Description

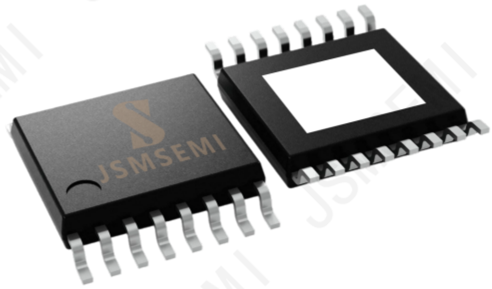
The DRV8833 device provides a dual bridge motor driver solution for toys, printers, and other mechatronic applications.

The device has two H-bridge drivers, and can drive two DC brush motors, a bipolar stepper motor, solenoids, or other inductive loads.

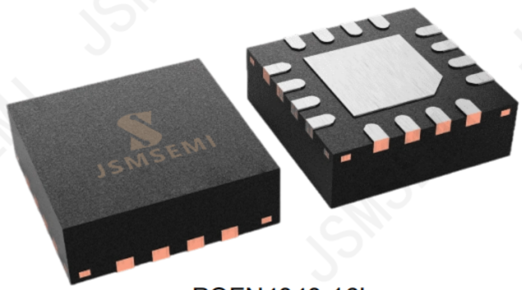
The output driver block of each H-bridge consists of N-channel power MOSFETs configured as an H-bridge to drive the motor windings. Each H-bridge includes circuitry to regulate or limit the winding current.

Internal shutdown functions with a fault output pin are provided for overcurrent protection, short-circuit protection, undervoltage,lockout,and overtemperature. A low-power sleep mode is alsoprovided.

The DRV8833 is available in Green TSSOP-16-EP and PQFN4040-16L packages. It operates over an ambient temperature range of -40°C to +125°C



TSSOP-16-EP



PQFN4040-16L

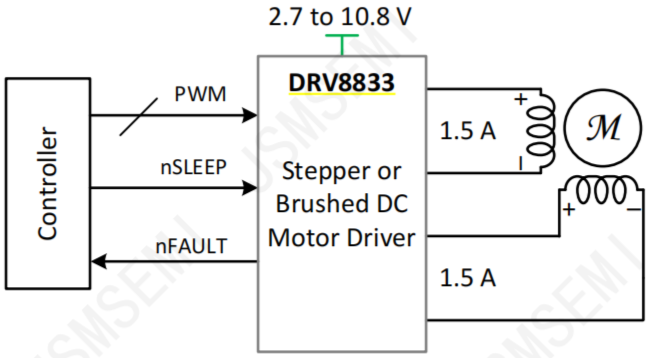
Features

- Dual-H-Bridge Current-Control Motor Driver
  - Can Drive Two DC Motors or One Stepper Motor
  - Low MOSFET ON-Resistance: HS + LS 360 mΩ
- Output Current (at V_M = 5 V, 25°C)
  - 1.5A RMS, 2A Peak per H-Bridge in PWP and RTY Package Options
  - 500mA RMS, 2A Peak per H-Bridge in PW Package Option
- Outputs can be in Parallel for
  - 3A RMS, 4A Peak
- Wide Power Supply Voltage Range: 2.7 to 12 V
- PWM Winding Current Regulation and Current Limiting
- Thermally Enhanced Surface-Mount Packages
  - TSSOP-16-EP and PQFN4040-16L

Applications

- Battery-Powered Toys
- POS Printers
- Video Security Cameras
- Office Automation Machines
- Gaming Machines
- Robotics

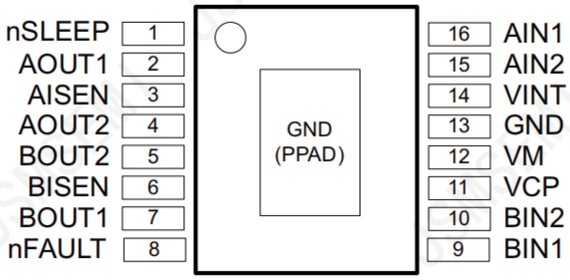
Simplified Schematic



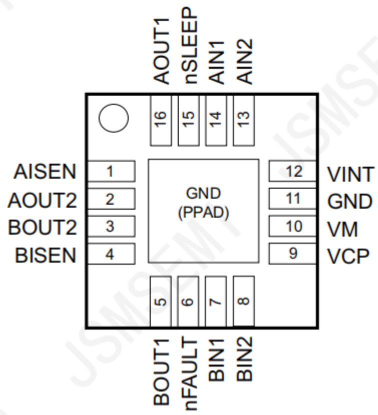
Ordering Information

Order number	Package	Marking	Operation Temperature Range	MSL Grade	Ship,Quantity	Green
DRV8833PWPR-JSM	TSSOP-16-EP	JSM8833	-40 to 125°C	3	TR&4000	Rohs
DRV8833RTYR-JSM	QFN4040-16L	JSM8833	-40 to 125°C	3	TR&5000	Rohs

Pin Configuration and Functions



TSSOP-16-EP
Top View



PQFN-16
Top View

Pin Functions

PIN			I/O (1)	DESCRIPTION	EXTERNAL COMPONENTS OR CONNECTIONS
NAME	PQFN	TSSOP			
POWER AND GROUND					
GND	11 PPAD	13	—	Device ground. HTSSOP package has PowerPAD.	Both the GND pin and device PowerPAD must be connected to ground.
VINT	12	14	—	Internal supply bypass	Bypass to GND with 2.2μF, 6.3V capacitor.
VM	10	12	—	Device power supply	Connect to motor supply. A 10-μF (minimum) ceramic bypass capacitor to GND is recommended.
VCP	9	11	IO	High-side gate drive voltage	Connect a 0.01μF, 16-V (minimum) X7R ceramic capacitor to VM.
CONTROL					
AIN1	14	16	I	Bridge A input 1	Logic input controls state of AOUT1. Internal pulldown.
AIN2	13	15	I	Bridge A input 2	Logic input controls state of AOUT2. Internal pulldown.
BIN1	7	9	I	Bridge B input 1	Logic input controls state of BOUT1. Internal pulldown.
BIN2	8	10	I	Bridge B input 2	Logic input controls state of BOUT2. Internal pulldown.
nSLEEP	15	1	I	Sleep mode input	Logic high to enable device, logic low to enter low-power sleep mode and reset all internal logic. Internal pulldown.
STATUS					
nFAULT	6	8	OD	Fault output	Logic low when in fault condition (overtemperature, overcurrent)
OUTPUT					
AISEN	1	3	IO	Bridge A ground / I_{SENSE}	Connect to current sense resistor for bridge A, or GND if current control not needed
BISEN	4	6	IO	Bridge B ground / I_{SENSE}	Connect to current sense resistor for bridge B, or GND if current control not needed
AOUT1	16	2	O	Bridge A output 1	Connect to motor winding A
AOUT2	2	4	O	Bridge A output 2	
BOUT1	5	7	O	Bridge B output 1	Connect to motor winding B
BOUT2	3	5	O	Bridge B output 2	

(1) I = Input, O = Output, OZ = Tri-state output, OD = Open-drain output, IO = Input/output

Specifications

Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) (1)

		MIN	MAX	UNIT
VM	Power supply voltage	–0.3	15	V
	Digital input pin voltage	–0.5	7	V
	xISEN pin voltage	–0.3	0.5	V
	Peak motor drive output current	Internally limited		A
T_J	Operating junction temperature	–40	150	°C
T_{stg}	Storage temperature	–60	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM)	±4000	V
		Charged device model (CDM)	±1500	

Recommended Operating Conditions

T_A =25°C (unless otherwise noted)

		MIN	NOM	MAX	UNIT
V_M	Motor power supply voltage range (1)	2.7		12	V
V_{DIGIN}	Digital input pin voltage range	–0.3		5.75	V
I_{OUT}	RTY package continuous RMS or DC output current per bridge (2)			1.5	A

(1) $R_{DS(ON)}$ increases and maximum output current is reduced at VM supply voltages below 5 V.
(2) V_M = 5 V, power dissipation and thermal limits must be observed.

Thermal Information

THERMAL METRIC		DRV8833		UNIT
		TSSOP	PQFN	
		16 PINS	16 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	40.5	38	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	33.9	35.3	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	27.8	15.3	°C/W
ψ_{JT}	Junction-to-top characterization parameter	0.6	0.3	°C/W
ψ_{JB}	Junction-to-board characterization parameter	12.5	16.4	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	4.8	3.5	°C/W

Electrical Characteristics

T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
POWER SUPPLY						
I_{VM}	VM operating supply current	V_M = 5 V, xIN1 = 0 V, xIN2 = 0 V		1.7	3	mA
I_{VMQ}	VM sleep mode supply current	V_M = 5 V		1.6	2.5	μA
V_{UVLO}	VM undervoltage lockout voltage	V_M falling			2.6	V
V_{HYS}	VM undervoltage lockout hysteresis			90		mV
LOGIC-LEVEL INPUTS						
V_{IL}	Input low voltage	nSLEEP			0.5	V
		All other pins			0.7	
V_{IH}	Input high voltage	nSLEEP	2.5			V
		All other pins	2			
V_{HYS}	Input hysteresis			0.4		V
R_{PD}	Input pulldown resistance	nSLEEP		500		kΩ
		All except nSLEEP		150		
I_{IL}	Input low current	VIN = 0			1	μA
I_{IH}	Input high current	VIN = 3.3 V, nSLEEP		6.6	13	μA
		VIN = 3.3 V, all except nSLEEP		16.5	33	
t_{DEG}	Input deglitch time			450		ns
nFAULT OUTPUT (OPEN-DRAIN OUTPUT)						
V_{OL}	Output low voltage	I_O = 5 mA			0.5	V
I_{OH}	Output high leakage current	V_O = 3.3 V			1	μA
H-BRIDGE FETs						
$R_{DS(ON)}$	HS FET on resistance	V_M = 5 V, I_O = 500 mA, T_J = 25°C		200		mΩ
		V_M = 5 V, I_O = 500 mA, T_J = 85°C			325	
		V_M = 2.7 V, I_O = 500 mA, T_J = 25°C		250		
		V_M = 2.7 V, I_O = 500 mA, T_J = 85°C			350	
	LS FET on resistance	V_M = 5 V, I_O = 500 mA, T_J = 25°C		160		
		V_M = 5 V, I_O = 500 mA, T_J = 85°C			275	
		V_M = 2.7 V, I_O = 500 mA, T_J = 25°C		200		
		V_M = 2.7 V, I_O = 500 mA, T_J = 85°C			300	
I_{OFF}	Off-state leakage current	V_M = 5 V, T_J = 25°C, V_{OUT} = 0 V	–1		1	μA
MOTOR DRIVER						
f_{PWM}	Current control PWM frequency	Internal PWM frequency		50		kHz
t_R	Rise time	V_M = 5 V, 16 Ω to GND, 10% to 90% V_M		180		ns
t_F	Fall time	V_M = 5 V, 16 Ω to GND, 10% to 90% V_M		160		ns
t_{PROP}	Propagation delay INx to OUTx	V_M = 5 V		1.1		μs
t_{DEAD}	Dead time (1)	V_M = 5 V		450		ns
PROTECTION CIRCUITS						
I_{OCP}	Overcurrent protection trip level		2	3.3		A
t_{DEG}	OCP Deglitch time		4			μs
t_{OCP}	Overcurrent protection period			1.35		ms
t_{TSD}	Thermal shutdown temperature	Die temperature	150	160	180	°C
CURRENT CONTROL						
V_{TRIP}	xISEN trip voltage		160	200	240	mV
t_{BLANK}	Current sense blanking time			3.75		μs
SLEEP MODE						
t_{WAKE}	Start-up time	nSLEEP inactive high to H-bridge on			1	ms

(1) Internal dead time. External implementation is not necessary.

Detailed Description

Overview

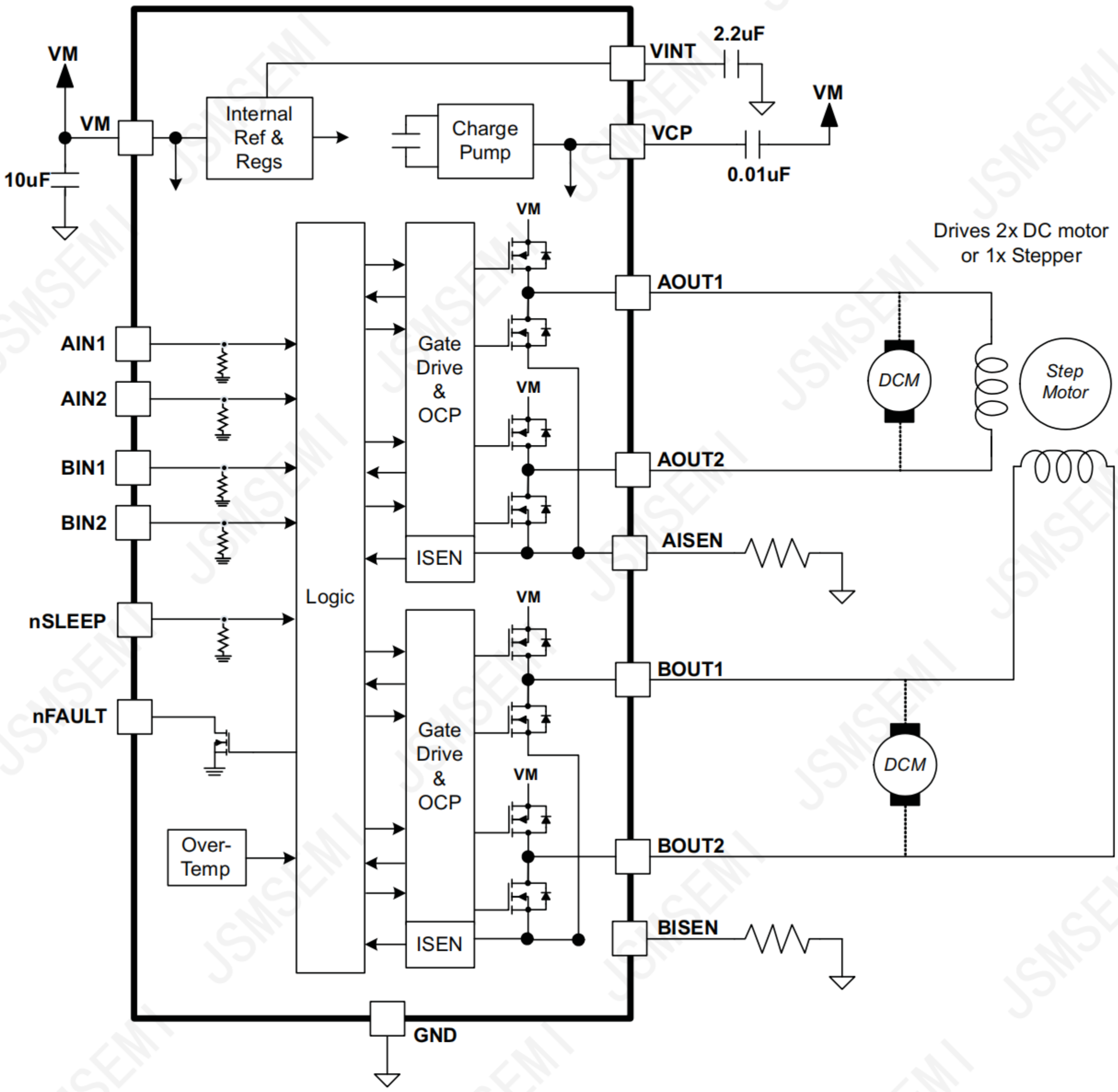
The DRV8833 device is an integrated motor driver solution for brushed DC or bipolar stepper motors. The device integrates two NMOS H-bridges and current regulation circuitry. The DRV8833 can be powered with a supply voltage from 2.7 to 12 V and can provide an output current up to 1.5A RMS.

A simple PWM interface allows easy interfacing to the controller circuit.

The current regulation is a fixed frequency PWM slow decay.

The device includes a low-power sleep mode, which lets the system save power when not driving the motor.

Functional Block Diagram



Feature Description

Fixed-Frequency PWM Motor Drivers

DRV8833 contains two identical H-bridge motor drivers with current-control PWM circuitry. Figure 1 shows a block diagram of the circuitry.

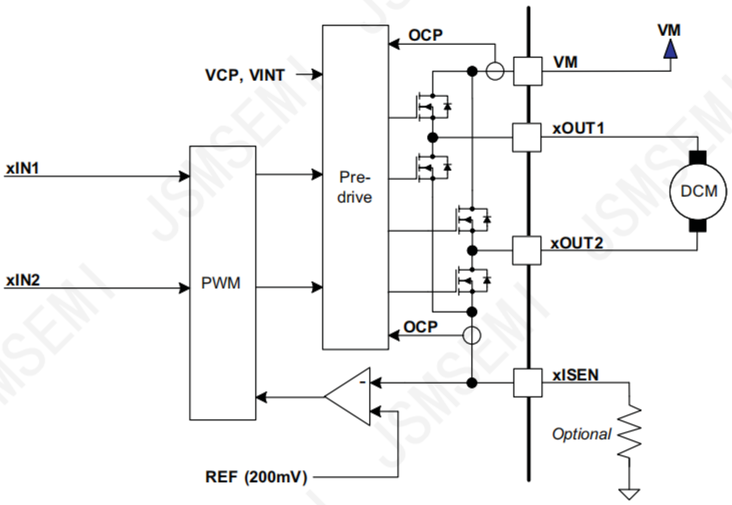


Figure 1. Motor Control Circuitry

Bridge Control and Decay Modes

The AIN1 and AIN2 input pins control the state of the AOUT1 and AOUT2 outputs; similarly, the BIN1 and BIN2 input pins control the state of the BOUT1 and BOUT2 outputs. Table 1 shows the logic.

Table 1. H-Bridge Logic

xIN1	xIN2	xOUT1	xOUT2	FUNCTION
0	0	Z	Z	Coast/fast decay
0	1	L	H	Reverse
1	0	H	L	Forward
1	1	L	L	Brake/slow decay

The inputs can also be used for PWM control of the motor speed. When controlling a winding with PWM, when the drive current is interrupted, the inductive nature of the motor requires that the current must continue to flow. This is called recirculation current. To handle this recirculation current, the H-bridge can operate in two different states: fast decay or slow decay. In fast decay mode, the H-bridge is disabled and recirculation current flows through the body diodes; in slow decay, the motor winding is shorted.

To PWM using fast decay, the PWM signal is applied to one xIN pin while the other is held low; to use slow decay, one xIN pin is held high.

Table 2. PWM Control of Motor Speed

xIN1	xIN2	FUNCTION
PWM	0	Forward PWM, fast decay
1	PWM	Forward PWM, slow decay
0	PWM	Reverse PWM, fast decay
PWM	1	Reverse PWM, slow decay

Figure 2 shows the current paths in different drive and decay modes.

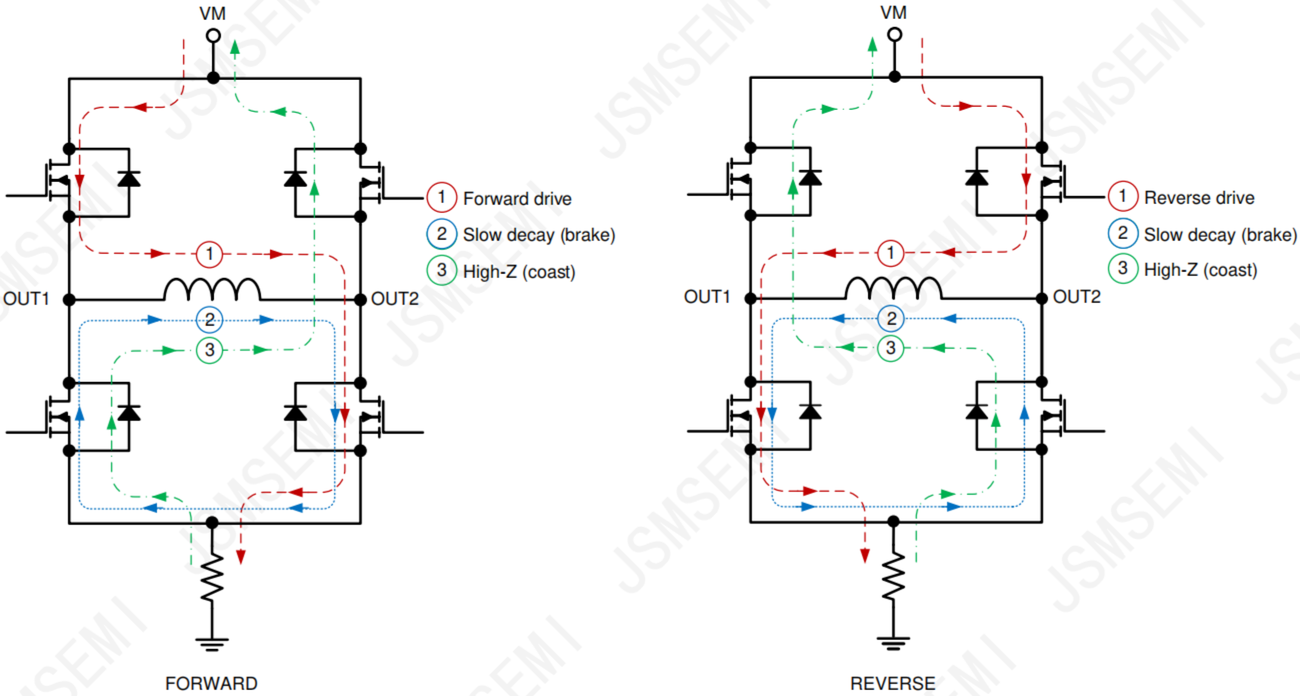


Figure 2. Drive and Decay Modes

Current Control

The current through the motor windings may be limited, or controlled, by a fixed-frequency PWM current regulation, or current chopping. For DC motors, current control is used to limit the start-up and stall current of the motor. For stepper motors, current control is often used at all times.

When an H-bridge is enabled, current rises through the winding at a rate dependent on the DC voltage and inductance of the winding. If the current reaches the current chopping threshold, the bridge disables the current until the beginning of the next PWM cycle. Immediately after the current is enabled, the voltage on the xISEN pin is ignored for a fixed period of time before enabling the current sense circuitry. This blanking time is fixed at 3.75 µs. This blanking time also sets the minimum on time of the PWM when operating in current chopping mode.

The PWM chopping current is set by a comparator which compares the voltage across a current sense resistor connected to the xISEN pins with a reference voltage. The reference voltage is fixed at 200 mV.

The chopping current is calculated in Equation 1.

$$I_{CHOP} = \frac{200\ \text{mV}}{R_{ISENSE}}$$

Example: If a 1Ω sense resistor is used, the chopping current will be 200 mV/1 Ω = 200 mA.

Once the chopping current threshold is reached, the H-bridge switches to slow decay mode. Winding current is recirculated by enabling both of the low-side FETs in the bridge. This state is held until the beginning of the next fixed-frequency PWM cycle.

If current control is not needed, the xISEN pins should be connected directly to ground.

nSLEEP Operation

Driving nSLEEP low will put the device into a low power sleep state. In this state, the H-bridges are disabled, the gate drive charge pump is stopped, all internal logic is reset, and all internal clocks are stopped. All inputs are ignored until nSLEEP returns inactive high. When returning from sleep mode, some time (up to 1 ms) needs to pass before the motor driver becomes fully operational. To make the board design simple, the nSLEEP can be pulled up to the supply (VM). Recommends using a pullup resistor when this is done. This resistor limits the current to the input in case VM is higher than 6.5 V. Internally, the nSLEEP pin has a 500-kΩ resistor to GND. It also has a clamping Zener diode that clamps the voltage at the pin at 6.5 V. Currents greater than 250 µA can cause damage to the input structure. Hence the recommended pullup resistor would be between 20 kΩ and 75 kΩ.

Protection Circuits

The DRV8833 is fully protected against undervoltage, overcurrent and overtemperature events.

Overcurrent Protection (OCP)

An analog current limit circuit on each FET limits the current through the FET by limiting the gate drive. If this analog current limit persists for longer than the OCP deglitch time, all FETs in the H-bridge will be disabled and the nFAULT pin will be driven low. The driver will be re-enabled after the OCP retry period (t_{OCP}) has passed. nFAULT becomes high again at this time. If the fault condition is still present, the cycle repeats. If the fault is no longer present, normal operation resumes and nFAULT remains deasserted. Please note that only the H-bridge in which the OCP is detected will be disabled while the other bridge will function normally.

Overcurrent conditions are detected independently on both high- and low-side devices; that is, a short to ground, supply, or across the motor winding will all result in an overcurrent shutdown. Overcurrent protection does not use the current sense circuitry used for PWM current control, so it functions even without presence of the xISEN resistors.

Thermal Shutdown (TSD)

If the die temperature exceeds safe limits, all FETs in the H-bridge will be disabled and the nFAULT pin will be driven low. Once the die temperature has fallen to a safe level, operation will automatically resume.

Undervoltage Lockout (UVLO)

If at any time the voltage on the VM pin falls below the undervoltage lockout threshold voltage, all circuitry in the device will be disabled, and all internal logic will be reset. Operation will resume when VM rises above the UVLO threshold. nFAULT is driven low in the event of an undervoltage condition.

Table 3. Device Protection

FAULT	CONDITION	ERROR REPORT	H-BRIDGE	INTERNAL CIRCUITS	RECOVERY
VM undervoltage (UVLO)	V_M < 2.5 V	None	Disabled	Disabled	V_M > 2.7 V
Overcurrent (OCP)	$I_{OUT} > I_{OCP}$	FAULTn	Disabled	Operating	OCP
Thermal Shutdown (TSD)	$T_J > T_{TSD}$	FAULTn	Disabled	Operating	$T_J < T_{TSD} – T_{HYS}$

Device Functional Modes

The DRV8833 is active unless the nSLEEP pin is brought logic low. In sleep mode, the H-bridge FETs are disabled (Hi-Z). The DRV8833 is brought out of sleep mode automatically if nSLEEP is brought logic high. tWAKE must elapse before the outputs change state after wakeup.

Table 4. Modes of Operation

FAULT	CONDITION	H-BRIDGE	INTERNAL CIRCUITS
Operating	nSLEEP pin high	Operating	Operating
Sleep mode	nSLEEP pin low	Disabled	Disabled
Fault encountered	Any fault condition met	Disabled	See Table 3

Application Information

The DRV8833 is used in brushed DC or stepper motor control. The following design procedure can be used to configure the DRV8833 in a brushed DC motor application. The inputs and outputs are connected in parallel to achieve higher current.

Typical Application

The two H-bridges in the DRV8833 can be connected in parallel for double the current of a single H-bridge. The internal dead time in the DRV8833 prevents any risk of cross-conduction (shoot-through) between the two bridges due to timing differences between the two bridges. Figure 3 shows the connections.

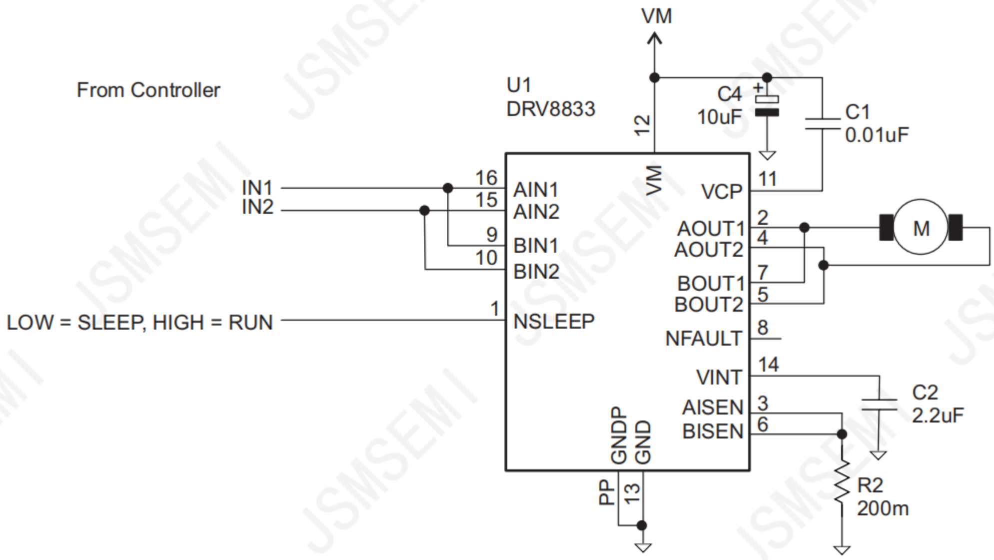


Figure 3. Parallel Mode

Design Requirements

Table 5. Design Parameters

DESIGN PARAMETER	REFERENCE	EXAMPLE VALUE
Motor voltage	V_M	10 V
Motor RMS current	I_{RMS}	0.8 A
Motor start-up current	I_{START}	2 A
Motor current trip point	I_{TRIP}	2.5 A

Detailed Design Procedure

Motor Voltage

The motor voltage to use will depend on the ratings of the motor selected and the desired RPM. A higher voltage spins a brushed DC motor faster with the same PWM duty cycle applied to the power FETs. A higher voltage also increases the rate of current change through the inductive motor windings.

Motor Current Trip Point

When the voltage on pin xISEN exceeds V_{TRIP} (0.2 V), current regulation is activated. The R_{ISENSE} resistor should be sized to set the desired I_{CHOP} level.

$$R_{ISENSE} = 0.2\ V / I_{CHOP} \quad (2)$$

To set I_{CHOP} to 1 A, R_{SENSE} = 0.2 V / 1 A = 0.2 Ω.

Sense Resistor

For optimal performance, it is important for the sense resistor to be:

- Surface-mount
- Low inductance
- Rated for high enough power
- Placed closely to the motor driver

The power dissipated by the sense resistor equals $I_{RMS}^2 \times R$. For example, if peak motor current is 3 A, RMS motor current is 2 A, and a 0.05Ω sense resistor is used, the resistor will dissipate 2 $A^2 \times$ 0.05 Ω = 0.2 W. The power quickly increases with higher current levels.

Resistors typically have a rated power within some ambient temperature range, along with a derated power curve for high ambient temperatures. When a PCB is shared with other components generating heat, margin should be added. For best practice, measure the actual sense resistor temperature in a final system, along with the power MOSFETs, as those are often the hottest components.

Because power resistors are larger and more expensive than standard resistors, the common practice is to use multiple standard resistors in parallel, between the sense node and ground. This distributes the current and heat dissipation.

Power Supply Recommendations

Bulk Capacitance

Having an 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 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 the motor drive system limits the rate current can change from the power supply. If the local bulk capacitance is too small, the system responds 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.

The data sheet generally provides a recommended value, but system-level testing is required to determine the appropriate sized bulk capacitor.

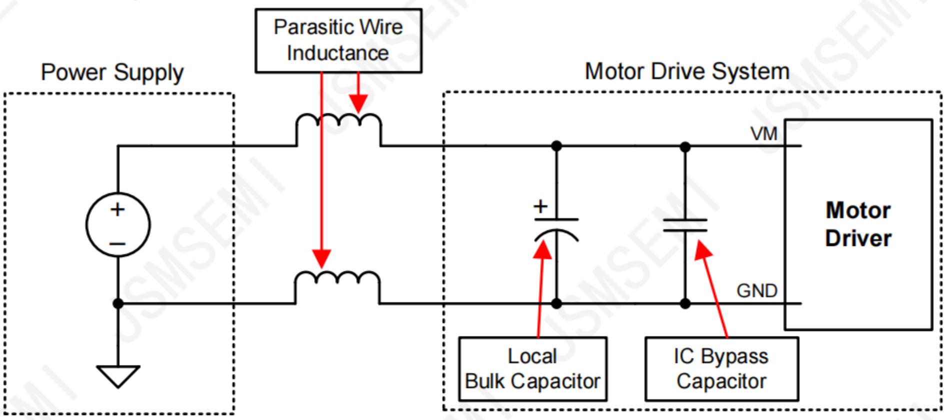


Figure 9. Example Setup of Motor Drive System With External Power Supply

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.

Power Supply and Logic Sequencing

There is no specific sequence for powering up the DRV8833. The presence of digital input signals is acceptable before VM is applied. After VM is applied to the DRV8833, the device begins operation based on the status of the control pins.

Layout

Layout Guidelines

The VM pin should be bypassed to GND using low-ESR ceramic bypass capacitors with a recommended value of 10μF rated for VM. This capacitor should be placed as close to the VM pin as possible with a thick trace or ground plane connection to the device GND pin.

A low-ESR ceramic capacitor must be placed in between the VM and VCP pins.JSMSEMI recommends a value of 0.01μF rated for 16 V. Place this component as close to the pins as possible.

Bypass VINT to ground with a 2.2μF ceramic capacitor rated 6.3 V. Place this bypass capacitor as close to the pin as possible.

Heatsinking

The PowerPAD package uses an exposed pad to remove heat from the device. For proper operation, this pad must be thermally connected to copper on the PCB to dissipate heat. On a multilayer PCB with a ground plane, this can be accomplished by adding a number of vias to connect the thermal pad to the ground plane. On PCBs without internal planes, copper area can be added on either side of the PCB to dissipate heat. If the copper area is on the opposite side of the PCB from the device, thermal vias are used to transfer the heat between top and bottom layers.

In general, the more copper area that can be provided, the more power can be dissipated.

Thermal Considerations

Maximum Output Current

In actual operation, the maximum output current achievable with a motor driver is a function of die temperature. This, in turn, is greatly affected by ambient temperature and PCB design. Basically, the maximum motor current will be the amount of current that results in a power dissipation level that, along with the thermal resistance of the package and PCB, keeps the die at a low enough temperature to stay out of thermal shutdown.

The dissipation ratings given in the data sheet can be used as a guide to calculate the approximate maximum power dissipation that can be expected to be possible without entering thermal shutdown for several different PCB constructions. However, for accurate data, the actual PCB design must be analyzed through measurement or thermal simulation.

Thermal Protection

The DRV8833 has thermal shutdown (TSD) as described above. If the die temperature exceeds approximately 150°C, the device will be disabled until the temperature drops by 45°C.

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

Power Dissipation

Power dissipation in the DRV8833 is dominated by the DC power dissipated in the output FET resistance, or $R_{DS(ON)}$. There is additional power dissipated due to PWM switching losses, which are dependent on PWM frequency, rise and fall times, and VM supply voltages. These switching losses are typically on the order of 10% to 30% of the DC power dissipation.

The DC power dissipation of one H-bridge can be roughly estimated by Equation 3.

$$P_{TOT} = \left(HS - R_{DS(ON)} \times I_{OUT(RMS)}{}^2\right) + \left(LS - R_{DS(ON)} \times I_{OUT(RMS)}{}^2\right) \tag{3}$$

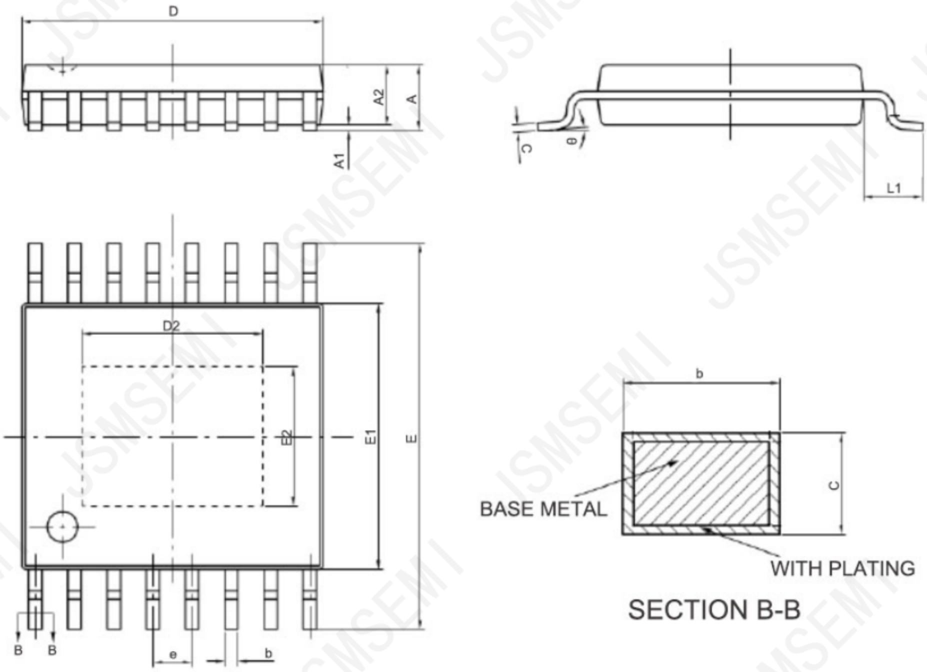
where

- P_{TOT} is the total power dissipation
- HS - $R_{DS(ON)}$ is the resistance of the high-side FET
- LS - $R_{DS(ON)}$ is the resistance of the low-side FET
- $I_{OUT(RMS)}$ is the RMS output current being applied to the motor

$R_{DS(ON)}$ increases with temperature, so as the device heats, the power dissipation increases. This must be taken into consideration when sizing the heatsink.

Package Information

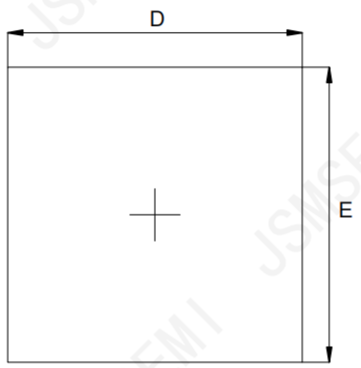
TSSOP-16-EP



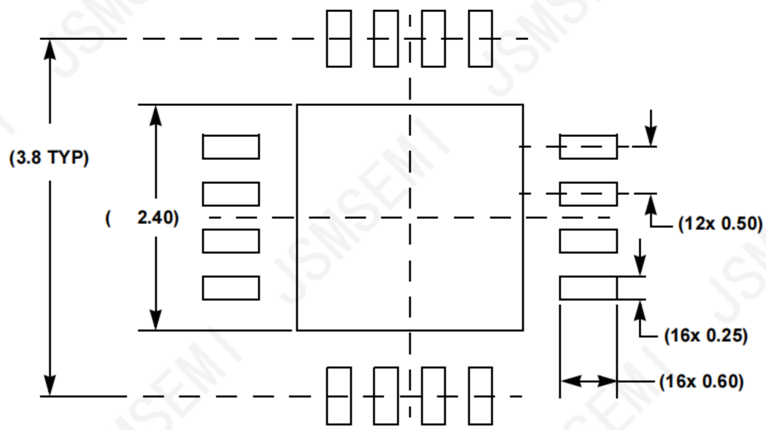
Symbol	Dimensions		
	Min.	Nom.	Max.
A	-	-	1.20
A1	0.05	-	0.15
A2	0.90	1.00	1.05
b	0.20	-	0.30
e	0.65 BSC		
c	0.13	-	0.19
D	4.86	4.96	5.06
D2	2.90	3.00	3.10
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
E2	2.20	2.30	2.40
L1	1.00 REF		
θ	0	-	8

Package Information

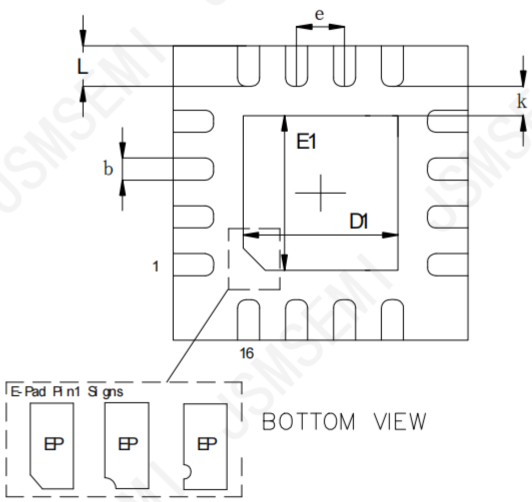
PQFN4040-16L



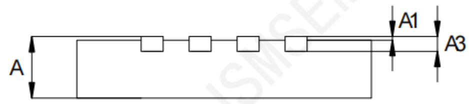
TOP VIEW



RECOMMENDED LAND PATTERN (Unit: mm)



BOTTOM VIEW



SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.203 REF		0.008 REF	
D	3.900	4.100	0.154	0.161
E	3.900	4.100	0.154	0.161
e	0.650 BSC		0.030 BSC	
b	0.250	0.350	0.010	0.013
L	0.450	0.650	0.018	0.026
D1	2.000	2.200	0.079	0.087
E1	2.000	2.200	0.079	0.087
K	0.200 MIN		0.008 MIN	

Revision History

Rev.	Change	Date
V1.0	Initial version	3/27/2023

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For additional information please contact Kevin@ jsmsemi.com or visit www.jsmsemi.com