

# LB1973JA



Monolithic Digital IC

**ON Semiconductor®**

<http://onsemi.com>

## Two-channel H-Bridge Driver Application Note

### Overview

The LB1973JA is a two-channel H-bridge driver that supports for low saturation drive operation. It is optimal for H-bridge drive of stepping motors (AF and zoom) in portable equipment such as camera cell phones. Also LB1973JA is suitable for use with gas burner for its latch valve drive. The latch valve functions as a safety device to prevent gas leakage.

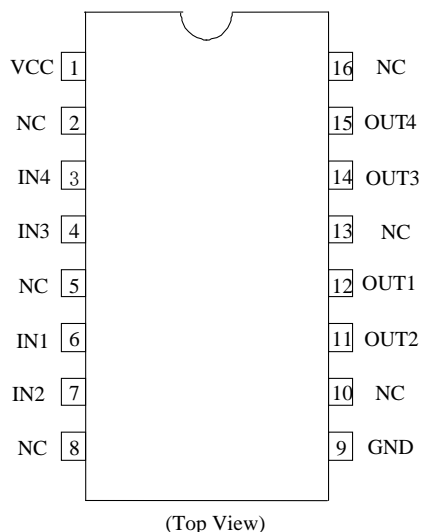
### Function

- Two-channel H-bridge driver
- The range of the operation voltage is wide. (1.8V to 7.5V)
- Small package: SSOP16 (225mil)
- Built-in thermal protection

### Typical Applications

- Projector
- Security camera
- Label Printer
- Stove Burner
- POS, Card Terminal

### Pin Assignment

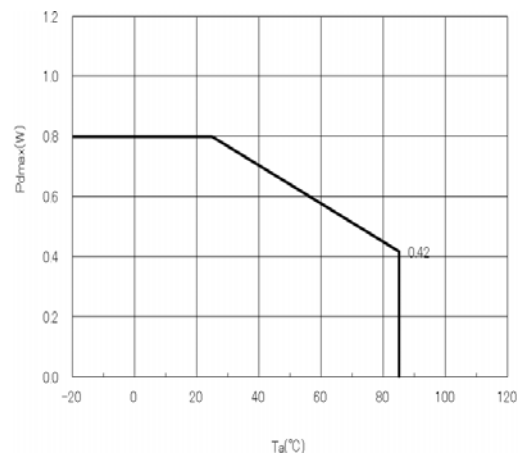
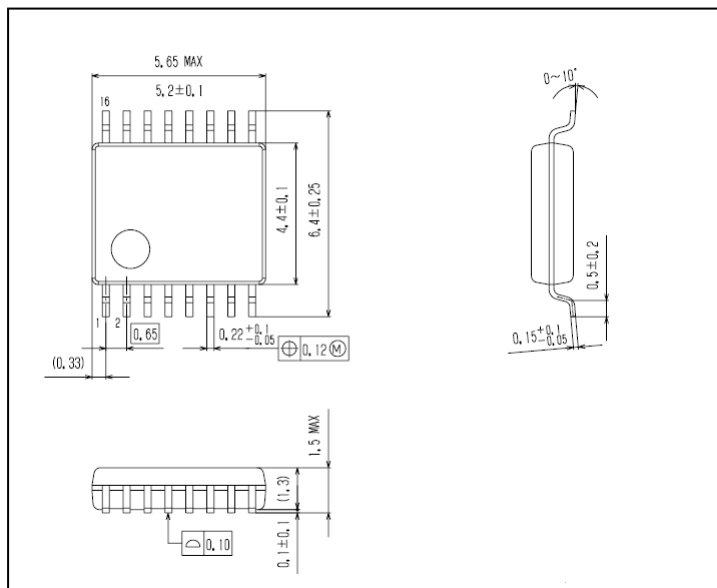


(Top View)

# LB1973JA Application Note

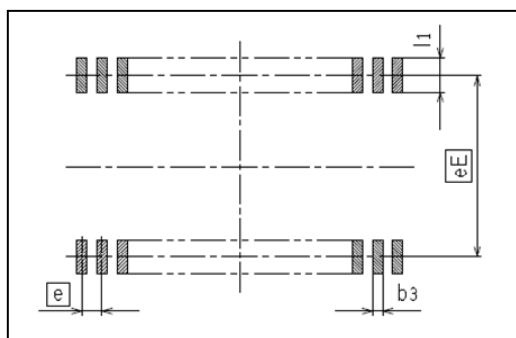
## Package Dimensions

unit : mm (typ)



Mount on board  
(114.3mm×76.1mm×1.6mm glass epoxy)

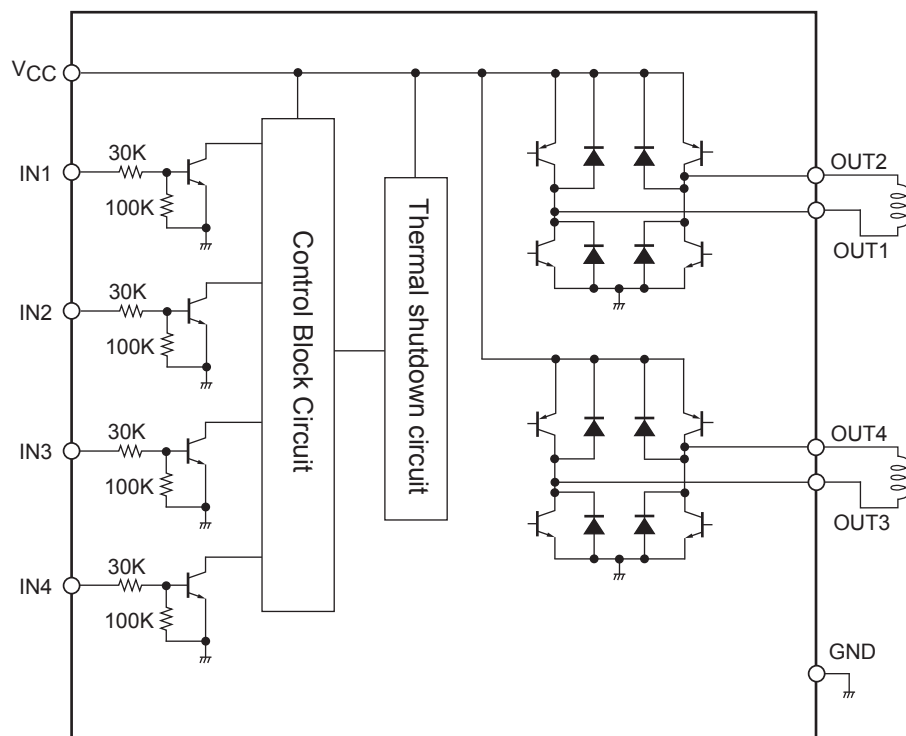
## Recommended Soldering Footprint



(Unit:mm)

Reference Symbol	SSOP16 (225mil)
eE	5.80
e	0.65
b3	0.32
l1	1.0

## Block Diagram

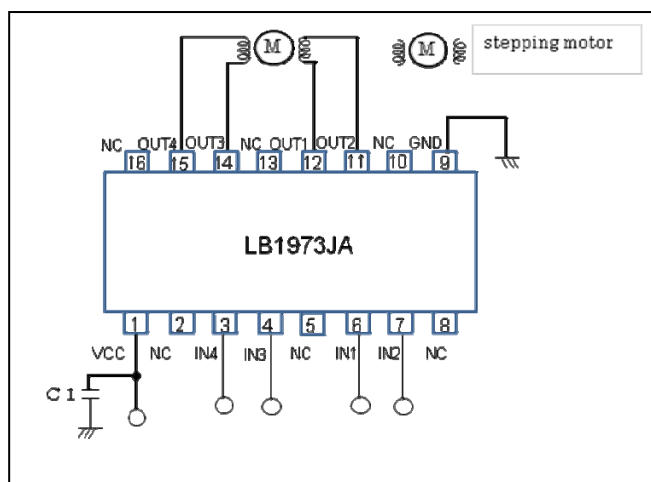
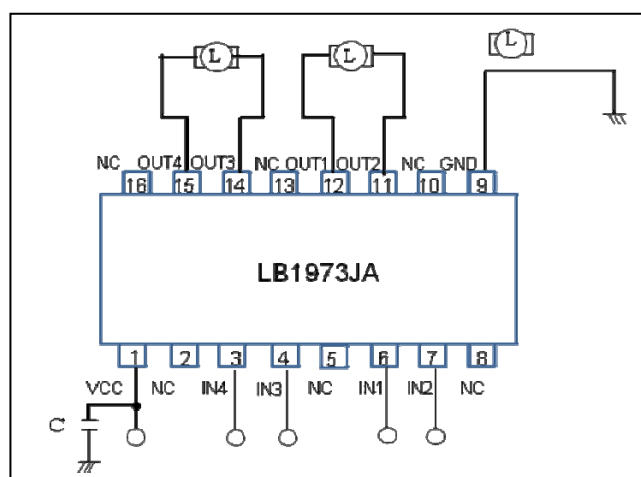


# LB1973JA Application Note

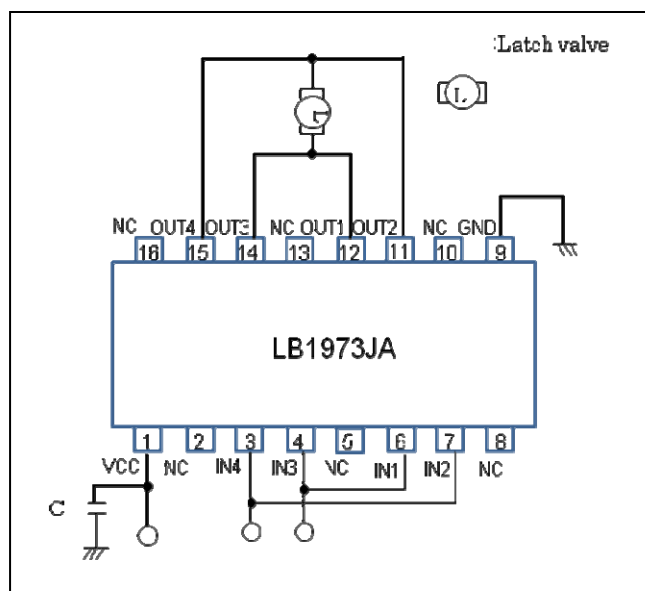
## Application Circuit Example

1. Example of applied circuit with two Latch valve driving

2. Example of applied circuit with one stepping motor driving



3. Example of applied circuit when connecting it in parallel (one latch valve application)



## Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V <sub>CC</sub> max		-0.3 to +8.0	V
Output voltage	V <sub>OUT</sub> max		-0.3 to V <sub>CC</sub> +V <sub>SE</sub>	V
Input voltage	V <sub>IN</sub> max	CONT, IN	-0.3 to +8.0	V
Ground pin source current	I <sub>GND</sub>	Per channel	1000	mA
Allowable power dissipation	Pd max1	For Unit	350	mW
	Pd max2	Mounted on a circuit board.*	870	mW
Operating temperature	T <sub>opr</sub>		-20 to +85	°C
Storage temperature	T <sub>stg</sub>		-40 to +150	°C

\* Mounted on a Specified board : 114.3mm×76.1mm×1.6mm, glass epoxy

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.

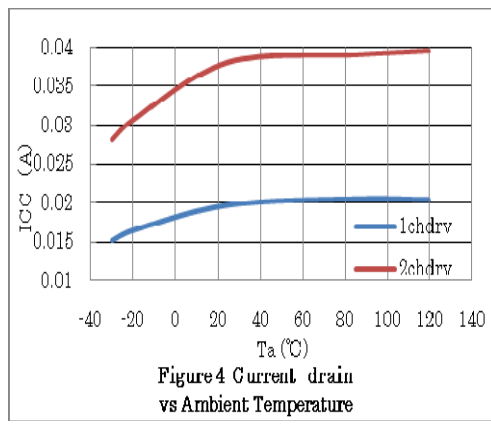
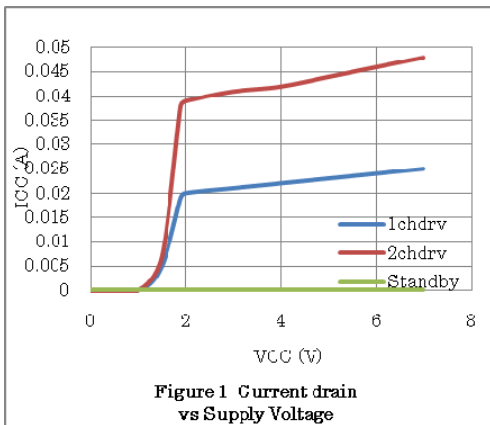
# LB1973JA Application Note

## Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V <sub>CC</sub>		1.8		7.5	V
High-level input voltage	V <sub>IH</sub>		1.3		7.5	V
Low-level input voltage	V <sub>IL</sub>		-0.3		+0.5	V

## Electrical Characteristics at Ta = 25°C, V<sub>CC</sub> = 1.9V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Source current	I <sub>CCO1</sub>	V <sub>CC</sub> = 1.9V, IN1 to IN4 = 0V		0.01	1	μA
	I <sub>CCO2</sub>	V <sub>CC</sub> = 3V, IN1 to IN4 = 0V		0.01	1	μA
	I <sub>CC1</sub>	IN1 = 1.9V, IN2 to IN4 = 0V		18	25	mA
	I <sub>CC2</sub>	IN1 = 3V, IN2 to IN4 = 0V, V <sub>CC</sub> = 3V		19	26	mA
Output saturation voltage1 (single connection)	V <sub>OUT11</sub>	I <sub>OUT</sub> = 270mA, V <sub>CC</sub> = 1.9V to 3.6V, V <sub>OUT</sub> = Upper Tr and Under Tr IN1 = 1.3V, IN2 to IN4 = 0V Supplementation: Standard similar as for IN2 to IN4 = 1.3V		0.2	0.3	V
	V <sub>OUT12</sub>	I <sub>OUT</sub> = 350mA, V <sub>CC</sub> = 1.9V to 3.6V, V <sub>OUT</sub> = Upper Tr and Under Tr IN1 = 1.3V, IN2 to IN4 = 0V Supplementation: Standard similar as for IN2 to IN4 = 1.3V		0.25	0.4	V
Output saturation voltage2 (parallel connection)	V <sub>OUT21</sub>	I <sub>OUT</sub> = 270mA, V <sub>CC</sub> = 1.9V to 3.6V, V <sub>OUT</sub> = Upper Tr and Under Tr OUT1-3, OUT2-4 short. IN1 and IN3 = 1.3V, IN2 and IN4 = 0V Supplementation: Standard similar as for IN2 and IN4 = 1.3V		0.12	0.2	V
	V <sub>OUT22</sub>	I <sub>OUT</sub> = 500mA, V <sub>CC</sub> = 1.9V to 3.6V, V <sub>OUT</sub> = Upper Tr and Under Tr OUT1-3, OUT2-4 short. IN1 and IN3 = 1.3V, IN2 and IN4 = 0V Supplementation: Standard similar as for IN2 and IN4 = 1.3V		0.2	0.35	V
Input current	I <sub>IN</sub>	V <sub>IN</sub> = 1.9V		32	70	μA
Thermal shutdown operation temperature	T <sub>tsd</sub>			140		°C
Temperature hysteresis width	ΔT			20		°C
Spark killer Diode						
Reverse current	I <sub>S(leak)</sub>	V <sub>CC-OUT</sub> = 8V, V <sub>IN</sub> = 0V			10	μA
Forward voltage	V <sub>SF</sub>	I <sub>OUT</sub> = 400mA, V <sub>IN</sub> = 0V			1.7	V



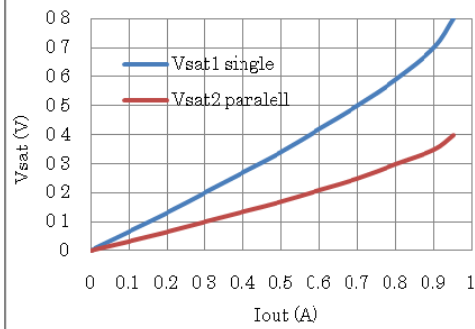


Figure 2 Output on Voltage  
vs Output Current

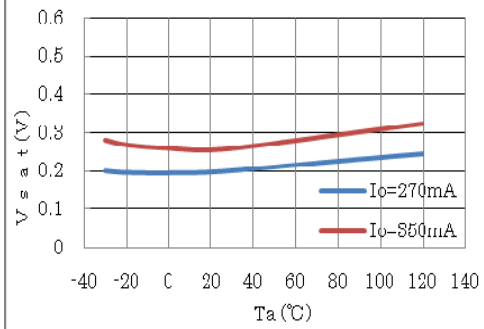


Figure 5 Output on Voltage(single)  
vs Ambient Temperature

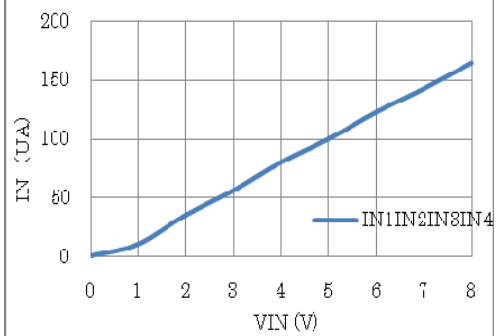


Figure 3 Input Current  
vs Input Voltage

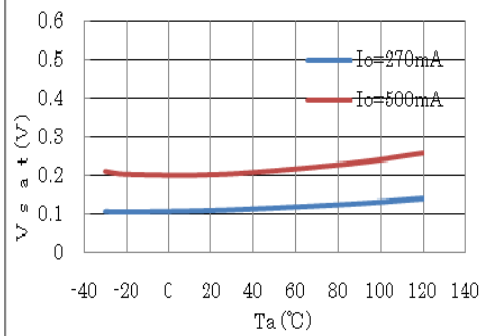


Figure 6 Output on Voltage(paralell)  
vs Ambient Temperature

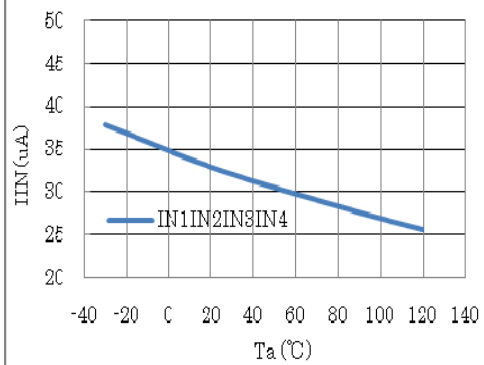
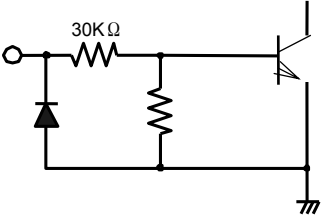
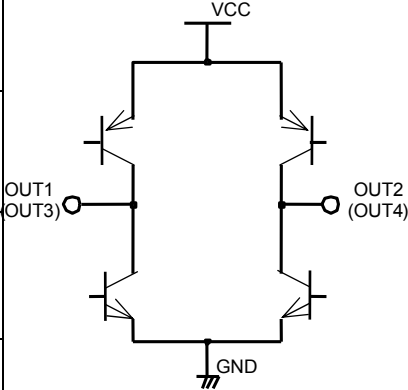


Figure 7 Output on Voltage  
vs Ambient Temperature

# LB1973JA Application Note

## Pin function

Pin No.	Pin name	Pin function	Equivalent Circuit
1	V <sub>CC</sub>	Power-supply voltage pin. V <sub>CC</sub> voltage is impressed. The permissible operation voltage is from 2.5 to 9.0(V). The capacitor is connected for stabilization for GND pin (7pin, 14pin).	
6	IN1	Motor drive control input pin. Driving control input pin of OUT1 (12pin) and OUT2 (11pin). It combines with IN2 pin (7pin) and it fights desperately. The digital input it, range of the "L" level input is 0 to 0.7(V), range of the "H" level input is from 1.8 to 9.0(V). PWM can be input. Pull-down resistance 30(kΩ) is built into in the pin. It becomes a standby mode because all IN1, IN2, IN3, and IN4 pins are made "L", and the circuit current can be adjusted to 0.	
7	IN2	Motor drive control input pin. Driving control input pin of OUT1 (12pin) and OUT2 (11pin). It combines with IN1 pin (6pin) and it uses it. PWM can be input. With built-in pull-down resistance.	
3	IN3	Motor drive control input pin. Driving control input pin of OUT3 (14pin) and OUT4 (15pin). It combines with IN4 pin (3pin) and it uses it. PWM can be input. With built-in pull-down resistance.	
2	IN4	Motor drive control input pin. Driving control input pin of OUT3 (14pin) and OUT4 (15pin). It combines with IN3 pin (4pin) and it uses it. PWM can be input. With built-in pull-down resistance.	
6	GND	Ground pin.	
15	OUT4	Driving output pin. The motor coil is connected between terminal OUT3 (14pin).	
14	OUT3	Driving output pin. The motor coil is connected between terminal OUT4 (15pin).	
11	OUT2	Driving output pin. The motor coil is connected between terminal OUT1 (12pin).	
12	OUT1	Driving output pin. The motor coil is connected between terminal OUT2 (11pin).	

## Operation explanation

### 1. LB1973JA Input-Output-Logic

Truth Table

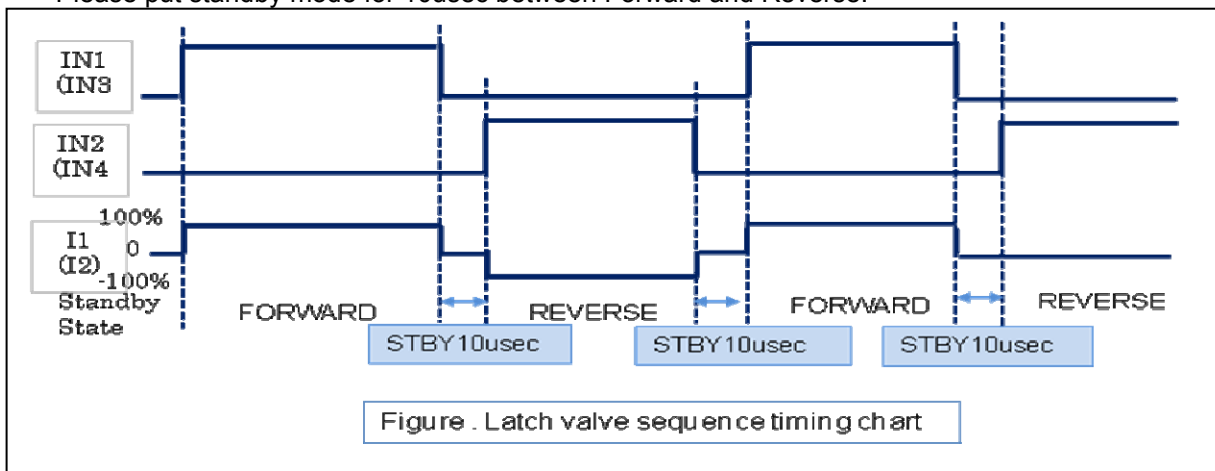
Input				Output				Mode
IN1	IN2	IN3	IN4	OUT1	OUT2	OUT3	OUT4	
Low	Low	Low	Low	Off	Off	Off	Off	Standby mode
High	Low	-	-	High	Low	-	-	Channel 1, forward
Low	High			Low	High			Channel 1, reverse
-	-	High	Low	-	-	High	Low	Channel 2, forward
		Low	High			Low	High	Channel 2, reverse
High	High	-	-	The logic output for the first high-level input is produced.				
-	-	High	High					

### 2. Latch valve operation sequence

The following diagram shows the example of latch valve sequence from Standby, Forward, Reverse, Forward, and Reverse.

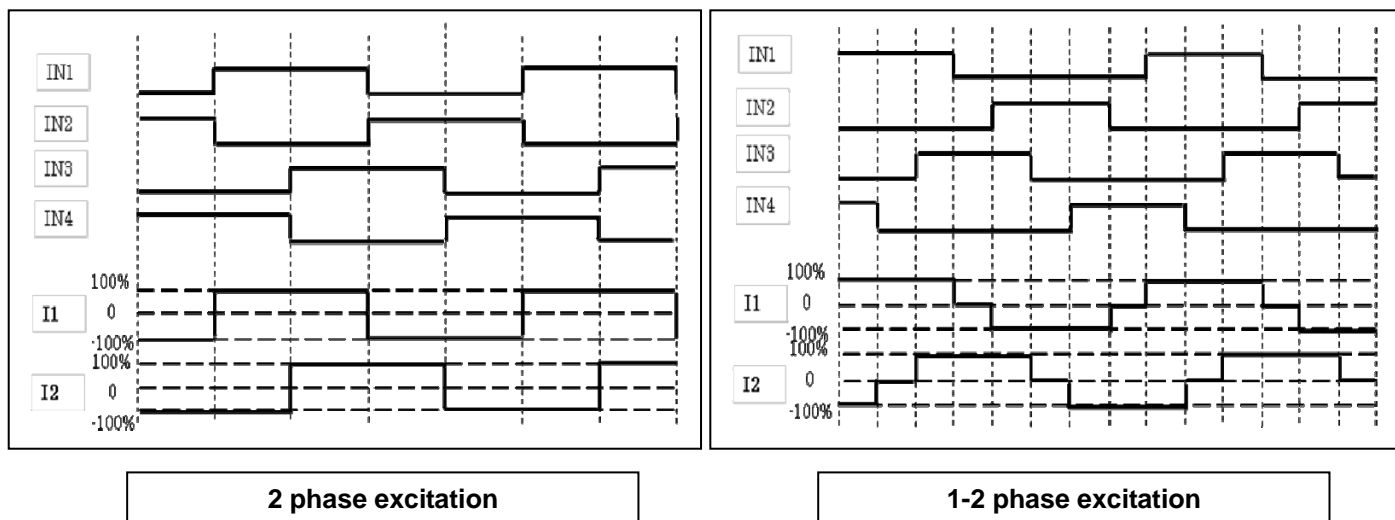
When IN1, IN2, IN3, IN4 are "L", the operation of LB1973JA is stopped.

Please put standby mode for 10usec between Forward and Reverse.



### 3. Stepping motor operation sequence

Example of current wave type in each excitation mode when stepping motor parallel input is controlled.

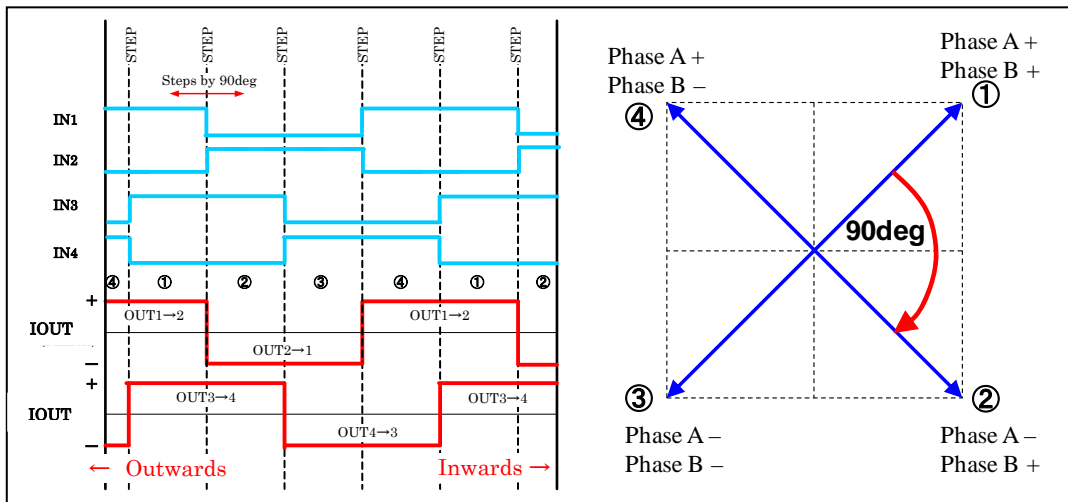


## LB1973JA Application Note

### 4. Theory

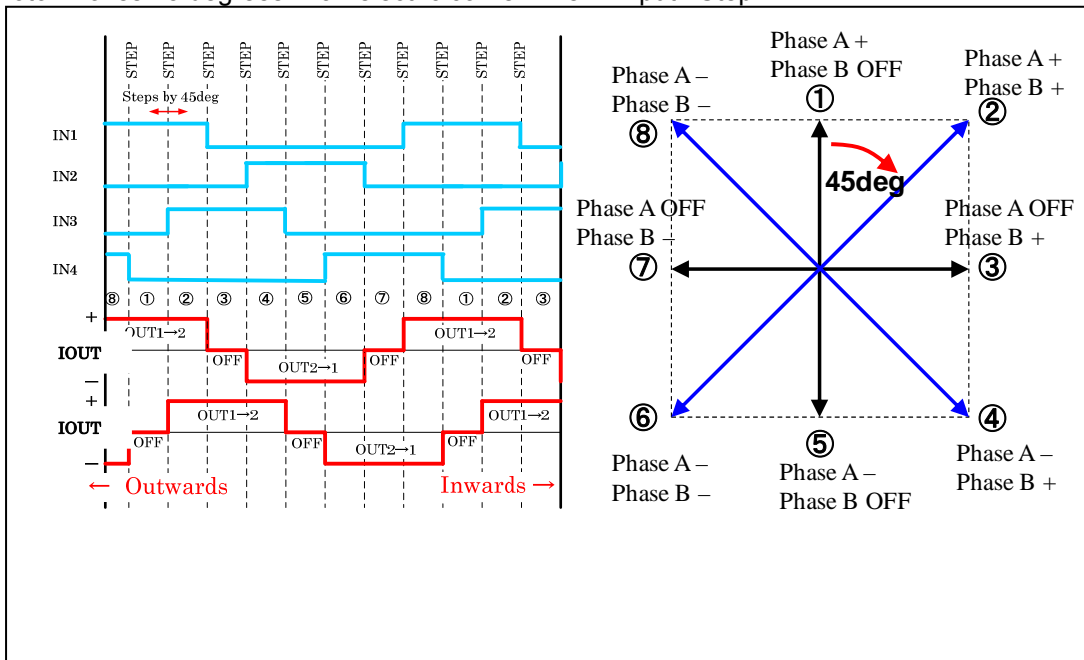
#### • Full-Step MODE

The motor moves 90 degrees in an electric corner when I input 1Step.



#### • Half-Step MODE

The motor moves 45 degrees in an electric corner when I input 1Step



### 5. Thermal Shutdown circuit

The thermal shutdown circuit is incorporated and the output is turned off when junction temperature  $T_j$  exceeds  $140^{\circ}\text{C}$  and the abnormal state warning output is turned on. As the temperature falls by hysteresis, the output turned on again (automatic restoration).

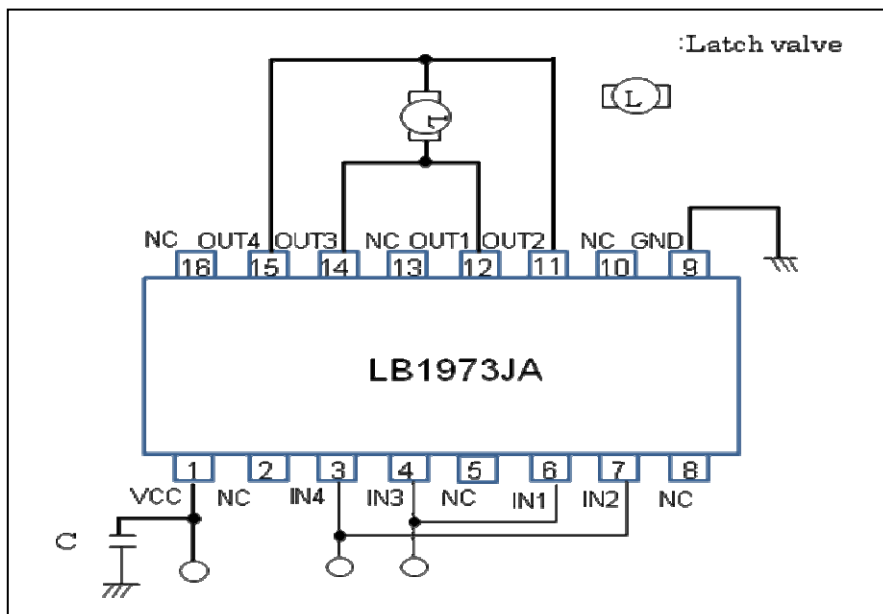
$TSD = 140^{\circ}\text{C}$  (typ)

$\Delta TSD = 20^{\circ}\text{C}$  (typ)

# LB1973JA Application Note

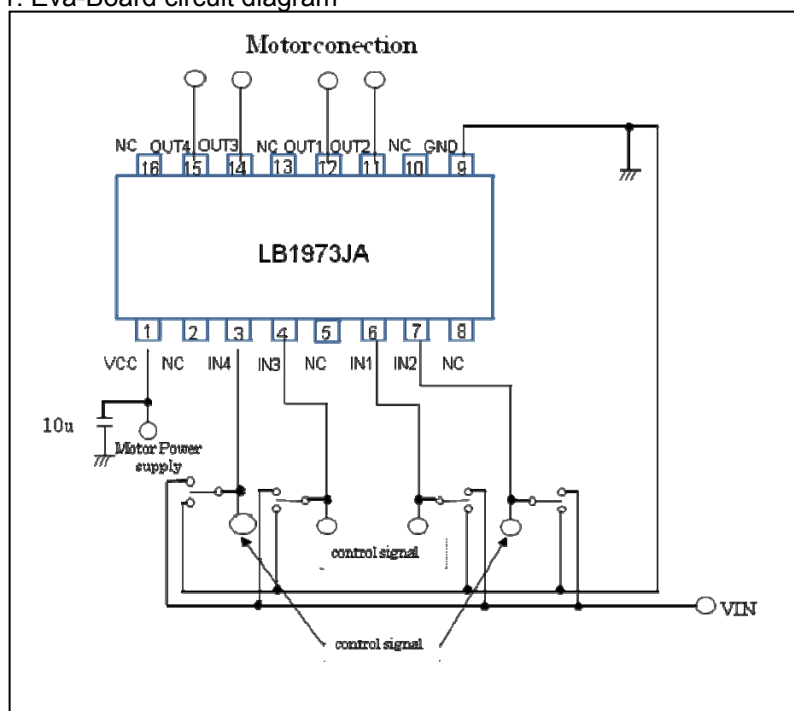
## Application Circuit Example

3. Example of applied circuit when connecting it in parallel (one latch valve application)



## Eva-Board Manual

1. Eva-Board circuit diagram



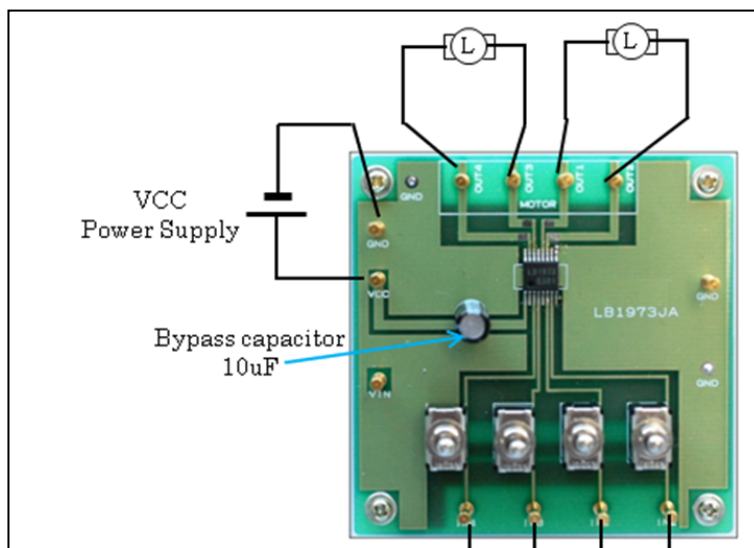
## Bill of Materials for LB1973JA Evaluation Board

Designator	Qty	Description	Value	Tol	Footprint	Manufacturer	Manufacturer Part Number	Substitution Allowed	Lead Free
IC1	1	Motor Driver			SSOP16 (225mil)	ON Semiconductor	LB1973JA	No	Yes
C1	1	VCC Bypass capacitor	10μF 50V			SUN Electronic Industries	50ME10HC	Yes	Yes
SW1-SW3	3	Switch				MIYAMA	MS-621-A01	Yes	Yes
TP1-TP11	11	Test points				MAC8	ST-1-3	Yes	Yes

## LB1973JA Application Note

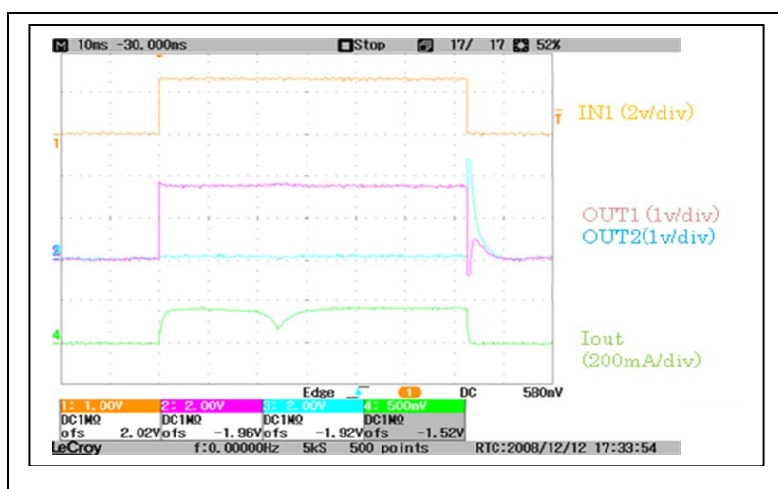
### 2-1. Eva-Board photograph

#### (1) Two latch valve drive



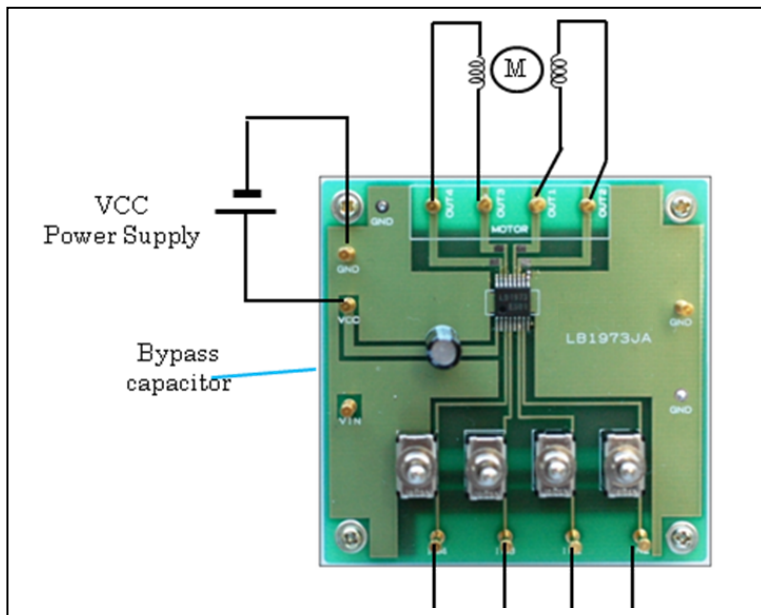
- Connect OUT1 and OUT2, OUT3 and OUT4 to a Latch valve each.
- Connect the motor power supply with the terminal VCC, the control power supply with the terminal VIN. Connect the GND line with the terminal GND.
- Latch valve becomes the predetermined output state corresponding to the input state by inputting an input signal such as the following truth value table into IN1~IN4.

Waveform of LB1973M evaluation board when driving Latch valve.



## LB1973JA Application Note

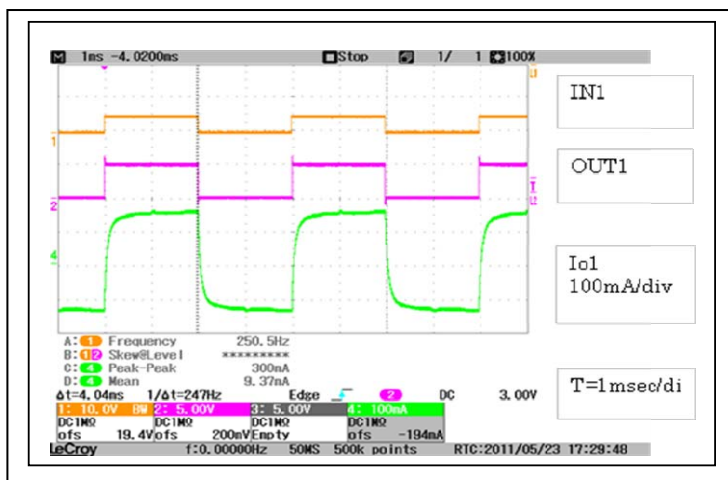
### (2) One stepping motor drive



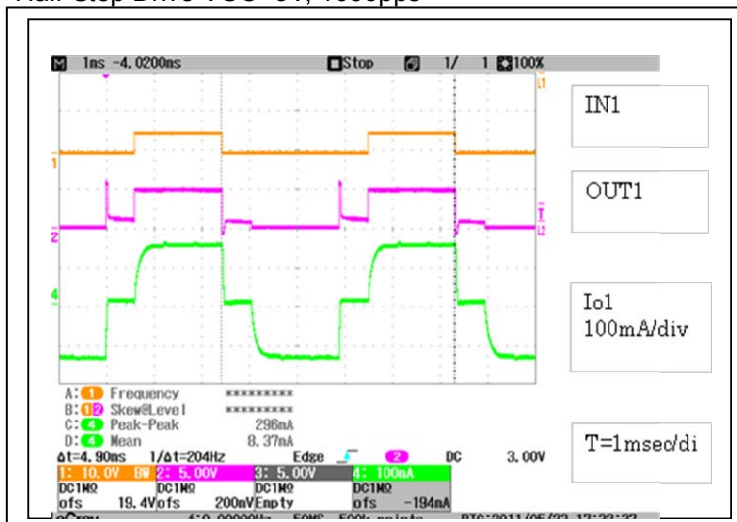
- Connect a stepping motor with OUT1, OUT2, OUT3 and OUT4.
- Connect the motor power supply with the terminal VCC, the control power supply with the terminal VIN. Connect the GND line with the terminal GND.
- STP motor drives it in an 2 phase excitation, 1-2 phase excitation by inputting an input signal such as follows into IN1~IN4.

Waveform of LB1973M evaluation board when driving stepping motor

- Full-Step Drive VCC=5V, 1000pps



- Half-Step Drive VCC=5V, 1600pps



ON Semiconductor and the ON logo are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.