General Description

The HL8837 provides an integrated motor driver solution for cameras, DSLR lenses, toys, smart door locks, robotics and other low-voltage or battery-powered motion control applications. The device can drive one DC motor or other devices like solenoids. The output driver block consists of N-channel power MOSFET's configured as an H-bridge to drive the motor winding. An internal charge pump generates needed gate drive voltages.

The HL8837 can supply up to 1.8A of output current. It operates on a motor power supply voltage from 0 to 11V, and a device power supply voltage of 1.8V to 5.5V. Internal shutdown functions are provided for overcurrent protection,short circuit protection, under voltage lockout, and over temperature. The HL8837 has a PWM(IN/IN) input interface.

The HL8837, which is totally Pb-free, is packaged in 8-pin, 2mm*2mm DFN package that is 100% tin-free plating for the lead frame with an exposed thermal pad on the back, which can effectively improve heat dissipation.

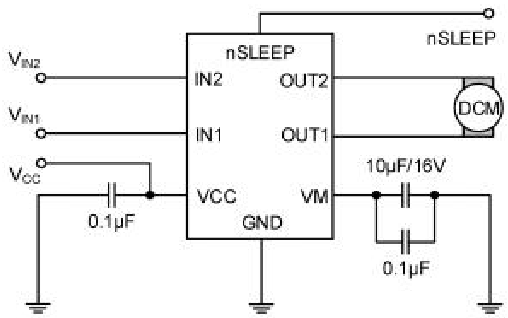
Features

- Separated H-bridge motor driver
- Low mosfet on-resistance: HS + LS 280 mΩ
- Overcurrent Protection (OCP)
- Thermal Shutdown (TSD)
- Vcc Under Voltage Lockout (UVLO)
- Automatic Fault Recovery
- Drives a DC Motor or Other inductive Loads
- Motor VM：0~11V,Logic VCC:1.8 - 5.5V
- 1.8A Maximum Drive Current
- Low-power sleep mode with 1uA Maximum Sleep Current controlled by nSLEEP pin
- Short Circuit Protection(SCP)
- Thermally-Enhanced Surface-mount small Package and Footprint DFN8-2x2mm

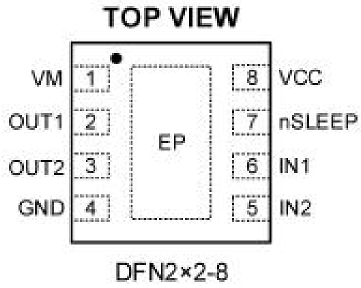
Applications

- Cameras & dslr lenses focusing
- Office automation equipment
- Toys
- Robotics
- Smart door locks
- All other motion control applications

Typical Applications



Package and Pin Description



Pin Description

Pin No	Pin Name	Pin Description
1	VM	Motor power supply, Bypass to GND with a 0. 1-μF ceramic capacitor rated for VM.
2	OUT1	Motor output1, Connect to motor winding.
3	OUT2	Motor output2, Connect to motor winding.
4	GND	Device ground, Must be connected to ground.
5	IN2	Logic input2, Control output state of the H-bridge.
6	IN1	Logic input1, Control output state of the H-bridge.
7	nSLEEP	sleep mode; logic high for normal operation; internal pulldown resistor.
8	VCC	Logic power supply. Bypass to GND with a 0.1μF ceramic capacitor rated for VCC.
9	EPAD	Thermal pad, Connected to board ground.

Absolute maximum rating[note1,2]

Parameter	Symbol	Conditions	Ratings	Unit
Motor power supply voltage range	VM		-0.3 – 12	V
Continuous output current	I_{OUT}		±1.2	A
Peak drive current	I_{PEAK}		>1.8	A
Logic power supply voltage range	V_{CC}		-0.7 to 5.5	V
Logic level input voltage	V_{IN}		-0.7 to VCC	°C
Operating ambient temperature	T_A	Range S	-40 to 85	°C
Maximum junction temperature	$T_{J(max)}$		150	°C
Storage temperature range	T_{stg}		-55 to 150	°C

note1：Absolute maximum ratings are those values beyond which the device could be permanently damaged.

note2：The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is notrecommended.

ESD ratings

Item	Desenption	Value	Unit
$V_{(ESD-HBM)}$	Human Body Model (HBM) ANSI/ESDA/JEDEC JS-001-2014 Classification, Class:2	±2000	V
$V_{(ESD-CDM)}$	Charged Device Mode(CDM) ANSI/ESDA/JEDEC JS-002-2014 Classification, Class: C0b	±200	V
$I_{LATCH-UP}$	JEDEC STANDARDNO.78E APRIL 2016 Temperature Classification, Class:I	±150	V

Recommended Operating Conditions[note1]

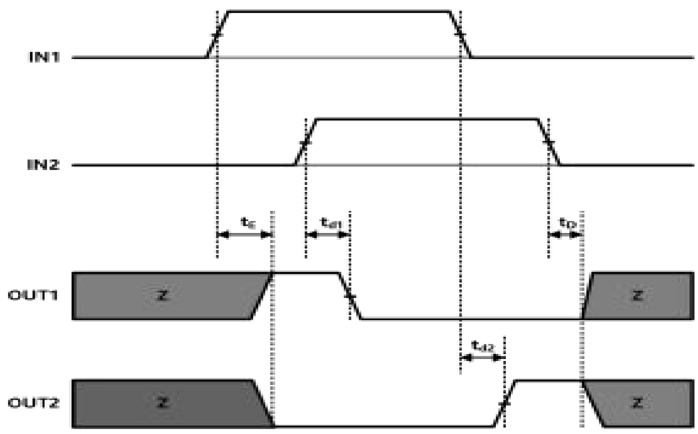
Parameter	Symbol	Min	Typ.	Max	Unit
Motor power supply voltage range	VM	0	-	11	V
Logic power supply voltage range	V_{CC}	1.8		5.0	V
Motor peak current	I_{OUT}	0		1.8	A
Externally applied PWM frequency	f_{PWM}	0	-	250	KHZ

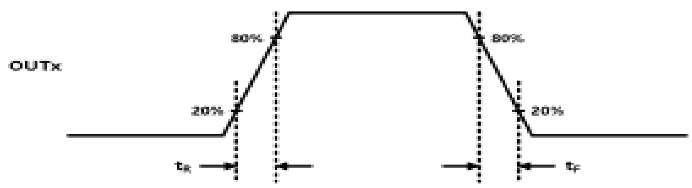
Electrical Characteristics[note1]

Parameter		Test conditions	Min	Typ.	Max	Unit
Power Supply						
I_{VM}	VM operating supply current			0.8	1.5	mA
I_{VMQ}	VM sleep mode supply current	nSLEEP=0		0.05	1	uA
I_{VCC}	VCC operating supply current			0.7	1.5	mA
I_{VCCQ}	VCC sleep mode supply current	nSLEEP=0		5	25	nA
Logic-Level Inputs						
V_{IL}	Input logic low voltage				0.25*VCC	V
V_{IH}	Input logic high voltage		0.5*VCC			V
V_{HYS}	Input logic hysteresis			0.08*VCC		V
I_{IL}	Input logic low current	VIN=0	-5		5	uA
I_{IH}	Input logic high current	VIN=3.3V			50	uA
		nSLEEP		60		uA
R_{pd}	Pull down resistance	nSLEEP		90		KΩ
		IN1,IN2		110		KΩ

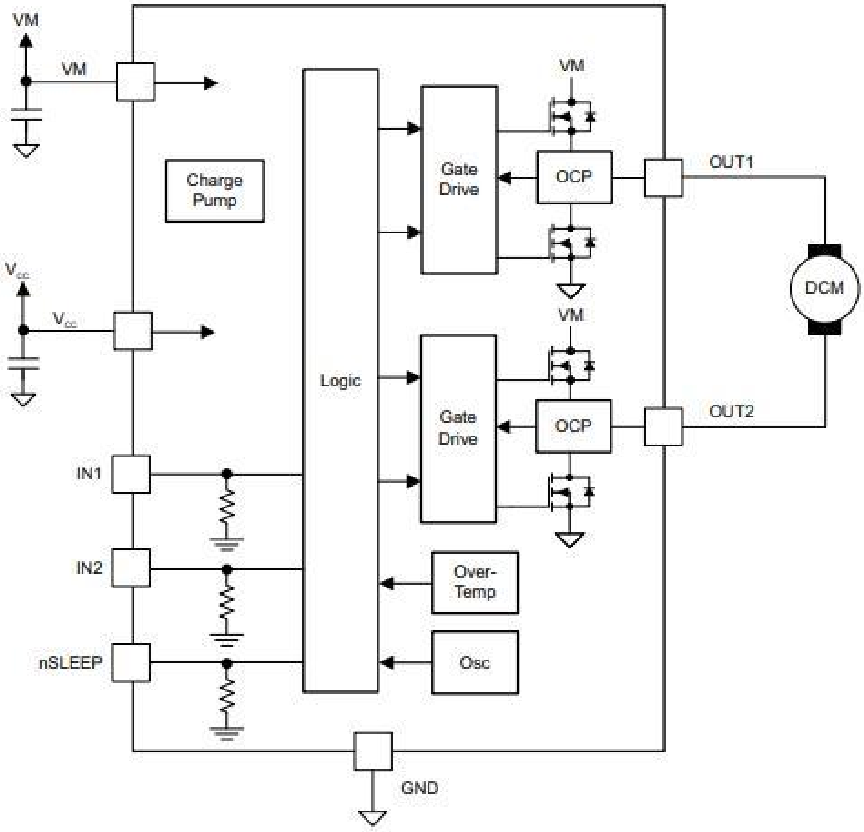
H-Bridge FETs						
$R_{DS(ON)}$	HS+LS FET on-resistance	VM=5V;V_{CC}=3V; I_O=800mA;T_J=25℃		280	330	mΩ
I_{OFF}	Off-state leakage current		-1		1	uA
Motor Driver						
t_R	Output rise time	20% to 80%	30		188	ns
t_F	Output fall time	80% to 20%	30		188	ns
t_E	Output enable time	Output enable time			300	ns
t_D	Output disable time	Output disable time			300	ns
t_{d1}	Delay time	IN2 high to OUT1 low			160	ns
t_{d2}	Delay time	IN1 low to OUT2 high			160	ns
t_{WAKE}	Sleep mode wake up time	Sleep inactive high to full bridge turn on			30	us
Protection Circuits						
I_{OCP}	Over current protection trip level		1.9		3.5	A
t_{DEG}	Over current deglitch time			1		us
t_{RETRY}	Over current retry time			1		ms
T_{SD}	Thermal shutdown temperature	Die temperature	150	160	180	℃
T_{HYS}	Thermal shutdown hysteresis			30		℃
V_{UVLO}	UVLO Threshold (Rising)	VCC rising			1.8	V
$V_{UVLOHYS}$	UVLO hysteresis			200		mV

note1： T_A=25°C, V_M=5V, V_{CC}=3V, over recommended operating conditions unless otherwise noted





Block diagram



Operation description

The HL8837 is a h-bridge driver that can drive one dc motor or other devices like solenoids. It can supply up to 1.8A of output peak current, operating on a motor power supply voltage from 0 to 11V, and a device power supply voltage of 1.8V to 5.5V. By pulling down the nsleep pin,HL8837 enters a low-power sleep mode.

HL8837greatly reduce the component count of motor driver systems by integrating the necessary driver FETs and FET control circuitry into a single device, and is fully protected against VCC undervoltage, overcurrent, shortcircuit, and overtemperature events.

H Bridge Control

The H-bridge output is controlled by the two logic inputs IN1 and IN2, according to the table below.

nSLEEP	IN1	IN2	OUT1	OUT2	Function
0	X	X	Z	Z	Coast(Sleep)
1	0	0	Z	Z	Coast
1	0	1	L	H	Reverse
1	1	0	H	L	Forward
1	1	1	L	L	Brake

The motor current can be regulated by applying external PWM signals on the input pins in1, in2. In external PWM control mode, the winding's inductive current ramps up when the high-side mosfet is on and freewheels during the high side mosfet's off time to cause the recirculation current. To handle this recirculation current, the h-bridge can operate in two different states: Fast decay and slow decay. For fast decay mode, the h-bridge is disabled and recirculation current flows through the body diodes. For slow decay mode, the current circulates through the two low-side mosfets.

To PWM using fast decay, the PWM signal is applied to one input pin while the other is held low. To using slow decay mode, one input is held high and apply the PWM signal to other input pin.

IN1	IN2	FUNCTION
PWM	0	Forward PWM, fast decay
1	PWM	Forward PWM, slow decay
0	PWM	Forward PWM, fast decay
PWM	1	Forward PWM, slow decay

PWM Control of Motor Speed

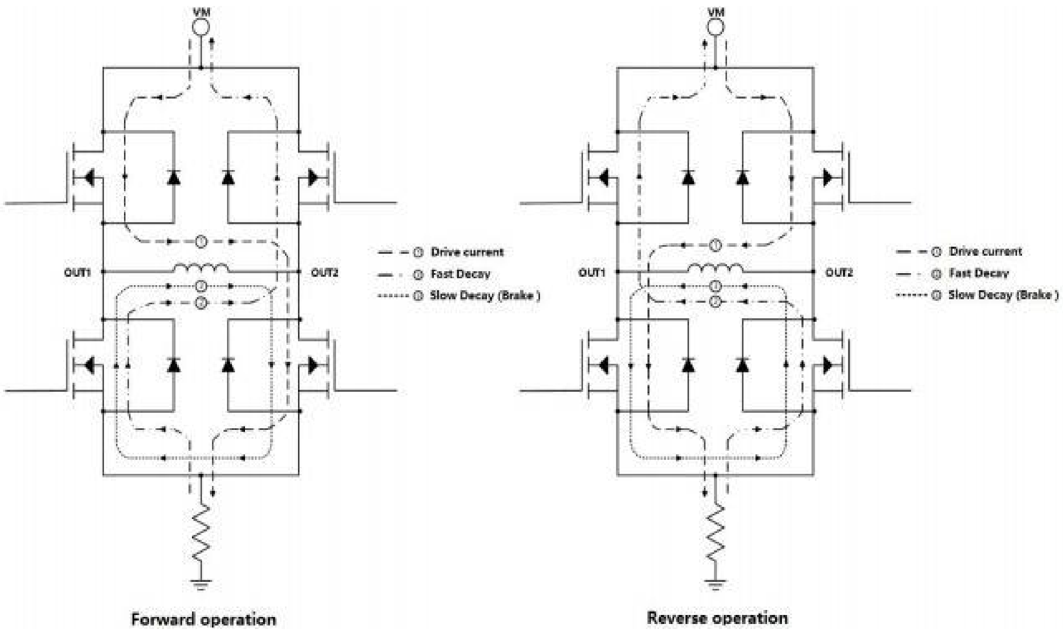


Figure5.Drive and Decay Modes

Overcurrent protection（OCP）

An analog current limit circuit on each FET limits the current through the FET by removing the gate drive. If this analog current limit persists for longer than tDEG, all FETs in the H-bridge will be disabled. Operation resumes automatically after tRETRY has elapsed.

Overcurrent conditions will be detected on both the high-side and low-side devices. A short to VM, GND, or from OUT1 to OUT2 results in an overcurrent condition

Thermal Shutdown（TSD）

If the die temperature exceeds safe limits, all FETs in the H-bridge will be disabled. After the die temperature falls to a safe level, operation automatically resumes.

VCC Under Voltage Lockout（UVLO）

If at any time the voltage on the VCC pin falls below the undervoltage lockout threshold voltage, all FETs in the H-bridge will be disabled. Operation resumes when VCC rises above the UVLO threshold.

Fault	Conditon	H-bridge	Recovery
VCC undervoltage（UVLO）	VCC < 1.5V	Disabled	VCC > 1.8V
Overcurrent（OCP）	I_{OUT} > 3.0A(MIN)	Disabled	tRETRY elapses
Thermal Shutdown（TSD）	T_J>150 ℃(MIN)	Disabled	T_J < 150℃

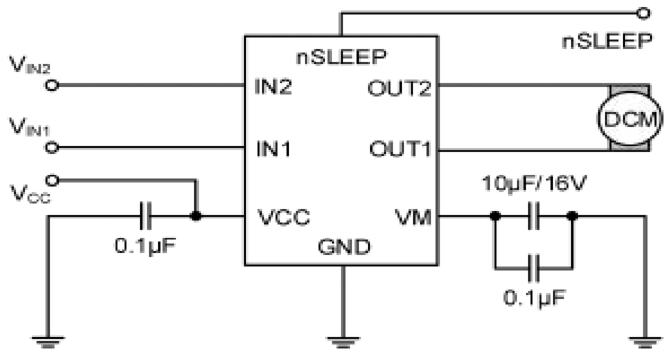
The HL8837 is active unless the nsleep pin is brought logic low. In sleep mode the h-bridge fets are disabled Hi-z. The HL8837 is brought out of sleep mode automatically if nsleep is brought logic high.

It is suggested that when entering the sleep mode, in order to further reduce the power consumption of the chip, all the input pins should be pulled down to low.

Modes	Conditon	H-bridge
Operating	nSLEEP = 1	Operating
Sleep mode	nSLEEP = 0	Disabled
Fault encountered	Any fault condition met	Disabled

Application Information

One DC Motor Drive application



Schematic of HL8837 DC Motor Drive application

Design Parameter	Reference	Example Value
Motor supply voltage	VM	9V
Logic supply voltage	V_{CC}	3.3V
Target RMS current	I_{OUT}	0.8A

Typical Design Requirements

Detailed Design Procedure

Power dissipation in the HL8837 is dominated by the power dissipated in the output fet resistance, or rds(on).

Average power dissipation when running a stepper motor can be roughly estimated by:

$P_{tot} = r_{ds(on)} \times (i_{out(rms)})^2$

Where

P_{tot} is the total power dissipation；

$R_{ds(on)}$ is the resistance ofthe hs plus ls fets；

$I_{out(rms)}$ is the rms or dc output current being supplied to the load。

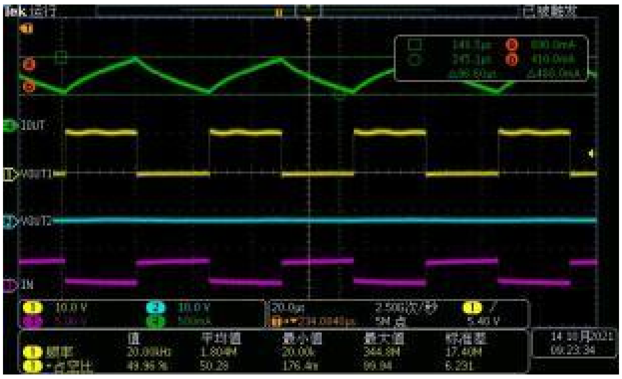
The maximum amount of power that can be dissipated in the device is dependent on ambient temperature and heatsinking

Note that rds(on) increases with temperature, so as the device heats, the power dissipation increases.

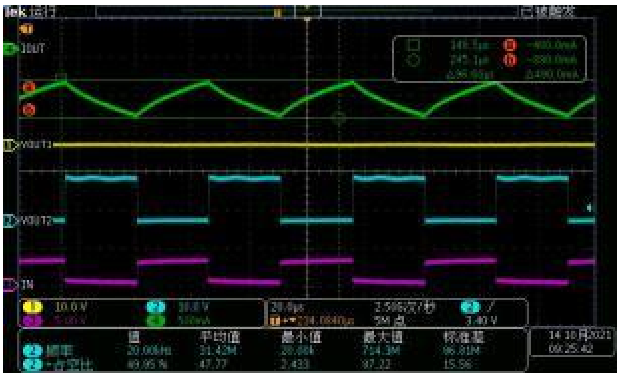
Hl8837 has thermal shutdown protection. If the die temperature exceeds approximately 150°c, the device will be disabled until the temperature drops to a safe level.

Any tendency of the device to enter thermal shutdown is an indication of either excessive power dissipation, insufficient heatsinking, or too high an ambient temperature.

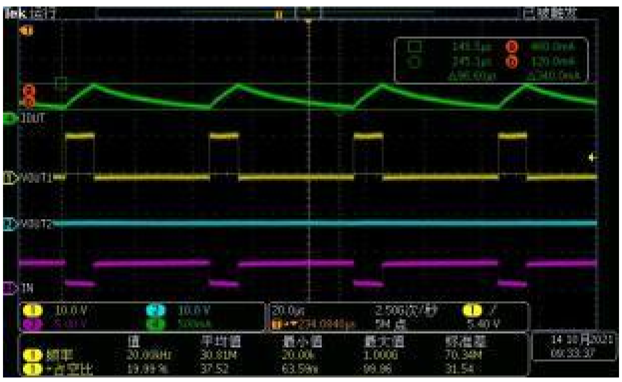
Application Performance Plots



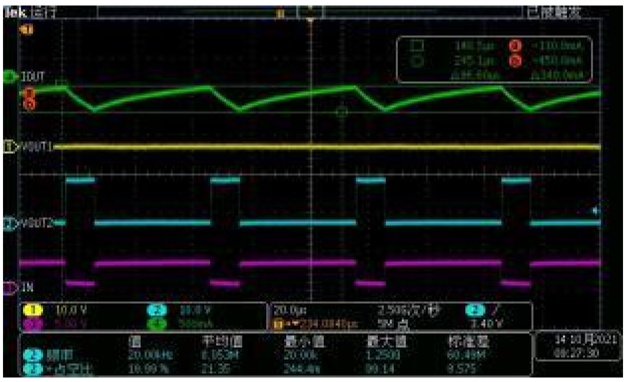
VM= 11V, 50% Duty Cycle, Forward Direction



VM= 11V, 50% Duty Cycle, Reverse Direction



VM= 11V, 20% Duty Cycle, Forward Direction



VM= 11V, 20% Duty Cycle, Reverse Direction

Power Supplies and Input Terminals

The VM voltage supply does not have any undervoltage lockout protection (UVLO), so as long as VCC > 1.8 V; the internal device logic will remain active. This means that the vm pin voltage may drop to 0V, however, the load may not be sufficiently driven at low vm voltages.

The input pins may be driven within their recommended operating conditions with or without the vcc and/or vm power supplies present. No leakage current path will exist to the supply. There is a weak pulldown resistor (approximately 110 kΩ) to ground on each input pin.

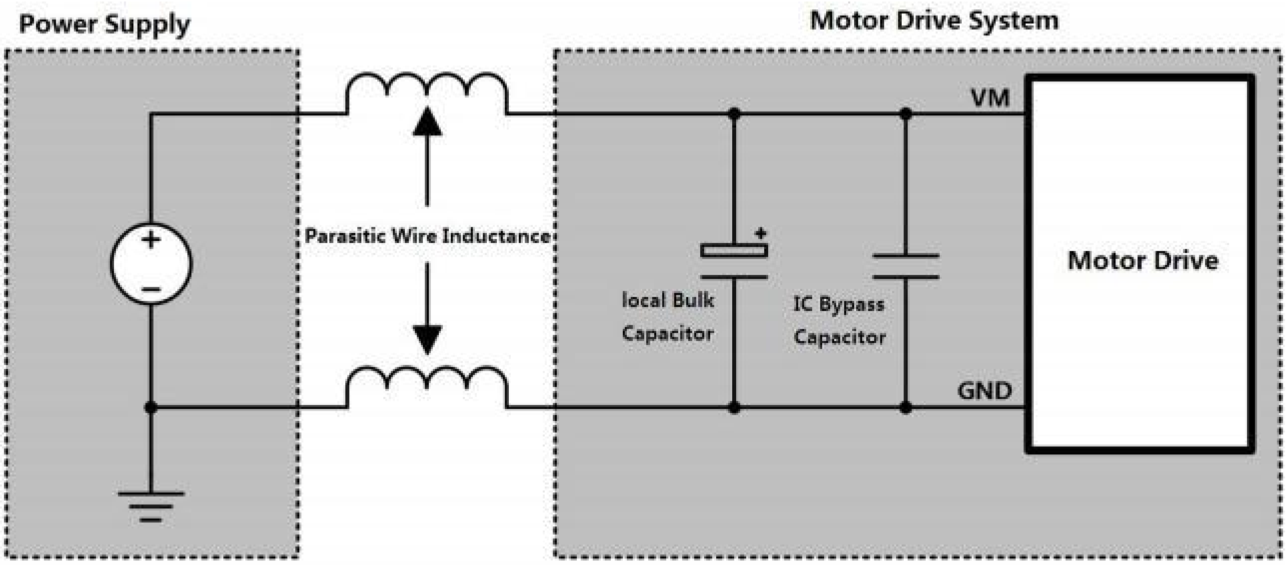
Power Supply Recommendations

Bypass vm and vcc with 0.1-μf ceramic capacitors rated for vm and vcc. Place these capacitors as close to the device as possible.

Having appropriate local bulk capacitance is an important factor in motor drive system design. It is generally beneficial to have more bulk capacitance, while the disadvantages are increased cost and physical size.

The amount of local capacitance needed depends on a variety of factors, including: The highest current required by the motor system, the power supply’s capacitance and ability to source current, the amount of parasitic inductance between the power supply and motor system, the acceptable voltage ripple, the type of motor used (brushed dc, brushless dc, stepper), the motor braking method.

The inductance between the power supply and motor drive system will limit the rate current can change from the power supply. If the local bulk capacitance is too small, the system will respond to excessive current demands or dumps from the motor with a change in voltage. When adequate bulk capacitance is used, the motor voltage remains stable and high current can be quickly supplied.



Example Setup of Motor Drive System with External Power Supply

The voltage rating for bulk capacitors should be higher than the operating voltage, to provide margin for cases when the motor transfers energy to the supply.

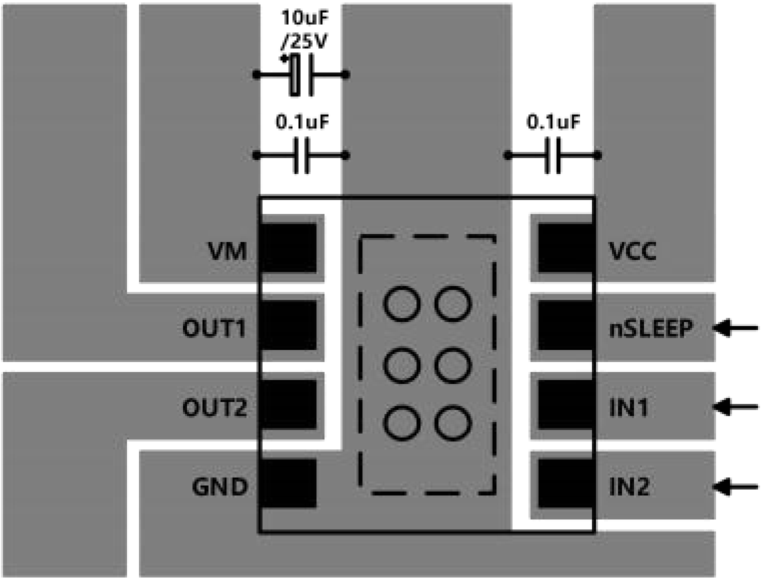
Layout Guidelines

The printed circuit board (pcb) should use a heavy ground-plane with thick power and ground trace. The HL8837 must be soldered directly onto the board for better electrical and thermal performance.

The vm and vcc terminals should be bypassed to gnd using low-esr ceramic bypass capacitors with arecommended value of 0.1 µf rated for vm and vcc. These capacitors should be placed as close to the vm and vcc pins as possible with a thick trace or ground plane connection to the device gnd pin.

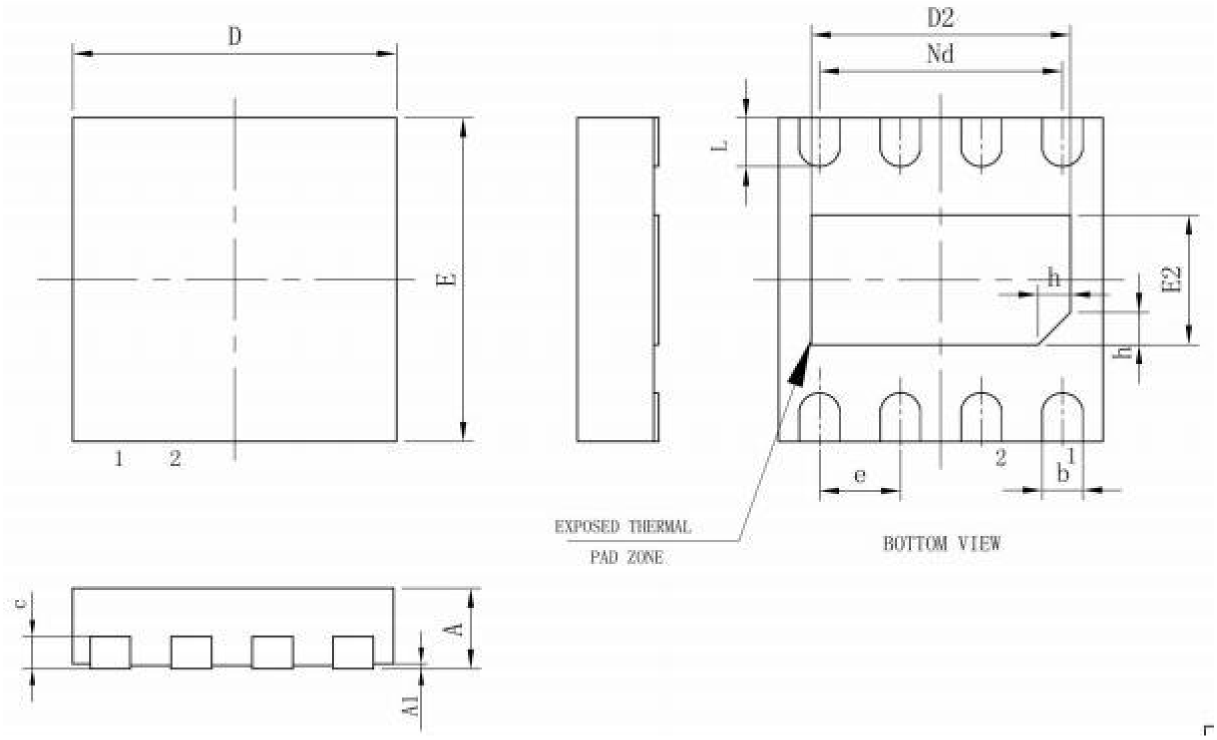
The ground-plane is used between the driver outputs and the logic control inputs to avoid the coupling problem caused by high-speed dv/dt conversion.

Layout Example



Layout Recommendation

Package information



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0. 45	0.50	0. 55
A1	—	0.02	0. 05
b	0. 18	0.25	0. 30
c	0. 18	0.20	0. 25
D	1. 90	2. 00	2. 10
D2	1. 50	1. 60	1. 70
e	0. 50BSC		
Nd	1. 50BSC		
E	1. 90	2. 00	2. 10
E2	0. 80	0. 90	1. 10
L	0. 25	0.30	0. 35
h	0. 15	0. 20	0. 25
L/F dimension	69X43		

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