SC8900
Dual Half Bridge Motor Driver

1 Features

- Low $R_{DS(on)}$ output
- 1.0-A Maximum Drive Current
- 2.5-V to 5.5-V Operating Supply-Voltage
- Standby mode with zero current drain
- Small Package and Footprint
  - 8 DFN (With Thermal Pad)
  - 2.00mm x 2.00mm
- Protection Features
  - VBB Undervoltage Lockout (UVLO)
  - Crossover Current Protection
  - Thermal Shutdown (TSD)

2 Applications

- IR-CUT
- Cameras
- DSLR Lenses
- Consumer Products
- Toys
- Robotics
- Medical Devices

3 Description

The SC8900 is a dual half bridge motor driver, designed for low cost, low voltage battery operated power applications.

Direct control of high- and low-side drivers is implemented to allow either high-side or low-side PWM. The motor can be connected to either supply or GND. Using a MOS switch results in improved braking action for the motor, compared to implementation with simple clamp diode.

The SC8900 supplies up to 1.0-A of output current. The power supply voltage from 2.5 V to 5.5 V.

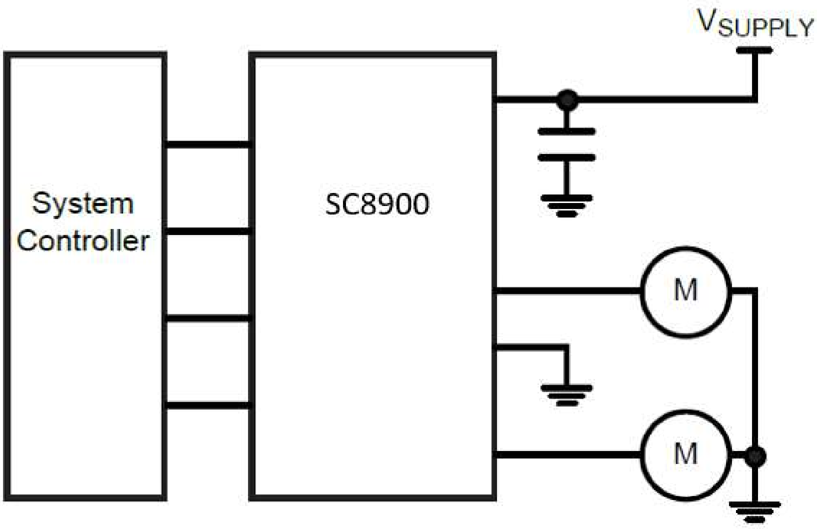
Internal shutdown functions are provided for crossover current protection, short circuit protection, undervoltage lockout, and over temperature.

The SC8900 is packaged in a 8-pin DFN2X2 package.

Device Information

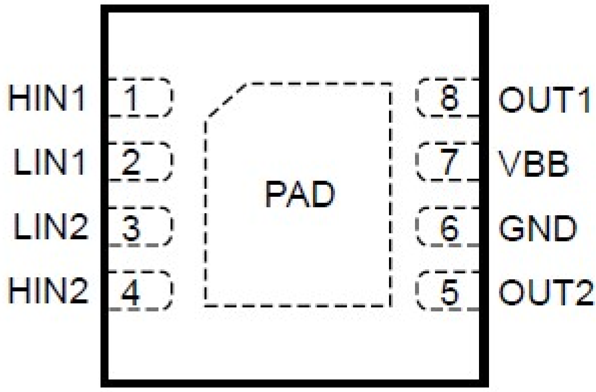
PART NUMBER	PACKAGE	BODY SIZE (NOM)
SC8900	DFN (8)	2.00 mm × 2.00 mm

Simplified Schematic



4 Pin Configuration and Functions

DFN Package
8-Pin DFN With Exposed Thermal Pad
Top View



Pin Functions

PIN		TYPE	DESCRIPTION	EXTERNAL COMPONENTS OR CONNECTIONS
NAME	NO.			
POWER AND GROUND				
GND	6	PWR	Device ground	This pin must be connected to the PCB ground
VBB	7	PWR	Motor supply	Bypass to GND with a 0.1uF(minimum) ceramic capacitor
CONTROL				
HIN1	1	I	Bridge input 1 high-side	Internal pulldown resistor
LIN1	2	I	Bridge input 1 low-side	Internal pulldown resistor
HIN2	4	I	Bridge input 2 high-side	Internal pulldown resistor
LIN2	3	I	Bridge input 2 low-side	Internal pulldown resistor
OUTPUT				
OUT1	8	O	Bridge output 1	Connect to motor winding
OUT2	5	O	Bridge output 2	

5 Specifications

5.1 Absolute Maximum Ratings

See(1)(2)

	MIN	MAX	UNIT
V_{BB} Supply voltage,	-0.3	5.5	V
V_{OUT} Output Voltage	-0.3	V_{BB}+1	V
V_{IN} Logic input pin voltage	-0.5	6.0	V
Peak motor drive output current	Internally limited		A
T_J Operating junction temperature	-40	150	℃
T_{stg} Storage temperature	-65	150	℃

(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.
(2) All voltage values are with respect to network ground terminal.

5.2 Recommended Operating Conditions

	MIN	NOM	MAX	UNIT
V_{BB} Motor power supply voltage	2.5		5.5	V
V_{IN} Logic level input voltage	0		5.5	V
I_{OUT} Continuous motor drive output current	0		1.0	A
T_A Operating ambient temperature	-40		85	℃

5.3 Thermal Information

THERMAL METRIC	VALUE	UNIT
R_{JA} Junction-to-ambient thermal resistance	75.6	℃/W
R_{JC} Junction-to-thermal resistance	48.3	℃/W

5.4 Electrical Characteristics

TA = 25°C, V_{BB}= 5.0 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
POWER SUPPLY						
I_{VBB}	VBB quiescent supply current	Both bridges, PWM = 50 kHz		0.3	1	mA
I_{VBBQ}	VBB sleep mode supply current	HIN1=HIN2=LIN1=LIN2=0V		< 1	1	μA
V_{UVLO}	VBB undervoltage lockout voltage	V_{BB} rising			2.5	V
		V_{BB} falling			2.3	V
LOGIC-LEVEL INPUTS						
V_{IL}	Input low voltage				0.5	V
V_{IH}	Input high voltage		$V_{BB}/2$			V
I_{IL}	Input low current	V_{IN}=0	-5		5	μA
I_{IH}	Input high current	V_{IN}=3.3V		33	50	μA
R_{PD}	Pulldown resistance			100		kΩ
H-BRIDGE FETS						
$R_{DS(ON)}$	Output Driver On-Resistance	Source driver, I=400mA, V_{BB}=3V		0.70	1.00	Ω
		Source driver, I=400mA, V_{BB}=5V		0.55	0.75	Ω
		Sink driver, I=400mA, V_{BB}=3V		0.40	0.60	Ω
		Sink driver, I=400mA, V_{BB}=5V		0.35	0.50	Ω
PROTECTION CIRCUITS						
t_{TSD} (1)	Thermal shutdown temperature	Die temperature		165		℃

(1) Not tested in production; limits are based on characterization data

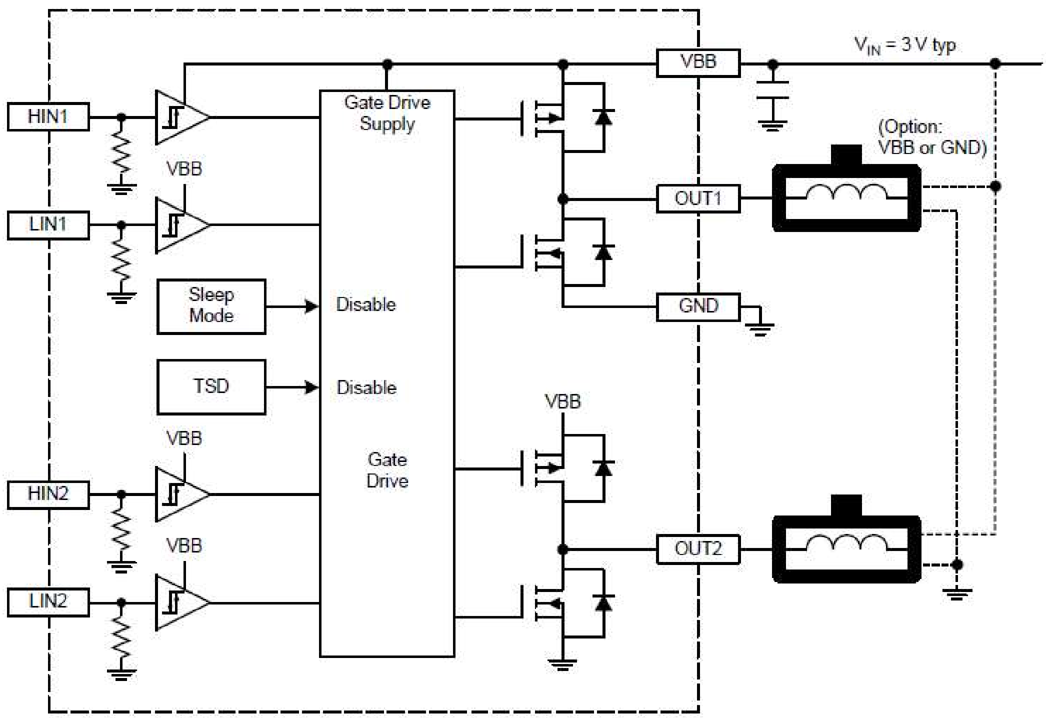
6 Detailed Description

6.1 Overview

The SC8900 device is an H-bridge driver that can drive one DC motor or other devices like solenoids.

This device greatly reduces the component count of motor driver systems by integrating the necessary driver FETs and FET control circuitry into a single device. In addition, the SC8900 device adds protection features beyond traditional discrete implementations: undervoltage lockout, overcurrent protection, and thermal shutdown.

6.2 Functional Black Diagram



6.3 Feature Description

6.3.1 Bridge Control

The SC8900 device is controlled using a PWM input interface Each output is controlled by a corresponding input pin. Table 1 shows the logic for the SC8900 device.

Table 1. SC8900 Device Logic

HINx	LINx	OUTx	Function Motor to Supply	Function Motor to GND
0	0	Hi-Z[1]	Coast (Sleep2)	Coast (Sleep2)
1	0	High	Brake	Drive
0	1	Low	Drive	Brake
1	1	Hi-Z[1]	Coast	Coast

1 Hi_Z is high impedance.

2 Sleep mode activated by all four inputs ＜100mV

6.3.2 Sleep Mode

If the HINx pin and LINx pin are brought to the logic-low state, the SC8900 device enters a low-power sleep mode. In this state, all unnecessary internal circuitry is powered down.

6.3.3 Power Supplies and Input Pins

The input pins can be driven within the recommended operating conditions with VBB. No leakage current path exists to the supply. Each input pin has a weak pulldown resistor (approximately 100 kΩ) to ground.

6.3.4 Protection Circuits

The SC8900 is fully protected against VBB undervoltage, overcurrent, and overtemperature events.

VBB undervoltage lockout

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

Overcurrent protection (OCP)

An analog current-limit circuit on each FET limits the current through the FET by removing the gate drive. A short to the VBB pin, GND, or from the OUT1 pin to the OUT2 pin results in an overcurrent condition.

Thermal shutdown (TSD)

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

Table 2. Fault Behavior

FAULT	CONDITION	H-BRIDGE	INTERNAL CIRCUIT	RECOVERY
VBB undervoltage(UVLO)	V_{BB}<2.3V	**Disabled**	**Disabled**	V_{BB}>2.5V
Thermal Shutdown(TSD)	T_J>165°C(MIN)	**Disabled**	**Operating**	T_J<165°C

7 Application and Implementation

NOTE

Information in the following applications sections is not part of the SteadiChips Component specification, and SteadiChips does not warrant its accuracy or completeness. SteadiChips's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

7.1 Application Information

The SC8900 device is device is used to drive one DC motor or other devices like solenoids. The following design procedure can be used to configure the SC8900 device.

7.2 Typical Application

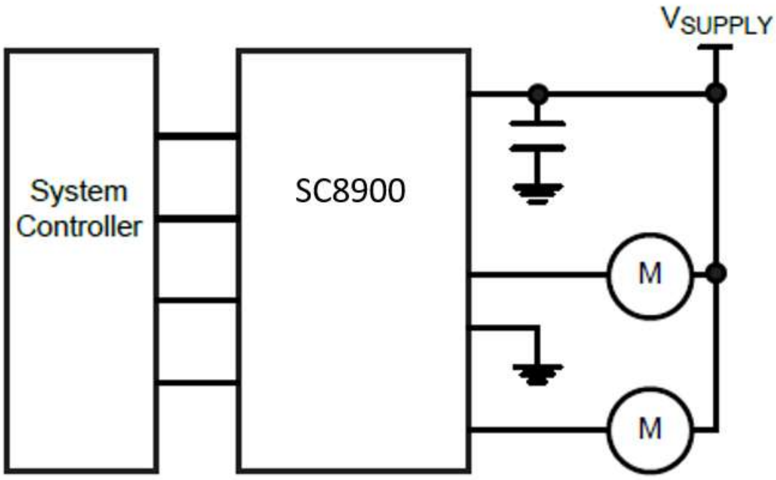


Figure 2. Schematic of SC8900 Application

8 Power Supply Recommendations

8.1 Bulk Capacitance

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 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 limits the rate at which 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 size of bulk capacitor.

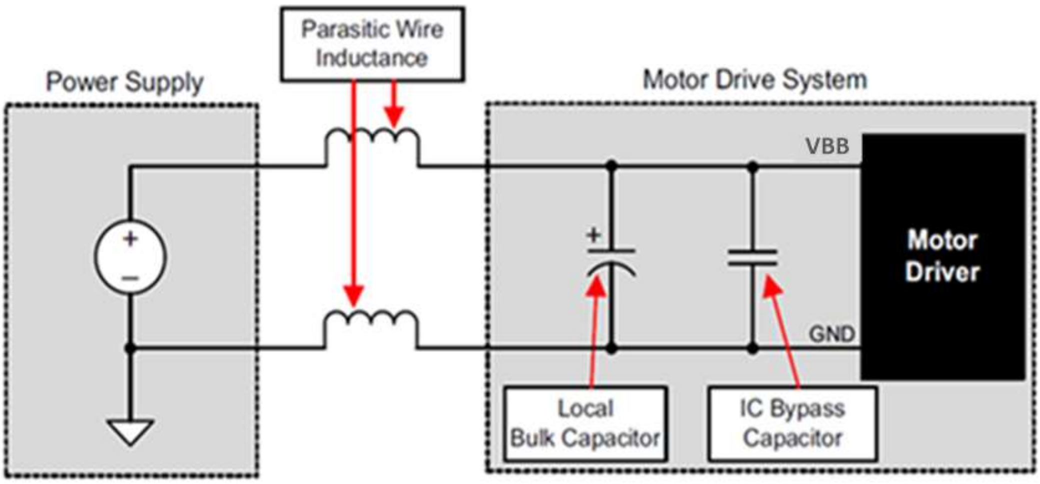


Figure 3. Example Setup of Motor Drive System With External Power Supply

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

9 Layout

9.1 Layout Guidelines

The VBB pins should be bypassed to GND using low-ESR ceramic bypass capacitors with a recommended value of 0.1 µF rated for the VBB supplies. These capacitors should be placed as close to the VBB pins as possible with a thick trace or ground plane connection to the device GND pin. In addition bulk capacitance is required on the VBB pin.

9.2 Layout Example

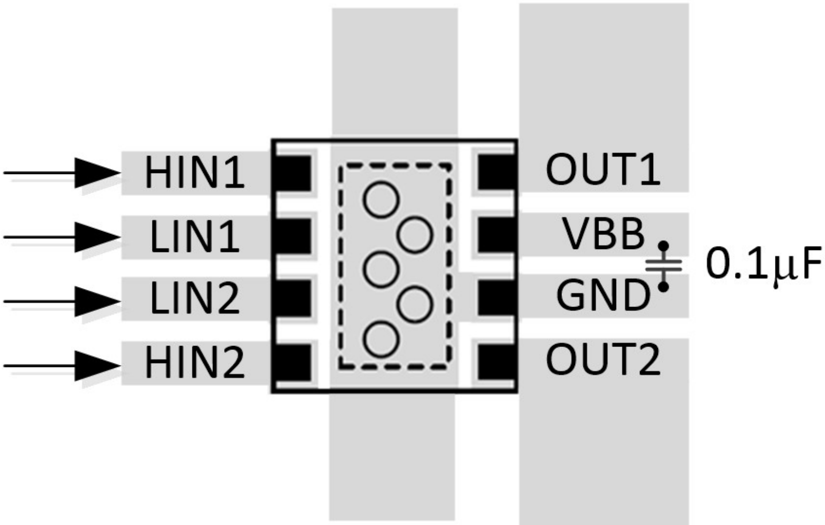


Figure 4. Simplified Layout Example

9.3 Power Dissipation

Power dissipation in the SC8900 is dominated by the power dissipated in the output FET resistance, or $R_{DS(on)}$. Average power dissipation when running both H-bridges can be roughly estimated by Equation 1:

$$P_{TOT} = R_{DS(ON)} \times (I_{OUT(RMS)})^2 \quad (1)$$

where

- P_{TOT} is the total power dissipation
- $R_{DS(ON)}$ is the resistance of the 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.

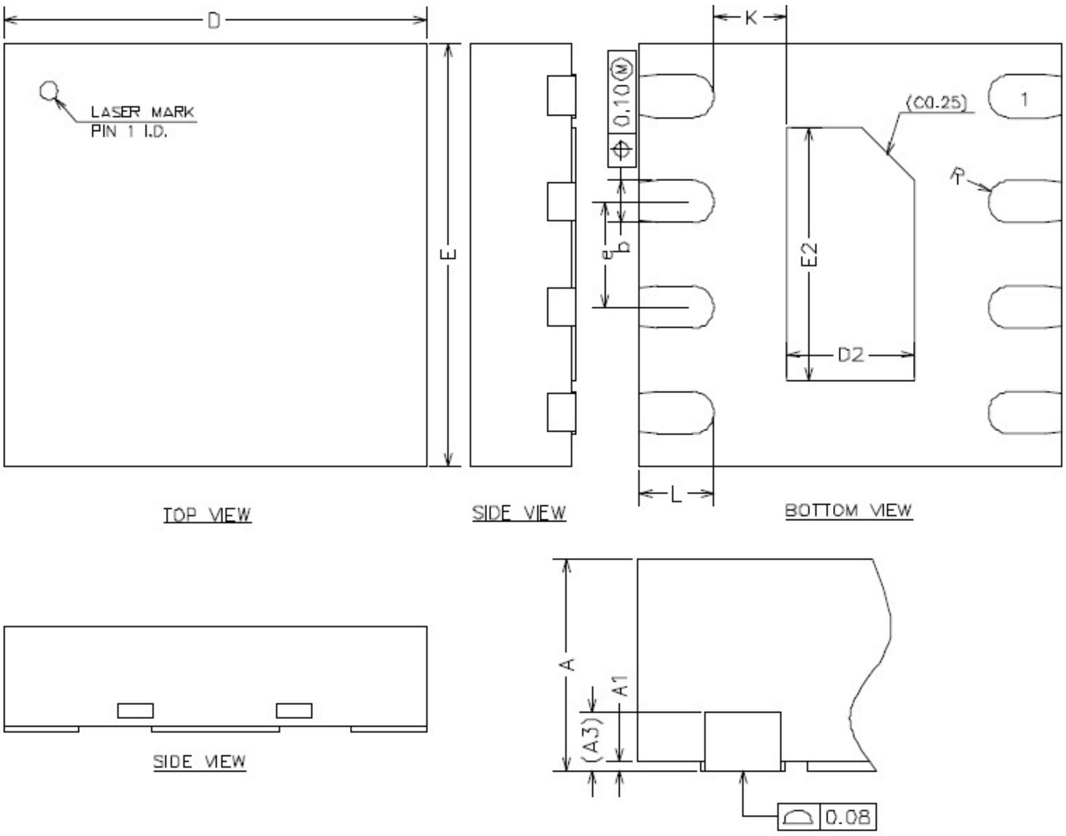
NOTE

The value of $R_{DS(ON)}$ increases with temperature, so as the device heats, the power dissipation increases.

The SC8900 device has thermal shutdown protection. If the die temperature exceeds approximately 150°C, the device is 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.

10 Package Outline



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0	0.02	0.05
A3	0.20REF		
b	0.15	0.20	0.25
D	1.90	2.00	2.10
E	1.90	2.00	2.10
D2	0.50	0.60	0.70
E2	1.10	1.20	1.30
e	0.40	0.50	0.60
K	0.20	—	—
L	0.30	0.35	0.40
R	0.09	—	—