3.6-A Brushed DC Motor Driver with Internal Current Sense (PWM Control)

Description：

GC8871 is a brushed DC motor driver chip with internal current sense. It is suitable for printers, industrial equipment and other small machines. Two logical inputs control the H-bridge driver, which consists of four NMOS and can control the motor in both directions with peak current up to 3.6A. Using the current attenuation mode, the motor speed can be controlled by pulse width modulation (PWM) on the input. If both inputs are set to low level, the motor driver will enter low power sleep mode.

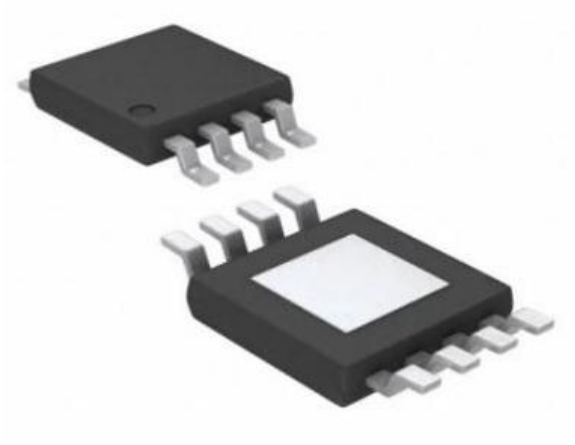
GC8871 has an integrated current regulation function, which uses low-cost resistors to set current thresholds without using analog voltage reference or external induction resistance, and does not require external large capacitors to maintain a stable voltage, especially when the motor is starting or stopping. The GC8871 provides full protection against failures and short-circuit problems, including under-voltage locking (UVLO), over-current protection (OCP), and overheat protection (TSD), and the chip will automatically return to normal operation after troubleshooting.

Features：

- Independent H-bridge motor
- Wide operating voltage： 6.5V to 45V
- 565m (typical value) RDS (on) (HS + LS)
- 3.6A Peak Current Driving Capability
- Pulse Width Modulation (PWM) Interface
- Current Regulation Without Sensing Resistance
- Low power sleep mode
- ESOP8 Packaging

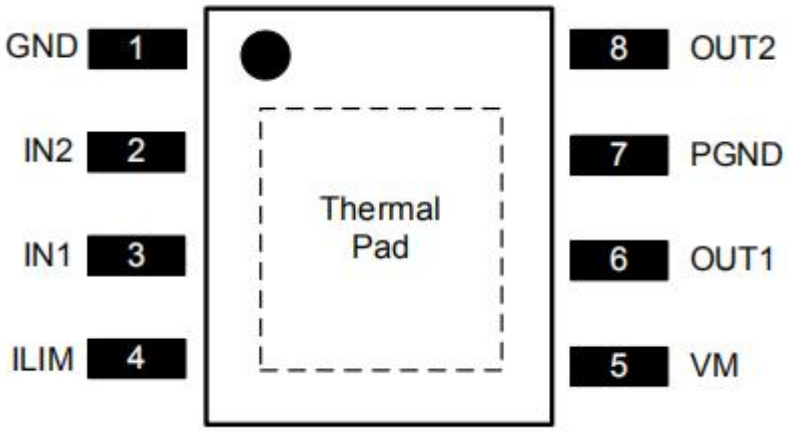
Applications：

- Printers
- Appliances
- Industrial Equipment
- Other Mechatronic Applications



Product name	Package Type	Detail description
GC8871	ESOP8	4.9*5.8，e=1.27

Pin Configuration：



Pin Functions：

PIN NO	PIN NAME	I/O	Pin Functions
1	GND	ground	ground
2	IN2	I	Logic inputs2, Controls the H-bridge output
3	IN1	I	Logic inputs1, Controls the H-bridge output
4	ILIM	I	Connect a resistor to ground to set the current chopping threshold
5	VM	power	power
6	OUT1	O	H-bridge output 1, Connect directly to the motor or other inductive load.
7	PGND	O	H-bridge ground
8	OUT2	O	H-bridge output 2, Connect directly to the motor or other inductive load.
	Thermal Pad	IO	Connect to board ground

Functional Block Diagram：

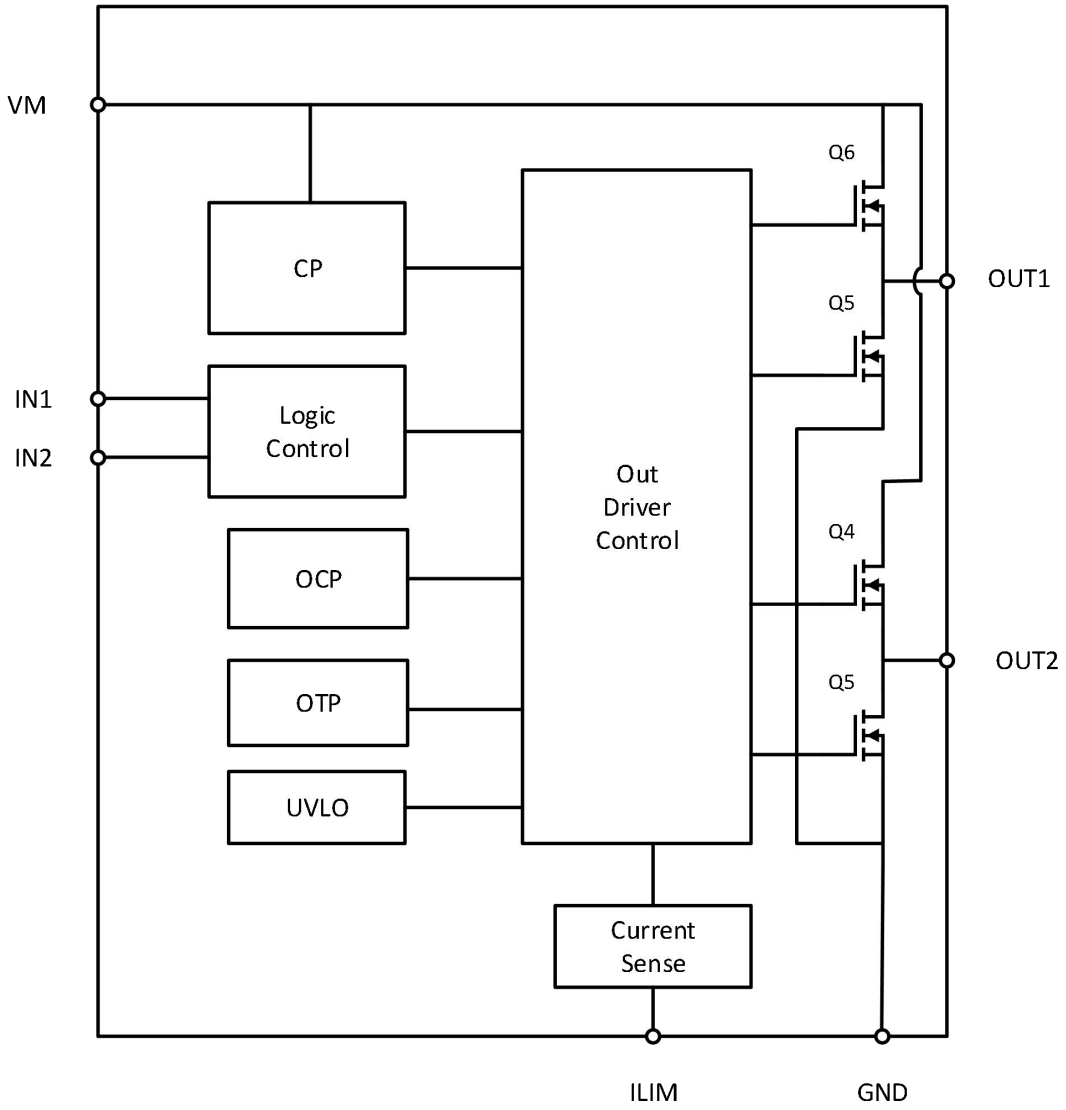


图 1 ： GC8871 internal block

Absolute Maximum Ratings：

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

PARAMETER	SYMBOL	RANGE	UNIT
Power supply voltage	VM	6.5~45	V
Logic input voltage	Vi	0~5.5	V
Peak output current	Imax	±3.6	A
Operating junction temperature	Tjmax	-40~150	℃
Storage temperature	Tstg	-60~150	℃
Electrostatic discharge（HBM）	ESD	±5000	V

Recommended Operating Conditions：

over recommended operating conditions (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Power supply voltage	VM		6.5		45	V
output current	IOUT		0		3.6	A
PWM frequency	fPWM		0		200	kHZ
Operating ambient temperature	Ta		-40		125	℃

Electrical Characteristics：

TA = 25°C,VM=12V, over recommended operating conditions (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
VM operating supply current	IVM	VM=12V		3	10	mA
VM sleep current	IVMsleep	VM=12V			10	uA
Turn-on time	Ton	VM > VUVLO with IN1 or IN2 high		40	50	us
MOTOR DRIVER OUTPUTS (OUT1, OUT2)						
High-side FET on resistance	RdsON1	VM=24V, Io=1A;T=25°		300	340	mΩ
Low-side FET on resistance	RdsON2	VM=24V, Io=1A;T=25°		260	320	mΩ
Output dead time	tDEAD			220		ns
LOGIC-LEVEL INPUTS (IN1, IN2)						
Input logic low voltage	VIL	INx			0.5	V
Input logic high voltage	VIH	INx	2.5			V
Input logic hysteresis	VHY	INx		300		mV
Input logic low current	IIL	Vinx=0	-5		5	uA
Input logic high current	IIH	Vinx=3.3V，INx 脚		10		uA
Input Pull down resistance	Rpd	INx		300		kΩ
CURRENT REGULATION						
Constant for calculating current regulation	VILIM	OUT = 1 A	59	64	69	kV
PWM off-time	tOFF			25		us
PWM blanking time	BLANK			2		us

PROTECTION CIRCUITS						
Thermal shutdown temperature	TSD		155	170	180	℃
Thermal shutdown hysteresis	ΔTSD			40		℃
VM undervoltage lockout	VUVLO	VM		6.1	6.4	V
VM undervoltage hysteresis	ΔVUVLO	VM		0.17		V
Overcurrent protection trip leve	IOCP		3.7	4.5	6.4	A
Overcurrent deglitch time	TDEG			1.5		us
Overcurrent retry time	Tretry			3		ms

Detailed Description：

GC8871 is a brushed DC motor driver with single power supply and built-in charge pump. Two logic inputs control the H-bridge driver, which is composed of four NMOS and can control the motor in both directions with a peak current of up to 3.6A. The chip uses current attenuation to preset the maximum output current, which can limit the current to a known level. If both inputs are set to low level, the motor driver will enter low power sleep mode. The internal shutdown function includes overcurrent protection, short circuit protection, under voltage locking and over temperature protection.

H-bridge control:

IN1	IN2	OUT 1	OUT 2	function
0	0	Z	Z	Coast; H-bridge disabled to High-Z (sleep entered after 1 ms)
1	0	H	L	Forward (Current OUT1 → OUT2)
0	1	L	H	Reverse (Current OUT2 → OUT1
1	1	L	L	Brake; low-side slow decay

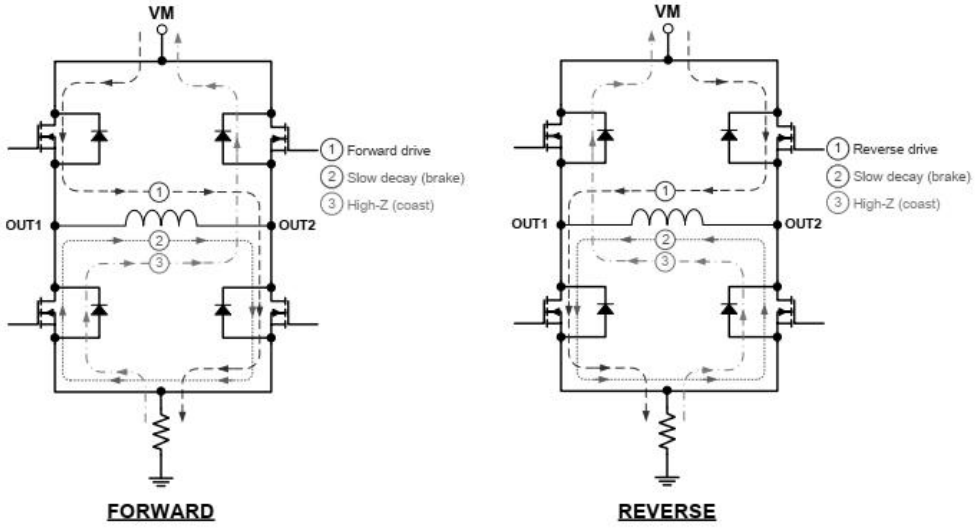
H-Bridge Control

The logic input can also use PWM control to achieve the speed regulation function. When a bridge arm is controlled by PWM wave and the driving current is off, the current is required to flow continuously due to the inductance characteristics of the motor. This current is called freewheeling. In order to operate this current, the H-bridge can operate in two different states, fast attenuation or slow attenuation. In the fast attenuation mode, the H-bridge is prohibited, and the freewheeling current flows through the body diode; In slow decay mode, the lower arm of the motor is short circuited. When PWM control is used in fast fading mode, PWM signal controls one INx pin and the other pin maintains low level; When used for slow attenuation, the other pin maintains a high level.

PWM Control of Motor Speed

IN1	IN2	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

The following figure shows the current path in different drive and decay modes.



Current control:

Through a fixed frequency PWM current rectifier, the current flowing through the motor drive axle arm is limited or controlled. In DC motor applications, the current control function is used to limit the opening current and stalling current.

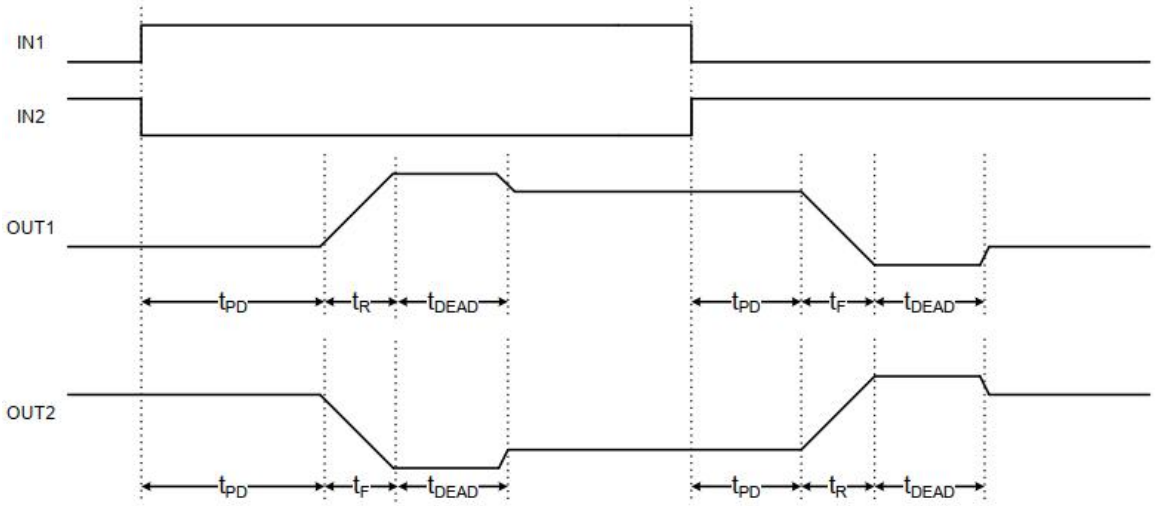
When a H bridge is enabled, the current flowing through the corresponding bridge arm rises at a slope, and this slope is determined by the DC voltage VM and the inductance characteristics of the motor. When the current reaches the set threshold, the driver will turn off the current until the next PWM cycle begins. Note that at the moment when the current is enabled, the voltage on the isen pin is ignored, and the current detection circuit is enabled after a fixed time. The blanking time is generally fixed at 2us. This blanking time also determines the minimum PWM time when the operating current decays.

The GC8871 current limit is set by ILIM to pull down the ground resistance. The formula is as follows:

$$I_{TRIP}\ (A) = \frac{V_{ILIM}\ (kV)}{R_{ILIM}\ (k\Omega)} = \frac{64\ (kV)}{R_{ILIM}\ (k\Omega)}$$

Dead time:

When the output changes from high level to low level, or from low level to high level, the existence of dead time is to prevent the upper and lower tubes from conducting at the same time. During the dead time, the output is a high resistance state. When the dead time needs to be measured on the output, it needs to be measured according to the current direction of the corresponding pin at that time. If the current flows out of this pin, the output voltage is a diode voltage drop lower than the ground level; If the current flows into this pin, the output voltage is a diode voltage drop higher than the supply voltage VM.



Propagation Delay Time

Sleep mode:

When IN1 and IN2 are low and 1ms is maintained, the device will enter a sleep mode, thereby greatly reducing the idle power consumption of the device. After entering the sleep mode, the H-bridge of the device is disabled and the charge pump circuit stops working. When VM is powered on, if the IN1 and IN2 are low, the chip will enter the sleep mode immediately. When IN1 or IN2 is turned to a high level and at least 5us, after a delay of about 50uS, the chip is restored to normal operation.

Overcurrent protection:

There is an analog current limiting circuit on each FET, which limits the current flowing through the FET, thereby limiting the gate drive. If the duration of this overcurrent analog current exceeds the OCP pulse time, all FETs in the H-bridge are prohibited. After an OCP attempt time (TOCP), the drive will be re enabled. If this error condition still exists, the above phenomenon repeats. If this error condition disappears, the drive will resume normal operation.

The overcurrent conditions on the upper arm and lower arm of H bridge are detected independently. Short circuit to ground, short circuit to VM and short circuit between and output will cause overcurrent shutdown. Note that the overcurrent protection does not use the current detection circuit controlled by PWM current, so the overcurrent protection function does not work with isen resistance.

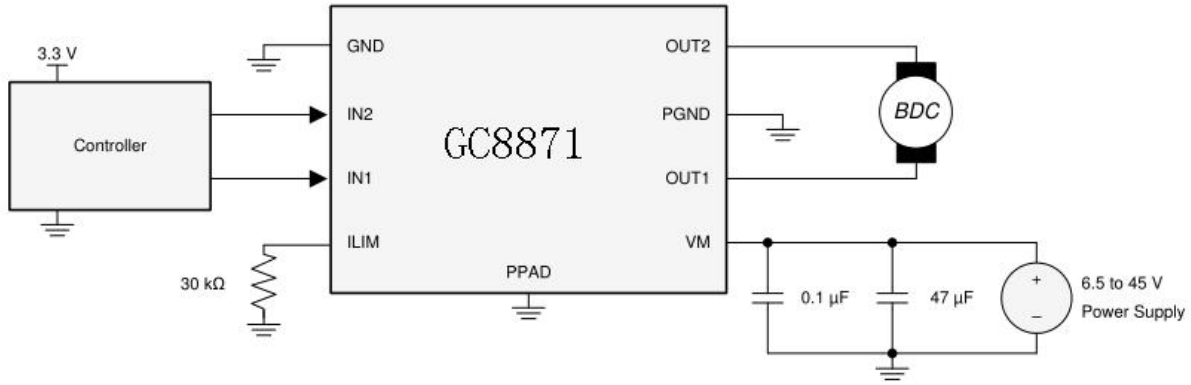
Over temperature protection:

If the junction temperature exceeds the safety limit threshold, the FET of H-bridge is prohibited. Once the junction temperature drops to a safe level, all operations will automatically return to normal.

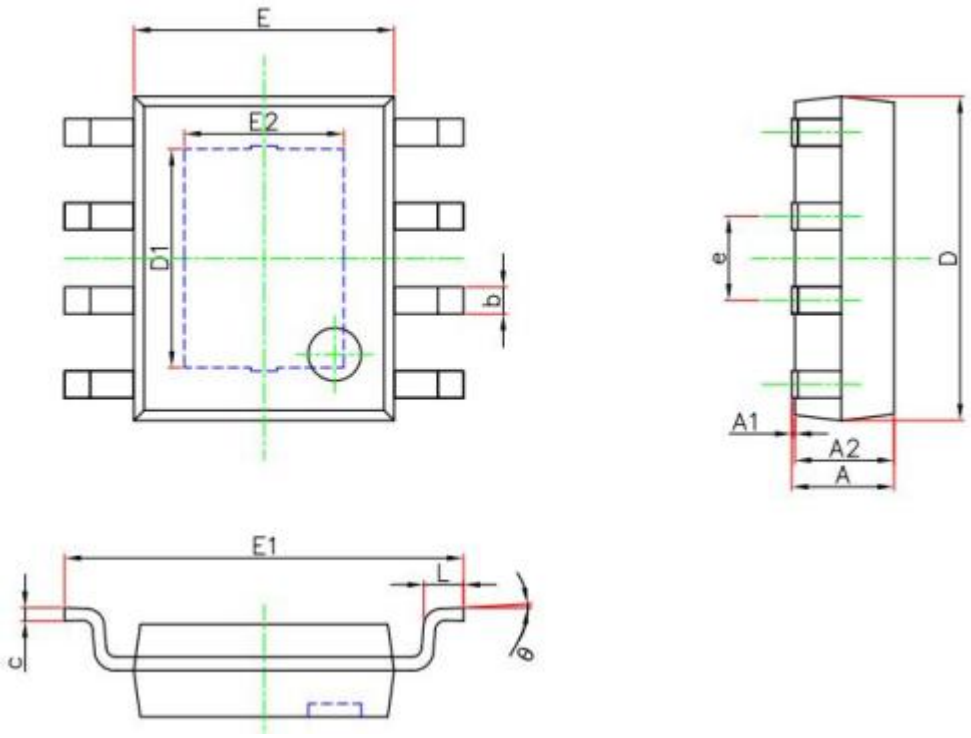
Undervoltage lockout protection:

At any time, if the voltage on the VM pin drops below the undervoltage locking threshold, all internal circuits will be disabled and all internal circuits will be reset. When the voltage on VM rises above UVLO, all functions will be restored automatically.

Typical Application:

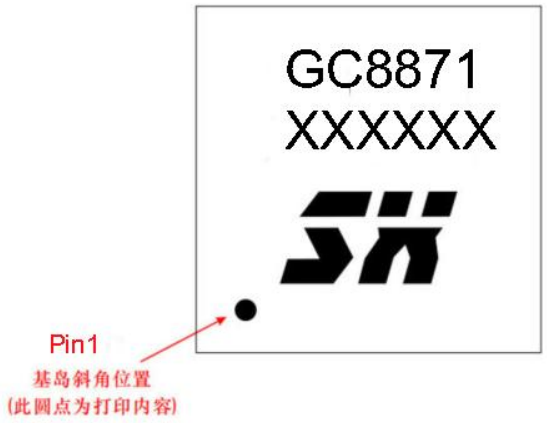


Package Outline Drawing：



Symbol	Dimensions (mm)		Dimensions (inches)	
	MIN	MAX	MIN	MAX
A	1.300	1.700	0.051	0.067
A1	0.000	0.100	0.000	0.004
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
D1	3.202	3.402	0.126	0.134
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
E2	2.313	2.513	0.091	0.099
e	1.270BSC		0.050BSC	
L	0.400	1.270	0.016	0.050
θ	0 °	8 °	0 °	8 °

Description of Lot Code



Printing instructions：

1.The first line GC8871 represents the product model；

2.The second line represents the traceability code；

Release Notes

GC8871 datasheet V1.0	**Initial 1.0 version；**
GC8871 datasheet V1.2	**Modified the parameter description of rdson ；**