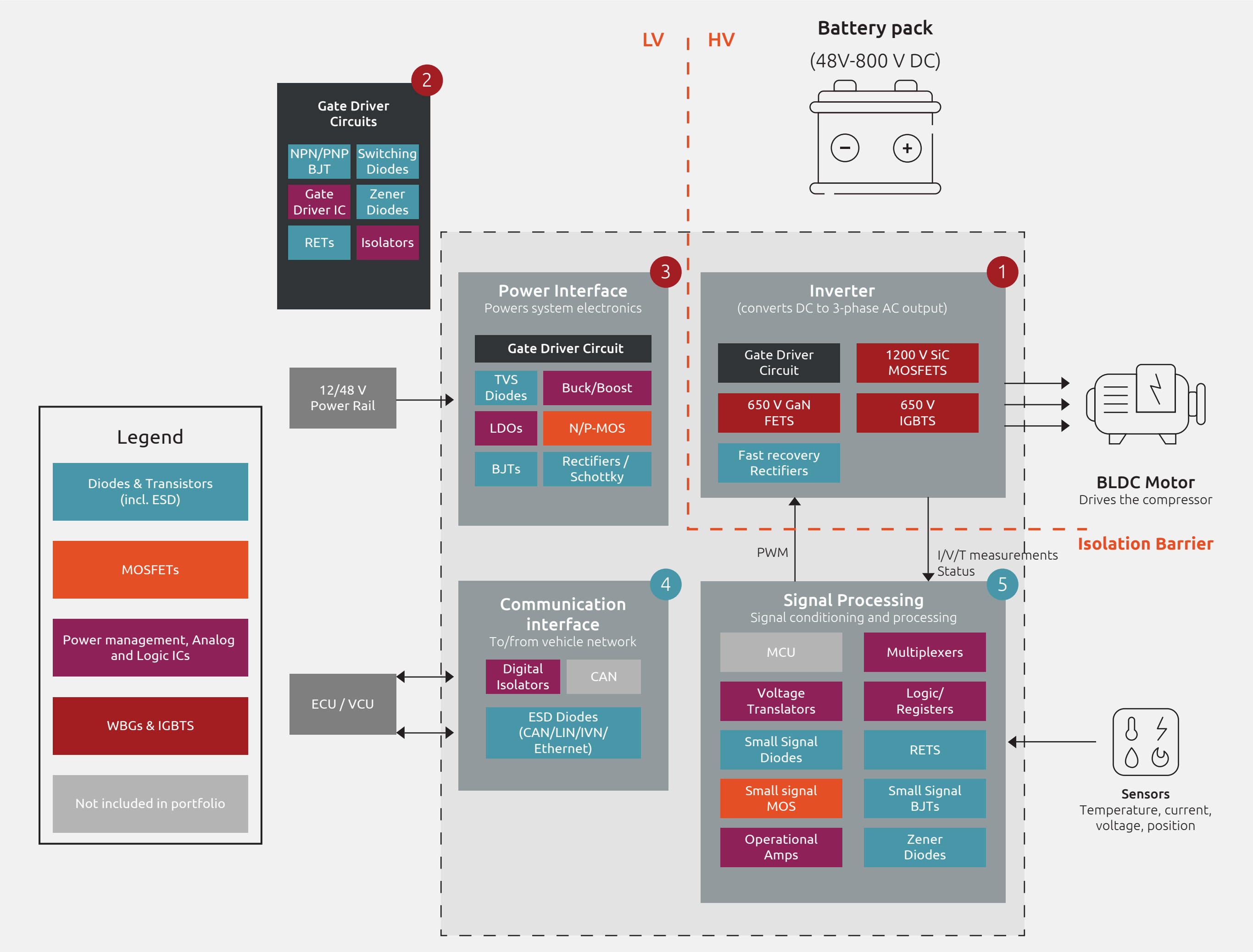


Fig. 5 e-Compressor block diagram

3.1 The Inverter

The inverter forms the core of the e-compressor power electronics, converting the HV DC voltage from the battery pack into variable frequency, variable amplitude three phase AC to drive the compressor motor. The inverter employs three half bridge topologies with six power switches, enabling precise field-oriented control of the electrical motor as shown in Figure 6 below.

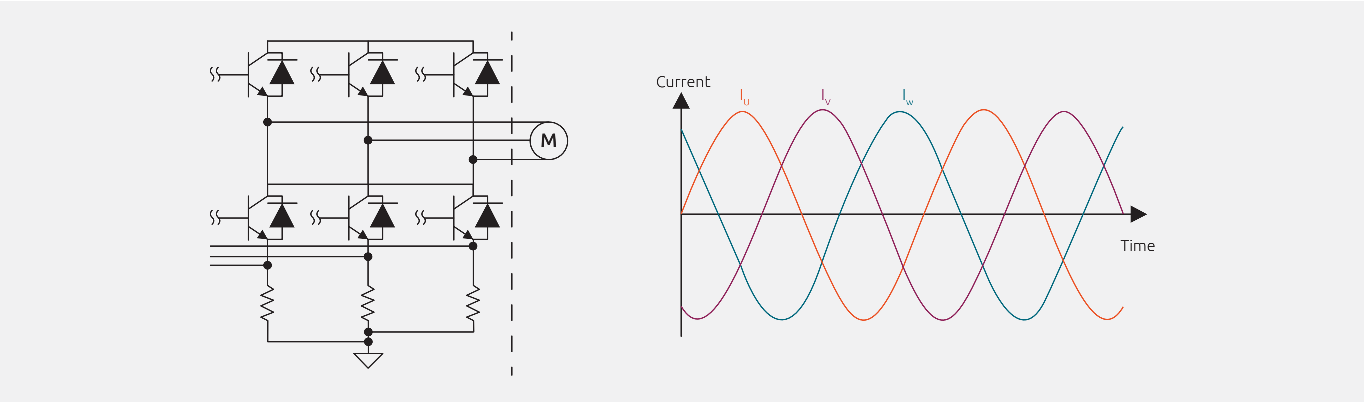


Fig.6 Three phase inverter is used to drive the compressor motor

The inverter is hermetically integrated within the sealed compressor housing for compactness. SiC adoption dominates 2020s designs due to lower switching losses, enabling smaller passives and air-cooling viability, critical for fast-charging thermal loads. Device paralleling (2-4 dies/switch) addresses higher current demands while maintaining low current imbalance. Nexperia offers discrete packaged 1200 V SiC MOSFETs suitable for 800 V vehicle platforms, 650 V GaN FETs and IGBTs are also available in discrete packages for 400 - 450 V battery pack vehicles.

3.2 Gate driver circuits

Gate driver circuits interface between the microcontroller (MCU) or sometimes called processors to the inverter's power switches, Si/SiC MOSFETs or IGBTs by amplifying low-level PWM signals into high-current, high-voltage gate drive waveforms (V_{GH} 15-20 V, V_{GL}-5 to 0V, peak 4-8A source/sink). They enable precise, high-frequency switching for FOC motor control while ensuring shoot-through protection, dV/dt control, and negative gate drive for robust turn-off under harsh refrigerant-exposed conditions.

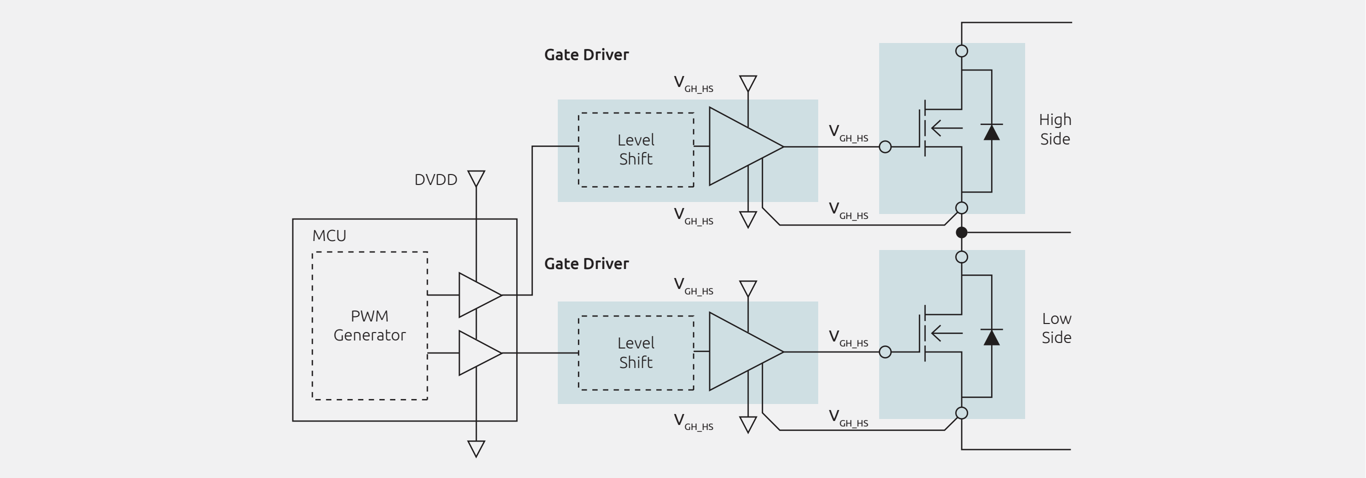


Fig. 7 Gate driver circuits are between the MCU and the power switches

The gate driver circuit consists of a gate driver and its peripheral circuits, but the gate driver is generally an IC. The gate driver IC must be selected according to the number of channels (low side, or low side and high side), insulation type, drive voltage, sink and source currents and other protection mechanisms. Nexperia offers non-isolated low side and half-bridge gate drivers which are ideal for low voltage e-compressor systems, such as the 48 V in hybrid EVs. In addition to the gate driver ICs, consideration must be given to switching device gate current requirements to turn on/off at the desired rate. By combining a NPN bipolar transistors and a PNP bipolar transistor, push pull/totem pole circuits can be used if the gate driver IC has insufficient drive capability as shown in the figure below.

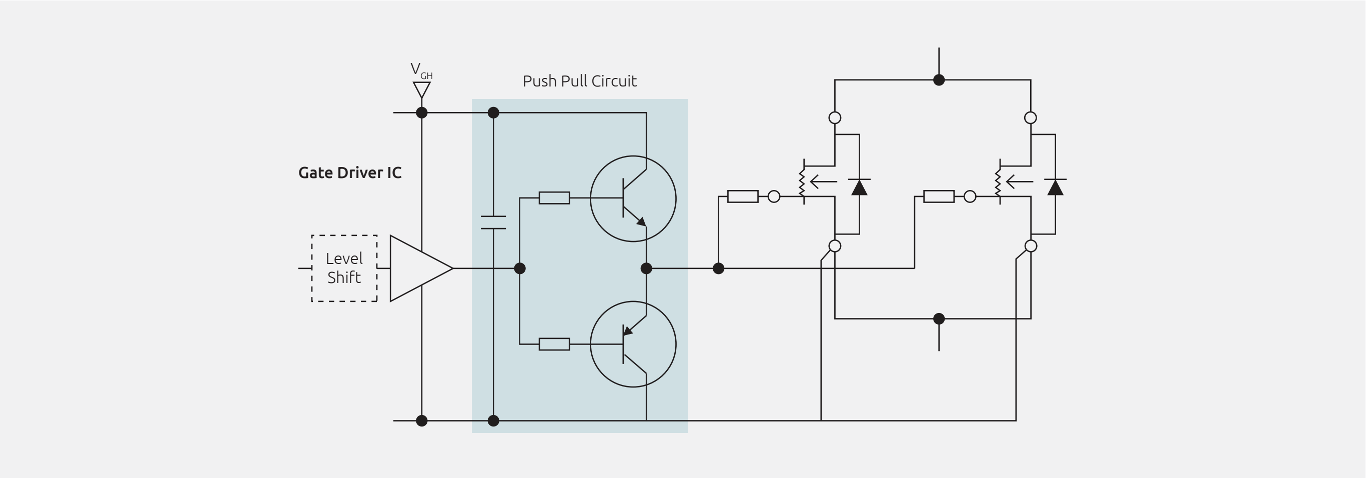


Fig. 8 Push Pull circuit for gate driver circuits

In push-pull circuits, when the gate driver IC is turned on, NPN bipolar transistor is turned on and current is supplied from VGH, and when the gate driver is turned off, the current is sunk through PNP bipolar transistor. In this way, if the gate-driver IC has insufficient drive current capability, it can be compensated from a power supply with enough current supplying capability. Nexperia has a variety of choices in NPN and PNP power transistors catalogues offering a varying class with voltage, current and package types.

Other gate driver circuits component considerations include bootstrap diodes, gate source voltage level shifting with Schottky diodes, miller clamps using logic level MOSFETs and Zener diodes for fault handling and voltage clamping requirements.

3.3 Power interface

The power interface manages low-voltage (LV) input from the vehicle's 12 V/24 V or 48 V auxiliary battery to supply the e-compressor PCB's control electronics, such as MCUs, gate drivers, sensors, and communication transceivers. Typically delivering 5 – 50 W continuous, stable, filtered power in harsh automotive conditions while isolating LV from HV domains to prevent ground loops or faults. The LV power interface occupies a dedicated PCB section, galvanically separated from HV inverter circuitry.

To achieve this, a combination of buck converters, low-dropout regulators (LDOs), and isolated DC-DC converters are used to step down low voltage (LV) supply from 12 / 24 V to safe operating levels like 12V, 5V, or 3.3V. These regulators must be automotive grade, with high efficiency and low quiescent current to minimize parasitic drain. Figure below shows solutions from Nexperia's to support that.

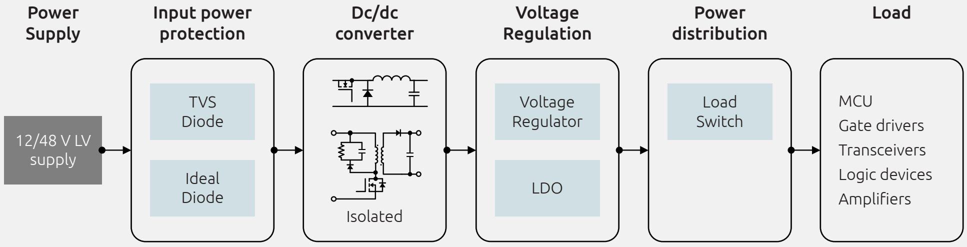


Fig. 9 LV power interface, regulation and distribution to various loads sequence

The LV input first encounters multi-function protection handling inrush current limiting, reverse battery protection, and transient suppression, as shown in Figure 9 above. Nexperia's wide portfolio excels here:

- Reverse Battery Protection: P-channel ideal diode controllers or discrete PMOS block reverse current via active gate control. Normal forward drop stays < 0.5 V with auto-retry after polarity correction, far superior to Schottky diodes 1V V_f and leakage. For more information on different types of reverse polarity protection solutions, refer to the website: Input power (reverse polarity) protection | Nexperia.
- Transient Suppression: TVS arrays clamp load dumps and negative pulses.
- Post-protection, non-isolated buck or isolated flyback converters generate intermediate rails (5-15 V). Synchronous topologies use current-mode control and ZVS for minimal ripple. Flybacks provide isolation via planar transformers, essential near HV. Outputs feed via multi rail supply, enable redundancy and sharing availability.
- Low-dropout regulators (LDOs) polish DC-DC outputs to precision values: e.g. 3.3 V/1 A (MCU/CAN transceivers, etc.), 5 V/500 mA (sensors), or 1.8 V/300 mA (low-power DSP).
- Load switches are optional depending on application needs.

3.4 Communication interface

The communication interface links the e-compressor controller to the vehicle's domain or thermal management controller, allowing command, status, and diagnostic data to be exchanged over standardized automotive networks such as CAN, CAN FD, LIN, or, in newer platforms, automotive Ethernet. It must operate reliably in a noisy electromagnetic environment while maintaining protocol timing, data integrity, and functional safety requirements for torque and thermal control commands.

The communication block typically implements one or more bus transceivers plus the physical layer protection and filtering needed for in-vehicle networks.

On the PCB, the communication interface sits between the microcontroller and the external harness connector, and consists of:

- One or more transceivers (e.g., CAN/CAN FD, LIN) interfacing the digital logic to the differential bus lines.
- ESD/EMC protection (TVS diodes, common-mode chokes) and filtering close to the connector.
- Optional galvanic isolation between logic ground and chassis or HV reference, depending on system safety concept. Nexperia's portfolio includes digital isolators applicable in this scenario.

For CAN/CAN FD, the transceiver provides differential drive on CANH/CANL, dominant/recessive bit levels, and built-in fail-safe states (bus off, dominant timeout). LIN transceivers combine single-wire bus drive with wake-up and sleep functions for low-power operation in simpler systems.

3.5 Signal processing

The signal processing sub-block conditions and digitize analog inputs from the e-compressor's sensors such as rotor position, temperature, pressure, current, and voltage, feeding clean, calibrated data to the MCU for field-oriented control (FOC), protection, and diagnostics. The sensor signal conditioning amplifies, filters, and level-shifts weak sensor outputs while rejecting EMI and common-mode noise from HV switching. The MCU then converts the signal from analog to digital format and then the firmware applies compensation techniques and correction methods to detect the status of the sensors. This precision signal chain enables compressor controllers to maintain high torque accuracy across the full speed/temperature range, directly supporting optimal EV thermal management and range extension.

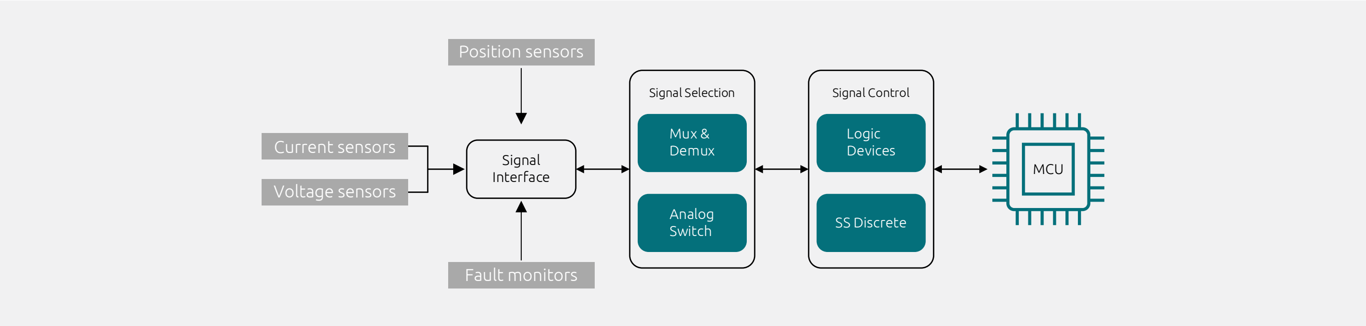


Fig.10 Signal processing of the measurements and other signals

4. Design challenges and Nexperia solutions

4.1 Determining the best power switch device for e-compressor inverters

The inverter stage is one of the most critical subsystems in the architecture of e-compressor systems. It must reliably convert the vehicle's high-voltage DC bus into a precisely controlled three-phase AC waveform to drive the PMSM or BLDC compressor motor. The inverter's required power rating is not chosen arbitrarily, its power rating derives directly from the compressor's mechanical load and motor electrical parameters, ensuring reliable operation under varying thermodynamic demands.

Compressor mechanical power depends on refrigerant type (e.g., R1234yf, R134a), pressure ratio, cooling capacity, ambient temperature, and HVAC load. The compressor performance is tied to the rotor speed (RPM) of the electric motor, so the torque of the motor determines the inverter current. The inverter must supply the electrical power consumed by the motor:

$$P_{elec} = \frac{P_{mech}}{\eta_{motor}}$$

where η_{motor} is the motor electrical efficiency,usually 90 - 95%.

OEMs typically apply a safety factor (SF) of 1.5 - 2 to account for transients, overloads, and worst-case conditions, so the inverter peak power rating becomes:

$$P_{peak} = P_{elec} * SF$$

This links the inverter rating directly to compressor's thermodynamic load and the motor's electrical conversion chain. At the heart of this inverter are the power switches, which define efficiency, thermal performance, switching behaviour, EMI performance, and even the acoustic signature of the compressor. Choosing the correct switch technology and device implementation is therefore the first and most important design challenge.

A 2-level Voltage Source Inverter (VSI) is commonly used as shown in Figure 11. This uses three switched half-bridge power switches to convert DC voltage to 3-phase AC to drive the motor.

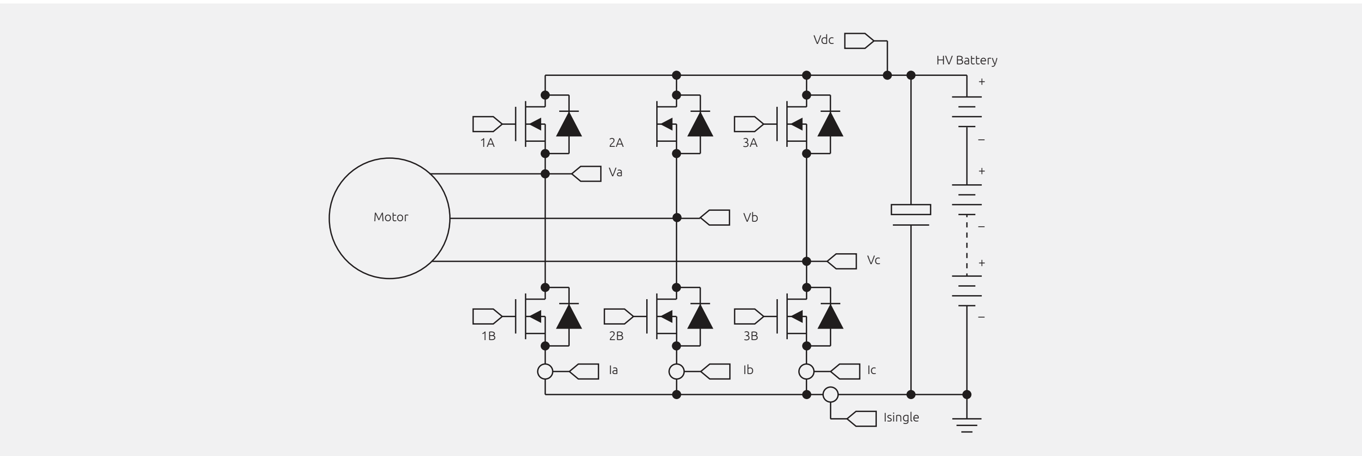


Fig. 11 Inverter provides the required AC power to the motor using 3x MOSFETs half bridges, the motor in turn drives the compressor mechanism

For a three-phase motor, the fundamental phase current (assuming sinusoidal currents and unity power factor for simplicity) is approximated as

$$I_{rms} = \frac{P_{peak}}{3 \,.\, V_{line} \,.\, \cos\varphi \,.\, \eta_{inv}}$$

η_{inv} is the inverter efficiency,usually 92 to 98 %,
$V_{line}=V_{bus}/\sqrt{2}$, and $\cos\Phi \approx 0.95$

The MOSFET or IGBT voltage rating VDS,max (or VCE,max) is then chosen with sufficient margin over the maximum DC bus voltage including tolerances, load dump, and ringing:

$$I_D > 2 * I_{rms} \text{ and } V_D > 1.5\, V_{bus}.$$

Power switches therefore dictate efficiency)via $R_{DS(on)}$ and switching losses), thermal rise, EMI, and noise. The technology choice should prioritize low $R_{DS(on)}$, low gate charge Q_g, controlled output capacitance, and robust avalanche capability. For high-speed compressors 10,000 rpm and above), fast and well-behaved body diodes and/or synchronous rectification are critical to minimize dead time while avoiding cross-conduction. For high-current inverters, it can be necessary to parallel 2–4 devices per switch position, while ensuring that the junction temperature remains below 150°C in all operating conditions.

Table 3 shows indicative power ranges and corresponding device classes that support high power density e-compressor inverters in different vehicle architectures.

Typical DC input voltage for different vehicle classes				
	EV Type			
Function	**MHEV/PHEVs**	**HEV**	**BEV**	**BEV (premium)**
HV DC input (typical)	48 V	~400 V	~470 V	800 V
Compressor power (typical)	1-3 kW	3 – 8 kW	15+ kW	15 + kW
Example power device technology	80–100 V Si MOSFET	650 – 750 V SiC/GaN/IGBTs	650 – 900 V SiC/GaN/IGBTs	1200 V IGBT/SiC

Table 3 Voltage and current estimates required to drive the inverter in the selected EV classes

Nexperia Solutions

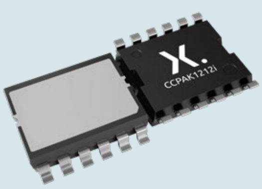
80 - 100 V Automotive MOSFETs for 48 V MHEVs e-compressor inverters

Nexperia's 80 – 100 V automotive-grade MOSFETs are specifically designed for high-performance 48 V mild-hybrid (MHEV) e-compressor inverter systems. These silicon power MOSFETs combine low conduction losses, fast switching behaviour, and exceptional thermal robustness to meet the stringent efficiency and reliability targets of modern 48 V subsystems.

For these applications, Nexperia's CCPAK (Copper Clip Package) portfolio offers optimal thermal and electrical performance through low-inductance interconnection and large current-handling capability. Available in both bottom-side cooled (BSC) and top-side cooled (TSC) variants, CCPAK devices leverage direct copper clamping for excellent heat spreading and reduced junction resistance. This results in junction-to-board thermal resistance ($R_{th(j-mb)}$) as low as 0.5 K/W, enabling compact inverter designs that sustain power levels up to 1.5 kW per device under automotive thermal cycling conditions.

The newly released 100 V CCPAK1212(i) MOSFET family represents Nexperia's latest generation of high-efficiency automotive MOSFETs. With best-in-class low $R_{DS(on)}$ and optimized switching charge characteristics, these devices support higher PWM frequencies and tighter control loops, minimizing inverter losses and improving transient response. Their predictable switching behaviour and low package parasitic effects make them particularly well-suited for compact, high-speed e-compressor drives, where thermal reliability and EMI robustness are key.

Recommended Parts: 100 V CCPAK1212(i) MOSFETs



Part Numbers
BUK7A1R0-100L: 100 V, 0.99 mΩ, BSC
BUK7A1R3-100L: 100 V, 1.3 mΩ, BSC
BUK7T1R0-100L: 100 V, 1 mΩ, TSC
BUK7T1R4-100L: 100 V, 1.35 mΩ, TSC

- Bottom- or top-side cooling options make CCPAK flexible for PCB integration and thermal-stack optimization.
- Ultra-low $R_{DS(on)}$ reduces conduction losses and enables smaller passive components.
- An exposed pad area of approximately 81 mm², provides a substantial surface for thermal conduction to the heatsink.
- Fully AEC-Q101-qualified, suitable for under-hood automotive environments.

Fig. 12 Nexperia's CCPAK top side and bottom side cooled devices and their benefits

Beyond raw electrical performance, CCPAK's scalability and cost-effectiveness offer a clear path for system designers transitioning from traditional through hole solutions. The mechanical robustness and board-level thermal integrity simplify integration and long-term reliability validation in high-density inverter modules.

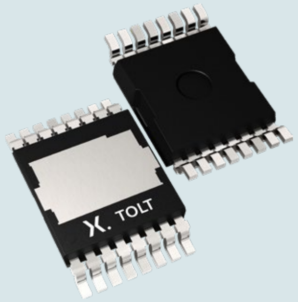
Detailed design guidance, including thermal performance analysis, layout optimization, and reliability validation, is provided in Application Note AN90046, which covers the 12 × 12 mm CCPAK1212(i) top-side cooled MOSFET and its engineering benefits for automotive and industrial high-power designs.

650 V GaN FETs for 400 V BEVs/PHEVs e-compressor inverters

For battery-electric (BEV) and plug-in-hybrid (PHEV) HVAC e-compressor systems, the DC-bus typically ranges from 400 V up to about 470 V under over-voltage conditions. A 650 V-rated device such as Nexperia's GANC035-650UTH, a 650 V, 35 mΩ Gallium Nitride (GaN) FET in a TOLT package provides an attractive solution for the inverter's half-bridge stages, combining high-voltage margin, low conduction loss, and excellent switching performance.

A 650 V rated device gives roughly 1.4–1.6x safety margin over the maximum DC-bus voltage, which is sufficient when combined with proper bus-bar layout and clamping or snubber networks

Recommended Part: 650 V, 35 mΩ Gallium Nitride (GaN) FET in a TOLT package



GANC035-650UTH: 650 V, 35 mΩ, TOLT package

- Low $R_{DS(on)}$ advantageous for high-current e-compressor inverters.
- Faster switching with lower gate and output charge compared to silicon devices of similar rating.
- Simple gate driver voltage 0 V to 12 V with high V_{TH} of 4 V for safeguards against parasitic turn-on.
- Top-side cooling compatibility, enabling direct heatsinking from the component side of the PCB, which is ideal for compact, under-hood modules.

Fig.13 Nexperia's GaN FETs in CCPAK packages

For a three-phase 400–470 V BEV/PHEV e-compressor inverter, the GANC035-650UTH can be used in the upper and lower legs of each half-bridge (six devices per three-phase leg).

For further consideration, the NX-HB-GAN039-BSCUL bottom-side cooled half-bridge evaluation board is available for ordering, it provides the elements for the basic study of the switching characteristics and efficiency achievable with Nexperia's 650 V GaN FETs. Alternatively, NX-HB-GAN039-TSCUL is another evaluation board for top-side cooled CCPAK1212i package, these circuits can be configured for half-bridge operation. The high-voltage input and output can operate at up to 400 V DC, with a power output of up to 3.5 KW or more, dependent upon cooling, ambient temperature and switching frequency. The TO-247 alternative package is evaluated using NX-HB-GAN041-650WSB.

1200 V SiC MOSFETs with top side cooling for 800 V BEVs

Nexperia's automotive qualified 1200 V planar SiC MOSFETs are engineered to meet the performance, efficiency, and reliability requirements of high-voltage inverter systems used in modern 800 V battery electric vehicles (BEVs). With package options such as TO-247-4L, X.PAK, and D²PAK (TO-263-7L), designers can optimize layout for low stray inductance and superior thermal management, supporting compact and high-power e-compressor inverter assemblies.

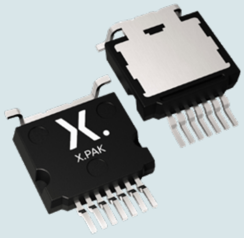
The planar SiC architecture offers inherent advantages in thermal stability, gate control, and ruggedness. A low and thermally stable $R_{DS(on)}$ ensures consistent conduction performance even at elevated junction temperatures, minimizing efficiency degradation under real-world thermal cycling. The tight gate threshold tolerance (Vth) simplifies gate driver design and allows for scalable, parallel device operation without the risk of current imbalance, an essential requirement in multi-phase compressor systems where current levels are high and load transients frequently.

An additional design benefit is the robust, low-forward-voltage body diode, which reduces reverse-recovery charge (Q_{rr}) and associated switching losses. This characteristic enables shorter dead-time design while mitigating cross-conduction risk, improving both system efficiency and dynamic response. Such behaviour is especially valuable in pulse-width-modulated compressor drives, where switching frequency and transient response directly affect power density and noise profile.

In e-compressor inverters, these MOSFETs provide a strong balance between switching speed, efficiency, and robustness. Their low output capacitance (C_{oss}) and fast transition capability reduce switching losses, while the planar device structure ensures predictable, reproducible behaviour across temperature and voltage swings. Combined with automotive qualification (AEC-Q101) and Nexperia's proven high-voltage process control, these devices deliver the reliability and repeatability demanded for high-volume automotive production.

For designers, the result is a scalable, thermally efficient, and easily integrated power stage suitable for compact inverter topologies, enabling smaller cooling systems, reduced parasitic effects, and extended lifetime in demanding environments.

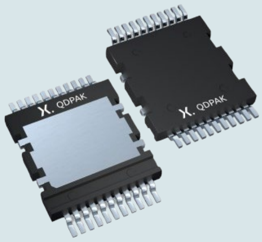
Recommended Parts: 1200 V SiC MOSFETs in X.PAK



- NSF017120T2A0: 1200 V, 17 mΩ
- NSF030120T2A0: 1200 V, 30 mΩ
- NSF040120T2A1: 1200 V, 40 mΩ
- NSF060120T2A0: 1200 V, 60 mΩ

- Excellent $R_{DS(ON)}$ temperature stability
- Tight threshold voltage specification
- Superior gate charge ratio
- Robust, low forward voltage body diode
- AEC-Q101 qualification

Recommended Parts: 1200 V SiC MOSFETs in QDPAK



- NSF017120T1A0-Q: 1200 V, 17 mΩ
- NSF030120T1A0-Q: 1200 V, 30 mΩ
- NSF040120T1A1-Q: 1200 V, 40 mΩ
- NSF060120T1A0-Q: 1200 V, 60 mΩ

Table 4 Nexperia's SiC MOSFETs in X.PAK and QDPAK, top side cooling packages

4.2 Gate driving solutions for safe and efficient inverter power switch operation

Gate drivers are the critical interface between the low-voltage control electronics and high-power inverter switches in e-compressor systems. Proper gate driver design is critical to maximize efficiency, reliability, and safe operation of power switches in e-compressor inverters. Gate drivers must deliver precise voltage levels, fast edge rates, and robust protection while matching the specific characteristics of Si MOSFETs, SiC MOSFETs, IGBTs, and GaN FETs across 48 V, 400 V, and 800 V systems.

As discussed before, e-compressor inverters commonly use three-phase, six-switch configurations with half-bridge gate drivers for high-side (HS) and low-side (LS) switches as shown in Figure 14. Low-side drivers receive direct supply from a regulated 12/18 V auxiliary rail. The gate driver controls both switches with complementary PWM signals while enforcing dead time to prevent shoot-through.

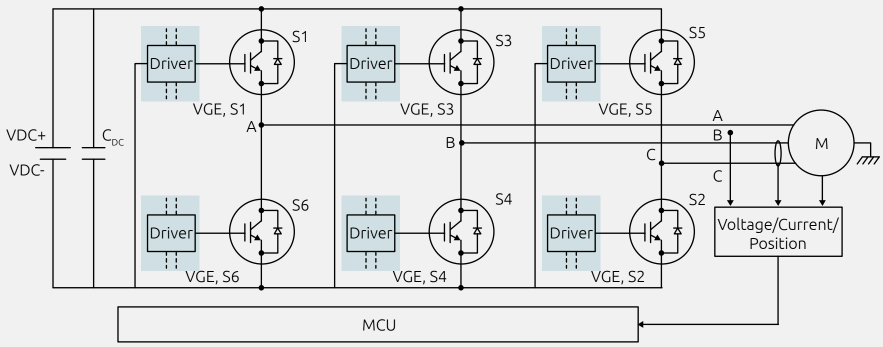


Fig. 14 Three phase two level inverter design using gate rivers for each power switch

Key considerations for gate drivers include:

- Gate current requirements: Total gate charge determines peak source/sink current $I_{(G,\ peak)} = Q_{G/t}$(rise/fall). High QG devices (SiC/GaN at 100–500 nC) demand peak currents >4 A to achieve fast rise/fall times without excessive EMI.
- Turn-on and turn-off gate voltage levels
  - Si MOSFETs: typical require +12 V/ -5 V (for optimal RDS(on) and safe miller region)
  - SiC MOSFETs: +15 V to 20 V and -3 V/-5 V (higher positive drive overcomes threshold and minimises $R_{DS(on)}$, higher negative drive during turn off minimises parasitic turn on effects)
  - GaN FETs: (+6 V to 10 V) and 0 V for direct-drive enhancement mode
- Miller clamp: during HS off time, dV/dt induced gate voltage spikes can trigger parasitic turn on. Fast turn off and pull down of current spikes will minimise possible short circuits.
- Desaturation detection: monitors V_{DS}/V_{CE} during on-state and trips if over-voltage is detected. This requires blanking time post turn-on.
- VGS monitoring: to detect gate drive faults (overvoltage, undervoltage) via ADC or comparator.
- Fault-monitoring: monitoring of short circuits, overcurrent, over-temperature via MCU interrupt to shutdown driver pin or initiate retry actions.
- Half bridge vs low side drivers: low side only is simpler for design; half-bridge gate drivers minimise the bill of materials and space constraints.
- CMTI: high common mode transient immunity usually >100 kV/us is required for fast dV/dt.

These considerations set up specific part recommendations in the next section, automotive-qualified half-bridge drivers, bootstrap diodes, clamp MOSFETs/BJTs, and DESAT diodes optimized for Nexperia Si/GaN/SiC switches. Proper implementation can reduce inverter losses by >1% while ensuring fail-safe operation under short-circuit, overload, and EMC stress.

Nexperia Solutions

Nexperia's automotive-qualified gate driver portfolio provides optimized solutions for bootstrap operation, high peak currents, DESAT protection, and fault monitoring tailored to these demanding applications.

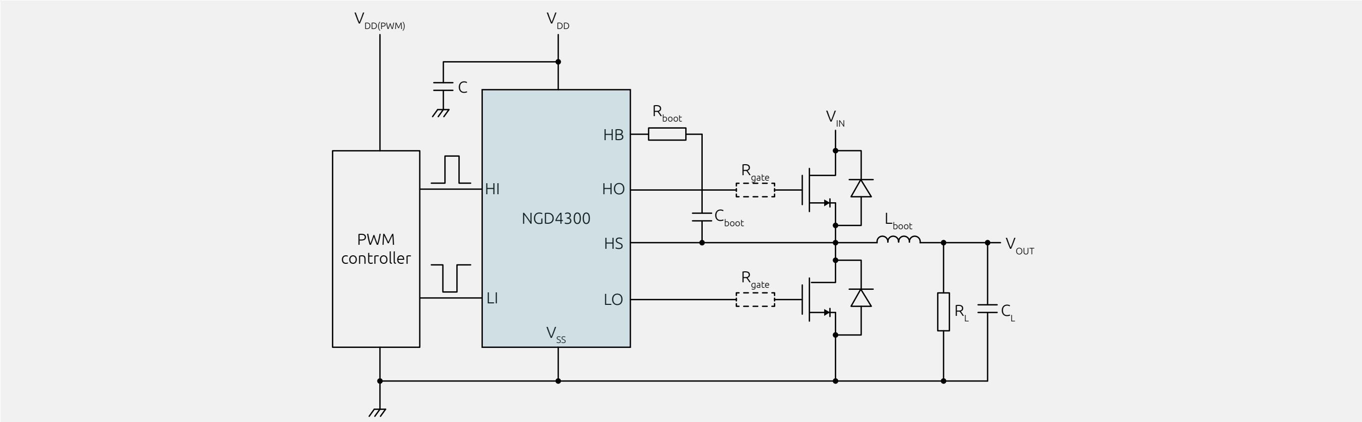


Fig. 15 Schematic of NGD4300 half bridge gate driver

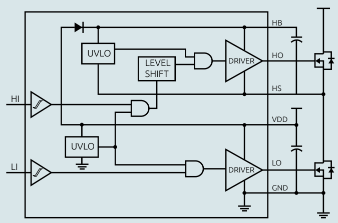
The NGD4300-Q100 is a high-performance gate driver designed to drive both high-side and low-side N-channel MOSFETs in a half bridge configuration. The floating high-side driver can work with rail voltages up to 120 V and uses a bootstrap supply with an integrated diode. Both low side and high-side output drivers have an independent undervoltage lockout (UVLO) circuit which disables the output driver when the driver supply is below its threshold level.

The NGD4300-Q100 accepts input control signals complying with both TTL and CMOS signalling as low as 2.5 V (±10%). The low voltage, provided by an internal voltage regulator, is used to supply circuitry in signal paths controlling the low side and high-side power switches. This enables low-power operation and better controlled driver performance irrespective of the IC supply voltage. Excellent delay matching of 1 ns typical is achieved for the low-side and high-side signal paths. The 4 A peak source and sink current capability of the driver's output stage guarantees short rise and fall-times even at high loads. The NGD4300-Q100 is offered in the HSO8 package and operates over an extended −40 °C to +125 °C temperature range. This product has been qualified to the AEC standard Q100 (Grade 1) and is suitable for use in e-compressor inverter applications.

Recommended Part: NGD4300-Q100

Package information

Functional diagram



Features

- Integrated Boot strap diode
- VHS (-5 to 115 V)
- VHB-HS (-0.3 to 20 V)
- HI/LI (-10 to 20 V)
- UVLO on both HS & LS drivers
- High source and sink current +4/-5 A at 12 V
- AEC-Q100 qualified

Table 5 Nexperia's gate driver solution for inverter power switches

4.3 Protecting the e-compressor control board from harsh transient conditions

An automotive HVAC e-compressor control board is typically powered from the vehicle's 12 V or 48 V auxiliary rail, which is inherently noisy and exposed to severe transient events. If not properly suppressed, these transients can damage MOSFETs, gate drivers, DC-DC converters, MCU power rails, and sensors, leading to premature field failures or intermittent malfunctions.

Three major transient classes pose a particular risk to e-compressor control electronics:

- Load-dump events occur when the battery is disconnected while the compressor is still running, causing the alternator or DC-DC bus to "dump" energy onto the remaining loads. For 12 V systems, load-dump voltage spikes can reach >60 V for tens to hundreds of milliseconds; for 48 V mild-hybrid systems, similar events can exceed 100 V for short but damaging durations. If the DC-rail protection chain is weak, these transients can overstress the input-stage MOSFETs, gate-driver supplies, and DC-DC converters, driving them into avalanche or catastrophic overvoltage failure.
- Reverse-battery events during jump-start, battery terminals can be connected in reverse polarity, applying a large negative voltage to the 12 V or 48 V input rail. The e-compressor control board must block this negative voltage and prevent reverse current from flowing through the bulk input capacitors and DC-DC converters, which would otherwise destroy downstream ICs.
- Startup inrush currents and voltage sag - When the system is powered, the DC-rail decoupling and DC-DC input capacitors present a near-short circuit, leading to high inrush currents at turn-on. Excessive inrush can trigger false undervoltage conditions, latch-up in sensitive ICs, or thermal stress in MOSFETs and fuses, while also causing voltage "snag" (temporary sag) on the main rail that can reset the MCU or sensors.

From a power-electronics perspective, the control board protection stage must therefore:

- Clamp transient voltages within the safe-operating area (SOA) of all downstream components.
- Withstand reverse-polarity and inductive-switching events compliant with automotive standards such as ISO 7637-2 and ISO 16750-2.
- Manage inrush energy so that the control-board startup is robust across temperature and SOC extremes.

Nexperia Solutions

A combination of TVS diodes, reverse battery protection MOSFETs, LC filters, smart high-side switches, pre-charge circuits, and robust AEC-Q101 MOSFETs can be used to clamp transient voltages, limit inrush currents, and ensure stable supply rails.

TVS Diodes

Nexperia's automotive-qualified PTVS diode families provide the primary protection barrier for the e-compressor's low-voltage power stage. By placing the TVS diode at the power-stage input, the e-compressor achieves a robust first line of defence against surge, load-dump, and switching-induced transients, significantly improving long-term system reliability as shown in Figure 16.

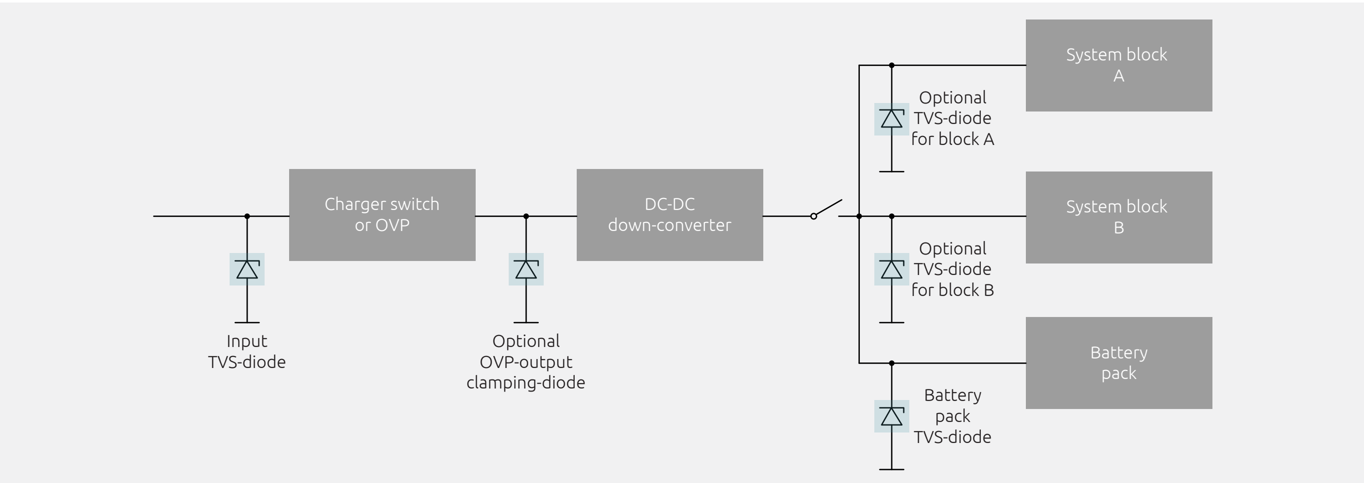


Fig. 16 TVS diodes placement in a power system

The PTVS family is available in unidirectional configuration with working voltages ranging from 3.5 V up to 64 V, making them suitable for 12 V and 24/48 V automotive power nets. Devices offer 400 W or 600 W rated peak pulse power (10/1000 μs) and come in SOD123W and SOD128 compact, thermally robust packages that help reduce PCB footprint in dense compressor control boards.

The critical parameter for selecting a TVS is the stand-off voltage (VWM), which defines the maximum continuous DC voltage the TVS diode can withstand without entering conduction. VWM must always be higher than the maximum operating voltage of the electrical system. For a 12 V automotive net, this typically requires a VWM of 18–24 V. For 24 V or 48 V systems, VWM choices typically fall between 33 V and 64 V. Other parameters to consider when selecting a TVS diode include the breakdown voltage, clamping voltage, peak pulse power (PPPM). Nexperia's product families of PTVSxS1Ux-Q (400 W) and PTVSxVP1Ux-Q (600 W) offer a wide range of solution fit for transient protection either at the power input or at the points of load.

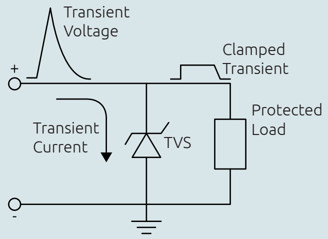
Recommended Part: PTVSxS1Ux-Q (400 W) and PTVSxVP1Ux-Q (600 W)

Package information

SOD123W (400 W)

SOD128 (600 W)

Application diagram



Features

- Unidirectional TVS diodes
- Rated peak pulse power: PPPM = 400 W or 600 W
- Reverse standoff voltage range: VRWM = 3.3 V to 64 V
- AEC-Q100 qualified

Table 6 Nexperia's PTVs in either 400 W or 600 W rated devices

For further information on different techniques of protecting the electronics from negative overvoltage caused by reverse battery connection, refer to the power input protection techbook. A summary of battery protection circuits which can be selected from Nexperia's product family are summarised as shown in the figure below.

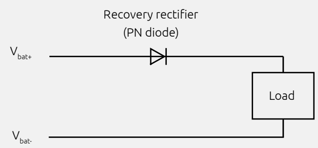
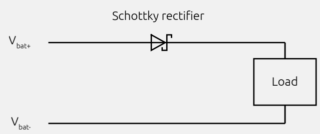
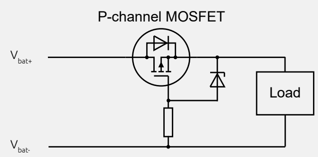
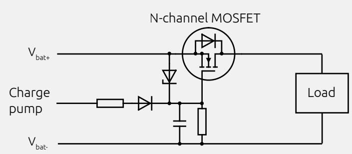
Recovery rectifier (PN diode) e.g. PNE20030EP in CPF5		› Low power ~1 A supply › Low cost › Device rating: 200 V; 3 A › High conduction loss
Schottky rectifier e.g. PMEG045T150EPD in CFP15		› Low-Medium power ~3 A supply › Slightly higher cost › Device rating: 45 V; 15 A › High leakage current, especially at high temperature
P-channel MOSFET e.g. BUK6Y14-40P in LFPAK56E		› Medium-High power ~5.7 A supply › Device specifications: 14 mΩ; 40 V; 110 W › High-side: very cost effective due to simple gate drive
N-channel MOSFET e.g. BUK7J1R4-40H in LFPAK56E		› High power ~25 A supply › Device specifications: 1.4 mΩ; 40 V; 395 W › High-side: requires charge pump circuitry, low-side is more cost effective

Fig. 17 Nexperia solutions for reverse battery protection

4.4 How to design a compact PCB footprint for tight mechanical integration

OEMs are increasingly requesting fully integrated power electronics inside the compressor housing, leaving extremely limited space for the PCB. Designers must achieve high power density while ensuring electrical robustness, low parasitic inductance, and adequate thermal paths, all within a mechanically constrained and vibration-rich environment.
The challenge is compounded by:

- Limited PCB area due to the proximity of the motor stator, compressor shell, and cooling passages.
- Thermal isolation requirements, separating hot inverter MOSFETs from sensitive control ICs.
- Routing constraints created by the need for very short motor phase paths and low-inductance high-current loops.
- Mechanical durability, requiring shock and vibration tolerance.
- Pressure sealed enclosures, which restrict connector placement, board height, and component orientation.

Achieving a compact yet manufacturable PCB stack-up requires careful co-design of the power stage layout, the control electronics, and the mechanical enclosure, with a strong emphasis on components that offer high performance in space-constrained footprints.

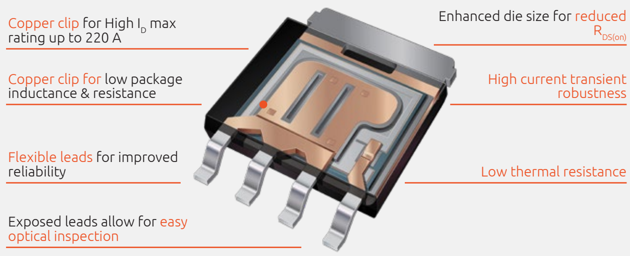
Nexperia Solutions

Designing a compact PCB for an e-compressor becomes particularly challenging due to severe space constraints, localized thermal hot spots, and the need for low-inductance, high-current routing. Nexperia addresses this by offering low-inductance, high-density power packages that are better suited for tight-space integration than conventional TO-style or long-lead devices.

Clip-bonded MOSFET packages (CCPAK, LFPAK)

Nexperia offers a family of low-inductance, clip-bonded power packages such as LFPAK and CCPAK specifically engineered to support high-density and thermally efficient PCB layouts for automotive e-compressor inverters. These devices are designed to replace conventional bond-wire-based packages without sacrificing reliability, enabling smaller board footprints, lower stray inductance, and better thermal coupling to compact heatsinks and cold plates.

<table>
<tr><th>Package option</th><th>Key features</th></tr>
<tr><td>LFPAK56 Automotive MOSFETs
Available from 40 V to 100 V N-channel MOSFETs

</td><td>
</td></tr>
<tr><td>LFPAK88 Automotive MOSFETs
Available for 40 V to N-channel MOSFETs

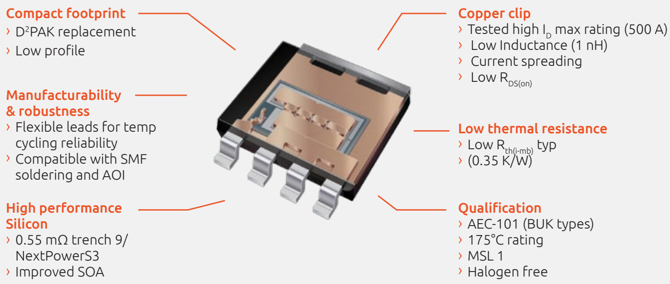
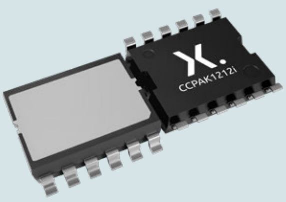
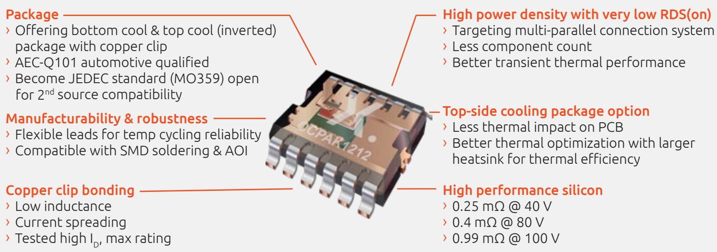
</td><td>
</td></tr>
<tr><td>CCPAK1212(i) (top side cooling or bottom side cooling)
Available for 100 V N-channel MOSFETs and
650 V Cascode GaN FETs

</td><td>
</td></tr>
</table>

Fig. 18 Nexperia's clip-bonded MOSFET package choices

These clip-bonded construction allows a more compact package outline versus equivalent wire-bond TO-style devices, while maintaining a large copper-exposed pad for thermal and current conduction. This reduces the required PCB area and enables tighter clustering of devices around the DC-link and motor phases, without sacrificing long-term reliability under repeated thermal cycling typical of HVAC-compressor duty cycles. Together, CCPAK and LFPAK-style MOSFETs provide an ideal mix of low inductance, high current density, and automotive-grade reliability, enabling compact inverter layouts that still meet efficiency, thermal, and EMC targets. The space saving advantage of CCPAK and LFPAK compared to D2PAK (TO263) and DPAK (TO252) is shown in the figure below.

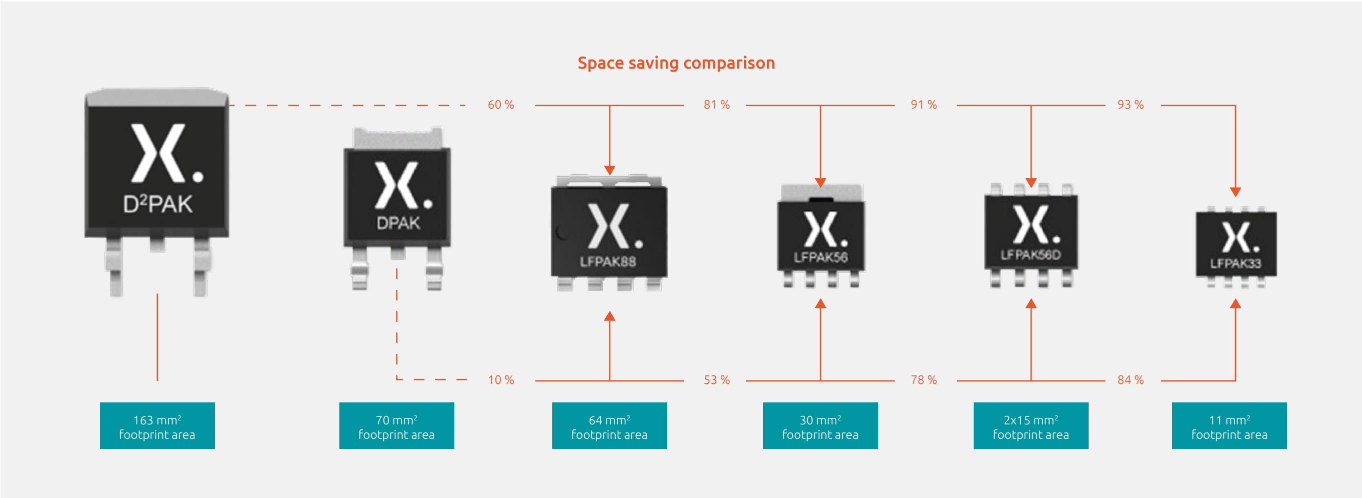


Fig. 19 Space saving comparisons of LFPAK to D2PAK and DPAK packages

Low-profile, clip-bonded power devices (CFP-style diodes)

In addition to clip-bonded MOSFETs, Nexperia offers low-profile, clip-bonded power devices such as CFP-style diodes and MOSFETs, which are particularly well-suited for space-constrained e-compressor PCBs and metal-core or double-sided cooling modules.
CFP-style packages feature a flat, low-profile body and a large, exposed copper-top surface, which helps reduce component height and allows the PCB to fit within shallow compressor housings or pressure-sealed enclosures.

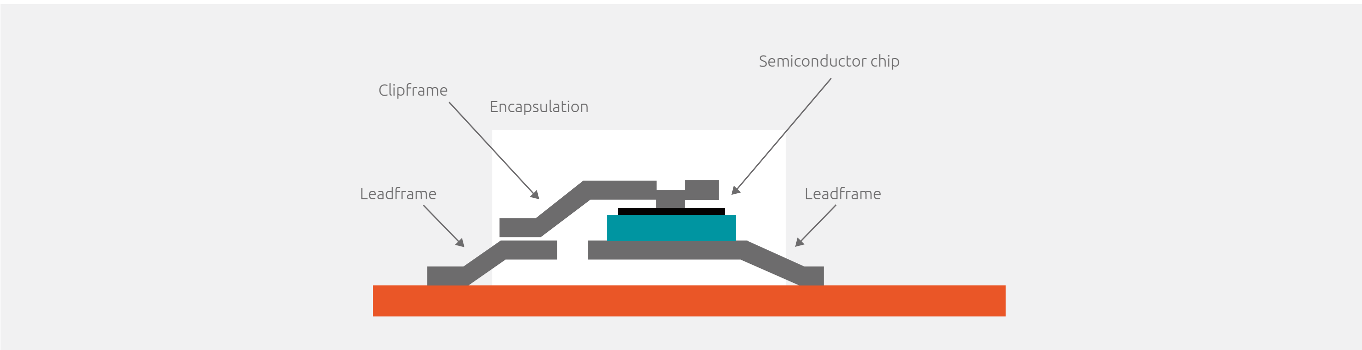


Fig. 20 CFP style features a large area between clip and die, reduces resistance and increases thermal conduction

At the same time, the clip-bonded structure provides excellent thermal coupling from the die directly to the PCB or to an overlying heatsink, reducing the need for bulky external heatsinks and complex thermal-stack designs.

Nexperia's Clip-bonded Flat Power (CFP) portfolio includes several variants - CFP5, CFP3, CFP3-HP, and CFP2-HP, each optimized for a different trade-off between footprint, current capability, and thermal performance. These are mainly used for Schottky, Zener diodes and rectifier diodes, and power BJTs. Figure below shows typical form factors for each footprint in comparison to standard SMA package.

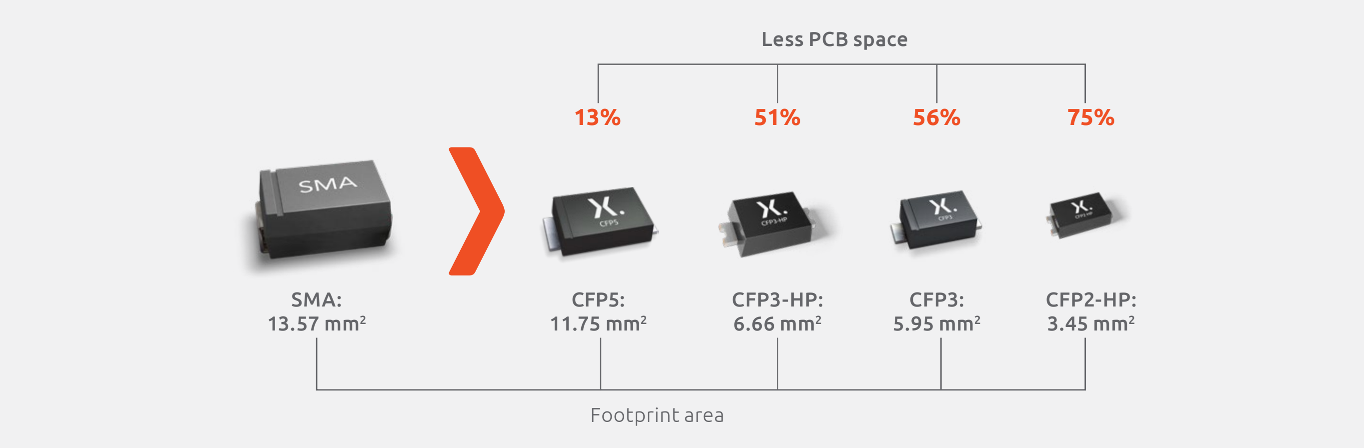


Fig. 21 Footprint advantages of CFP packages with SMA while maintaining same power capability

- The advantage is clear that CFP5 has 13% smaller PCB area than equivalent SMA style devices, while maintaining similar or higher power-dissipation capability. CFP5 is ideal where you need moderate-to-high current in a compact surface-mount rectifier footprint, such as DC-link clamp or DC-DC secondary-side rectification in the e-compressor control board.
- CFP3 (SOD123W) has a footprint of 5.95 mm^2, which is 56% smaller and lower profile package than SMA. It is used for medium-current Schottky and rectifier diodes, suitable for lower-current DC-DC stages, flyback snubbers, and auxiliary-rail freewheeling in the e-compressor control module.
- CFP3-HP Same industry-standard SOD123W footprint as CFP3, but with enhanced internal design for higher current density and thermal performance. It has higher current capability per unit area due to optimized clip-bond and silicon design. CFP3-HP is the "high-performance" sibling of CFP3, positioned as a direct upgrade where you already use SOD123W-footprint devices but need better efficiency and reliability.
- CFP2-HP has a form factor of approximately 3.45 mm2 – one of the smallest rectifier/diodes footprints in Nexperia's CFP family. It can be used in low-to-medium-current Schottky or rectifier diodes, used in very compact DC-DC stages, rail-clamping, and auxiliary-supply paths where PCB area is extremely tight. It is designed to follow IC-style miniaturization trends, making it easier to place rectifiers next to MOSFETs, gate-drivers, or DC-DC ICs on dense layouts.

Across the CFP family (CFP2-HP, CFP3, CFP3-HP, CFP5), Nexperia provides several system-level improvements over legacy SMA/B/C and DPAK devices. Refer to online resources for more information on CFP packages.

4.5 Considerations for reliable communication between MCU and external interfaces such as VCUs

The compressor Control Unit (MCU) frequently exchanges commands and status data with higher-level vehicle controllers such as the Vehicle Control Unit (VCU), battery management system (BMS), and body control modules. This communication typically runs over CAN / CAN-FD, LIN, or automotive Ethernet and must be robust, low-latency, and fault-tolerant even in harsh EMC, 12/24 V-system, and under-hood environments.

Achieving reliable MCU–VCU communication therefore requires careful signal-protection, EMC filtering, and interface-level design, not just software-layer robustness. Common challenges at the hardware level include:

- ESD and transient sensitivity of data lines
- Signal-integrity degradation at higher data rates
- Electromagnetic interference and crosstalk

Nexperia Solutions

Nexperia offers a portfolio of AEC-Q101-qualified ESD, TVS and isolation devices specifically tailored for automotive data communication links, which can be integrated directly at the MCU or VCU interface. These solutions preserve signal integrity while enabling compact, cost-effective PCBs suitable for e-compressor-level integration. A solution manual for overcoming these challenges is available at [communication interface techbook]. Please refer to it for communication specific solutions.

5. Recommended products

Technology	Description	Key part numbers
Inverter power switches		
Automotive MOSFETs	100V MOSFET in CCPAK1212(i), bottom side or top side cooled package, ultra-low $R_{DS(on)}$ and ideal for 48 V battery architectures inverters such as MHEVs.	BUK7A1R0-100L, BUK7A1R3-100L, BUK7T1R0-100L, BUK7T1R4-100L
GaN FETs	650 V Cascode GaN FETs, 39 to 41 mΩ $R_{DS(on)}$, high power density packages such as CCPAK1212(i) and TO247.	GAN039-650NTB, GAN039-650NBB, GAN041-650WSB
SiC MOSFETS	1200 V SiC MOSFETs in X.PAK and QDPAK, surface mount top side cooled packages. Offers low $R_{DS(on)}$ from 17 mΩ to 60 mΩ.	NSF017120T2A0, NSF030120T2A0, NSF040120T2A1, NSF060120T2A0
Gate drivers		
Gate Drivers	120 V 4A HS/LS gate driver in SOT8063-1 package. Low propagation delay and integrated bootstrap diode.	NGD4300-Q100, NGD31251D
Input power protection (12 V to 48 V)		
TVS diodes	Working voltage from 3.3 V to 64 V, 400 W or 600 W PPM rating, SOD123W or SOD128 package options	PTVSxS1Ux-Q (400 W) or PTVSxVP1Ux-Q (600 W)
Schottky diodes	20 – 100 V in CFP5 packages and >1 A. Placed in series with input supply line to block reverse current flow incase of reverse connection.	PMEG40Txx-Q
P-channel MOSFETs	-30 V to -80 V LFPAK33 and LFPAK56 packages for reverser polarity protection. Offers simpler gate control and lower $R_{DS(on)}$	BUK6Yxx-60P, BUK6Yxx-80P, BUK6Mxx-60P
e-Fuse	Low ohmic (17 mΩ), high current (13.5 A), resettable electronic fuses targeted for 12 V battery supplies.	NPS3102A, NPS3102B
Input power regulation (12/24 V to 5/3.3 V)		
LDOs	40 V, 150 mA/ 300 mA ultra-low Iq linear, low-dropout (LDO) regulators ideal for powering always-on components, MCUs, CAN or LIN transceivers. 3.3 V/ 5V or adjustable outputs.	NEX90X30-Q100, NEX91X15-Q100, NEX91X30-Q100
Schottky diodes	40 V in CFP5/CFP3 for power rectification in discrete based DCDC converters.	PMEG40Txx-Q, PMEG40xx-Q
N-channel MOSFETs	40/60 V N-channel MOSFETs with low RDS(on) for application in any kind of switching converters. LFPAK33/56 and MLPAK33/56 for mid-range power converters.	BUK9Mxx-60H, BUK9Yxx-40H, BUK9Qxx-40H
Signal processing		
Voltage Translators (level- shifters)	Autosense bi-directional, direction controlled or unidirectional voltage level translators. 2 to 8 channels options.	NXU0101-Q100, NXU0202-Q100, NXB0108PW-Q100
Logic gates	Inverters/Buffers/AND/NOR/OR …. gates/Registers/ latches in miniaturized package options for routing simplification. TTL/CMOS compatible with Schmitt triggered inputs.	74AHC1G126; 74AHCT1G126, 74ALVC16244; 74ALVCH16244, 74AUP2G17, 74AXP1G10
Zener diodes	Wide range of working voltages up to 52 V with narrow working voltage tolerances. CFP3, DFN packages available.	BZT52H-Q Series, BZX384-Q Series, BZX84-Q Series, PZUxB_B2-Q
Switching diodes	General purpose use case in either single or dual solutions packages. Reverse voltage up to 300 V. DFN packages for space constrained designs or alternatively SOT23/SOT223	BAV20; BAV21, BAS101S-Q, BAV70, BAW56-Q, PMBD914-Q
Resistor equipped transistors (RETs)	100 mA, 500 mA and up to 600 mA output current capability. Built-in bias resistors and range of packages such as DFNs and SMD packages.	PDTA115E series, PDTA143/114/124/144EQA series, PDTC143X_TO_124XQB Series, PEMD12; PUMD12
Bipolar Junction Transistors (BJTs)	General purpose and low V_{CEsat} bipolar transistors. Single or double BJTs, either with NPN, PNP or NPN/PNP combinations.	BC51PAS; BC52PAS; BC53PAS, BC807-25QA; BC807-40QA, BC856W; BC857W; BC858W
Small signal MOSFETs	Low current switching MOSFETs with DFN, SOT23 options. N/P channels up to 100 V / - 100V with options for logic level gate control compatibility.	2N7002AK-Q, BUK4D110-20P, BUK6D125-60E
I2C repeaters	Level translation for reliable and smarter I²C systems, 2-bit bidirectional multi; open-drain; push-pull	NCA9306-Q100
Multiplexers	6-channel, 1 of 2 multiplexer and demultiplexer. Integrated level shifting and wide supply voltage.	NMUX27518BY, NMUX27518EPW

Technology	Description	Key part numbers
Communication Interface		
ESD diodes	ESD diodes for CAN/ LIN, Ethernet or IVNs. DFN or SOT packages, range of selection for 12V, 24V or 48 V board nets. Unidirectional or bidirectional options available.	PESD2IVN27T-Q, PESD2IVN27U-Q, PESD2CANFD24UT-Q PESD2CANFD24UU-Q, PESD2CANFD24UQB-Q, PESD2CANFD24UQC-Q
Digital Isolators	2 channel digital galvanic isolators for communication channels up to 50 Mbps.	NXI7720LD-Q100 *Coming soon

7. References

Application notes

AN90046 CCPAK1212i Design Guide
AN90030 Paralleling of Nexperia Cascode GaN FETs in half-bridge topology
AN90005 Understanding Power GaN FET data sheet parameters
AN90003 | LFPAK MOSFET thermal design guide
AN11882 | High-speed interfaces | ESD protection and EMI filtering
AN50007 | Applying ISO standard conducted transients to MOSFETs in 12 V, 24 V and 48 V systems
AN50020 | MOSFETs in Power Switch applications
AN90011 | Half-bridge MOSFET switching and its impact on EMC
AN90024 | Resistor Equipped Transistors (RETs): Key parameters and application insights
AN90052 | Nexperia load switch ICs compared to discrete solutions
AN11550 | Performance of Schottky rectifier in CFP15 package in low power adapter
AN50001 | Reverse battery protection in automotive applications
AN50005 | Paralleling power MOSFETs in high power application
AN50019 | Thermal boundary condition study on MOSFET packages and PCB substrates

Evaluation boards

NX-HB-GAN039-BSCUL bottom-side cooled half-bridge evaluation board | Nexperia
NX-HB-GAN039-TSCUL top-side cooled half-bridge evaluation board | Nexperia
NEVB-HB-GAN041-650WSB - 400 V, 3.5 kW, 100 kHz GaN FET half-bridge evaluation board
NEVB-MTR1-KIT1 – 1kW, 12-48 V BLDC motor driver kit
NEVB-NSF-XPAK-A - 1200 V SiC MOSFET (X.PAK) dual half-bridge evaluation board
NEVB-NEX90530BPA-Q100 - 3-40 V, 300 mA ultra-low Iq LDO evaluation board
NEVB-HB-GAN111-650WSB - 400 V, 2 kW GaN FET half-bridge evaluation board

Nexperia handbooks

MOSFET and GaN FET application handbook
ESD Application Handbook
Bipolar Junction Transistor (BJT) Application Handbook
Diode fundamentals, characteristics and applications
Logic product features and application insights

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