LB1930MC

BIP monolithic IC

Low-Voltage, Low-Saturation Brush DC Motor Driver Application Note

ON Semiconductor®

http://onsemi.com

Overview

The LB1930MC is a low saturation voltage single-channel H-bridge Brush DC motor driver that supports low-voltage drive.

Function

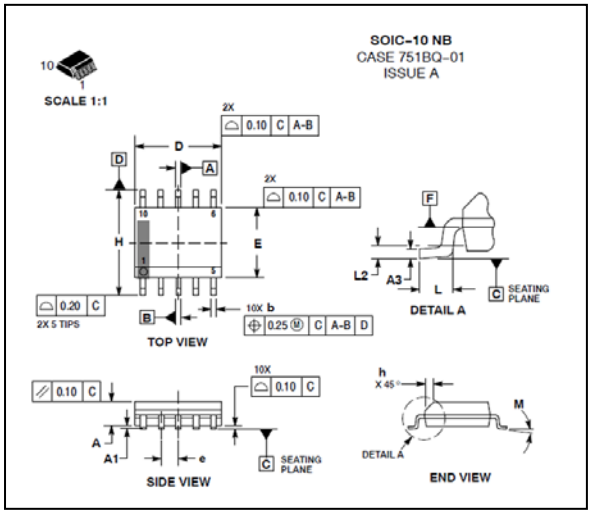
- The low saturation voltage reduces IC internal heating and allows a high voltage to be applied to the motor. Thus this device can be used even in environments with a high operating ambient temperature.
  Output saturation voltage: Vsat1 = 0.25V typical (I_O = 0.2A)
  (High side + low side): Vsat2 = 0.55V typical (I_O = 0.5A)
  Operating temperature range: Ta = -30 to +85°C
- The LB1930MC features the wide operating voltage range of 2.2 to 10.8V and the low standby current drain of 0.1μA, and therefore can easily be used in battery operated systems.
- To minimize through currents, the LB1930M internal logic passes through an internal standby state when switched by the input signals between forward/reverse and brake, or between forward and reverse.
- There are no constraints on the relationship between the input voltage and the supply voltage. For example, the LB1930MC can be used with V_{CC} = 3V, and V_{IN} = 5V.
- If the IC chip exceeds 180°C due to an output short causing a large current flow, the built-in thermal protection circuit suppresses the drive current to prevent fires or destruction of the IC.
- SOIC-10NB miniature package. Also, the LB1930MC features the high allowable power dissipation of Pd = 800mW.

Typical Applications

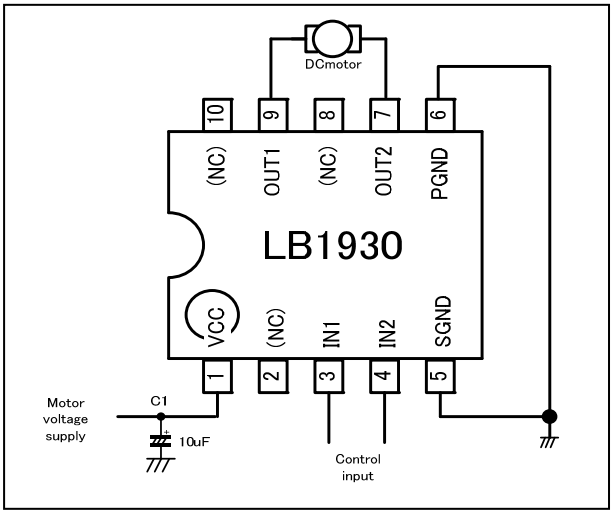
- CD, MD, and cassette player loading motors.
- Camera lens/shutter/lens barrier control
- Battery powered toys and games
- Robotic actuators and pumps
- Portable printers/scanners

Package Dimensions

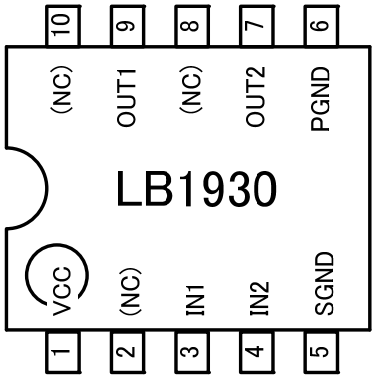
unit : mm (typ)



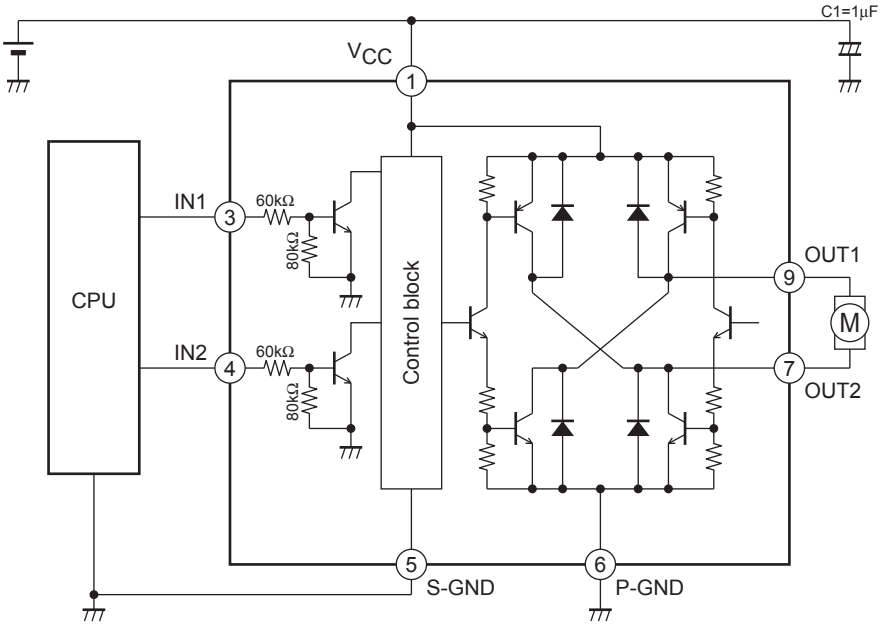
Typical Application



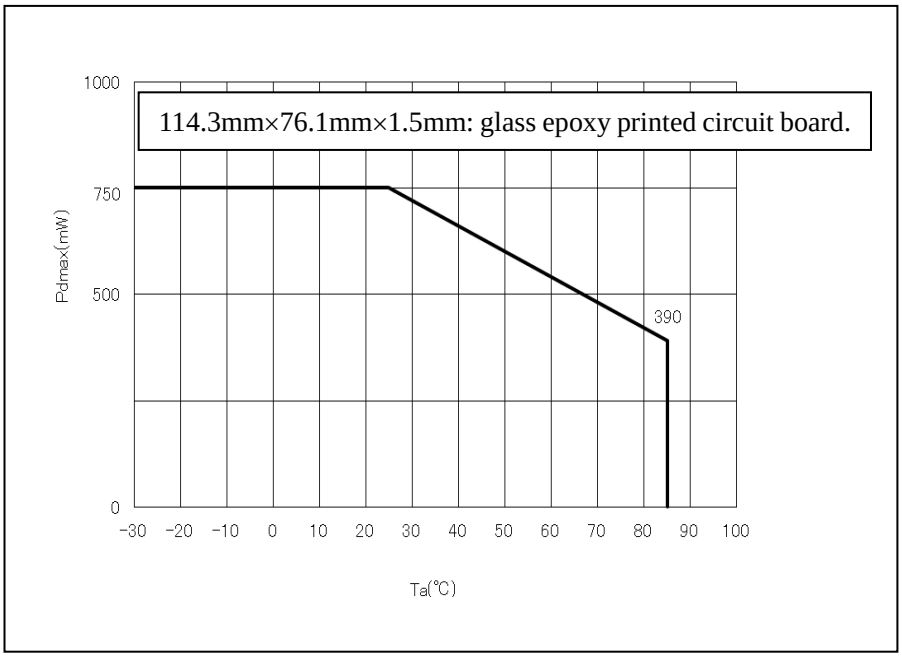
Pin Assignment



Block Diagram and Application Circuit Example



Pdmax－Ta



Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC} max		11	V
Output current	I_{OUT} max		1000	mA
Output voltage handling	V_{OUT} max		V_{CC} + V_{SF}	V
Applied input voltage	I_H max		10.5	V
Allowable power dissipation	Pd max	Mounted on a specified board *	750	mW
Operating temperature	Topr		-30 to +85	°C
Storage temperature	Tstg		-55 to +150	°C

. * Specified board: 114.3mm × 76.1mm × 1.5mm, glass epoxy board.

Caution 1) Absolute maximum ratings represent the value which cannot be exceeded for any length of time.

Caution 2) Even when the device is used within the range of absolute maximum ratings, as a result of continuous usage under high temperature, high current, high voltage, or drastic temperature change, the reliability of the IC may be degraded. Please contact us for the further details.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V_{CC}		2.2		10.8	V
High-level input voltage	V_{IH}		2.0		10	V
Low-level input voltage	V_{IL}		-0.3		+0.3	V

Electrical Characteristics at Ta = 25°C, V_{CC} = 3V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain	$I_{CC}1$	Standby mode		0.1	5	μA
	$I_{CC}2$	Forward or reverse drive operation		15	21	mA
	$I_{CC}3$	Braking		22	31	mA
Output saturation voltage	V_O(sat)1	Forward or reverse drive: High side + low side, I_O = 200mA		0.25	0.35	V
	V_O(sat)2	Forward or reverse drive: High side + low side, I_O = 500mA		0.55	0.75	V
	V_O(sat)3	Forward or reverse drive: High side only, I_O = 200mA		0.15	0.25	V
Input current	I_{IN}	V_{IN} = 5V		70	95	μA
Thermal detection operating temperature	THD	Design guarantee value*	150	180	200	°C
Spark killer diode						
Forward voltage	V_{SF}	I_O = 200mA		0.9	1.7	V
Reverse current	I_{RS}	V_{OUT} = 10V		0.1	5	μA

* Design guarantee value, Do not measurement.

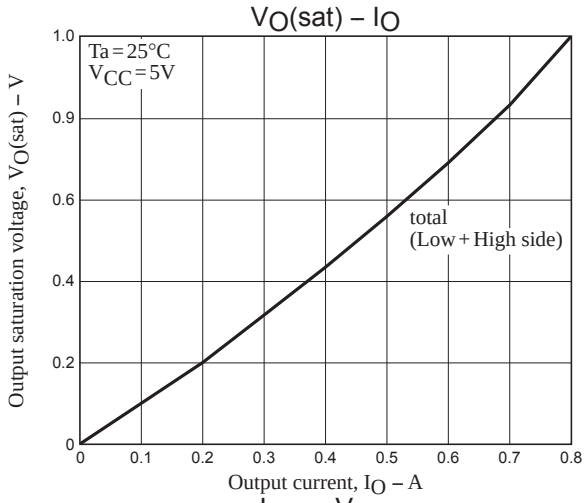
Truth Table

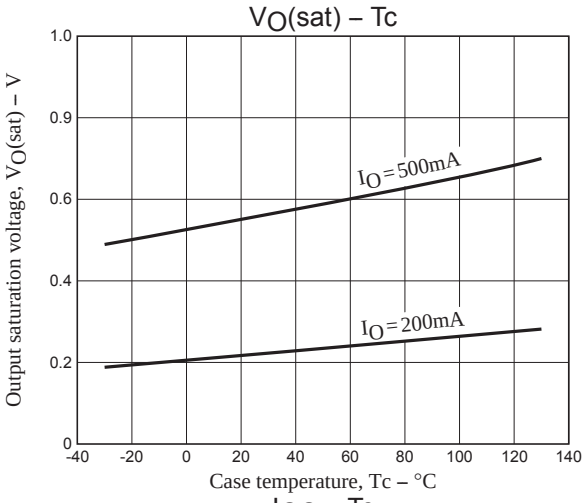
IN1	IN2	OUT1	OUT2	Mode
L	L	OFF	OFF	Standby
H	L	H	L	Forward
L	H	L	H	Reverse
H	H	H	H	Brake

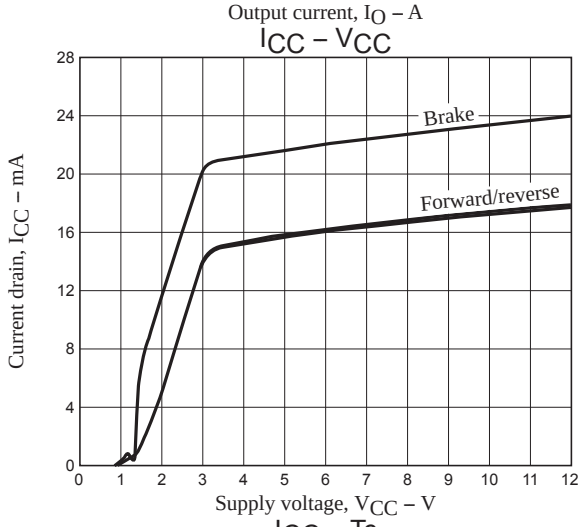
Usage Notes

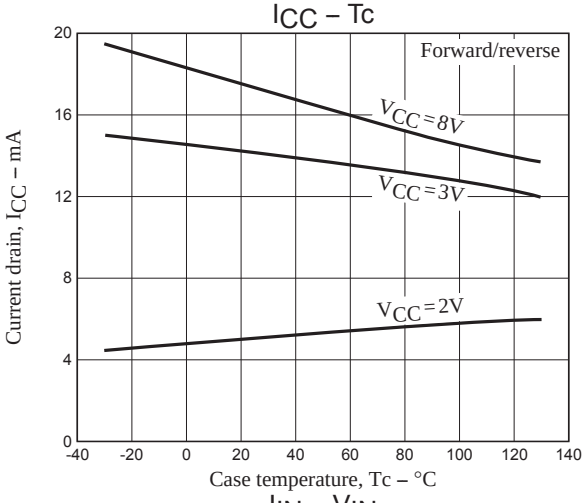
Oscillation may occur in the V_{CC} and P-GND lines, since these lines carry a wide range of currents. The following may help if this is a problem.

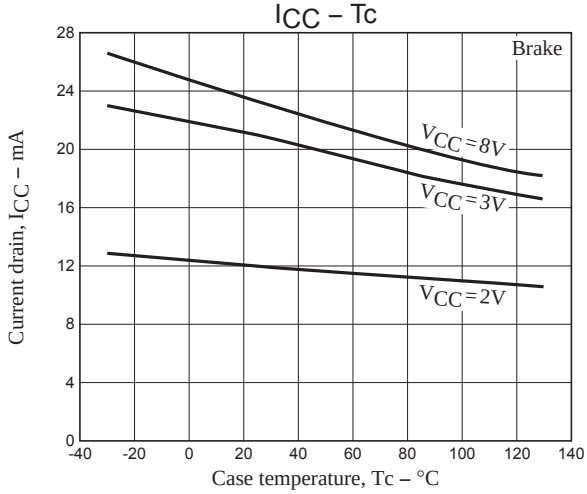
(1) Lower the inductance of the wiring by making lines wider and shorter.
(2) Insert capacitors with good frequency characteristics close to the IC.
(3) Consider adopting the following methods if the CPU and this IC are mounted on different printed circuit boards that could easily have different ground potentials.
- Connect S-GND to the CPU ground and connect P-GND to the power system ground.
- Insert resistors of about 10kΩ in series between the controller outputs and the inputs on this IC.

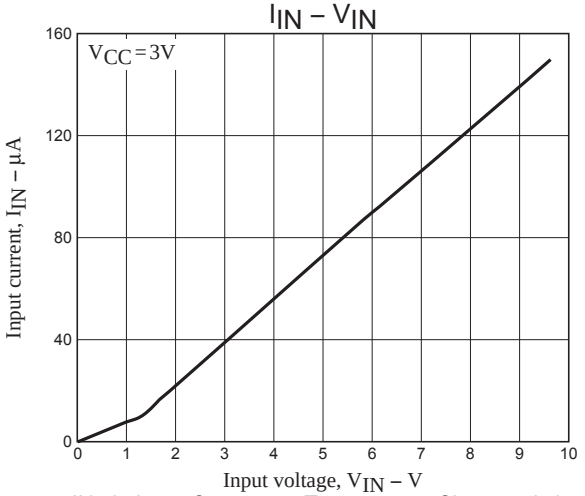

VO(sat) – IO
Ta = 25°C
VCC = 5V
total
(Low + High side)
Output saturation voltage, VO(sat) – V
Output current, IO – A

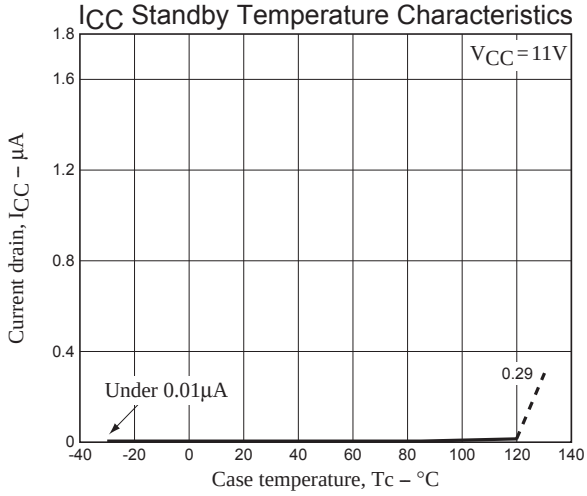

VO(sat) – Tc
IO = 500mA
IO = 200mA
Output saturation voltage, VO(sat) – V
Case temperature, Tc – °C

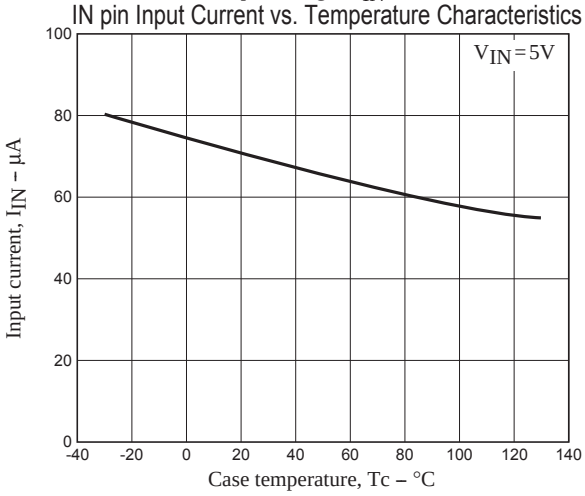

ICC – VCC
Brake
Forward/reverse
Current drain, ICC – mA
Supply voltage, VCC – V


ICC – Tc
Forward/reverse
VCC = 8V
VCC = 3V
VCC = 2V
Current drain, ICC – mA
Case temperature, Tc – °C

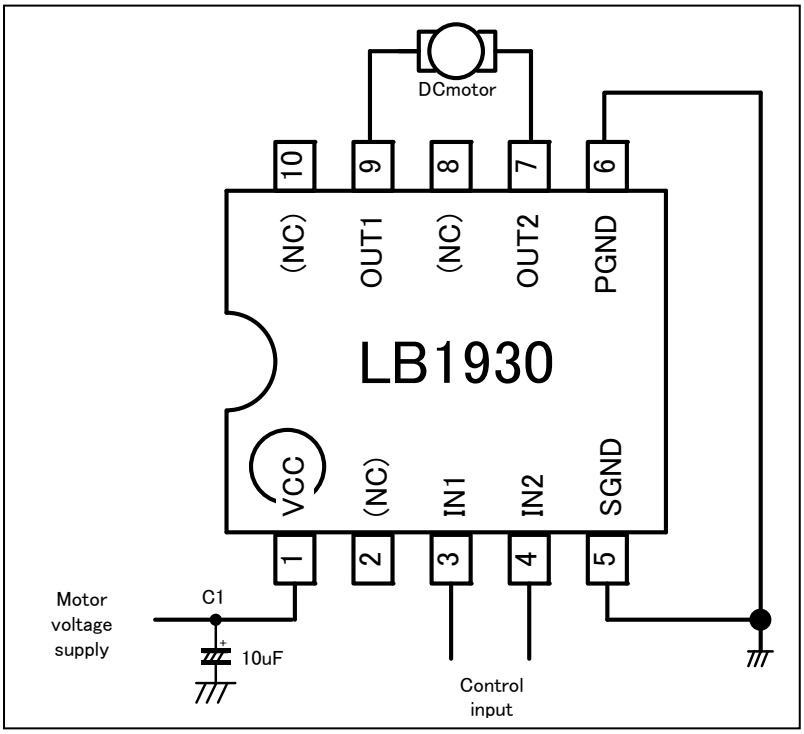

ICC – Tc
Brake
VCC = 8V
VCC = 3V
VCC = 2V
Current drain, ICC – mA
Case temperature, Tc – °C


IIN – VIN
VCC = 3V
Input current, IIN – µA
Input voltage, VIN – V


ICC Standby Temperature Characteristics
VCC = 11V
Under 0.01µA
0.29
Current drain, ICC – µA
Case temperature, Tc – °C


IN pin Input Current vs. Temperature Characteristics
VIN = 5V
Input current, IIN – µA
Case temperature, Tc – °C

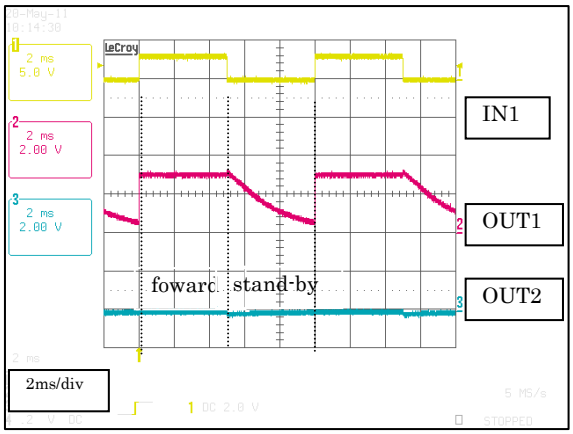
Motor connecting figure



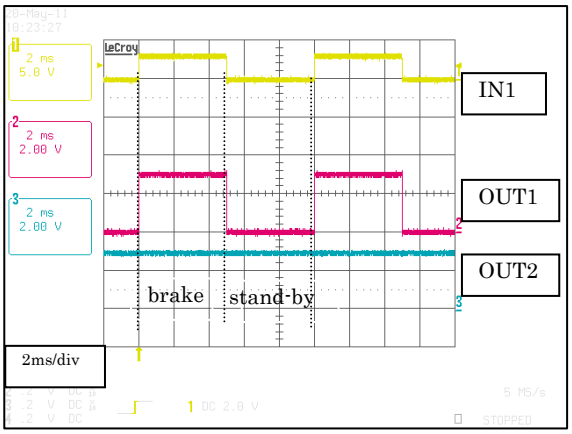
Electrostatic capacitor C1 is used to stabilize power.
Requirement for capacitance value varies depends on substrate wiring, motor, and power.
The recommendation range of C1 is approximately 0.1μF to 10μF.
Please check supply voltage waveform when motor is under operation and use a capacitor for stable operation.

Waveform example

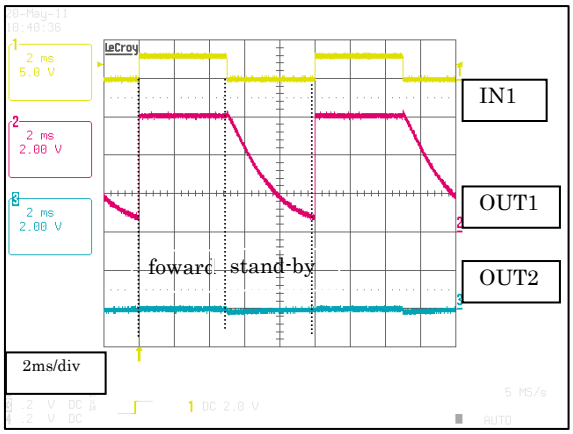
No load VCC=3V IN2="L"



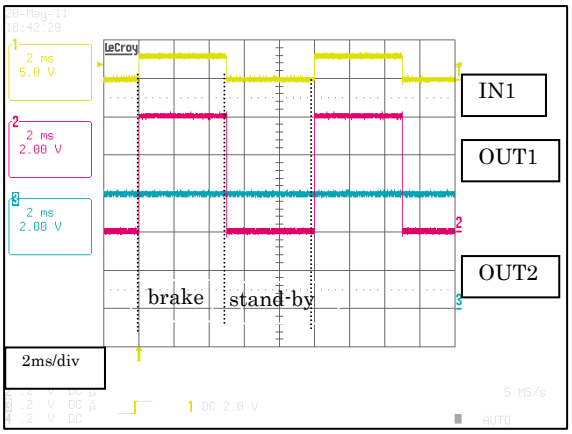
No load VCC=3V IN2="H"



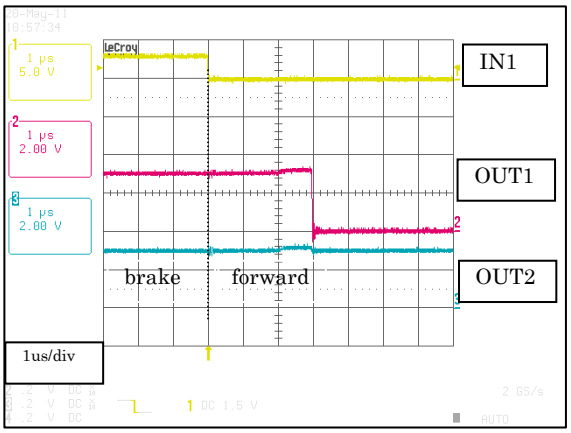
No load VCC=6V IN2="L"



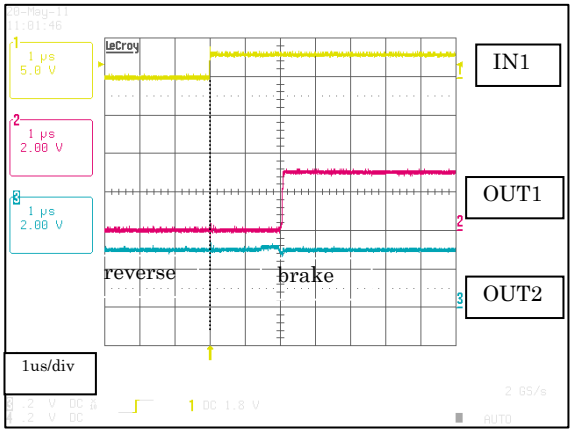
No load VCC=6V IN2="H"



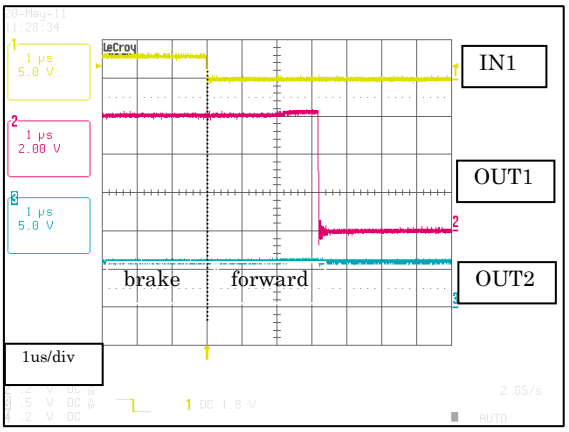
No load VCC=3V IN2="H"
Time scale expansion "fall time"



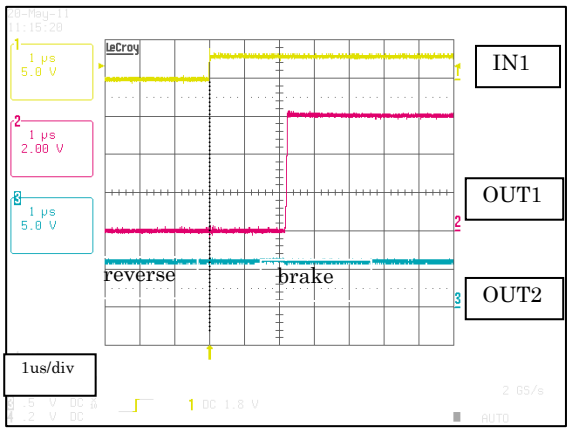
No load VCC=3V IN2="H"
Time scale expansion "rise time"



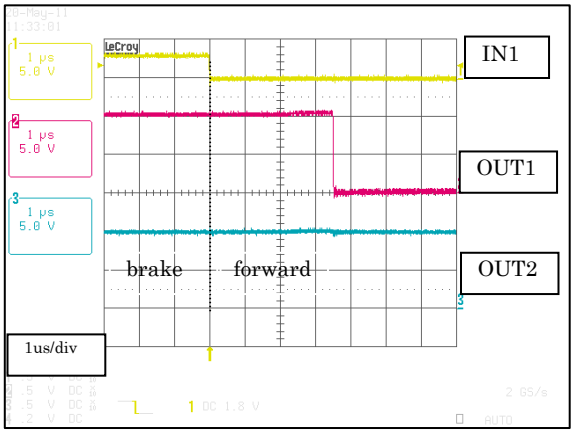
No load VCC=6V IN2=”H”
Time scale expansion “fall time”



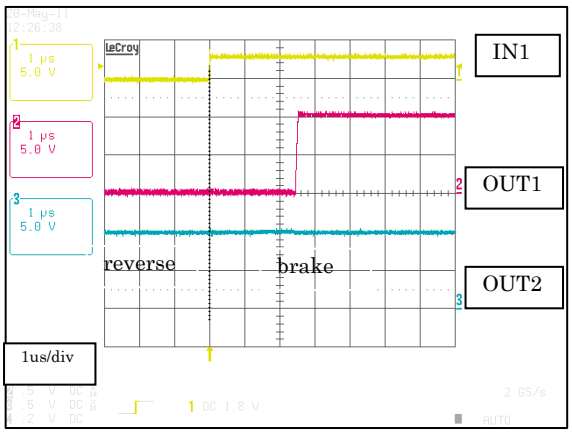
No load VCC=6V IN2=”H”
Time scale expansion “rise time”



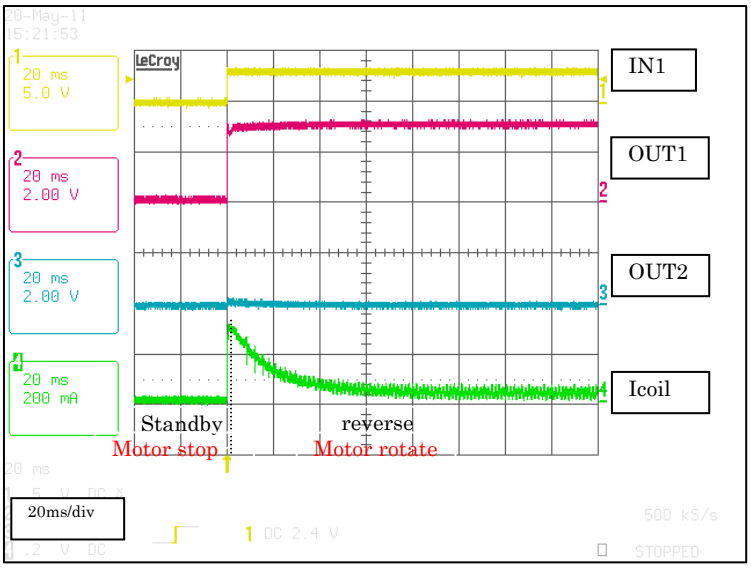
No load VCC=10V IN2=”H”
Time scale expansion “fall time”



No load VCC=10V IN2=”H”
Time scale expansion “rise time”

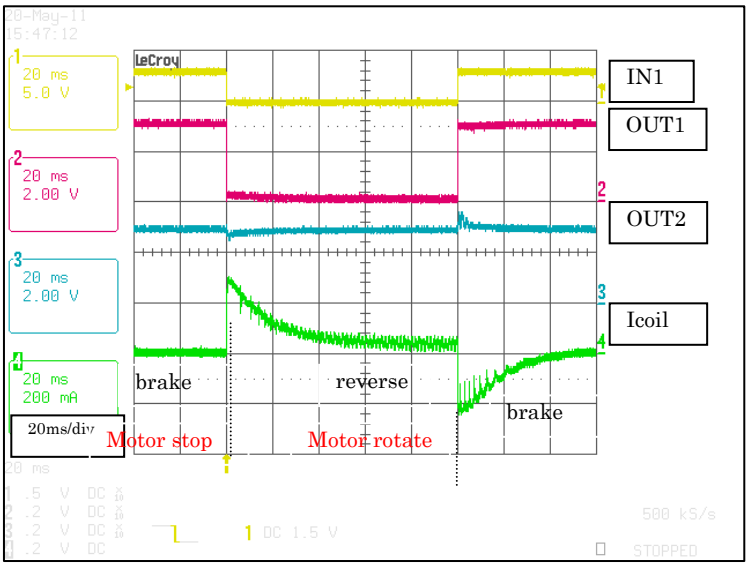


DC motor load VCC=3V IN2="L"
Current waveform example "motor start"



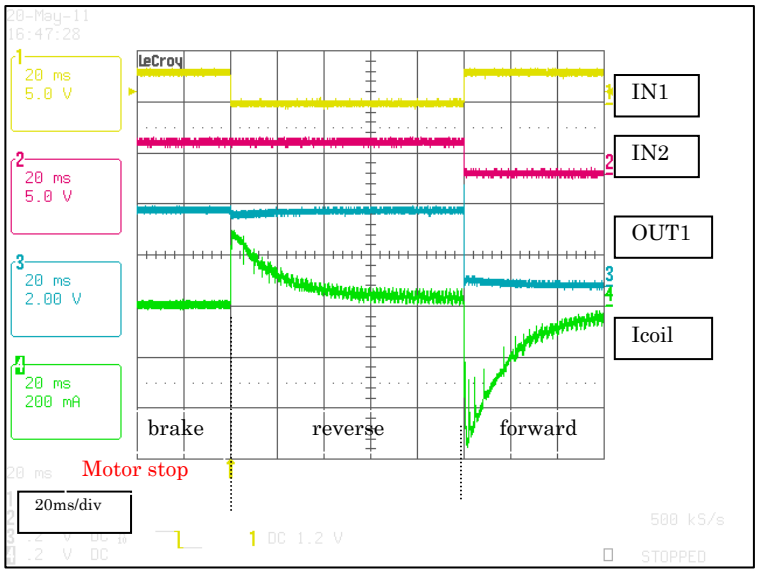
When DC motor starts up, the current value becomes high. However, rotation of DC motor starts, induced voltage Ea is generated, and current decreases according to the rotation frequency.
If a coil resistance is set to Rcoil and motor voltage is set to Vm, then motor current is obtained as follows: Im=(Vm-Ea)/Rcoil.

DC motor load VCC=3V IN2="H"
Current waveform example "brake current"



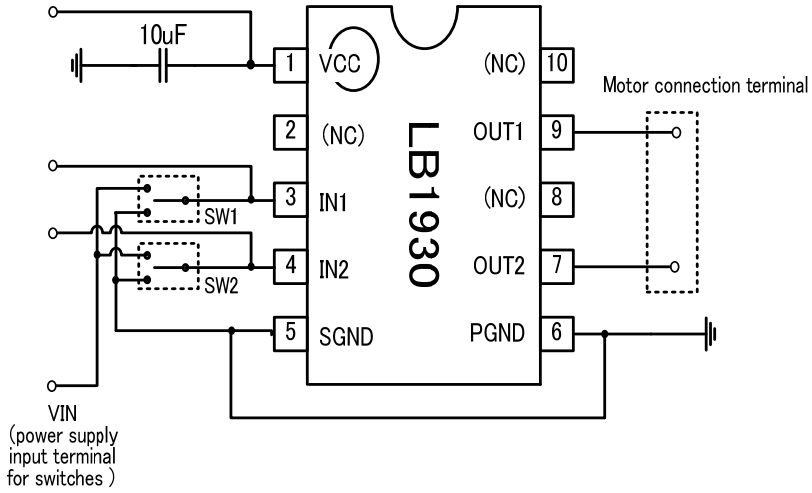
When DC motor is under rotation, if brake mode is set, then DC motor becomes short-brake status, and speed falls rapidly.
In this case, current Im (Im=Ea/Rcoil) flows to the opposite direction by the induced voltage Ea generated during motor rotation. If DC motor stops rotation, then Ea=0, and current becomes 0.

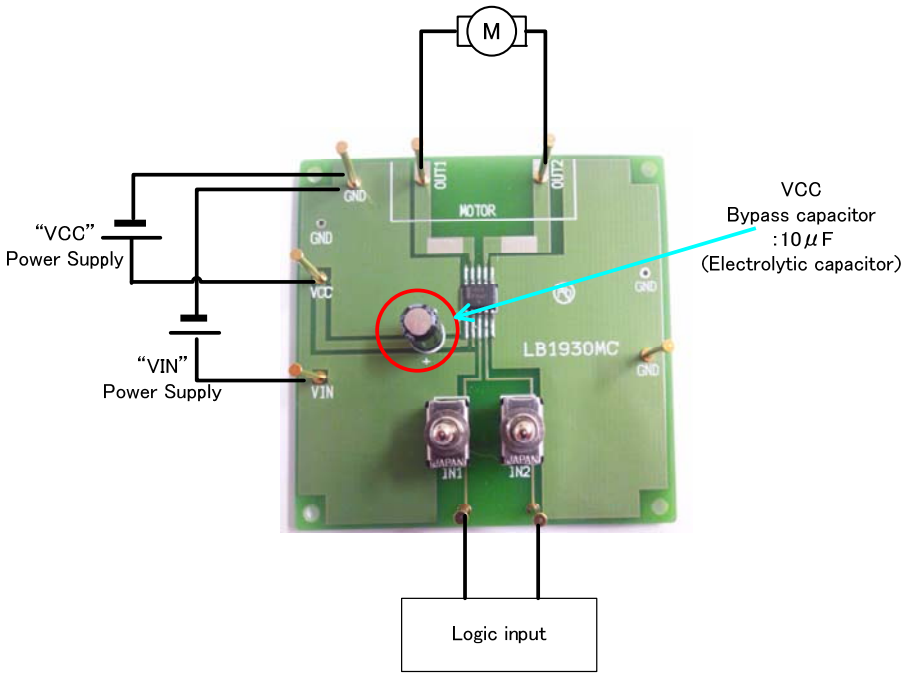
DC motor load VCC =3V
Current waveform example “active reverse brake current”



If rotation direction is switched while DC motor is rotating, then torque of reverse-rotation is generated, the speed of motor rotation becomes slow and reverse rotation is performed.
In this case, since voltage of VM is added to induced voltage Ea generated during motor rotation, the motor current flows into the motor coil which is obtained as follows: Im=(VM+Ea)/Rcoil.
When you switch from forward to reverse, if the current exceeds Iomax, make sure to set brake mode until the induced voltage is reduced between forward and reverse.

Evaluation board description



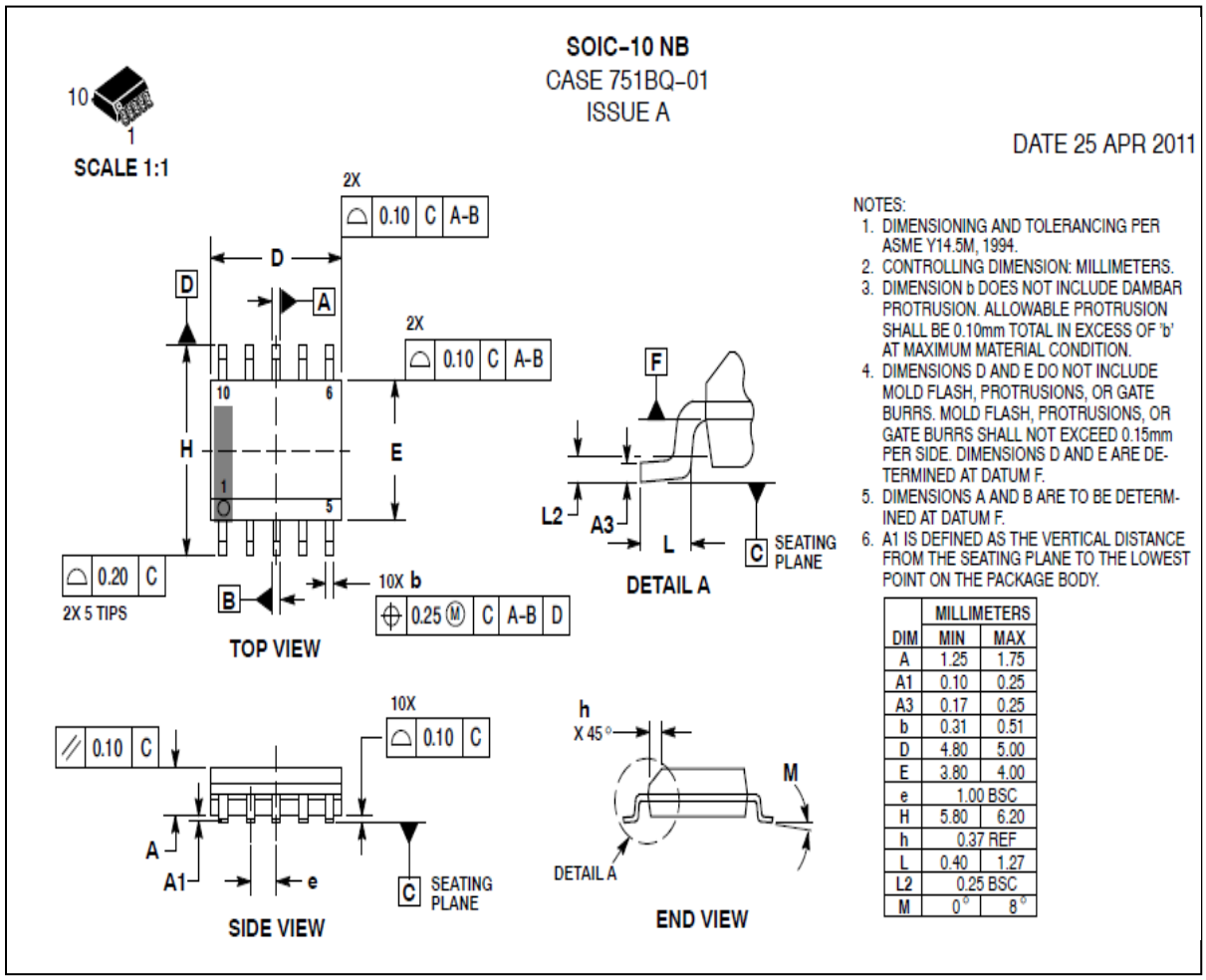


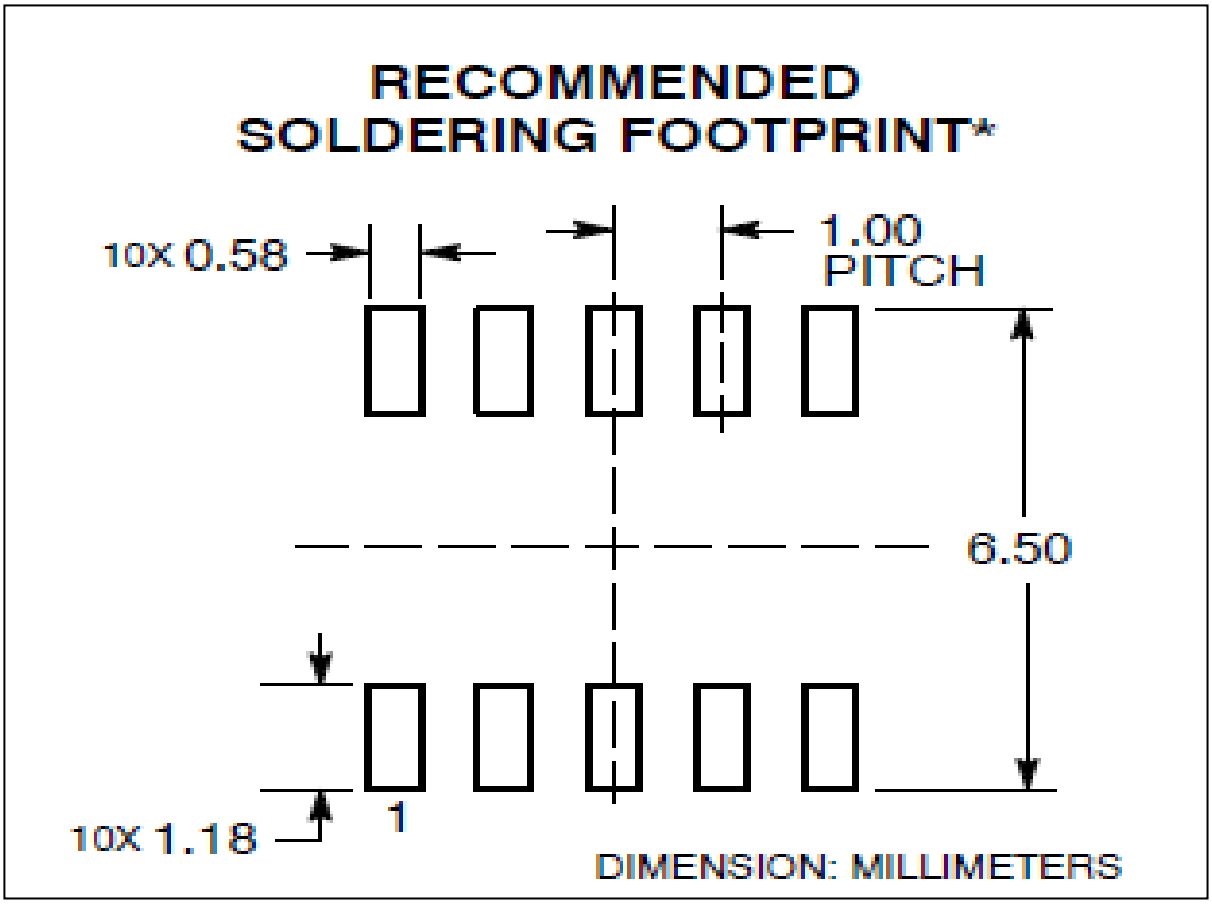
- VIN terminal is a power supply input terminal for switches.
  5V are to impress it and can perform the setting that is in a state by the switch operation and logic input.

- **Operation method**
  Power supply injection order: VCC → VIN

- **Truth value table**

IN1	IN2	OUT1	OUT2	Mode
L	L	OFF	OFF	Standby
H	L	H	L	Forward
L	H	L	H	Reverse
H	H	H	H	Brake


SOIC-10 NB
CASE 751BQ-01
ISSUE A
DATE 25 APR 2011
SCALE 1:1
TOP VIEW
SIDE VIEW
END VIEW
DETAIL A
SEATING PLANE
2X 5 TIPS
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.10mm TOTAL IN EXCESS OF 'b' AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15mm PER SIDE. DIMENSIONS D AND E ARE DETERMINED AT DATUM F.
5. DIMENSIONS A AND B ARE TO BE DETERMINED AT DATUM F.
6. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.
MILLIMETERS
DIM MIN MAX
A 1.25 1.75
A1 0.10 0.25
A3 0.17 0.25
b 0.31 0.51
D 4.80 5.00
E 3.80 4.00
e 1.00 BSC
H 5.80 6.20
h 0.37 REF
L 0.40 1.27
L2 0.25 BSC
M 0° 8°


RECOMMENDED
SOLDERING FOOTPRINT*
10X 0.58
1.00
PITCH
6.50
10X 1.18
1
DIMENSION: MILLIMETERS