LB1863M, LB1869M

Monolithic Digital IC

Two-Phase Brushless Motor Driver

ON Semiconductor®

Overview

The LB1863M and LB1869M are 2-phase unipolar brushless motor drivers that are provided in a miniature flat package that contributes to end product miniaturization and supports automatic mounting. These products support the implementation of motor drive lock protection and automatic recovery circuits, and alarm specifications with a minimal number of external components.
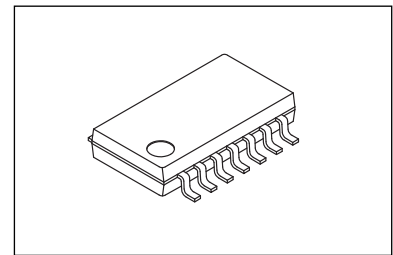
SOIC14 W / MFP14S (225 mil)

Features and Functions

- Hall elements can be connected directly to the IC itself.

- 1.5-A output current output transistors built in

- Rotation detection function that provides a low-level output during motor drive and a high-level output when the motor is stopped

- Motor lock protection and automatic recovery functions built in

- Thermal shutdown circuit

- Switching noise can be reduced with an external ceramic capacitor.

Classification

System Voltage / Package	MFP-14S
12V	LB1869M
24V	LB1863M

Note: The LB1869M and LB1863M are pin compatible so that the same printed circuit board can be used for both 12 V and 24 V products.

ORDERING INFORMATION

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum input current	I_{CC} max	t ≤ 20 ms	200	mA
Output voltage	V_{OUT}	LB1863M	−0.3 to +85	V
		LB1869M	−0.3 to +60	V
Output current	I_{OUT}		1.5	A
RD influx current	I_{RD}		10	mA
RD voltage	V_{RD}		30	V
Allowable power dissipation	Pd max	When mounted (on a 20 × 15 × 1.5-mm^3 glass-epoxy printed circuit board)	800	mW
Operating temperature	Topr		−30 to +80	°C
Storage temperature	Tstg		−55 to +150	°C

Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Input current range	I_{CC}		6.0 to 50	mA
Common-mode input voltage range	V_{ICM}		0 to V_{IN} −1.5	V

Electrical Characteristics at Ta = 25°C, I_{CC} = 10 mA

| Parameter	Symbol	Conditions	Ratings min	Ratings typ	Ratings max	Unit
Output voltage 1	V_{OR}	LB1863M	80			V
		LB1869M	60			V
Output voltage 2	$V_{O(SUS)}$	LB1863M : I_O = 0.1 A	65			V
		LB1869M : I_O = 0.1 A	40			V
Output saturation voltage	$V_O(sat)1$	I_O = 0.5 A		0.95	1.2	V
	$V_O(sat)2$	I_O = 1.0 A		1.15	1.5	V
Input voltage	V_{IN}	I_{CC} = 7.0 mA	6.4	6.7	7.0	V
Amplifier input offset voltage	V_{OFF}		−7	0	+7.0	mA
Amplifier input bias current	I_{BA}		−250			nA
RD output saturation voltage	$V_{RD}(sat)$	I_{RD} = 5 mA		0.1	0.3	V
Capacitor discharge current	I_C1		2.1	3	3.9	µA
	I_C2		0.31	0.44	0.59	µA
Comparator input threshold voltage	$V_{TH}1$		0.77	$0.8V_{IN}$	0.83	V
	$V_{TH}2$		0.42	$0.45V_{IN}$	0.48	V

Pin Assignment
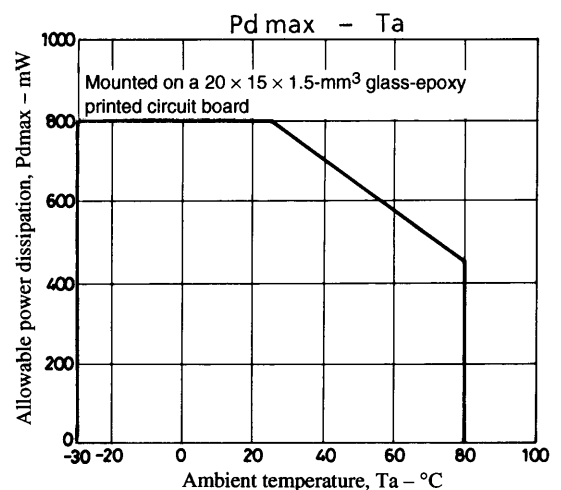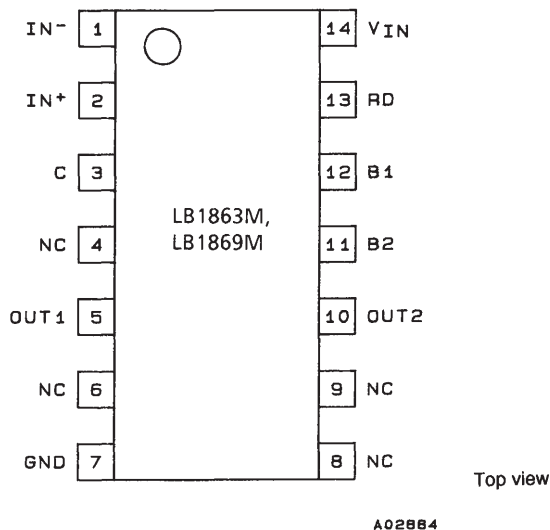
Equivalent Circuit, Block Diagram, and Sample Application
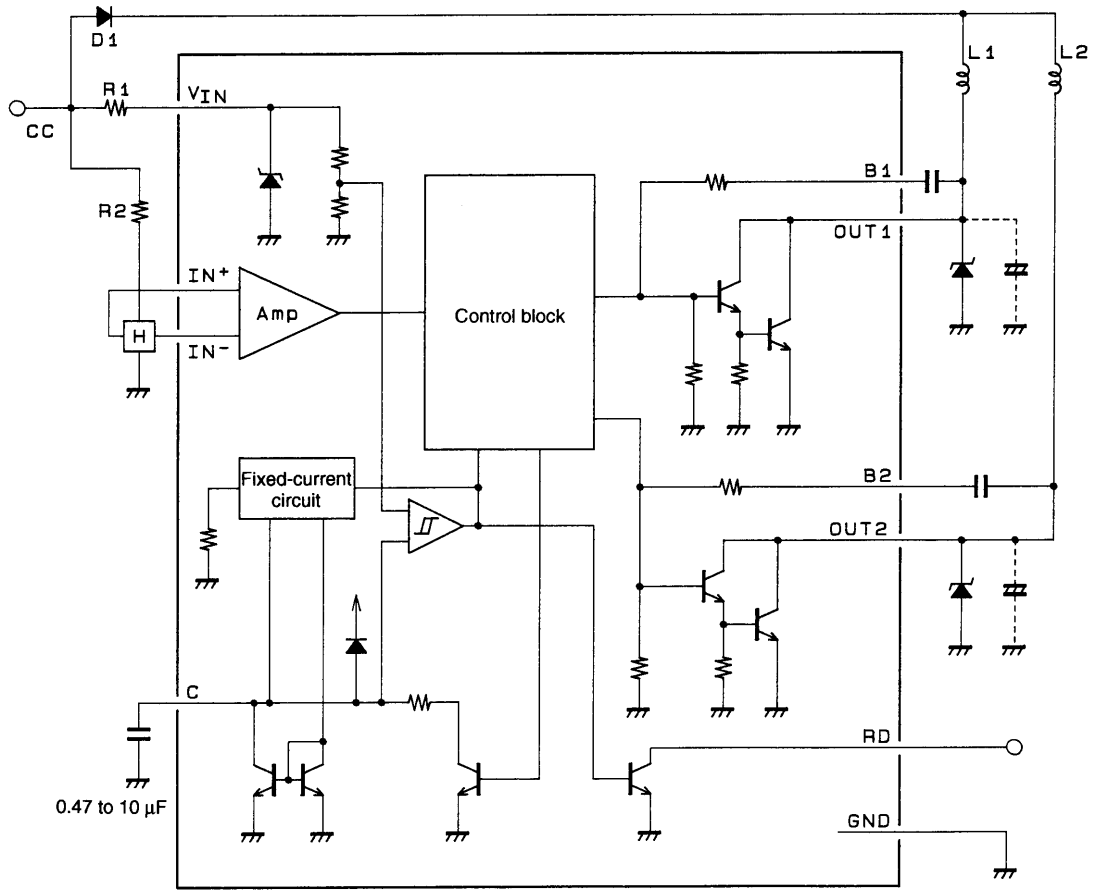
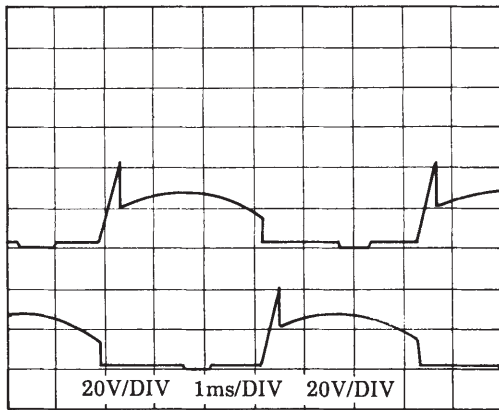## Sample Application Circuit
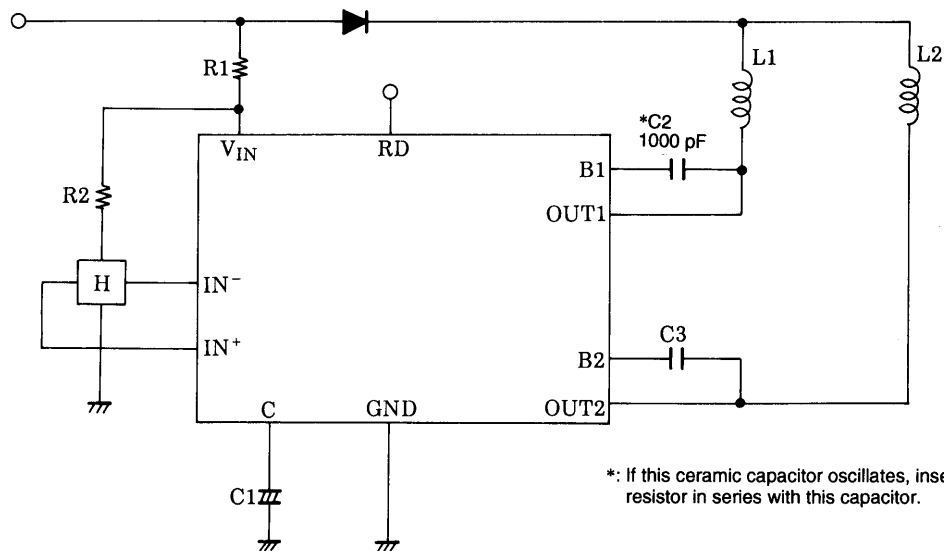
*: If this ceramic capacitor oscillates, insert a
resistor in series with this capacitor.

Sample Application Circuit Output Waveforms

20V/DIV   1ms/DIV   20V/DIV

Truth Table

IN$^+$	IN$^-$	C	OUT1	OUT2	RD
H	L	L	H	L	L
L	H	L	L	H	L
H	L	H	H	H	H
L	H	H	H	H	H

Design Documentation (See the application circuit diagram.)

1. Power-supply voltage (V_{IN} pin)

   Since these miniature flat package products supply power to the Hall amplifier block and the control block from an internal parallel regulator, they operate with good stability with respect to kickback currents from the motor and variations in the power-supply voltage. They also provide an adequate ability to withstand surges. The resistor R1 between the V_{CC} and V_{IN} pins should be set up so that a current in the range I_{CC} = 6 to 50 mA flows into the V_{IN} pin in the fan motor power-supply voltage range.

   V_{IN} has a typical value of 6.7 volts when I_{CC} is 7 mA. The current flowing into V_{IN} can be calculated with the following formula.

   $$I_{CC} = \frac{V_{CC} - V_{IN}}{R1} \quad ....(1)$$

   • Abnormal voltage considerations

   The maximum allowable current for the V_{IN} pin is 200 mA. Therefore, the IC design allows it to withstand voltages up to the plus side abnormal voltage Vsurge give by formula (2).

   $$Vsurge = V_{IN} + R1 \times 200 \text{ mA} ......(2)$$

2. Hall input pin voltages (IN$^-$ and IN$^+$ pins)

   The Hall element output voltages to the Hall element input pins must be in the range 0 to (V_{IN} −1.5 V). The gain from the Hall input pins to the output pin is over 100 dB. The Hall input amplifier offset voltage is ±7 mV. This means that the Hall element output must be set up taking this ±7 mV offset into account.

3. Output transistors (OUT1 and OUT2 pins)

   Output current: I_O = 1.5 A maximum

   Output saturation voltage: $V_O$sat = 1.15V/1.0 A (typical)

   Applications should adopt one of the following three output protection techniques.

   ① If a capacitor is inserted between OUT and ground, use a capacitor with a value up to C = 10 μF, and design that value so that the kickback and reverse voltages do not exceed V_{OR}.

   ② If a Zener diode is added, determine a value for the Zener voltage that is lower than $V_{O(SUS)}$. If radio-frequency noise is a problem, insert a capacitor between B1 and B2.

   ③ If a capacitor is inserted between OUT and B1, set the capacitor value so that the kickback voltage is lower than $V_{O(SUS)}$. If oscillation occurs, insert a resistor in series with the capacitor.

4. Output protection function (C pin)

This pin connects the capacitor that forms the automatic recovery circuit. If rotation stops due to, for example, a motor overload, the pin voltage rises and the output stops. The system automatically recovers from stopped to drive mode when the load is set to an appropriate level. The lock detection time can be set by changing the value of the capacitor.

For a 1-μF capacitor: Lock detection time   About 2 seconds

Lock protection time (output on)   About 1 second

(output off)   About 6 seconds
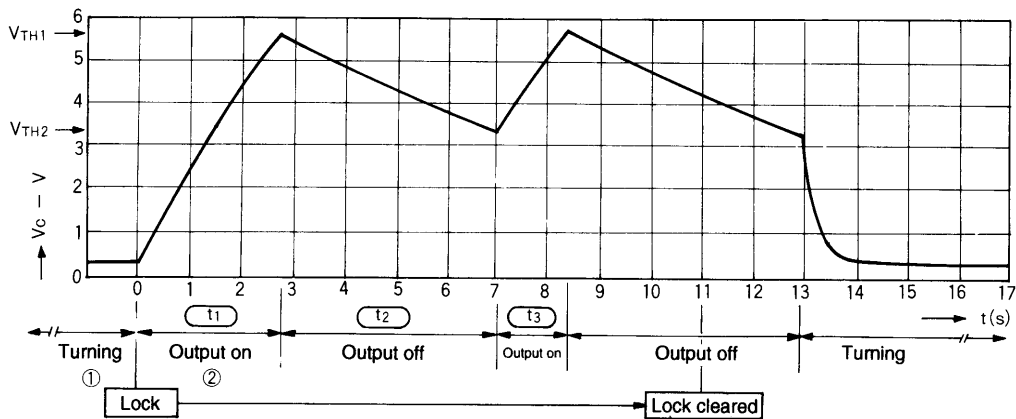
Automatic recovery circuit pin C voltage

① While the blades are turning, the capacitor is charged with a current of about 3 μA (typical), and C is discharged by pulses that correspond to the motor speed.

② When the blades lock, the capacitor is no longer discharged, and the voltage across the capacitor increases. The output is turned off when that voltage reaches $0.8 \times V_{IN}$.

③ When the output is turned off, the capacitor is discharged at a current of about 0.44 μA (typical). When the capacitor voltage falls under $V_{TH}2$, if the lock state is not yet cleared the capacitor continues discharging until $V_{TH}1$. (Note that the output is turned on at this time.) These operations, i.e. items ② and ③, are repeated with a ton:toff ratio of about 1:6 to protect the motor.

④ If the lock state has been cleared when the capacitor voltage reaches $V_{TH}2$, motor rotation is started by turning the output on.

5. Rotation detection signal (RD pin)

This is an open collector output, and outputs a low level in drive mode and a high level when the motor is stopped.

6. Radio-frequency noise reduction function (B1 and B2 pins)

These are base pins for Darlington pair outputs. Add capacitors of about 0.01 to 0.1 μF if radio-frequency noise is a problem.

7. Thermal shutdown function

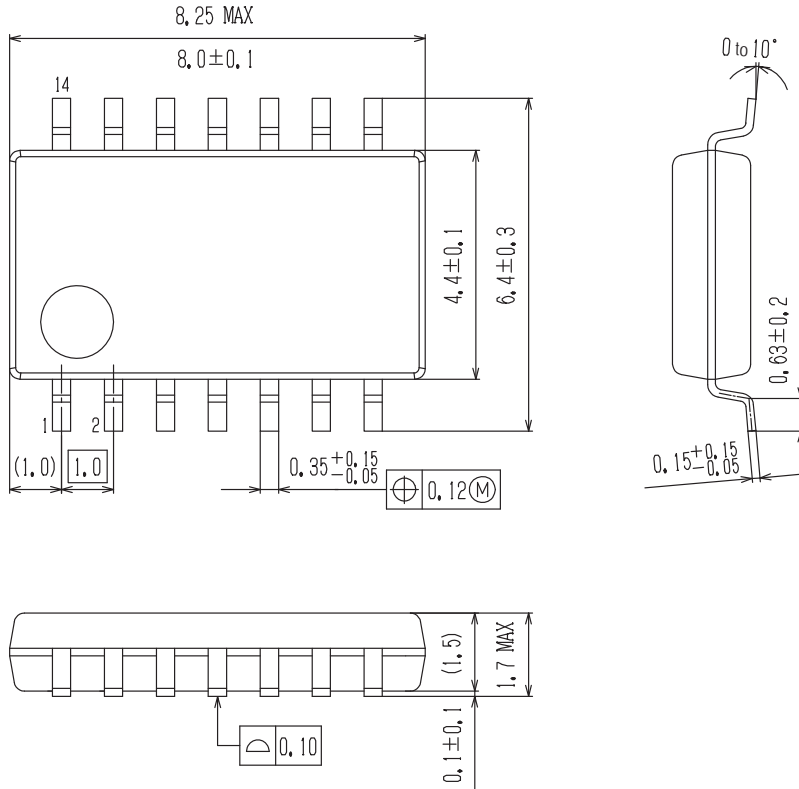Turns off the output in response to coil shorting or IC overheating.
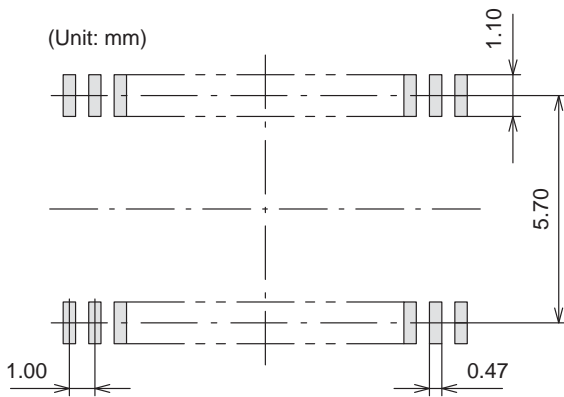
Package Dimensions

unit : mm

SOIC14 W / MFP14S (225 mil)
CASE 751CB
ISSUE A

8.25 MAX
8.0±0.1
14
4.4±0.1
6.4±0.3
1   2
(1.0)   1.0
0.35 +0.15 −0.05
⊕ 0.12 Ⓜ

0 to 10°
0.63±0.2
0.15 +0.15 −0.05

(1.5)
1.7 MAX
◁ 0.10
0.1±0.1

SOLDERING FOOTPRINT*

(Unit: mm)
1.10
5.70
1.00   0.47

NOTE: The measurements are not to guarantee but for reference only.

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

**GENERIC
MARKING DIAGRAM***
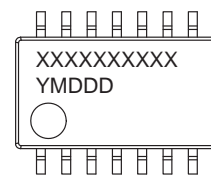
XXXXXXXXXX
YMDDD

XXXXX = Specific Device Code
Y = Year
M = Month
DDD = Additional Traceability Data

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

ORDERING INFORMATION

Device	Package	Shipping (Qty / Packing)
LB1863M-MPB-E	SOIC14 W / MFP14S (225 mil) (Pb-Free)	60 / Fan-Fold
LB1863M-MPB-H	SOIC14 W / MFP14S (225 mil) (Pb-Free / Halogen Free)	60 / Fan-Fold
LB1863M-TLM-E	SOIC14 W / MFP14S (225 mil) (Pb-Free)	1000 / Tape & Reel
LB1863M-TLM-H	SOIC14 W / MFP14S (225 mil) (Pb-Free / Halogen Free)	1000 / Tape & Reel
LB1869M * Discontinued	SOIC14 W / MFP14S (225 mil) (Pb-Free)	- / -

† For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel
  Packaging Specifications Brochure, BRD8011/D. http://www.onsemi.com/pub_link/Collateral/BRD8011-D.PDF