■ General Description

Designed for pulse width modulated (PWM) control of DC motors, the OCB8870 is capable of peak output currents to ±3.6 A and operating voltages to 36 V.

Input terminals are provided for use in controlling the speed and direction of a DC motor with externally applied PWM control signals. Internal synchronous rectification control circuitry is provided to lower power dissipation during PWM operation.

Internal circuit protection includes overcurrent protection, motor lead short to ground or supply, thermal shutdown with hysteresis, under voltage monitoring of VM, and crossover current protection.

OCB8870 is available in SOP-8L-EP package and is rated over the -40° C to 125° C.

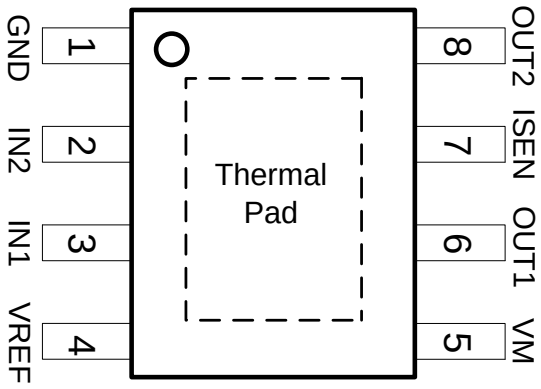
■ Features

- Wide Operating Input Voltage Range :6.5V~36V
- Typical RDS(on): 600mΩ(HS + LS)
- Peak output current:±3.6A
- Input PWM Control
- Adjustable PWM current limit
- Low Power Standby mode
- Internal under voltage lockout (UVLO)
- Overcurrent protection (OCP)
- Thermal Shutdown Protection
- Available in SOP-8L-EP Package
- -40℃ to + 125 ℃ Temperature Range
- RoHS Compliant

■ Applications

- Automotive Infotainment
- Sweeper、printer
- HUD Projector Adjustment
- Motorized Shifter Knobs
- On-board chargers
- commercial installation

■ Pin Configuration



SOP-8L-EP

Figure 1, Pin Assignments of OCB8870

Pin Name	SOP-8L-EP	Pin Function
GND	1	Logic ground
IN2	2	Logic inputs 2
IN1	3	Logic inputs 1
VREF	4	Analog input
VM	5	Power supply
OUT1	6	H-bridge output 1
ISEN	7	High-current ground path
OUT2	8	H-bridge output 2

Typical Application Circuit

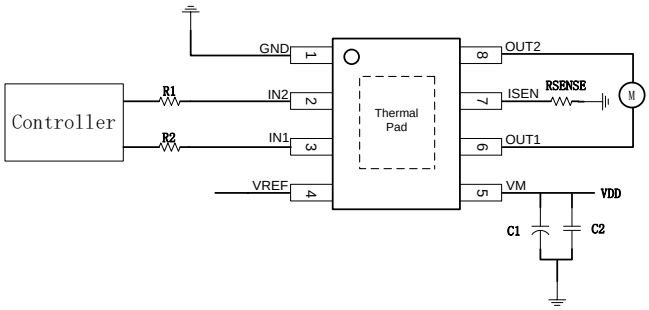


Figure 2, Typical Application Circuit Of OCB8870

Note1:

1) C1 typical value is 47uF,C2 typical value is 0.1uF.
2) R1/R2 is Optional, the typical value R1/R2 is 100Ω.
3)The maximum value of current limiting is set by the selection of R_{SENSE}.
For example, VREF=3.3V,R_{SENSE}=0.15Ω, the I_{TRIP}=2.2A.

Ordering Information

Part Number	Package Type	Packing Qty.	Temperature	Eco Plan	Lead
OCB8870ESAE	SOP-8L-EP	4000pcs/Reel	-40℃ to + 125 ℃	RoHS	Cu

Block Diagram

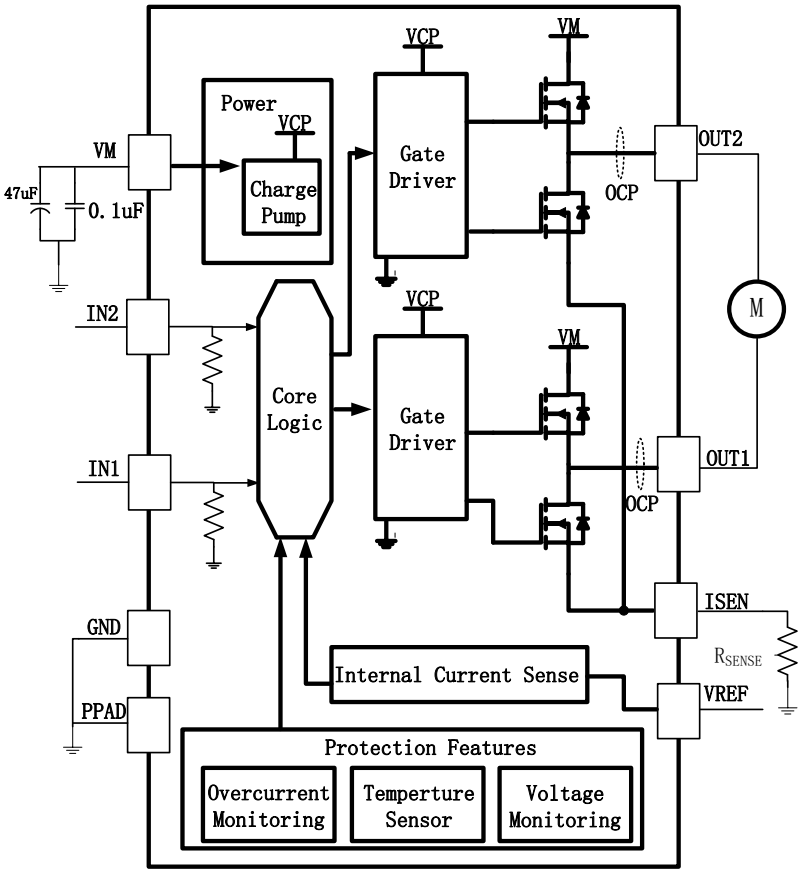


Figure 3, Block Diagram Of OCB8870

■ Absolute Maximum Ratings[2/3/4] (T_A=25°C, unless otherwise noted)

Parameter	Symbol	Rating	Unit
Power supply voltage (VM)	VM	-0.3 to +42	V
Logic input voltage (IN1, IN2)	V_{IN}	-0.3 to +7	V
Continuous phase node pin voltage (OUT1, OUT2)	V_{OUT}	-0.7 to VM +0.7	V
Peak Output Current	$I_{O(PEAK)}$	3.6	A
Junction temperature	T_J	160	°C
Thermal Resistance	θ_{JA}	43	°C /W
Storage Temperature Range	T_S	-55 to +150	°C
Maximum Soldering Temperature (at leads, 10 sec)	T_{LEAD}	260	°C

Note2:The maximum dissipation power P_D allowed at any ambient temperature point is calculated: P_D（max）=（T J-TA）/θ_{JA}, TJ＝160°C。When applied, do not exceed the maximum rating to prevent chip damage, and work for a long time at maximum rating may affect chip reliability.
Note3: Stresses above those listed in absolute maximum ratings may cause permanent damage to the device. Functional operation at conditions other than the operating conditions specified is not implied. Only one absolute maximum rating should be applied at any one time.
Note 4: The device is not guaranteed to function outside of its operating conditions.

■ Recommended Operating Conditions[5/6]

Parameter	Symbol	Rating	Unit
Power supply voltage	VM	6.5 to 36	V
Logic input voltage (IN1, IN2)	V_{IN}	0 to 5.5	V
Logic input PWM frequency (IN1, IN2)	F_{PWM}	0 to 200	kHZ
Peak output current	$I_{O(PEAK)}$	3.6	A
Operating Temperature Range	T_{OP}	-40 to +125	°C

Note5：The voltages applied to the inputs should have at least 800 ns of pulse width to ensure detection. Typical devices require at least 400 ns. If the PWM frequency is 200 kHz, the usable duty cycle range is 16% to 84%.
Note6：Power dissipation and thermal limits must be observed.

■ Electrical Characteristics

T_A = +25°C, over recommended operating conditions (unless otherwise noted).

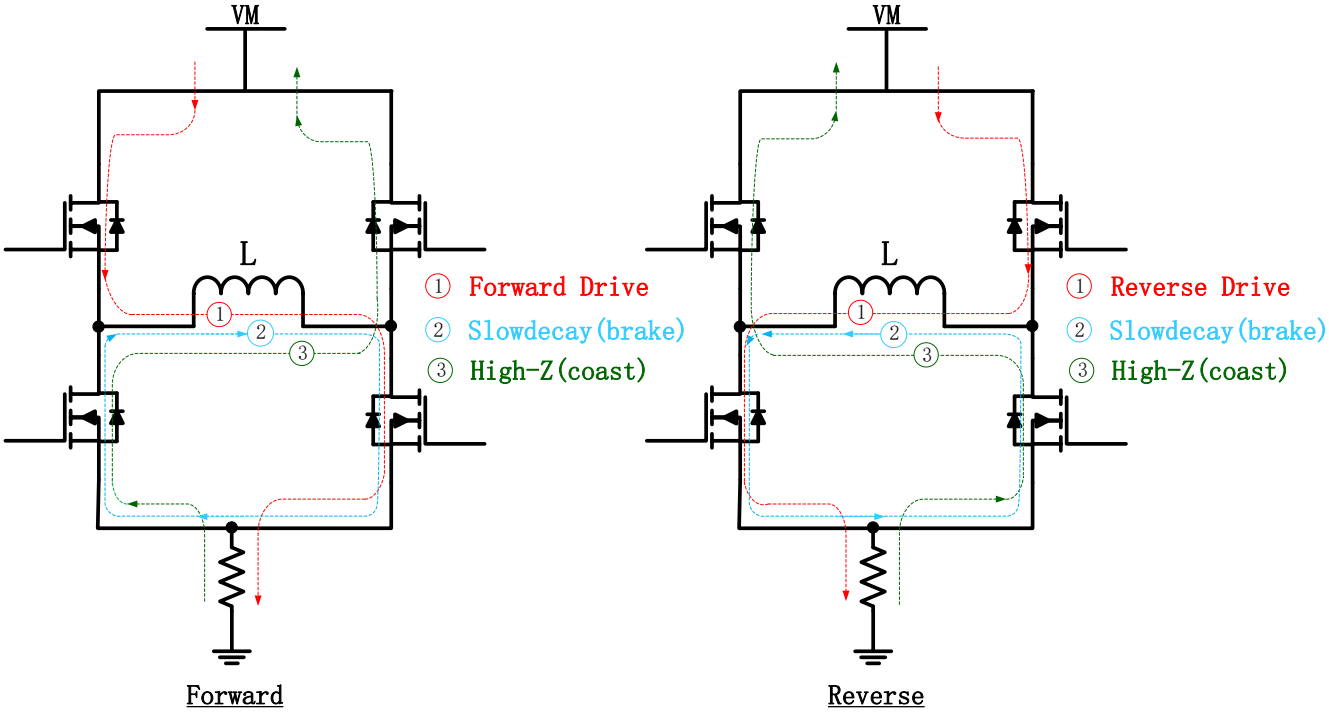
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
POWER SUPPLY (VM)						
VM	Input Voltage		6.5	-	36	V
I_{VM1}	Supply Current Of Operation Mode	IC is in operation mode No Load, VM=12V	-	2.5	5	mA
I_{VM2}	Supply Current Of Sleep Mode	IC is in sleep mode No Load, VM=12V	-	-	10	uA
t_{ON}	Turn-on time	VM > VUVLO with IN1 or IN2 high	-	40	50	us
LOGIC-LEVEL INPUTS (IN1, IN2)						
V_{INL}	Input logic low voltage	-	-	-	0.8	V
V_{INH}	Input logic high voltage		2.0	-	-	V
V_{HYS}	Input logic hysteresis	V_{INH}- V_{INL}	-	0.3	-	V
I_{INL}	Input logic low current	VIN = 0.8 V	-	10	40	uA
I_{INH}	Input logic high current	VIN = 3.3 V	-	20	100	uA
R_{PD}	Pulldown resistance	To GND	-	100	-	KΩ
t_{PD}	Propagation delay	INx to OUTx change	-	0.8	1.2	us
t_{sleep}	Time to sleep	Inputs low to sleep	-	1	1.5	ms
MOTOR DRIVER OUTPUTS (OUT1, OUT2)						
RDSON_H	High-side FET onresistance	VM = 12 V, I = 1 A, f_{PWM} = 25 kHz	-	300	-	mΩ
RDSON_L	Low-side FET onresistance	VM = 12 V, I = 1 A, f_{PWM} = 25 kHz	-	300	-	mΩ
t_{DEAD}	Output dead time	-	-	220	-	ns
V_d	Body diode forwardvoltage	I_{OUT} = 1 A	-	0.8	-	V
CURRENT REGULATION						
t_{OFF}	PWM off-time	-	-	25	-	us
t_{BLANK}	PWM blanking time	-	-	3	-	us
Protection						
V_{UVLO_L}	Input UVLO rising threshold	-	-	6.0	-	V
V_{UVLO_H}	VM rises until operation recovers	-	-	6.3	-	V
V_{UVLO_HYS}	Input UVLO hysteresis	-	-	0.3	-	V
BI_{OCP}	Over current protection trip level	-	-	5	-	A
t_{OCP}	Overcurrent deglitch time	-	-	1.5	-	us
t_{RETRY}	Overcurrent retry time	-	-	3	-	ms
T_{SD}	Thermal shutdown temperature	-	-	170	-	°C
T_{HYS}	Thermal shutdown hysteresis	-	-	40	-	°C

■ Function Description

Bridge Control

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

The inputs can be set to static voltages for 100% duty cycle drive, or they can be pulse-width modulated (PWM)for variable motor speed. When using PWM, it typically works best to switch between driving and braking. For example, to drive a motor forward with 50% of its max RPM, IN1 = 1 and IN2 = 0 during the driving period, andIN1 = 1 and IN2 = 1 during the other period. Alternatively, the coast mode (IN1 = 0, IN2 = 0) for fast current decay is also available. The input pins can be powered before VM is applied.



Sleep Mode

When IN1 and IN2 are both low for time t_{SLEEP} (typically 1 ms), the OCB8870 device enters a low-power sleep mode, where the outputs remain High-Z and the device uses I_{VM2} (uA) of current. If the device is powered up while both inputs are low, sleep mode is immediately entered. After IN1 or IN2 are high for at least 5μs, the device will be operational 40 μs (t_{ON}) later.

Current Regulation

The OCB8870 device limits the output current based on a standard resistor attached to pin ISEN according to this equation:

$$I_{TRIP}(A) = \frac{VREF(V)}{Av \times R_{SENSE}(\Omega)} = \frac{VREF(V)}{10 \times R_{SENSE}(\Omega)}$$

For example, if VREF = 3.3 V and a RISEN = 0.15 Ω, the OCB8870 will limit motor current to 2.2 A no matter how much load torque is applied.

■ Function Description

The OCB8870 is fully protected against VM under voltage, over current, and over temperature events.

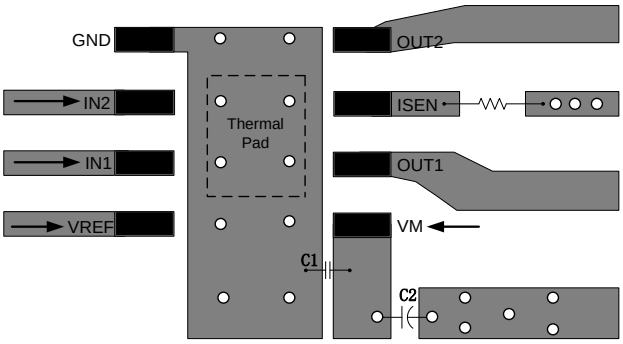
VM Under voltage Lockout (UVLO)
If at any time the voltage on the VM pin falls below the under-voltage lockout threshold voltage, all FETs in the H bridge will be disabled. Operation will resume when VM rises above the UVLO threshold.

Overcurrent Protection (OCP)
If the output current exceeds the OCP threshold IOCP for longer than tOCP, all FETs in the H-bridge are disabled for a duration of tRETRY. After that, the H-bridge will be re-enabled according to the state of the INx pins. If the overcurrent fault is still present, the cycle repeats; otherwise normal device operation resumes.

Thermal Shutdown (TSD)
If the die temperature exceeds safe limits, all FETs in the H-bridge will be disabled. After the die temperature has fallen to a safe level, operation automatically resumes.

■ Application Note

Layout Guidelines
The bulk capacitor should be placed to minimize the distance of the high-current path through the motor driver device. The connecting metal trace widths should be as wide as possible, and numerous vias should be used when connecting PCB layers. These practices minimize inductance and allow the bulk capacitor to deliver high current.
Small-value capacitors should be ceramic, and placed closely to device pins.
The high-current device outputs should use wide metal traces.
The device thermal pad should be soldered to the PCB top-layer ground plane. Multiple vias should be used to connect to a large bottom-layer ground plane. The use of large metal planes and multiple vias help dissipate the $I^2 \times R_{DS(on)}$ heat that is generated in the device.

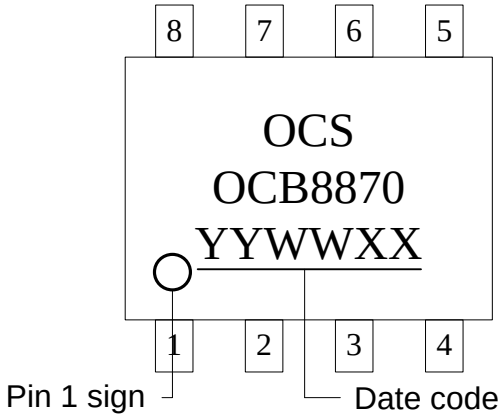


Layout Recommendation

Power Dissipation
Power dissipation in the OCB8870 device is dominated by the power dissipated in the output FET resistance, RDS(on). Use the equation in the Drive Current section to calculate the estimated average power dissipation when driving a load.
Note that at startup, the current is much higher than normal running current; this peak current and its duration must be also be considered.
The maximum amount of power that can be dissipated in the device is dependent on ambient temperature and heat sinking. RDS(on) increases with temperature, so as the device heats, the power dissipation increases. This fact must be taken into consideration when sizing the heat sink.
The power dissipation of the OCB8870 is a function of RMS motor current and the FET resistance (RDS(ON)) of each output.
$Pd \approx I_{RMS}^2 \times R_{DS(on)}$
For this example, the ambient temperature is 50°C,. At 50°C, the sum of $R_{DS(ON)}$ is about 0.65 Ω. With an example motor current of 0.8 A, the dissipated power in the form of heat will be $(0.8\ A)^2 \times 0.65\ \Omega = 0.416\ W$.
The temperature that the OCB8870 reaches will depend on the thermal resistance to the air and PCB. It is important to solder the device Power PAD to the PCB ground plane, with vias to the top and bottom board layers, in order dissipate heat into the PCB and reduce the device temperature. In the example used here, the OCB8870 had an effective thermal resistance $R_{\theta JA}$ of 43°C/W.
$T_J = T_A + (PD \times R_{\theta JA}) = 50℃ + (0.416W \times 43℃/W) = 68℃$。

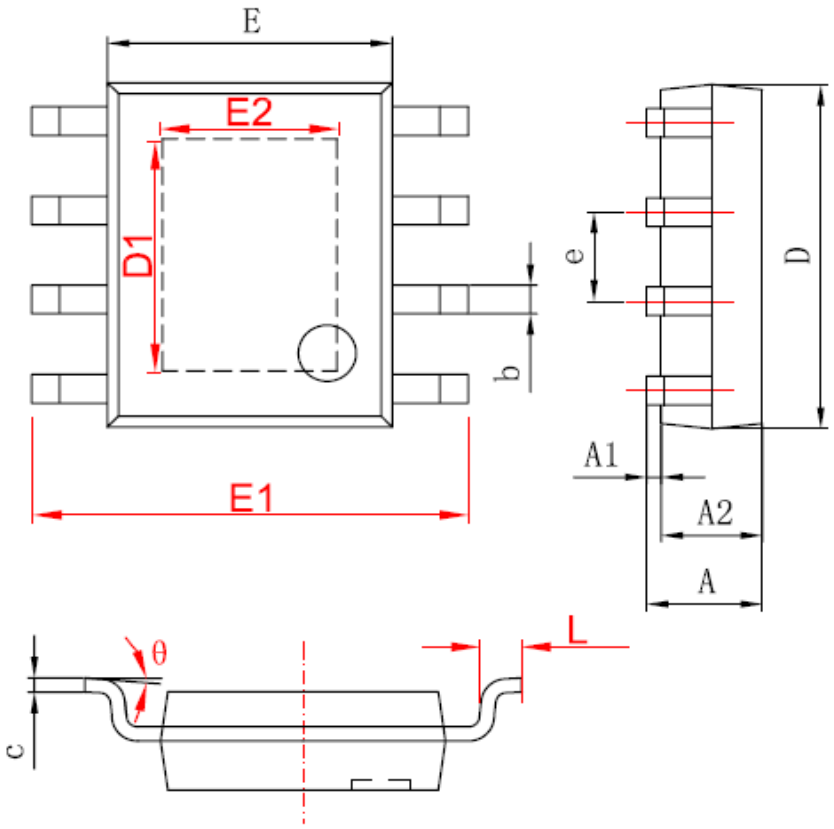
■ Marking Information

1）SOP-8L-EP:



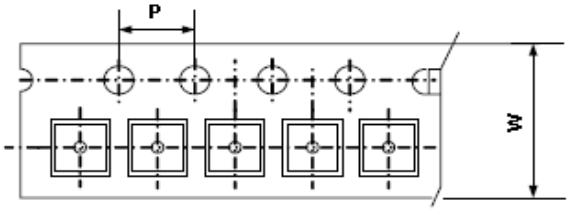
■ Package Information

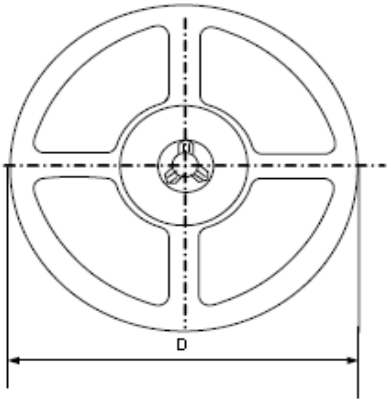
1) SOP-8L-EP



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.350	1.550	1.750	0.053	0.061	0.069
A1	0.050	0.100	0.150	0.004	0.007	0.010
A2	1.350	1.450	1.550	0.053	0.057	0.061
b	0.330	0.420	0.510	0.013	0.017	0.020
c	0.170	0.210	0.250	0.006	0.008	0.010
D	4.700	4.900	5.100	0.185	0.192	0.200
D1	3.202	3.302	3.402	0.126	0.130	0.134
E	3.800	3.900	4.000	0.150	0.154	0.157
E1	5.800	6.000	6.200	0.228	0.236	0.244
E2	2.313	2.413	2.513	0.091	0.095	0.099
e	1.270 (BSC)			0.050 (BSC)		
L	0.400	0.835	1.270	0.016	0.033	0.050
θ	0°	-	8°	0°	-	8°

■ Packing information





Package Type	Carrier Width(W)	Pitch(P)	Reel Size(D)	Packing Minimum
SOP-8L-EP	12.0±0.1 mm	4.0±0.1 mm	330±1 mm	4000pcs

Note: Carrier Tape Dimension, Reel Size and Packing Minimum

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