



High-performance MOSFETs for automotive systems

HPA TrenchMOS – powering automotive innovation

Today's vehicles pack in more features than ever before: engine management units and catalytic converters to reduce environmental impact, ABS and passenger restraint systems for increased safety, and power assisted steering, electric windows, mirrors and seats to make driving a more comfortable and convenient experience.

The demand for higher efficiency in all these automotive systems is pushing the need for increasingly complex, high-performance electronics. NXP Semiconductors is leading the development of high-performance automotive semiconductor solutions that meet the considerable power demands of systems that were once purely mechanical and are now being replaced by electrical equivalents. For example, electric power assisted steering (EPAS) systems require around 1 kW, while pump and fan motors draw between 500 and 800 W. Other applications, such as electric braking, turbochargers or valve train control, can be equally power hungry with the most extreme example being Integrated Starter Alternators (ISA), requiring around 10 kW.

Increased power demands mean higher current levels must be drawn from the standard 14 V automotive supply. This results in two key issues for power MOSFETs to meet the needs of today's electrical systems:

- ▶ large current handling capability in standard, inexpensive discrete packages without the need for large arrays of devices to share the burden
- ▶ minimum heat dissipation even when operated for long periods

NXP' High Performance Automotive (HPA) TrenchMOS™ family of MOSFETs has been designed specifically to satisfy these requirements and improve overall system performance throughout the car. Extremely rugged and with very low on-state resistance, they are supremely suited to the unique automotive environment and provide an excellent balance of current handling, low dissipation and cost-effectiveness all in industry-standard packages. With HPA devices, today's automotive electrical power demands can be easily met while remaining flexible enough for future innovations.

Key applications

- ▶ Electric power assisted steering (EPAS)
- ▶ Integrated starter alternator (ISA)
- ▶ Electric turbochargers
- ▶ Catalytic converter heaters
- ▶ Water, oil and fuel pump motors
- ▶ Windscreen wiper, seat, window and mirror motors
- ▶ Engine Management

Key benefits

- ▶ Reduced heat dissipation and increased efficiency due to extremely low on-state resistance
- ▶ Low parasitic capacitances lead to faster switching
- ▶ Improved ruggedness to survive the tough automotive environment
- ▶ Fully qualified to AEC Q101 standard for automotive discrete semiconductors
- ▶ Portfolio includes all common automotive breakdown voltage grades
- ▶ Available in a choice of industry-standard packaging options



SOT404/D²PAK



SOT428/DPAK



LFAK (SOT669)



SOT78/TO220AB



SOT226/I²PAK

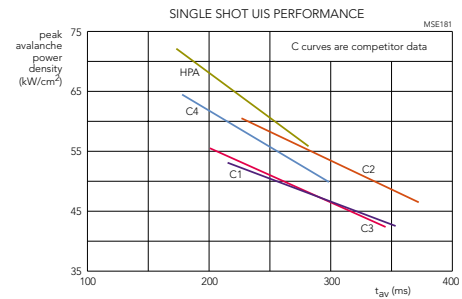
Advanced TrenchMOS technology for improved performance

Thanks to an advanced manufacturing process, NXP' HPA MOSFETs deliver unbeatable performance. An established leader in proven Trench technology, NXP has taken its capabilities to the next level. Our innovative stripe configuration for the MOSFET cells allows the cell pitch – and hence on-state resistance – to be reduced without the corresponding increase in capacitance and gate charge. Consequently, HPA devices offer faster switching for a given $R_{DS(ON)}$, leading to an outstanding combination of size, efficiency and performance that helps you reduce overall system costs without cutting back on functionality.

This increased performance is accompanied by improved reliability. Designed specifically for the automotive market, devices fabricated using this process are 20% more rugged than previous generations, allowing HPA devices to perform to their maximum potential even in the harshest of automotive environments. Alongside enhanced avalanche capability, they are rated for temperatures between -55 and +175 °C and are fully compliant with the internationally accepted AEC Q101 standard Stress Test Qualification for discrete semiconductors.

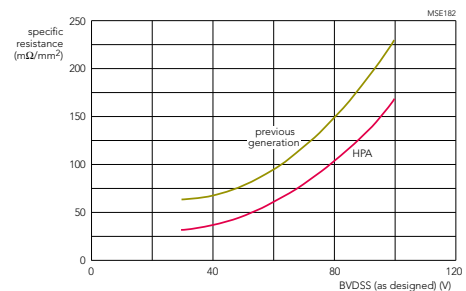
As space-efficiency becomes an important factor in system design, the HPA family maximizes the performance that can be delivered from small footprints.

Devices are available in a wide range of compact, industry-standard packages including TO220, D²PAK, LFAK and DPAK. For the ultimate design freedom, HPA MOSFETs can also be delivered as naked dies with the added benefit of further reduced $R_{DS(on)}$ values.



HPA stripe technology enhances the device avalanche power density.

Above plot demonstrates HPA versus competitors normalised maximum avalanche power handling capability prior to failure (higher = better)



HPA technology's increased active cell density reduces the device specific on-state resistance

E(H)PAS (Electronic (Hydraulic) Power Assisted Steering)

E(H)PAS systems are an increasingly common feature in new vehicles. Whilst EPAS systems themselves are more costly to manufacture than conventional hydraulic systems, major overall cost-savings result as they are simpler to fit. NXP is leading the way in helping reduce the cost of this MOSFET-intensive application, with its TrenchMOS technology and upcoming naked die capability.

Catalytic converter heater

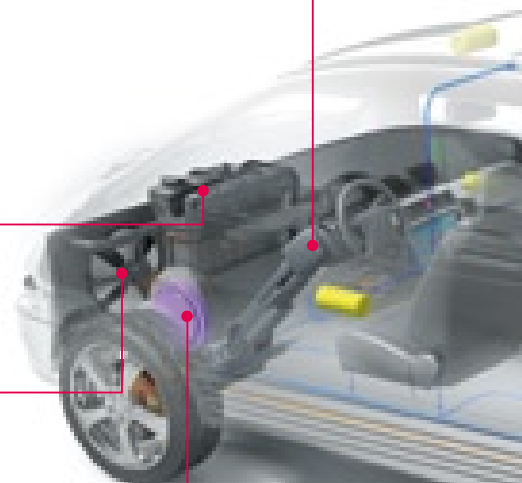
Low on-resistance TrenchMOS devices help reduce pollution by switching high power electric heaters to ensure the catalytic converter is at working temperature as soon as possible after starting.

Power train motors

NXP' Trench and TrenchPLUS devices provide optimum solutions for driving larger electric motors in water pump, oil pump and cooling fan applications.

Integrated Starter Alternator

NXP is becoming a leading supplier of very low on-resistance Power MOSFETs in naked die form, designed to cope with the huge current requirements of future ISA systems.



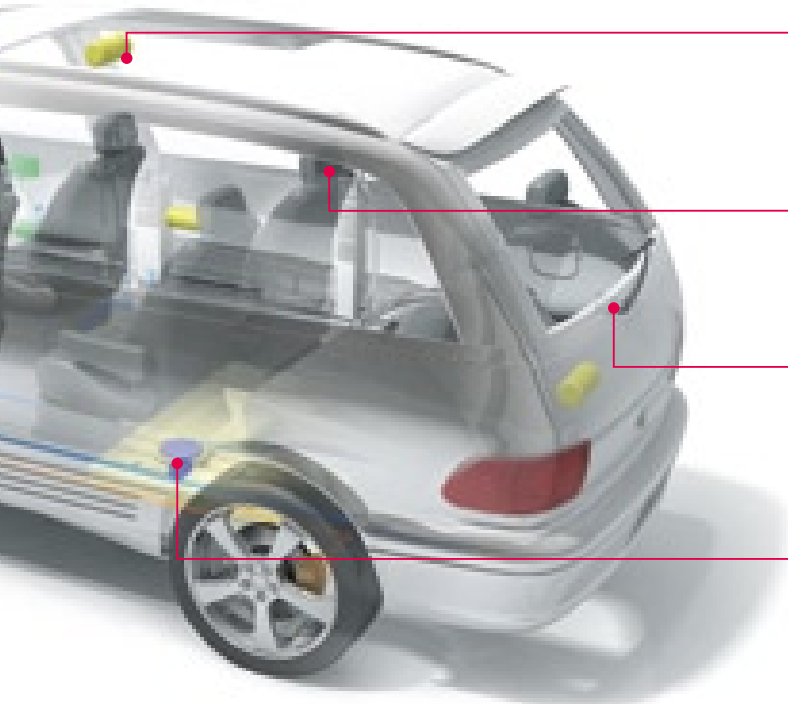
A growing family for increased power needs and performance



30 V - HPA TRENCHMOS							
Max $R_{DS(on)}$ (m Ω)	@ V_{GS} (V)	I_D (max) @ 25°C (A)	PACKAGE				
			SURFACE MOUNT			LEADED	
			D ² PAK (SOT404)	DPAK (SOT428)	LPAK (SOT669)	TO220AB (SOT78)	I ² PAK (SOT226)
2.7	10	75	BUK762R7-30B			BUK752R7-30B	BUK7E2R7-30B
2.8	5	75	BUK962R8-30B			BUK952R8-30B	
3.5	5	75					BUK9E3R5-30B
7	5	55		BUK9207-30B			
7	10	55		BUK7207-30B			
7	5	75	BUK9607-30B			BUK9507-30B	
7	10	75	BUK7607-30B			BUK7507-30B	
11	5	59			BUK9Y11-30B		

40 V - HPA TRENCHMOS							
Max $R_{DS(on)}$ (m Ω)	@ V_{GS} (V)	I_D (max) @ 25°C (A)	PACKAGE				
			SURFACE MOUNT			LEADED	
			D ² PAK (SOT404)	DPAK (SOT428)	LPAK (SOT669)	TO220AB (SOT78)	I ² PAK (SOT226)
3.1	10	75	BUK763R1-40B			BUK753R1-40B	
3.2	5	75	BUK963R2-40B			BUK953R2-40B	BUK9E3R2-40B
4.3	10	75	BUK764R3-40B			BUK754R3-40B	
4.4	5	75	BUK964R4-40B			BUK954R4-40B	
5.2	10	75	BUK765R2-40B			BUK755R2-40B	
6.4	5	75	BUK9606-40B			BUK9506-40B	
8	10	55		BUK7208-40B			
8	10	75	BUK7608-40B			BUK7508-40B	
9	5	55		BUK9209-40B			
9	5	75	BUK9609-40B			BUK9509-40B	
13	10	55			BUK7Y13-40B		
14	5	53			BUK9Y14-40B		

Key applications



Roof and door modules

NXP High Performance Automotive devices may be used for driving motors in powered roof, mirror and window applications as well as door locks.

Seat module

Seat position motors and seat belt pre-tensioning can all benefit from NXP' automotive PowerMOS solutions.

Wipers

HPA TrenchMOS technology offers a wide range of $R_{DS(ON)}$ choices for driving general motors such as those used in wipers.

Fuel pump

In line with NXP' strategy to provide optimum driving solutions for electric motors, TrenchMOS and TrenchPLUS technologies are often found in fuel pump applications.



55 V - HPA TRENCHMOS

Max $R_{DS(ON)}$ (m Ω)	@ V_{GS} (V)	I_D (max) @ 25°C (A)	PACKAGE				
			SURFACE MOUNT			LEADED	
			D ² PAK (SOT404)	DPAK (SOT428)	LFPAK (SOT669)	TO220AB (SOT78)	I ² PAK (SOT226)
4	10	75	BUK764R0-55B			BUK754R0-55B	
4.2	5	75	BUK964R2-55B			BUK954R2-55B	
6	5	75	BUK9606-55B			BUK9506-55B	BUK9E06-55B
6	10	75	BUK7606-55B			BUK7506-55B	BUK7E06-55B
7	10	75	BUK7607-55B			BUK7507-55B	
8.4	5	75	BUK9608-55B			BUK9508-55B	
11	10	75	BUK7611-55B			BUK7511-55B	BUK7E11-55B
12	10	55		BUK7212-55B			
12	5	55		BUK9212-55B			
12	5	75	BUK9612-55B			BUK9512-55B	
19	5	40			BUK9Y19-55B		
40	5	20			BUK9Y40-55B		

75 V - HPA TRENCHMOS

Max $R_{DS(ON)}$ (m Ω)	@ V_{GS} (V)	I_D (max) @ 25°C (A)	PACKAGE				
			SURFACE MOUNT			LEADED	
			D ² PAK (SOT404)	DPAK (SOT428)	LFPAK (SOT669)	TO220AB (SOT78)	I ² PAK (SOT226)
6	5	75	BUK9606-75B			BUK9506-75B	
6	10	75	BUK7606-75B			BUK7506-75B	
13	10	75	BUK7613-75B			BUK7513-75B	
14	10	55		BUK7214-75B			
16	5	67	BUK9616-75B			BUK9516-75B	
17	5	55		BUK9217-75B			
30	5	30			BUK9Y30-75B		

100 V - HPA TRENCHMOS

Max $R_{DS(ON)}$ (m Ω)	@ V_{GS} (V)	I_D (max) @ 25°C (A)	PACKAGE				
			SURFACE MOUNT			LEADED	
			D ² PAK (SOT404)	DPAK (SOT428)	LFPAK (SOT669)	TO220AB (SOT78)	I ² PAK (SOT226)
10	5	75	BUK9610-100B			BUK9510-100B	
10	10	75	BUK7610-100B			BUK7510-100B	
26	10	49	BUK7626-100B	BUK7227-100B		BUK7526-100B	
29	5	46	BUK9629-100B			BUK9529-100B	
30	5	44		BUK9230-100B			
53	5	23			BUK9Y53-100B		



For more information about automotive power: www.nxp.com/autopower
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