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VIPower® M0-7
Miniaturized high-side driver family

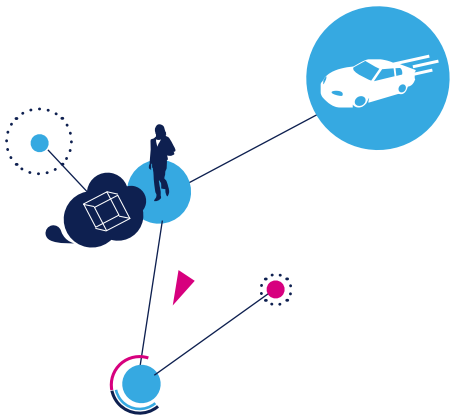
Content

VIPower® M0-7 HSD family

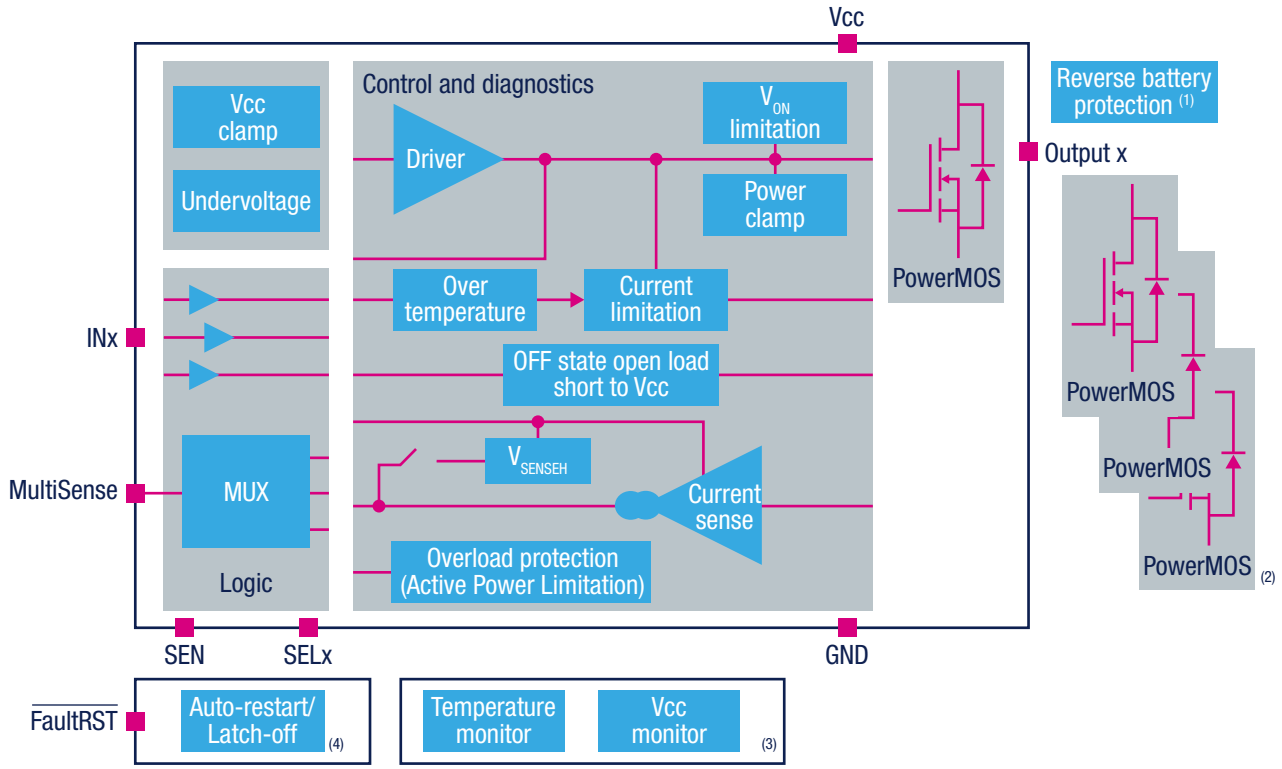
ST's VIPower® M0-7 family consists of a set of high-side drivers specifically designed for the automotive environment.
This family covers the full load range in terms of type and rated power and includes state-of-the-art embedded control circuitry and an advanced protection mechanism, making it the ideal solution for systems such as car junction boxes. In addition, the pin-to-pin compatibility across the whole family offers flexibility and scalability when addressing several variants of the same module.

Key benefits of VIPower® M0-7 high-side drivers	
New short-circuit protection mechanism In addition to the Auto-restart operation during an enduring load short circuit, the device can be configured in latch-off mode simply through the fault reset pin ($\overline{\text{FaultRST}}$). The advantage of the latch-off configuration is a significant increase in the device's lifetime under short-circuit conditions (Grade A according to the AEC-Q100-012 standard).	**New MultiSense diagnostics** In addition to analog output current sensing, it is possible to sense the supply voltage (on V_{CC} pin) as well as the chip's temperature in real time and in On as well as Off states.

Advanced tiny power packages
• Up to 75% of body size reduction versus previous family for PCB shrinkage and system weight reduction
• Wide offer including:
  • PowerSSO-16
  • Octapak
  • PowerSSO-36
  • SO-8
  • PowerSSO-12
	Ultra-low power consumption
	• Maximum 0.5 µA standby current per device
	
	This keeps the device's power consumption low despite an increased number of electronic components on board.

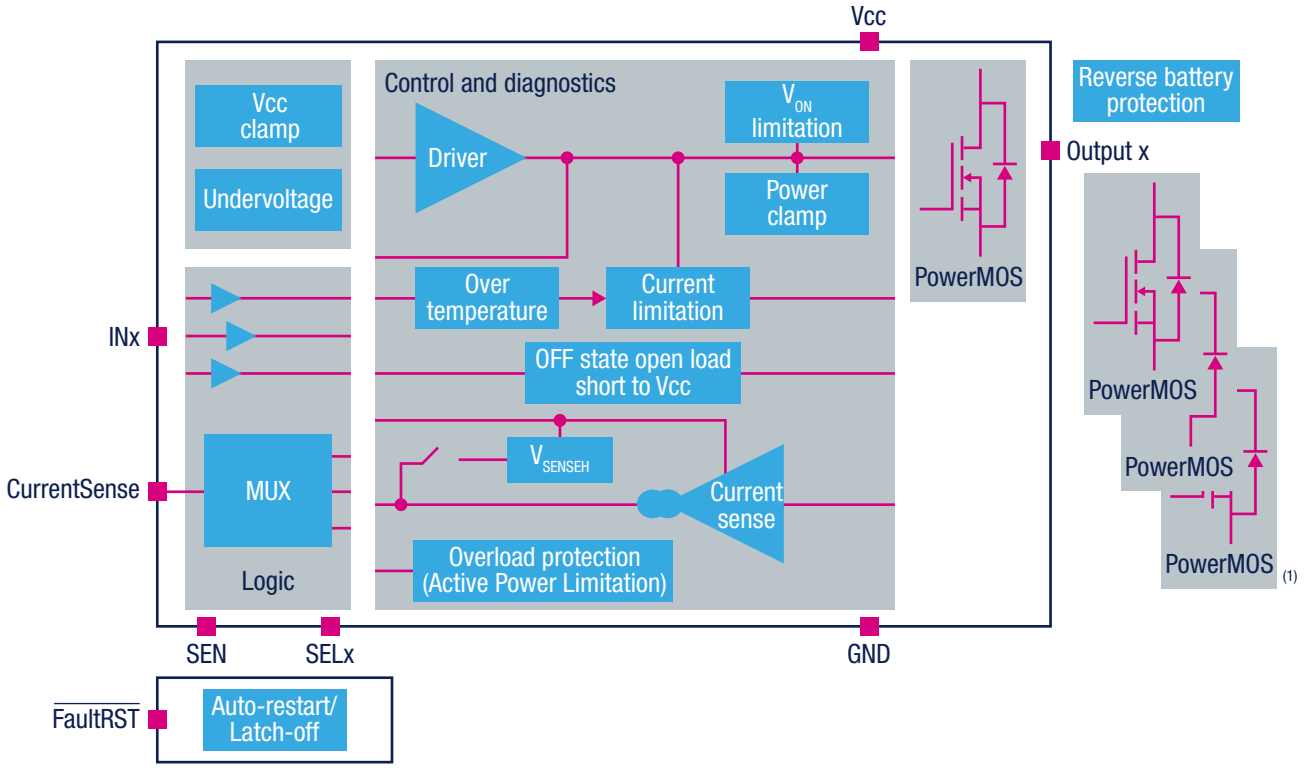


VIPower M0-7 HIGH-SIDE DRIVER BLOCK DIAGRAM



Note: (1) Built-in reverse battery protection, allowing self turn-on of the output power MOSFETs, available on selected devices
(2) One to four integrated power MOSFETs, depending on the number of channels
(3) Features available on selected devices
(4) Configurable auto-restart or latch-off functionality available on selected devices

VIPower M0-7E HIGH-SIDE DRIVER BLOCK DIAGRAM



Note: (1) One to four integrated power MOSFETs, depending on the number of channels

VIPower M0-7 AND M0-7E HIGH-SIDE DRIVER ADVANTAGES

KEY BENEFITS

- The highest package density on the market, makes your design compact and lightweight
- Ultra-low quiescent current allows extremely low battery consumption in idle mode
- The high-precision analog current sensing allows currents to be monitored for different load types, such as bulbs and LEDs
- Chip temperature reading in On and Off states allows detection of smooth overloads
- Battery line reading allows setting of correct PWM duty cycle without additional microcontroller I/Os
- Configurable auto-restart or latch-off modes makes the most of native devices robust against overload, regardless of the application's constraints
- Optimized EMC design together with extremely low switching losses allow best-in-class thermal efficiency and electromagnetic emission performance
- Low-voltage operation down to 4 V (down to 2.85 V for M0-7E) ensures critical functions are activated during cold cranking
- Minimization of external components

KEY FEATURES

- Extremely high current sensing precision and ultra-low voltage capability during the car cold cranking phase (Enhanced Series only)
- Optimized for LED driving
- Integrated sense multiplexer provides feedback on analog load current, temperature and V_{CC}
- Configurable auto-restart or latch-off protection against overload and short-circuit conditions by means of $\overline{\text{FaultRST}}$ pin
- Off-state open load detection
- Output short to V_{CC} detection
- Current limitation, power limitation and over-temperature shutdown
- Reverse polarity protection
- ESD integrated protection according to human body model and charge device model standards
- 0.5 µA standby current (maximum)

VIPower M0-7 HIGH-SIDE DRIVER PRODUCT PORTFOLIO

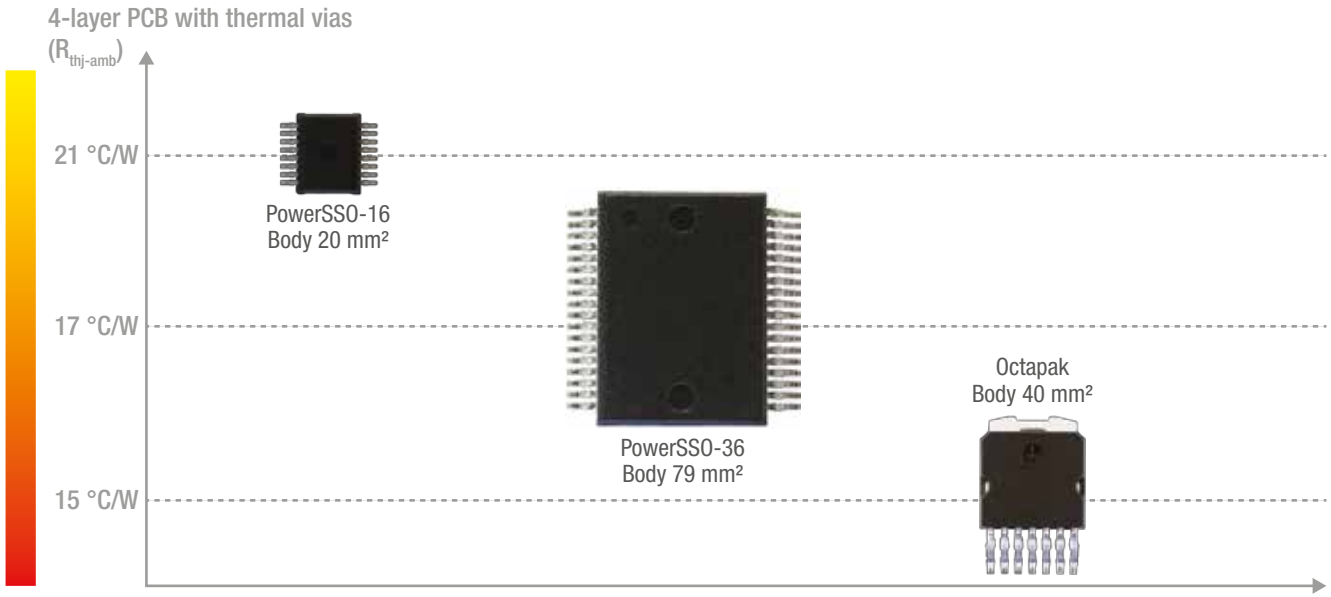
		Single channel	Dual channel	Quad channel
VIP Zero	1.3 mΩ	VN7000AY ● ●		
	3 mΩ	VN7003ALH ● ● ● VN7003AH ● ●		
	4 mΩ	VN7004CLH ● ● VN7004CH	VND7004AY	
	7 mΩ	VN7007ALH ● VN7007AH		
	8 mΩ	VN7008AJ ●		
	10 mΩ	VN7E010AJ ● ● ● ● VN7010AJ ●	VND7012AY	
	16 mΩ	VN7016AJEP ●		
	20 mΩ	VN7020AJ ●	VND7020AJ ●	
	25 mΩ		VND7E025AJ ● ● ● ●	
	30 mΩ		VND7030AJ ●	
	40 mΩ	VN7040AJ ● VN7040AS	VND7E040AJ ● ● ● ● VND7040AJ ●	VNQ7040AY
	50 mΩ	VN7050AJ ● VN7050AS	VND7E050AJ ● ● ● ● VND7050AJ12 ● VND7050AJ ●	VNQ7050AJ ●
	100 mΩ 140 mΩ	VN7140AJ ● VN7140AS	VND7140AJ12 ● VND7140AJ ●	VNQ7E100AJ ● ● ● ● VNQ7140AJ ●

● Programmable Protection ● Extended Current Sensing ● Very Low-Voltage Operation
● M0-7E series ● PowerSSO-16

VIPower M0-7 HIGH-SIDE DRIVER PACKAGES

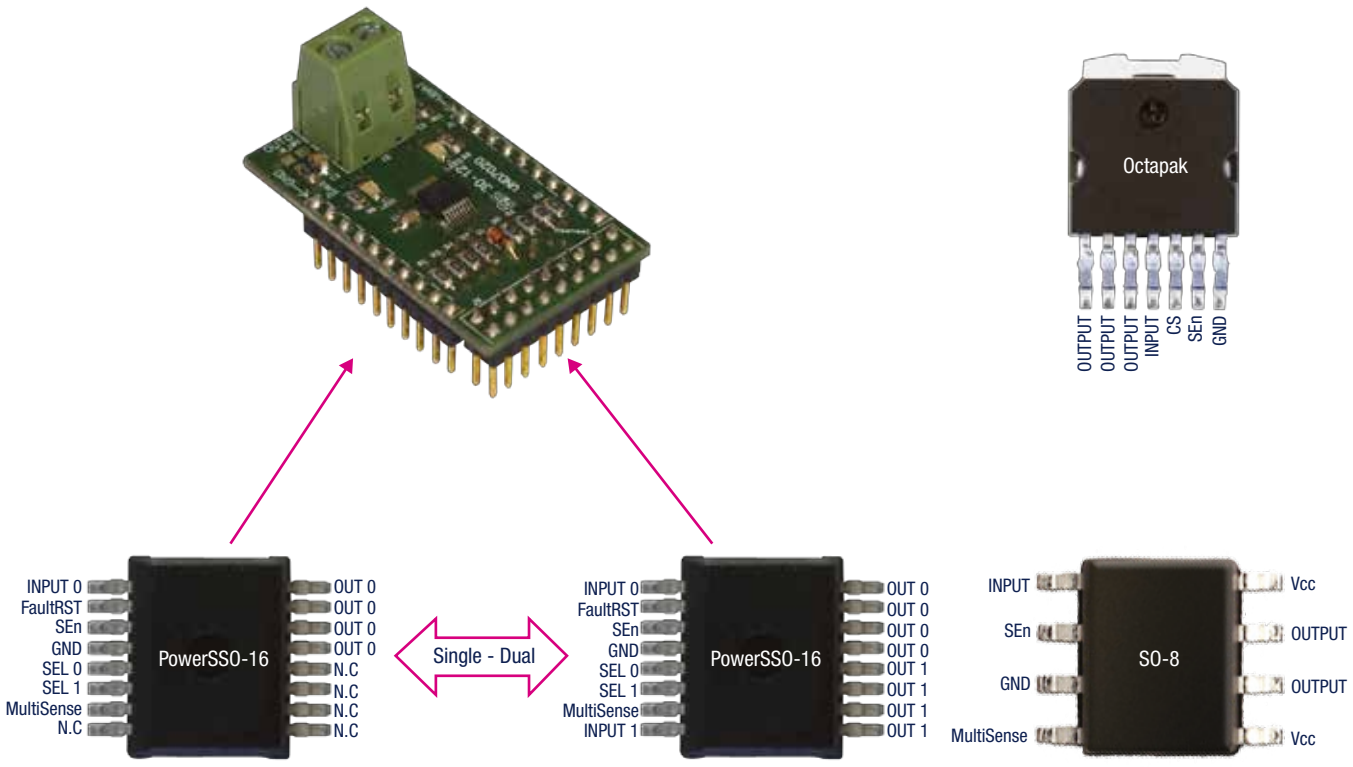
M0-7 available in tiny packages

Smaller and smaller module sizes and weight reduction are a must today, in order to increase the overall energy efficiency in the car. To meet these requirements, the VIPower® M0-7 family offers an eco-friendly product portfolio of lead-free packages ensuring outstanding thermal performance in tiny SMD packages (for example, $R_{thj\text{-}amb}$ = 15 °C/W for the Octapak). Thanks to the outstanding M0-7 die size shrinking versus previous technologies, a 8 mΩ HSD can be housed in the tiny PowerSSO-16 package.



M0-7 power of scalability

VIPower® M0-7 HSDs feature scalability between different $R_{DS(on)}$ categories and between single- and dual-channel devices housed in the same package. The hardware design can therefore match different configurations for the same PCB by replacing the device with zero effort in hardware and software.



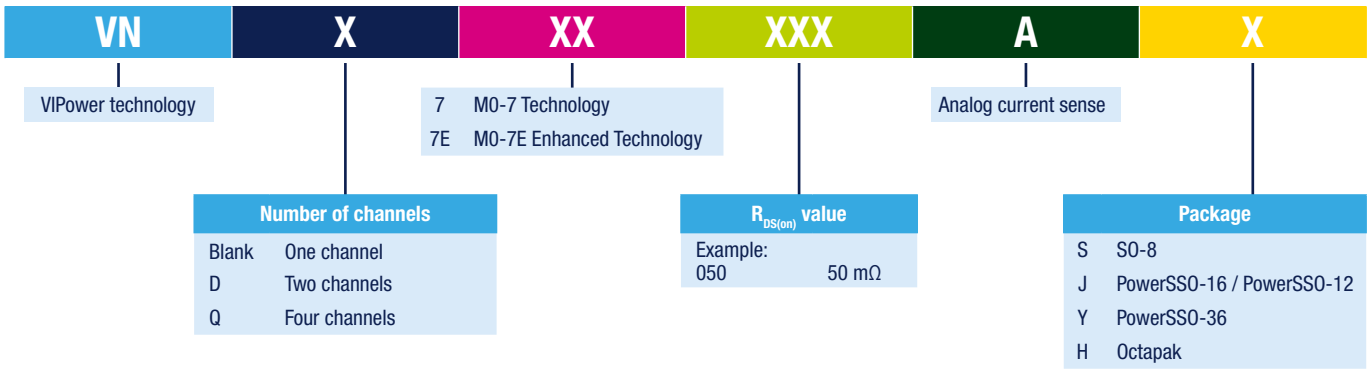
Full pin-to-pin compatibility

VIPower M0-7 HIGH-SIDE DRIVER PRODUCT PORTFOLIO

Part number	Package	Operating range V_{CC} (V)	Max supply voltage V_{CC} max (V)	On-state resistance $R_{DS(ON)}$ typ (mΩ)	Current limitation I_{lim} typ (A)	Configurable auto-restart or latch-OFF	Multisense	Reverse battery	Enhanced current sense
Single-channel devices									
VN7000AY	PowerSSO-36	4 - 28	38	1.3	200	Latch-off	•	•	•
VN7003AH	Octapak	4 - 28(1)	38	4	100	Auto-restart	Current sense	•	•
VN7003ALH	Octapak	4 - 28(1)	38	4	100	•	Current sense	•	•
VN7004CH	Octapak	4 - 28	38	4	100	Auto-restart	Current sense	•	
VN7004CLH	Octapak	4 - 28	38	4	100	•	Current sense	•	
VN7007AH	Octapak	4 - 28	38	7	100	Auto-restart	Current sense	•	
VN7007ALH	Octapak	4 - 28	38	7	100	•	Current sense	•	
VN7008AJ	PowerSSO-16	4 - 28	38	8.5	96	•	Current sense	External components	
VN7010AJ	PowerSSO-16	4 - 28	38	10	91	•	•	External components	
VN7E010AJ	PowerSSO-16	4 - 28(1)	38	10.5	88	•	Current sense	External components	•
VN7016AJEP	PowerSSO-16	4 - 28	38	16	77	•	•	External components	
VN7020AJ	PowerSSO-16	4 - 28	38	20	63	•	•	External components	
VN7040AS	SO-8	4 - 28	38	40	34	Auto-restart	Current sense	External components	
VN7040AJ	PowerSSO-16	4 - 28	38	40	34	•	•	External components	
VN7050AS	SO-8	4 - 28	38	50	30	Auto-restart	Current sense	External components	
VN7050AJ	PowerSSO-16	4 - 28	38	50	30	•	•	External components	
VN7140AS	SO-8	4 - 28	38	140	12	Auto-restart	Current sense	External components	
VN7140AJ	PowerSSO-16	4 - 28	38	140	12	•	•	External components	
Double-channel devices									
VND7004AY	PowerSSO-36	4 - 28	38	4	100	•	•	•	
VND7012AY	PowerSSO-36	4 - 28	38	12	75	•	•	•	
VND7020AJ	PowerSSO-16	4 - 28	38	20	63	•	•	External components	
VND7E025AJ	PowerSSO-16	4 - 28(1)	38	27	61	•	Current sense	External components	•
VND7030AJ	PowerSSO-16	4 - 28	38	30	56	•	•	External components	
VND7E040AJ	PowerSSO-16	4 - 28(1)	38	38	38	•	Current sense	External components	•
VND7040AJ	PowerSSO-16	4 - 28	38	40	34	•	•	External components	
VND7050AJ	PowerSSO-16	4 - 28	38	50	30	•	•	External components	
VND7050AJ12	PowerSSO-12	4 - 28(1)	38	50	30	Auto-restart	Current sense	External components	
VND7E050AJ	PowerSSO-16	4 - 28(1)	38	50	40	•	Current sense	External components	•
VND7140AJ	PowerSSO-16	4 - 28	38	140	12	•	•	External components	
VND7140AJ12	PowerSSO-12	4 - 28(1)	38	140	12	Auto-restart	Current sense	External components	
Quad-channel devices									
VNQ7040AY	PowerSSO-36	4 - 28	38	40	34	•	•	•	
VNQ7050AJ	PowerSSO-16	4 - 28	38	50	27	•	Current sense	External components	
VNQ7E100AJ	PowerSSO-16	4 - 28(1)	38	100	15	•	Current sense	External components	•
VNQ7140AJ	PowerSSO-16	4 - 28	38	140	12	•	•	External components	

Note: (1) Extended operating range down to 2.85 V for deep cold cranking applications (compliant with LV124, revision 2013)

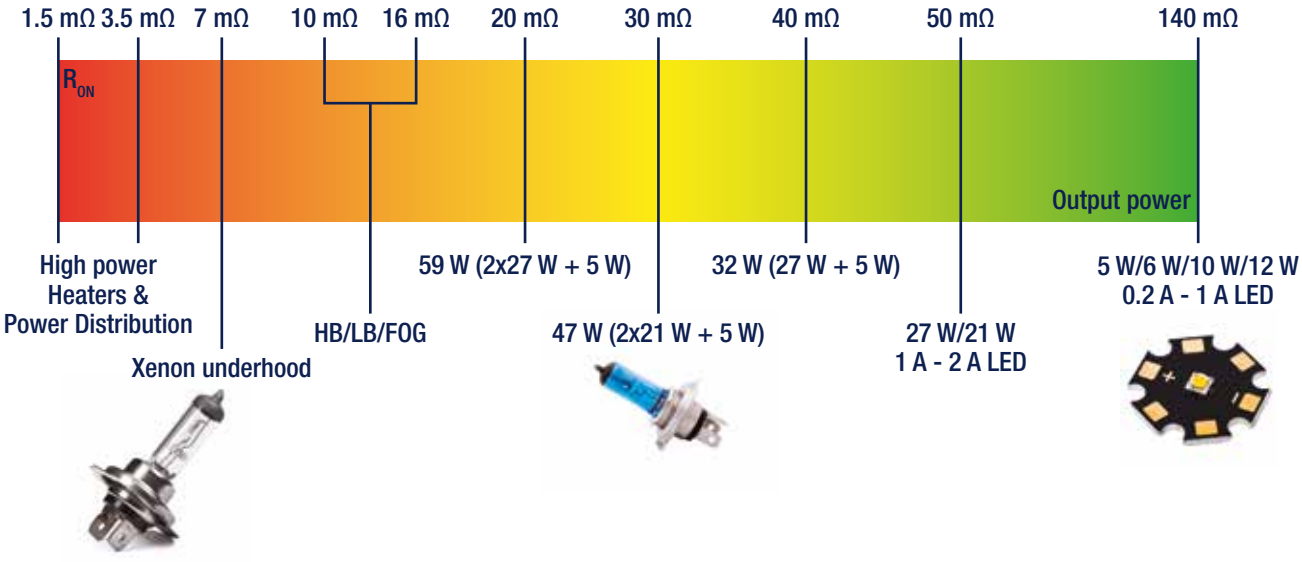
VIPower M0-7 HIGH-SIDE DRIVER PART NUMBERING SCHEME



APPLICATIONS

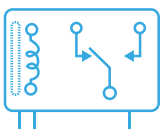
Exterior and interior lighting

VIPower® M0-7 HSDs are designed to drive different car lights, including headlights, blinkers, position, fog, or brake lights, regardless of their type (incandescent bulbs, HID lamps or LED clusters).
The availability of different classes of $R_{DS(on)}$ makes the M0-7 the right solution for each standalone light or combination of paralleled lights. The embedded current limitation circuitry ensures that the lamp is correctly turned on at each extreme condition (in hot or cold ambient temperature). Moreover, the high-precision current sensing makes it possible to diagnose different failure conditions, including the detection of the disconnection of a single bulb out of two or three paralleled bulbs or a complete open load condition. In case of a LED cluster, the ultra-low leakage of the power stage ensures no glowing effect of the LED during idle mode.



Inductive loads

The VIPower® M0-7 family is able to drive inductive loads such as DC motors and relay coils from a few µH to hundreds of mH, and the power stage can switch them off through the activation of their 46 V power clamp allowing for fast demagnetization. The integrated chip temperature reading via the MultiSense function can support the designer by giving advance warning of, for example, how many sequential motor activations the device can manage without over-heating.



ADAS systems

The VIPower® M0-7 family is able to provide protected supply for radars, sensors and cameras in Advanced Driver Assistance Systems environments.

Other applications

Other applications where VIPower® M0-7 HSDs are particularly suitable are heaters, glow plugs and power distribution boxes. In this latter case, the HSD, as well as driving one or more ECUs, can be used as an overload protection for the downstream power tracks, thus replacing the fuse function.

Development support tools

ST offers a wide range of support tools to ensure engineers can rapidly develop the best solutions for their applications. For more information, visit www.st.com/vipower_m07

TwisterSIM

TwisterSIM is a unique electro-thermal simulator that helps shorten the design solution cycle by enabling complex engineering evaluations.
TwisterSIM is available for free at www.st.com/twistersim

FEATURES

Accurate and dynamic simulations of:

- Load compatibility
- Wiring harness optimization
- Fault condition impact analysis
- Diagnostic behavior analysis
- Dynamic thermal performance

VIPower SMART FINDER

VIPower-FINDER is a mobile app for Android™ and iOS™ that lets developers find the best VIPower high/low-side switch and H-bridge solution for their applications.
VIPower-FINDER is available for free at www.st.com/vipower-finder

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FEATURES

- Smart parametric or part number search capability
- Technical datasheet download and off-line consulting
- Access to product general description, key features, electrical parameters, and marketing status
- "Add to favorites" selected products and datasheets
- Share technical documentation via social media or e-mail

AUTOMOTIVE IC EVALUATION BOARDS

Flexible & Low-cost

ST's Easyboard concept gives engineers the chance to evaluate products without committing to the expenses, time and resources typically necessary to design a customized circuit board. Easyboards are simple and low-cost evaluation tools that wire-in a VIPower product to a load for a straightforward evaluation of the device and application functions including the auto-protection capability under hazardous conditions.
For more information, visit www.st.com/automotive_evalboards

DOCUMENTATION

User manual UM1922 is an encyclopedia of VIPower™ M0-7 HSD information for developers. The document provides application design tips for MultiSense usage, choice of components given a certain load, paralleling of pins, and more.
The Application note AN5368 describes the state of the art protections and the behavior of the devices in case of inrush, overload and shortcircuit events.


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