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# VIPOWER™ M0-7 family H-bridges for DC motor control





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# VIPower™ M0-7 H-bridges

The new VIPower™ M0-7 H-bridge family is a set of full integrated and protected bridge circuits especially designed for DC motor control.

Covering a wide range of load conditions, thanks to scalable power stages and packages, its combination of state-of-the-art embedded DC or 20-kHz PWM speed control modes with an embedded protection mechanism makes it the ideal solution for driving DC motors in cars.

Further embedded features including independent load current sensing on each branch of the H-bridge and open load in off-state as well as chip temperature and VCC reading enhance system simplicity and flexibility, avoiding having to use external components.

## KEY BENEFITS OF VIPower™ M0-7 H-BRIDGES

### Targeting different DC motors

The availability of different on-state resistance ( $R_{ON}$ ) classes in the same package ensures flexible driving and control of various DC motors from a few watts up to 200 W in automobiles:

- Full H-bridge configuration
- Double-half H-bridge configuration
- Cascaded configuration

### New MultiSense diagnostics

Output current is multiplexed through selectors and reports:

- In ON state: current on each leg, chip temperature\*,  $V_{CC}$  reading\*, and short circuit/overload flags
- In OFF state: open load, output shorted to battery or GND

### Advanced tiny power packages

Body size reduced up to 70% versus previous family for PCB shrinkage and system weight reduction.

- SO-16N
- PowerSSO-36 (single- and triple-pad)

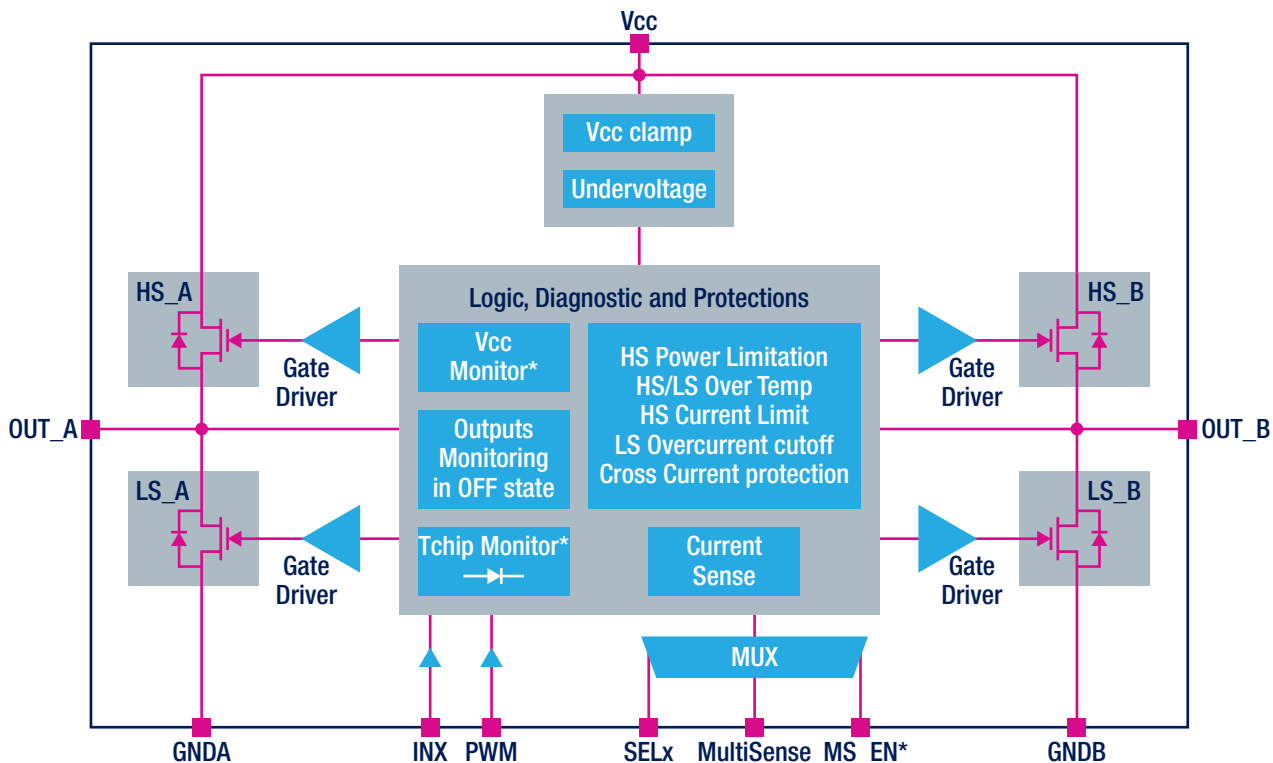
### Ultra-low power consumption

Maximum 3  $\mu$ A standby current for low power DC motors (10  $\mu$ A for VNHDxx)

This keeps the power consumption of the module low in spite of the increased electronic components on board.

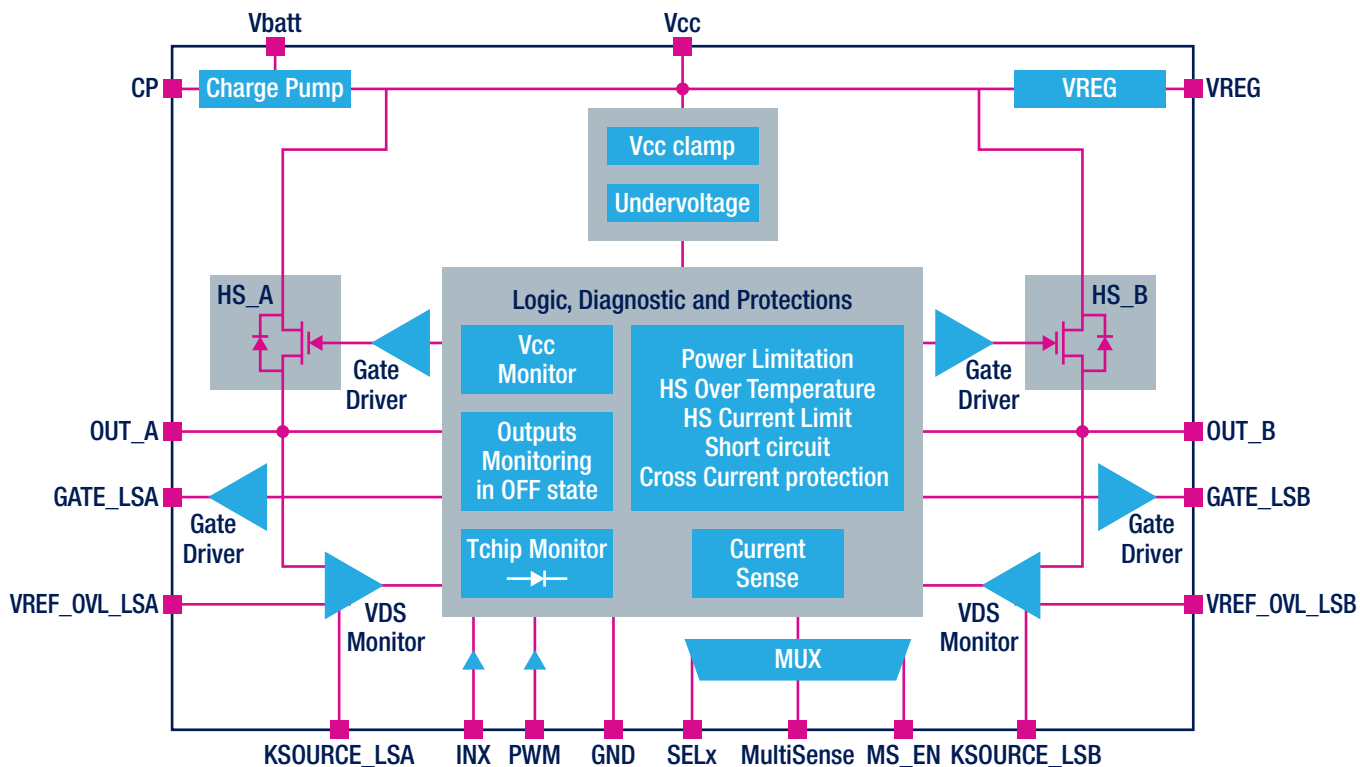
# VIpower M0-7 H-BRIDGE BLOCK DIAGRAMS

VNH7040AY – VNH7070BAS – VNH7100BAS



Note: \* Not available in VNH7100AS/ VNH7100BAS and VNH7070AS/VNH7070BAS

VNHD7012AY – VNHD7008AY



## HIGHLIGHTS OF VIPower™ M0-7 H-BRIDGES

### Key features

- Able to drive mono- or bi-directional loads through three 3 V CMOS compatible inputs (INA, INB, and PWM)
- Integrated Sense Multiplexer provides feedback on the analog load current on each high-side MOS, chip temperature\* and  $V_{CC}$  voltage\*
- Undervoltage shutdown
- On- and Off-state open load detection
- OUT short to GND short to  $V_{CC}$  and short across load terminals latch-off\*\*
- Cross-conduction protection
- PWM up to 20 kHz
- Charge pump for external reverse polarity protection\*\*\*
- Integrated ESD Protections according to Human Body and Charge Device model standards
- Maximum standby current: 3  $\mu$ A (VNHxx), 10  $\mu$ A (VNHDxx)

### Key benefits

- High precision of current sensing allows detection of different loads
- The possibility to read load current on each high-side allows operation in full, double-half and cascaded H-bridge configurations
- Fault flag combined with current sense multiplexing allows detection of different types of short-circuits.
- Chip temperature and  $V_{CC}$  reading aid application monitoring over the PCB\*
- 20kHz PWM allows motor speed control without audible noise
- Low-voltage operation down to 4 V battery ensures critical functions are activated during battery cranking
- Reduced number of external components
- Ultra-low quiescent current allows extremely low battery consumption in Idle mode
- The highest package density in the market in terms of number of channels housed in one tiny package, makes your design compact and lightweight

Note: \* Not available in VNH7100BAS and VNH7070BAS

\*\* VNH7008AY and VNHD7012AY feature a drain-source voltage monitoring of the external low-side

\*\*\* Available in VNHD7008AY and VNHD7012AY only

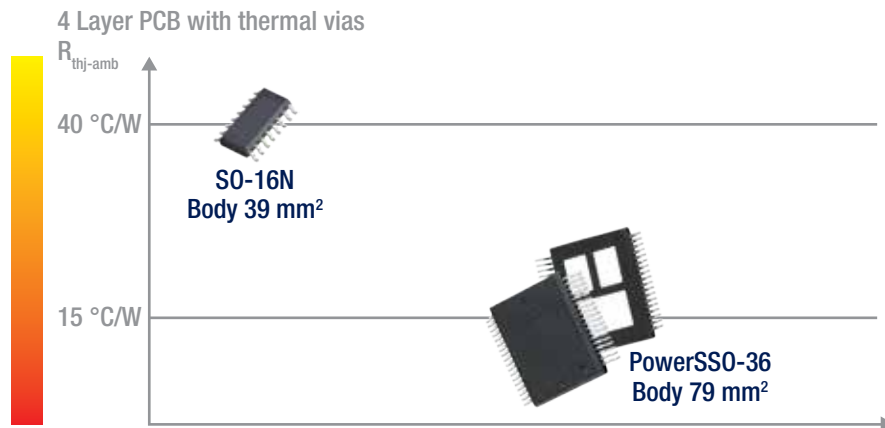
## VIPower™ M0-7 H-BRIDGES PACKAGES

### Available in tiny packages

To meet today's requirements to increase the overall energy efficiency of cars, manufacturers must reduce module size and weight. Due to the outstanding shrinking of the M0-7 die size versus previous technologies, a 2-channel 8 m $\Omega$  HSD can now be housed in the tiny PowerSSO-36 package.

Moreover, ST's **VIPower™ M0-7**

**H-bridges** offer an eco-friendly product portfolio of lead-free packages ensuring outstanding thermal performance in really tiny SMD packages.



## VIPower™ M0-7 H-BRIDGE PRODUCT PORTFOLIO

Part number	Package	Operating range $V_{CC}$ (V)	Maximum PWM frequency (kHz)	Max Output Current (A)	On-state resistance $R_{on}$ HS and LS (m $\Omega$ )	Diagnostic in OFF state	MultiSense (Current Sense, Tchip, $V_{CC}$ reading)	Short-circuit protection	Charge Pump for reverse battery protection
VNH7100BAS	SO-16N	4 - 28	20	12	60 - 40	•	Current sense	To GND, to $V_{CC}$ , across load	
VNH7070BAS	SO-16N	4 - 28	20	15	42 - 30	•	Current sense	To GND, to $V_{CC}$ , across load	
VNH7040AY	PowerSSO-36 T. P.	4 - 28	20	35	27 - 30	•	MultiSense	To GND, to $V_{CC}$ , across load	
VNHD7012AY*	PowerSSO-36	4 - 28	20	40	12	•	MultiSense	To GND, to $V_{CC}$ , across load**	•
VNHD7008AY*	PowerSSO-36	4 - 28	20	51	8	•	MultiSense	To GND, to $V_{CC}$ , across load**	•

Note: \* H-bridge driver driving and protecting two external PowerMOS as low-sides (suggested STL76DN4LF7AG, STL15DN4F5)

\*\* Protection is performed by a drain-source monitoring of each low-side with a programmable threshold



# Applications

## LOW-POWER DC MOTORS

**VIpower™ MO-7 H-bridges** are designed to drive different DC motors in the car bodies including mirror adjust, headrest position, door lock, dual washer pump, seat adjustment, sunroof, power window, etc.

The availability of different on-state resistance ( $R_{ON}$ ) classes makes the family the right solution for standalone as well as paralleled or cascaded motor configurations.

Additional features include current sensing, PWM up to 20 kHz, open-load in off state detection, and a charge pump for external reverse polarity protection.

**VNH7100BAS**



Mirror adjust

**VNH7070BAS**



Door lock

**VNH7040AY**



Dual washer pump



Child lock



Sun shades



Wipers

## HIGH-POWER DC MOTORS

VNHD7008AY and VNHD7012AY **VIpower™ drivers** combined with two external PowerMOS ICs is suitable for driving up to 200 W DC motors.



Seat position



Power lift gate



Window lift

## EMERGING APPLICATIONS

The wide-spread integration of advanced functions in cars requires the use of smart power ICs for driving DC motors. Car manufacturers can rely on ST's **VIpower™ MO-7 H-bridges** for an increasing number of car body applications.

**VNHD7012AY**



Tow bar

**VNH7040AY**



Spoiler adjustment

**VNH7070BAS**



Camera folding

**VNH7100BAS**



Sound flap control



# 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](http://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](http://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](http://www.st.com/vipower-finder)



### 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](http://www.st.com/automotive_evalboards)



## DOCUMENTATION

User manual AN5026 is an encyclopedia of VIpower™ M0-7 H-bridge information for developers. In addition to giving detailed explanations on how to get the most from device functions and protection features, the user manual provides application design tips for integrating MultiSense diagnostics, multi-motor topologies, and more.

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