Ordering number : EN5806

Monolithic Digital IC

# LB1943

## Forward/Reverse Motor Driver with Braking Function

## Overview

The LB1943 is a forward/reverse motor driver IC. This IC supports forward, reverse, and braking control from a single input, and the desired output voltage can be set with a resistor. Either full drive or VC drive can be selected from the single input, and the LB1943 can be controlled from a microprocessor.

## Functions

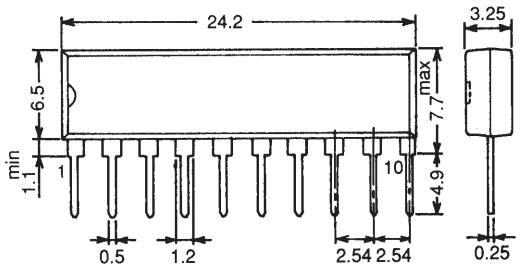
- Single-input control of forward, reverse, and braking operations
- Resistor output voltage setup
- Either full drive or VC drive can be selected from the single control input.
- Can be controlled from a microprocessor.
- Built-in motor dash current absorbing device
- Built-in reference voltage circuit
- Built-in thermal protection circuit

## Package Dimensions

unit: mm

**3043A-SIP10**

[LB1943]




SANYO: SIP10

## Specifications

### Absolute Maximum Ratings at Ta = 25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| Maximum supply voltage | $V_{CC}$ max | | 18 | V |
| Input voltage | $V_{IN}$ | $V_{CC} \geq V_{IN}$ | –0.3 to +6 | V |
| Output current | $I_{OUT}$ | | ±1.6 | A |
| Allowable power dissipation | Pd max | | 1.2 | W |
| Operating temperature | Topr | | –25 to +75 | °C |
| Storage temperature | Tstg | | –55 to +125 | °C |

### Allowable Operating Ranges at Ta = 25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| Supply voltage range | $V_{CC}1$ | | 8 to 18 | V |
| | $V_{CC}2$ | $V_{CC}1 \geq V_{CC}2$ | 5 to 18 | V |
| Forward-reverse disabled time | Toff | | Over 20 | µs |

### Electrical Characteristics at Ta = 25°C, $V_{CC}$ = 12 V

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| Input low-level voltage | $V_{INL}$ | | 0 | | 1 | V |
| Input high-level voltage | $V_{INH}$ | | 4.2 | | 6.0 | V |
| Input mid-level voltage | $V_{INM}$ | | 2 | | 3 | V |
| Input impedance | $Z_{IN}$ | | | 75 | | kΩ |
| Current drain | $I_{CC}$ | | | 5.5 | 10.0 | mA |

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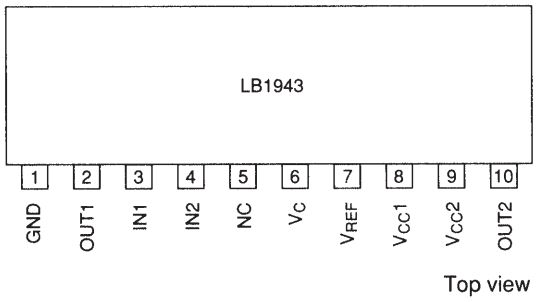
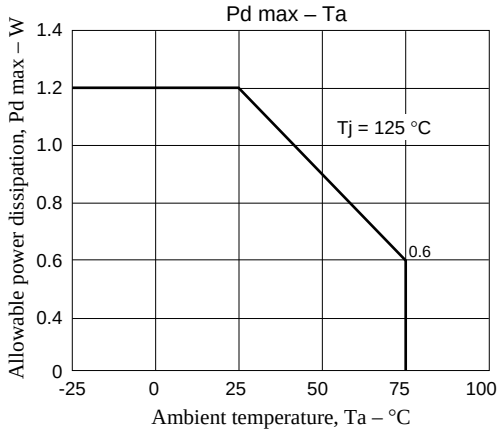
| Parameter | Symbol | Conditions | Ratings | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| Output voltage | $V_{OUT}1$ | $R_L$ = 60 Ω, $V_C$ = 2.5 V<br>$V_{IN}1$ = 2.5 V, $V_{IN}2$ = 0 V | 4.4 | 4.95 | 5.4 | V |
| | $V_{OUT}2$ | $R_L$ = 60 Ω, $V_C$ = 2.5 V<br>$V_{IN}1$ = 2.5 V, $V_{IN}2$ = 5.0 V | 4.4 | 4.95 | 5.4 | V |
| Output leakage current | $I_{OL}$ | $R_L$ = ∞ | | 0.01 | 1.0 | mA |
| Saturation voltage (upper) | V (sat)11 | $V_{CC}$ = 12V, $I_{OUT}$ = 300 mA | | 1.9 | 2.2 | V |
| | V (sat)12 | $V_{CC}$ = 12V, $I_{OUT}$ = 500 mA | | 1.9 | 2.3 | V |
| Saturation voltage (lower) | V (sat)21 | $V_{CC}$ = 12V, $I_{OUT}$ = 300 mA | | 0.25 | 0.5 | V |
| | V (sat)22 | $V_{CC}$ = 12V, $I_{OUT}$ = 500 mA | | 0.4 | 0.65 | V |
| Reference power supply | $V_{REF}$ | | 6.0 | 6.35 | 6.8 | V |
| Reference voltage load characteristics | $\Delta V_{REF}/\Delta I_{REF}$ | $I_{REF}$ = 0 to –2.0 mA | | 0.05 | 0.1 | V/mA |
| Control-to-output gain | | $V_{OUT}/V_C$, $V_C$ = 2.5 V, $R_L$ = 60 Ω | 1.5 | 1.9 | 2.4 | × |
| TSD operating temperature | $T_{STD}$ | * | 150 | 180 | | °C |

Note: Items marked with an asterisk (*) are design target values, and are not tested.

## Pin Assignment



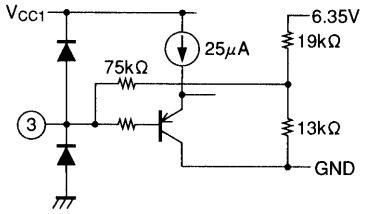
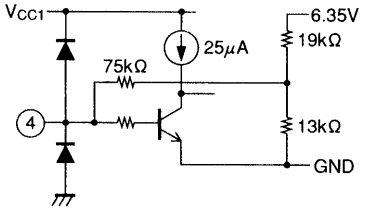
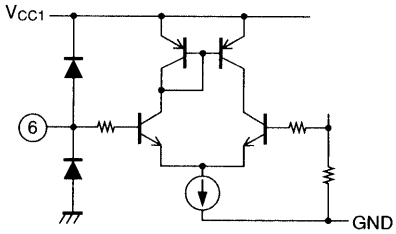
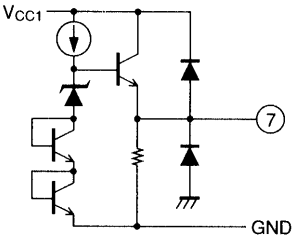
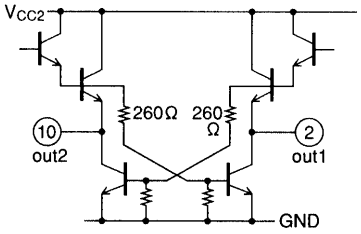




## Truth Table

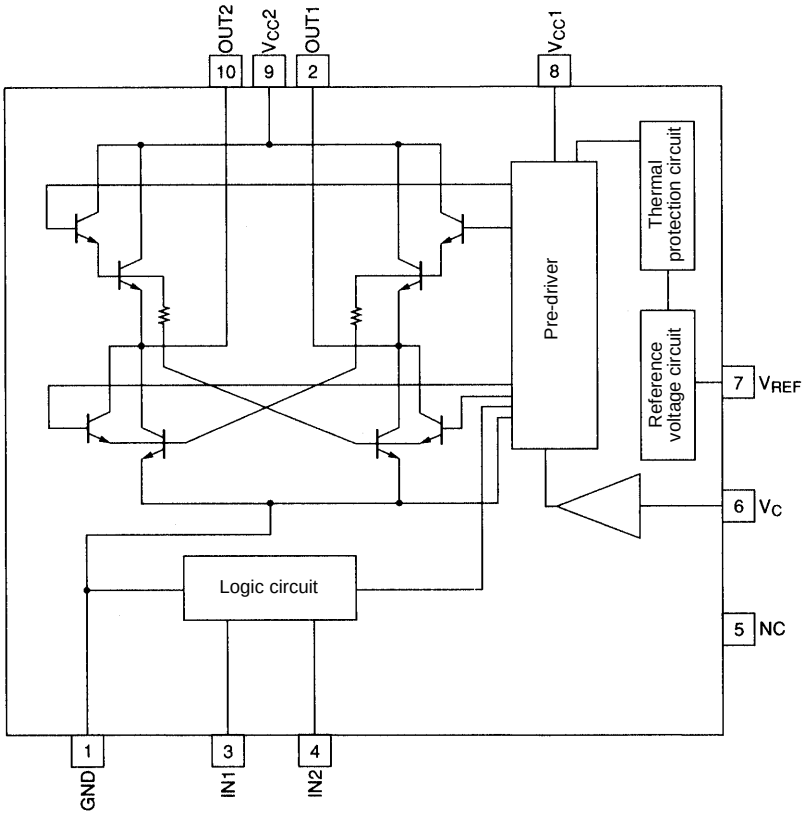
| Input | | Output voltage | | Operation |
|---|---|---|---|---|
| IN1 | IN2 | OUT1 | OUT2 | |
| H | H | L | FULL | Forward (reverse) operation |
| M | H | L | $V_C \times 2$ | Forward (reverse) operation |
| L | H | L | $V_C \times 2$ | Forward (reverse) operation |
| H | M | OFF | OFF | Braking |
| M | M | OFF | OFF | Braking |
| L | M | OFF | OFF | Braking |
| H | L | FULL | L | Reverse (forward) operation |
| M | L | $V_C \times 2$ | L | Reverse (forward) operation |
| L | L | $V_C \times 2$ | L | Reverse (forward) operation |

Input levels: $V_H$: Over 4.2 V
$V_M$: 2.0 to 3.0 V
$V_L$: Under 1.0 V
IN1 and IN2 go to 2.5 V when left open.
LB1943 operation is equivalent to that of the LB1641.

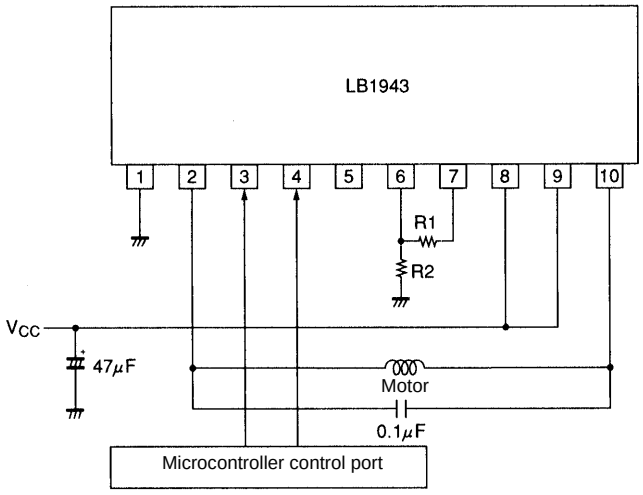
## Pin Functions

| Pin No. | Symbol | Pin function | Equivalent circuit |
|---|---|---|---|
| 1 | GND | • Power system ground. This line is shared with the signal system ground. | |
| 3 | IN1 | • Output voltage switching input<br>• Goes to $V_M$ (about 2.5 V) when left open. |  |
| 4 | IN2 | • Forward, reverse, or braking control input<br>• Goes to $V_M$ (about 2.5 V) when left open. |  |
| 6 | $V_C$ | • Output voltage setting |  |
| 7 | $V_{REF}$ | • Reference voltage output. $V_{REF}$ = 6.35 V |  |
| 8 | $V_{CC}1$ | • Signal system power supply | |
| 9 | $V_{CC}2$ | • Power system power supply | |
| 2<br>10 | OUT1<br>OUT2 | • Outputs that are connected to the motor coils |  |

## Internal Equivalent Circuit




## Peripheral Circuit Example




Usage Notes

1. The microprocessor output ports are CMOS outputs, and must be used in the high, low, or open states.
2. We recommend using a value of about 60 kΩ for R1 and R2.
3. Voltages applied to the IN1 and IN2 pins must not exceed the range 0 to 6 V. Note that negative voltages can cause the IC to operate incorrectly. Also, do not apply voltages to IN1 or IN2 when the $V_{CC}$ voltage is not applied.
4. To prevent the upper and lower output transistors from both being in the on state at the same time, when switching the IN1 and IN2 values, always hold the input open for a brief period during the transition. We recommend holding the open state for a few tens of microseconds.
5. A capacitor must be inserted between $V_{CC}$ and ground. We recommend that this capacitor have a value of at least 20 μF.

6. During motor drive, large currents (on the order of several hundred mA) flow in the motor power supply block. Therefore, the printed circuit board layout and interconnections must be designed so that there are no shared devices.
7. If negative voltages are applied to OUT1 and OUT2 and the IC operates incorrectly, insert Schottky diodes between OUT1 and ground and between OUT2 and ground.