

# 48V POSITION CONTROL: OVERVIEW

Solutions for BLDC motor applications have been increasing rapidly because of the demand for products that are smaller in size and provide high efficiency. The core of a BLDC motor design is a robust and reliable motor control circuit and a versatile MCU for a safe control algorithm. Key building blocks of a motor control circuit include a MOSFET driver, versatile MCU, voltage regulators, a cell balancer, and the battery charger.

## Key Features:

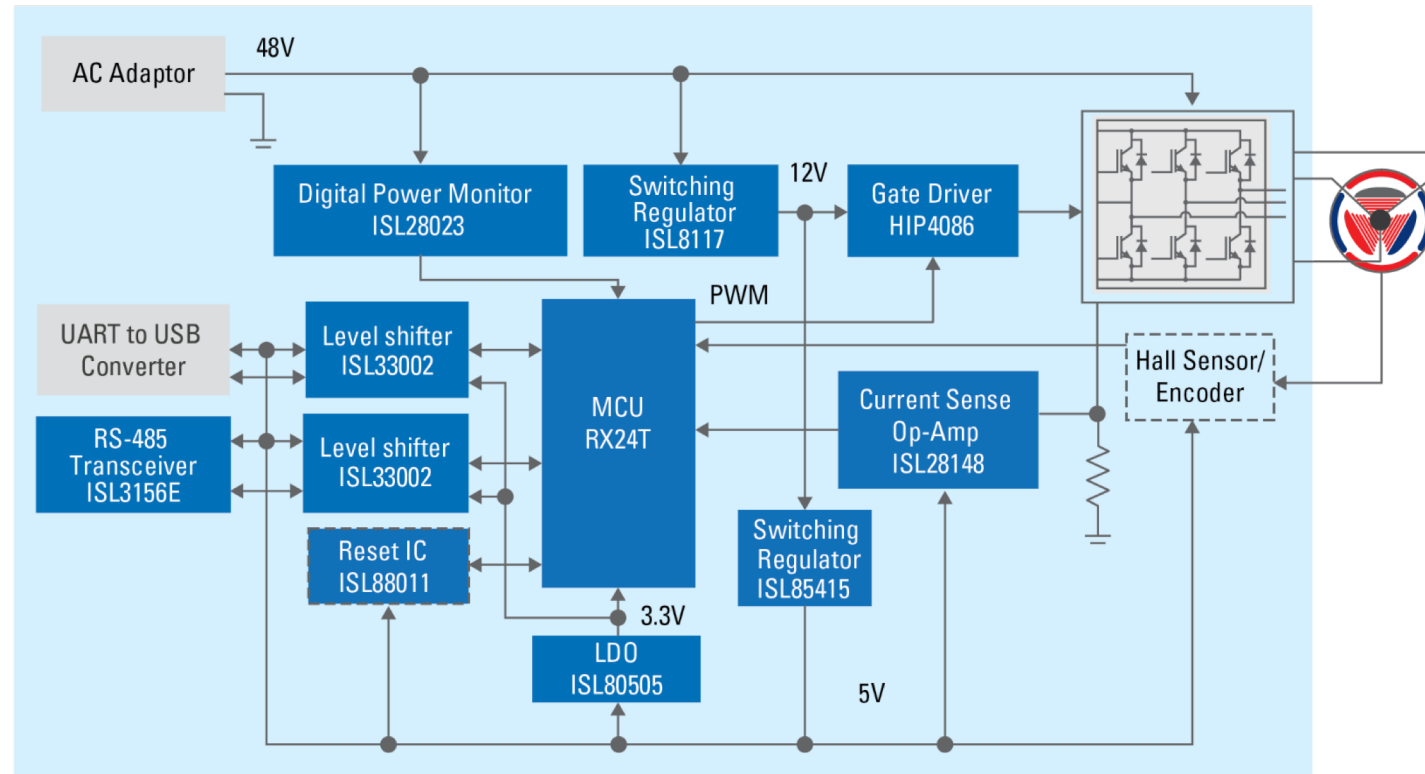
- Ultra-low power MCU
- High speed wake up time 4 $\mu$ s
- Integrated 12-bit ADC with op amp and comparator
- High accuracy cell balancer and monitor with customer programmable EEPROM

## Applications:

- Factory automation
- Robotics

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# 48V POSITION CONTROL SOLUTION: BLOCK DIAGRAM



1. High performance 32 bit 80MHz MCU optimized for motor control
2. High efficiency power supply for lower power loss and lower working temperature
3. Compatible with RS485 and USB communication

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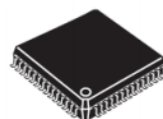
# RX24T: 32 BIT, WIDE VIN MCU WITH BUILT-IN FPU

## Motor Control MCU series within the RX Family

Features	Benefits	Applications
<ul style="list-style-type: none"> <li>32-bit MCU @ 80MHz</li> <li>RX24T microcontrollers operate in a broad voltage range from 2.7 V to 5.5 V</li> <li>Great set of timers to support Inverter Control</li> <li>Incorporating a floating point unit (FPU), able to control up to 3 inverters</li> <li>Up to 512kB Flash and 32kB RAM</li> <li>64pin, 80pin and 100pin LQFP packages</li> </ul>	<ul style="list-style-type: none"> <li>The RX24T Group is 32-bit microcontroller with built-in FPU (floating-point processing unit) that enables it to easily program complex inverter control algorithms. RX24T Group enables simultaneous control of up to 3 motors by max 80 MHz operating frequency CPU core and motor control peripherals.</li> </ul>	<ul style="list-style-type: none"> <li>Industrial automation</li> <li>Industrial process control</li> <li>Office Automation</li> <li>Home Appliance</li> <li>Inverter Control</li> <li>Motor Control</li> </ul>

## Typical application and key performances

80-MHz 32-bit RX MCUs, built-in FPU, 153.6 DMIPS, 12-bit ADC (equipped with three S/H circuits, double data registers, and comparator), Simultaneous sampling up to 5 channels ADC, CAN, 80MHz PWM (Up 3-phase complementary output × 3ch)



PLQP0100KB-B 14 x 14 mm, 0.5 mm pitch  
 PLQP0080JA-A 14 x 14 mm, 0.65 mm pitch  
 PLQP0080KB-B 12 x 12 mm, 0.5 mm pitch  
 PLQP0064KB-C 10 x 10 mm, 0.5 mm pitch

Renesas Motor Workbench 2.0:  
Motor Control Development Tool 2.0



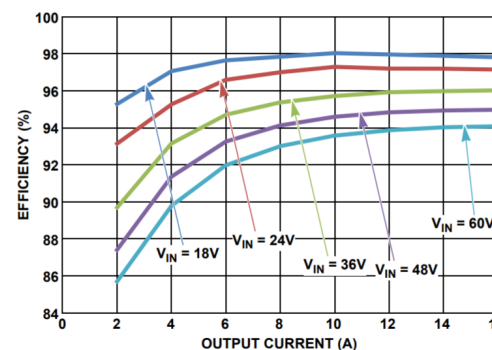
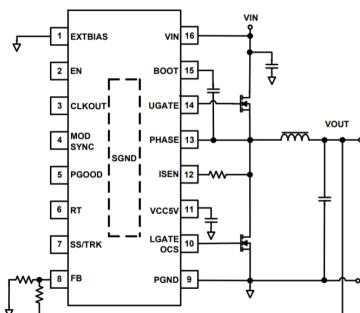
# ISL8117/A: DEFAULT SETTINGS, LOW COMPONENT COUNT

## 60V Synchronous Step-Down PWM Controller with wide $V_{in}$ – $V_{out}$ range

Features	Benefits	Applications
<ul style="list-style-type: none"> <li>Wide input voltage range: 4.5V to 60V</li> <li>Wide output voltage range: 0.6V to 54V</li> <li>Light-load efficiency enhancement</li> <li>Programmable soft-start</li> <li>Programmable frequency: 100kHz to 2MHz</li> <li>Adaptive shoot-through protection</li> <li>No external current sense resistor</li> <li>Complete protection</li> </ul>	<ul style="list-style-type: none"> <li>It uses the valley current modulation technique to bring hassle-free power supply design with a minimal number of components and complete protection from unwanted events.</li> <li>Low pin count, fewer external components, and default internal values makes the ISL8117 an ideal solution for quick to market simple power supply designs.</li> <li>The unique DEM/Skipping mode at light-load dramatically lowers standby power consumption with consistent output ripple over different load levels.</li> </ul>	<ul style="list-style-type: none"> <li>PLC and factory automation</li> <li>Amusement machines</li> <li>Security surveillance</li> <li>Servers and data centers</li> <li>Switchers and routers</li> <li>Telecom and datacom</li> <li>LED panels</li> </ul>

## Typical application and key performances

Typical application circuit



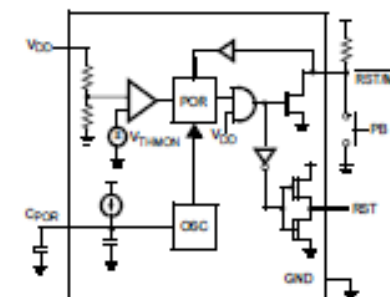
## Dual voltage supervisor with monitoring or watchdog timer Capability

Features	Benefits	Applications
<ul style="list-style-type: none"> <li>• Single/dual voltage monitoring supervisors</li> <li>• Fixed-voltage options allow precise monitoring of +2.5V, +3.0V, +3.3V, and +5.0V power supplies</li> <li>• Adjustable POR timeout delay options</li> <li>• Watchdog timer with 1.6s normal and 51s start-up timeout durations</li> </ul>	<ul style="list-style-type: none"> <li>• Manual reset input on all devices</li> <li>• Reset signal valid down to VDD = 1V</li> <li>• Accurate <math>\pm 1.5\%</math> voltage threshold</li> <li>• Immune to power-supply transients</li> <li>• Ultra low 5.5<math>\mu</math>A supply current</li> <li>• Small 5 Ld SOT-23 Pb-Free package</li> <li>• Pb-Free (RoHS Compliant) Pb-free (RoHS compliant)</li> </ul>	<ul style="list-style-type: none"> <li>• Process control systems</li> <li>• Intelligent instruments</li> <li>• Embedded control systems</li> <li>• Computer systems</li> <li>• Critical <math>\mu</math>P and <math>\mu</math>C power monitoring</li> <li>• Portable/battery-powered equipment</li> <li>• PDA and handheld PC devices</li> </ul>

## Typical application and key performances

The ISL88011 offers both fixed and/or adjustable voltage-monitoring that combine popular functions such as Power-On reset control, watchdog timer, supply voltage supervision, and manual reset assertion in a small 5 Ld SOT-23 package.

### Block diagram



# ISL85415: COMPENSATION FREE, HIGH EFFICIENCY REGULATOR

## Wide VIN 500mA Synchronous Buck Regulator

### Features

- Synchronous Operation for high efficiency
- No compensation required
- Selectable PFM or forced PWM mode at light loads
- Internal fixed (500kHz) or adjustable Switching frequency 300kHz to 2MHz
- Internal or external soft-start
- Minimal external components required
- Power-good and enable functions available

### Benefits

- It provides an easy to use, high efficiency low BOM count solution for a variety of applications.
- It will provide a very robust design for high voltage Industrial applications as well as an efficient solution for battery powered applications

### Applications

- Industrial control
- Medical devices
- Portable instrumentation
- Distributed Power supplies
- Cloud Infrastructure

## Typical application and key performances

Typical application circuit

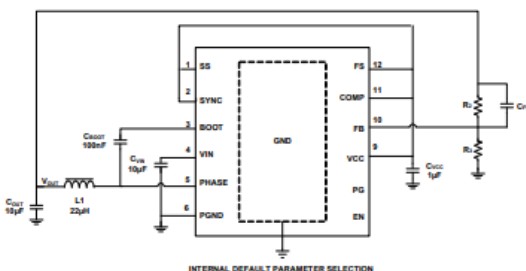


FIGURE 1. TYPICAL APPLICATION

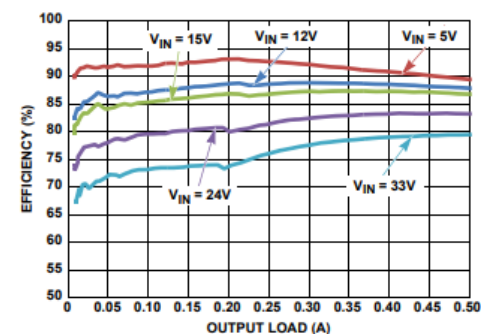


FIGURE 2. EFFICIENCY vs LOAD, PFM,  $V_{OUT} = 3.3V$

# ISL80505: SINGLE OUTPUT LOW DROPOUT REGULATOR

## High accuracy 5V/500mA LDO

### Features

- $\pm 1.8\%$   $V_{OUT}$  accuracy guaranteed over line, load, and  $T_J = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- Very low 45mV dropout voltage at  $V_{OUT} = 2.5\text{V}$
- Stable with a  $4.7\mu\text{F}$  output ceramic capacitor
- Very fast transient response
- Programmable output soft-start time
- Excellent PSRR over wide frequency range
- Current limit protection
- Thermal shutdown function

### Benefits

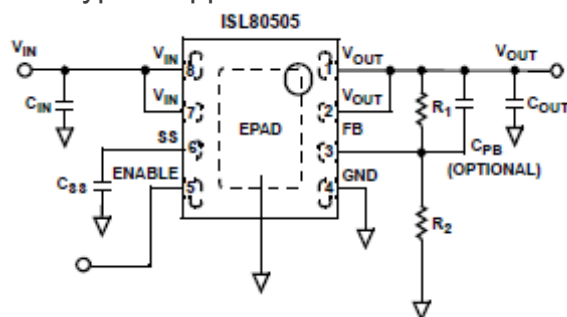
- A submicron BiCMOS process is utilized for this product family to deliver the best in class analog performance and overall value.
- State-of-the-art internal compensation achieves a very fast load transient response and excellent PSRR.

### Applications

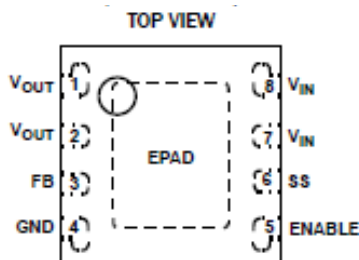
- Noise sensitive instrumentation systems
- Post regulation of switched mode power supplies
- Industrial systems
- Medical equipment
- Telecommunications and networking equipment
- Servers

## Typical application and key performances

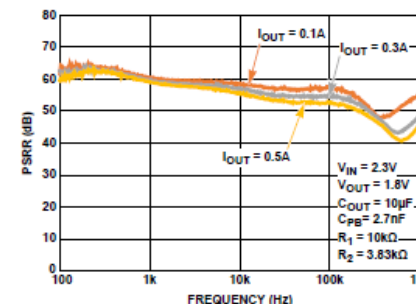
Typical application circuit



Pinout  
8LD QFN



PSRR



# ISL28023:HIGH RESOLUTION, HIGH OR LOW SIDE SENSING

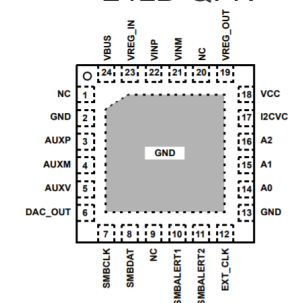
*High voltage Digital power monitor with very small gain error*

Features	Benefits	Applications
<ul style="list-style-type: none"> <li>• Bus voltage sense range 0V to 60V</li> <li>• Voltage gain error 0.05%</li> <li>• Current gain error 0.05%</li> <li>• Internal temperature sensor accuracy +1.0°C</li> <li>• High or low (RTN) side sensing</li> <li>• Bidirectional current sensing</li> <li>• Auxiliary low voltage channel</li> <li>• <math>\Delta\Sigma</math>ADC, 16-bit native resolution</li> <li>• Internal 3.3V regulator</li> <li>• Internal temperature sense</li> </ul>	<ul style="list-style-type: none"> <li>• The VCC power can either be externally supplied or internally regulated, which allows the ISL28023 to handle a common-mode input voltage range from 0V to 60V.</li> <li>• The wide range permits the device to handle telecom, automotive and industrial applications with minimal external circuitry.</li> <li>• An 8-bit voltage DAC enables a DC/DC converter output voltage margining.</li> <li>• Fault indication includes a Bus Voltage window and overcurrent fast fault logic indication.</li> </ul>	<ul style="list-style-type: none"> <li>• Data processing servers</li> <li>• DC power distribution</li> <li>• Telecom equipment</li> <li>• Portable communication equipment</li> <li>• DC/DC, AC/DC converters</li> <li>• Many I2C DAC and ADC with alert applications</li> </ul>

## Typical application and key performances

The ISL28023 is a bidirectional high-side and low-side digital current sense and voltage monitor with a serial interface. The device monitors power supply current, voltage and provides the digital results along with calculated power. The ISL28023 provides tight accuracy of 0.05% for both voltage and current monitoring. The auxiliary input provides an additional power monitor function.

Pinout  
24LD QFN





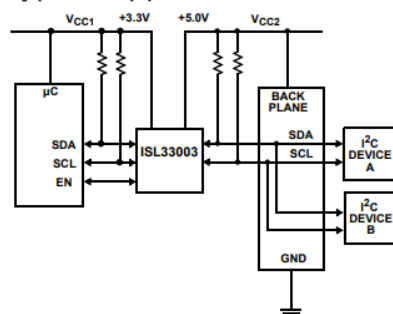
# ISL33002: TWO CHANNEL BIDIRECTIONAL BUFFER

## *I2C Bus Buffer with Rise Time Accelerators and Hot Swap Capability*

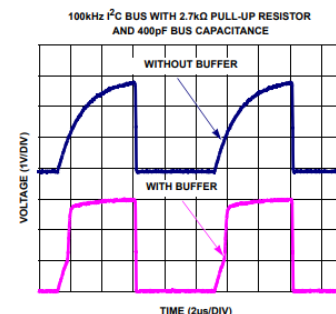
Features	Benefits	Applications
<ul style="list-style-type: none"> <li>• 2 Channel I2C compatible bi-directional buffer</li> <li>• +2.3VDC to +5.5VDC supply range</li> <li>• &gt;400kHz operation</li> <li>• Bus capacitance buffering</li> <li>• Rise time accelerators</li> <li>• Hot swapping capability</li> <li>• <math>\pm 6\text{kV}</math> Class 3 HBM ESD protection on all pins</li> <li>• <math>\pm 12\text{kV}</math> HBM ESD protection on SDA/SCL pins</li> <li>• Logic level translation</li> </ul>	<ul style="list-style-type: none"> <li>• Accelerator disable pin</li> <li>• Pb-free (RoHS Compliant) 8 Ld SOIC (ISL33001 only), 8 Ld TDFN (3mmx3mm) and 8 Ld MSOP packages</li> <li>• Low quiescent current: 2.1mA typ</li> <li>• Low shutdown current: 0.5<math>\mu\text{A}</math> typ</li> </ul>	<ul style="list-style-type: none"> <li>• I<sup>2</sup>C bus extender and capacitance buffering</li> <li>• Server racks for telecom, datacom, and computer servers</li> <li>• Desktop computers</li> <li>• Hot-swap board insertion and bus isolation</li> </ul>

## Typical application and key performances

Typical application circuit



Bus accelerator performance



# ISL3156E: LARGE 3V OUTPUT SWING, FULL FAIL SAFE

16.5kV ESD, 1/8 Unit Load, RS-485/RS-422 Transceivers

## Features

- High VOD: 3.1V (Typ) into  $R_D = 54\Omega$
- Low bus currents: 125 $\mu$ A constitutes a true 1/8 unit load
- Allows for up to 512 transceivers on the bus
- $\pm 16.5$ kV ESD protection on bus I/O pins
- High transient overvoltage tolerance of  $\pm 100$ V
- Full fail-safe outputs for open or shorted inputs
- Hot plug capability - driver and receiver outputs remain high-impedance during power-up and power-down

## Benefits

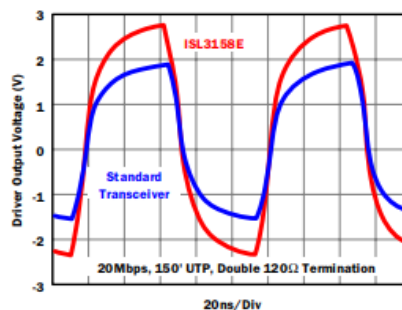
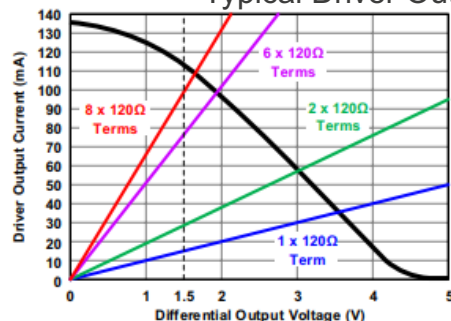
- Supported data rates: 115kbps, 1Mbps, 20Mbps
- Low supply current (driver disabled): 550 $\mu$ A
- Ultra-low shutdown current: 70nA

## Applications

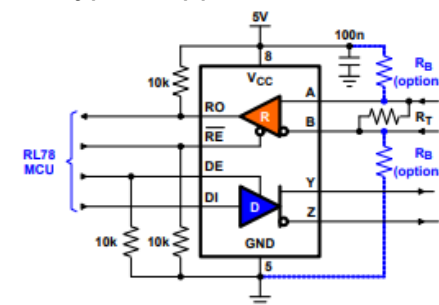
- Automated utility e-meter reading systems
- High node count systems
- PROFIBUS and Fieldbus systems in factory automation
- Security camera networks
- Lighting, elevator, and HVAC control systems in building automation
- Industrial process control networks
- Networks with star topology
- Long-haul networks in coal mines and oil rigs

## Typical application and key performances

Typical Driver Output Performance



Typical application circuit



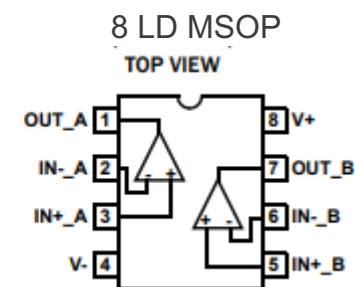
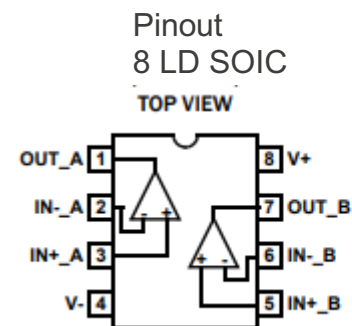
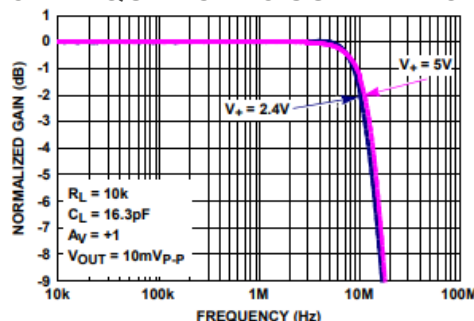
# ISL28148: 4.5MHZ GBW OPAMP, SMALL SOT-23 PKG

*Single and Dual Precision Rail-to-Rail Input-Output Op Amps with Very Low Input Bias Current*

Features	Benefits	Applications
<ul style="list-style-type: none"> <li>• 4.5MHz gain bandwidth product</li> <li>• 900µA supply current (per amplifier)</li> <li>• 1pA typical input bias current</li> <li>• Down to 2.4V single supply operation</li> <li>• Rail-to-rail input and output</li> <li>• Enable pin (ISL28148 SOT-23 package only)</li> <li>• -40°C to +125°C operation</li> <li>• Pb-free (RoHS compliant)</li> </ul>	<ul style="list-style-type: none"> <li>• The parts are optimized for single supply operation from 2.4V to 5.5V, allowing operation from one lithium cell or two Ni-Cd batteries</li> </ul>	<ul style="list-style-type: none"> <li>• Low-end audio</li> <li>• 4mA to 20mA current loops</li> <li>• Medical devices</li> <li>• Sensor amplifiers</li> <li>• ADC buffers</li> <li>• DAC output amplifiers</li> </ul>

## Typical application and key performances

GAIN vs FREQUENCY vs SUPPLY VOLTAGE



# HIP4086:INDEPENDENTLY DRIVEN, ADJUSTABLE DEAD TIME

**80V, 500mA, 3-Phase Motor driver**

## Features

- Independently drives 6 N-channel MOSFETs in 3-phase bridge configuration
- Bootstrap supply maximum voltage up to 95VDC with bias supply from 7V to 15V
- 1.25A peak turn-off current
- User programmable dead time
- Bootstrap and optional charge pump maintain the high-side driver bias voltage
- Programmable bootstrap refresh time
- Programmable undervoltage set point

## Benefits

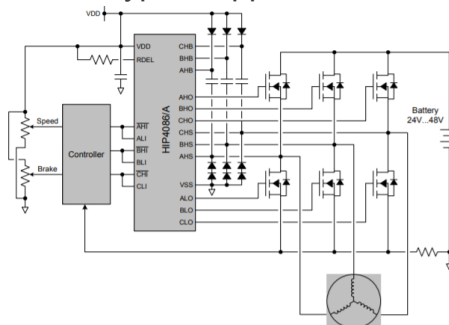
- The HIP4086 has a wide range of programmable dead times (0.5 $\mu$ s to 4.5 $\mu$ s) which makes them very suitable for the low frequencies (up to 100kHz) typically used for motor drives
- It has flexible input protocol for driving every possible switch combination. The user can even override the shoot-through protection for switched reluctance applications.

## Applications

- Brushless Motors (BLDC)
- 3-phase AC motors
- Switched reluctance motor drives
- Battery powered vehicles
- Battery powered tools

## Typical application and key performances

Typical application circuit



Pinout  
24LD PDIP, SOIC

BHB	1	BHO	24
BHI	2	BHS	23
BLI	3	BLO	22
ALI	4	ALO	21
AHI	5	VDD	20
VSS	6	CLO	19
RDEL	7	AHS	18
UVLO	8	AHO	17
RFSH	9	AHB	16
DIS	10	CHS	15
CLI	11	CHO	14
CHI	12	CHB	13

Charge pump output current

