SANYO Semiconductors

APPLICATION NOTE

An ON Semiconductor Company

Monolithic Digital IC

LB1973M — Two-channel H-Bridge Driver

Overview

The LB1973M is a two-channel H-bridge driver that supports for low saturation draive operation. It is optimal for H-bridge drive of stepping motors (AF and zoom) in portable equipment such as camera cell phones.

Also LB1973M is suitable for use with gas burner for its latch valve drive. The latch valve functions as a safety device to prevent gas leakage.
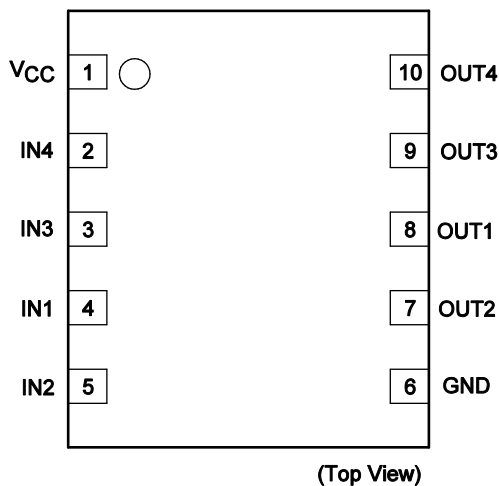
Features

- Two-channel H-bridge driver
- The range of the operation voltage is wide.(1.8V to 7.5V)
- Small package : MFP10S(225mil)
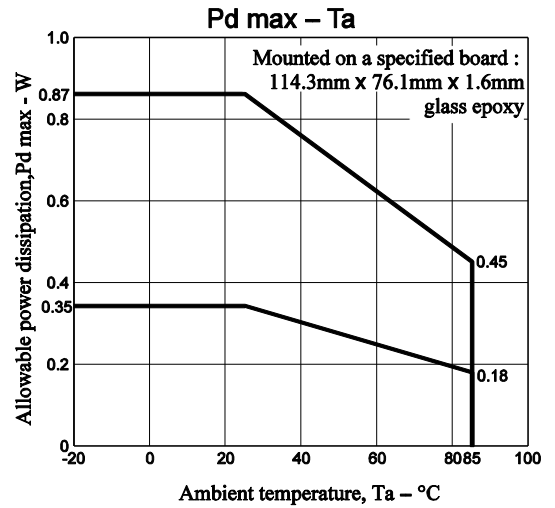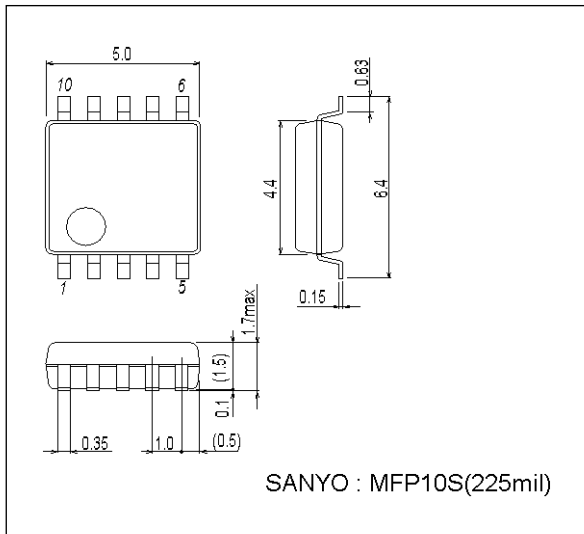- Built-in thermal protection

Typical Applications

- Projector
- Security Camera
- Label Printer

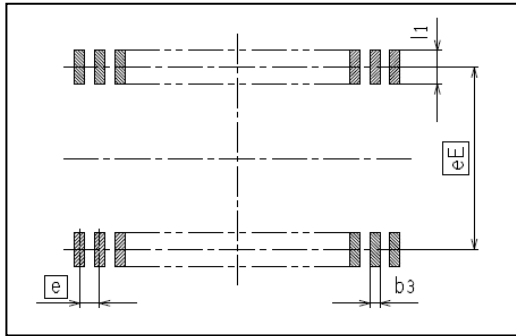- Stove burner
- POS, Card Terminal
-

Pin Assignment

VCC	1 ○	10 OUT4
IN4	2	9 OUT3
IN3	3	8 OUT1
IN1	4	7 OUT2
IN2	5	6 GND

(Top View)

Package Dimensions

unit : mm (typ)

3086B

SANYO : MFP10S(225mil)

Pd max – Ta

Mounted on a specified board : 114.3mm x 76.1mm x 1.6mm glass epoxy

Allowable power dissipation,Pd max - W

Ambient temperature, Ta – °C

Recommended Soldering Footprint

(Unit:mm)

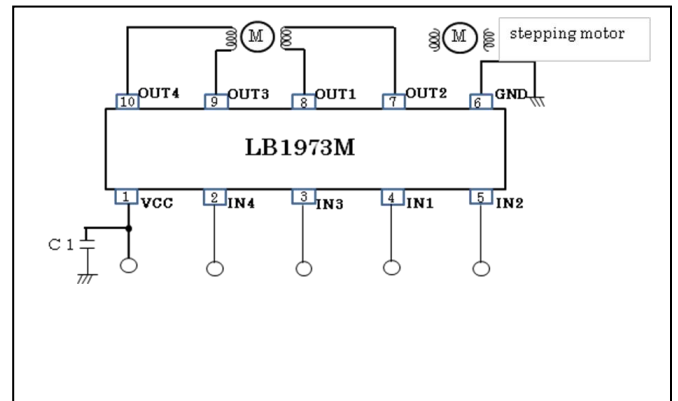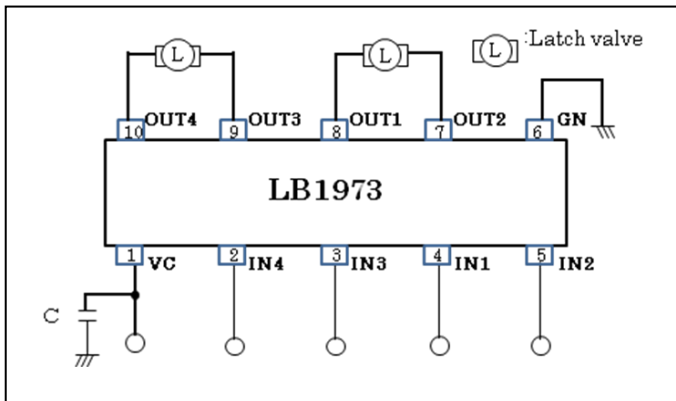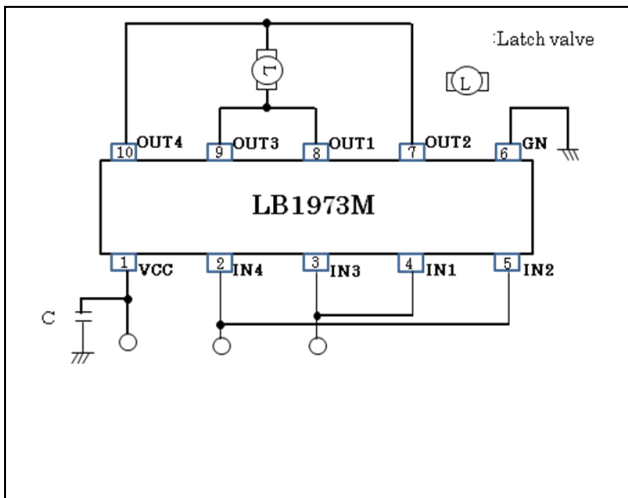| Reference Symbol	MFP10S (225mil)
eE	5.70
e	1.00
b3	0.47
l1	1.10
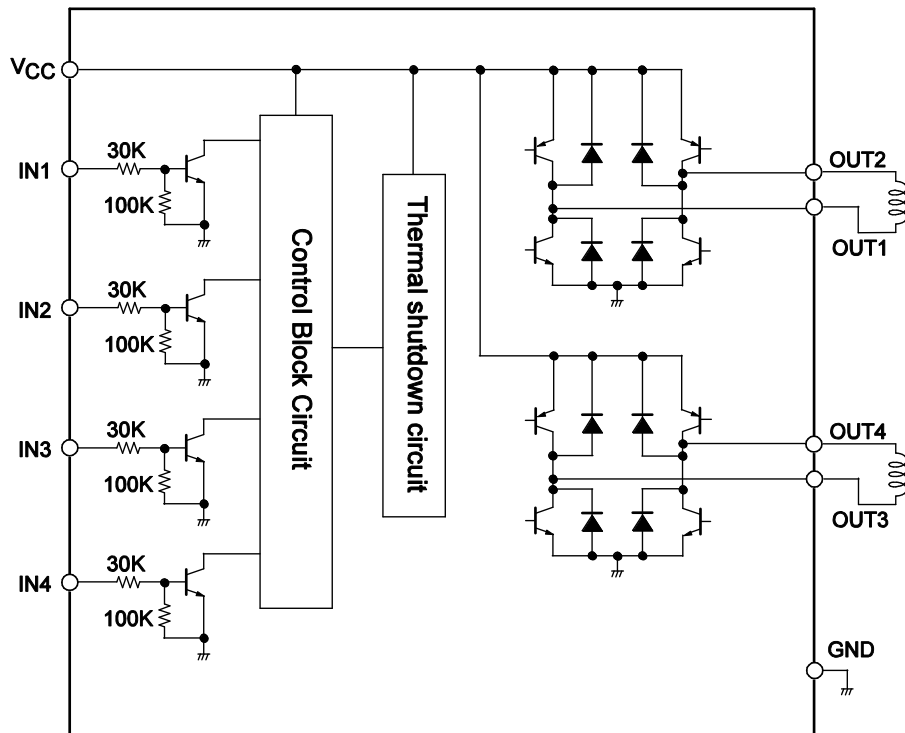
Block Diagram

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

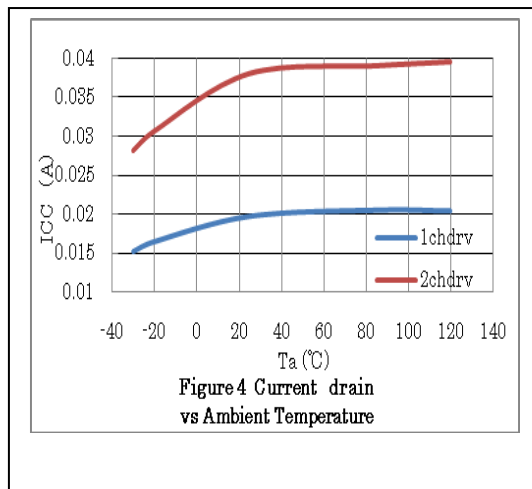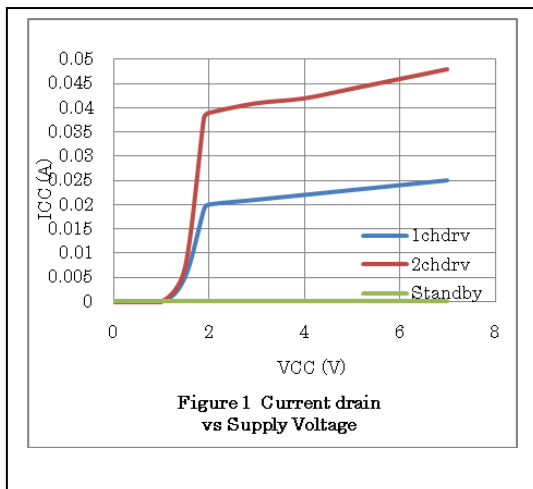| Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		-0.3 to +8.0	V
Output voltage	V_{OUT} max		-0.3 to $V_{CC}+V_{SF}$	V
Input voltage	V_{IN} max	CONT, IN	-0.3 to +8.0	V
Ground pin source current	I_{GND}	Per channel	1000	mA
Allowable power dissipation	Pd max1	For Unit	350	mW
	Pd max2	Mounted on a circuit board.*	870	mW
Operating temperature	Topr		-20 to +85	°C
Storage temperature	Tstg		-40 to +150	°C

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

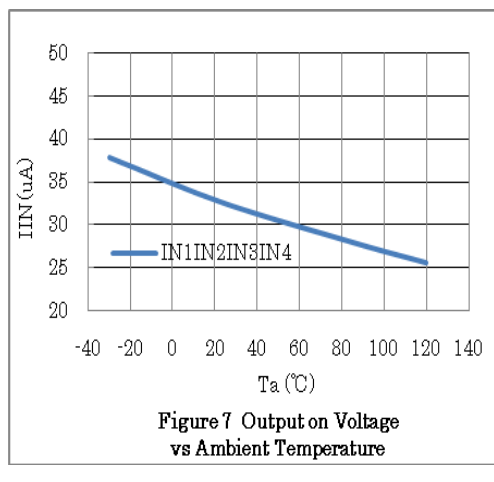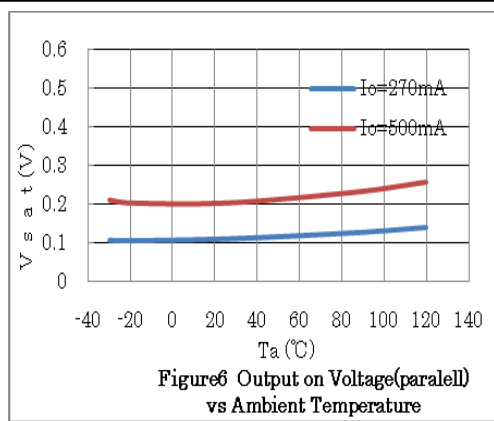### Allowable Operating Ratings at Ta = 25°C

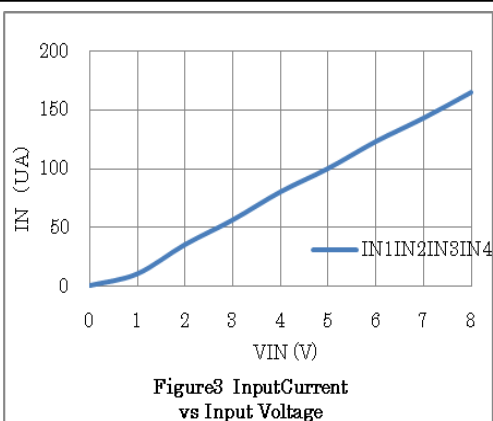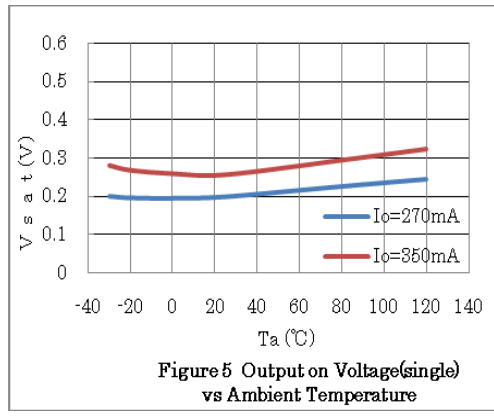| Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC}		1.8 to 7.5	V
High-level input voltage	V_{IH}		1.3 to 7.5	V
Low-level input voltage	V_{IL}		-0.3 to +0.5	V

Electrical Characteristics at Ta = 25°C, V_{CC} = 1.9V
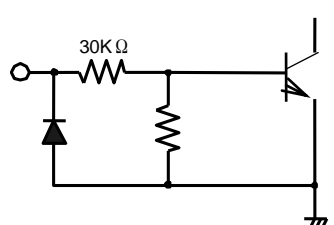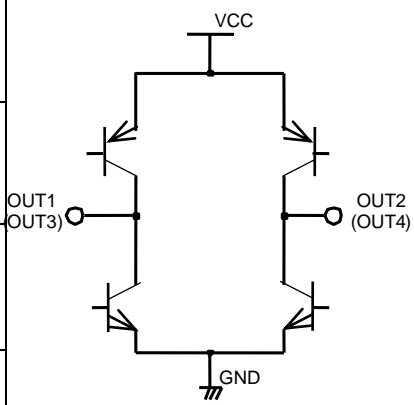
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Source current	$I_{CCO}1$	V_{CC} = 1.9V,IN1 to IN4 = 0V		0.01	1	μA
	$I_{CCO}2$	V_{CC} = 3V,IN1 to IN4 = 0V		0.01	1	μA
	$I_{CC}1$	IN1 = 1.9V,IN2 to IN4 = 0V		18	25	mA
	$I_{CC}2$	IN1 = 3V,IN2 to IN4 = 0V,V_{CC} = 3V		19	26	mA
Output saturation voltage1 (single connection)	$V_{OUT}11$	I_{OUT} = 270mA,V_{CC} = 1.9V to 3.6V,V_{OUT} = 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
	$V_{OUT}12$	I_{OUT} = 350mA,V_{CC} = 1.9V to 3.6V,V_{OUT} = 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)	$V_{OUT}21$	I_{OUT} = 270mA,V_{CC} = 1.9V to 3.6V,V_{OUT} = 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
	$V_{OUT}22$	I_{OUT} = 500mA,V_{CC} = 1.9V to 3.6V,V_{OUT} = 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_{IN}	V_{IN} = 1.9V		32	70	μA
Themal shutdown operation temperature	Ttsd			140		°C
Temperature hysteresis width	ΔT			20		°C
Spark killer Diode						
Reverse current	I_S(leak)	V_{CC}-OUT = 8V,V_{IN} = 0V			10	μA
Forword voltage	V_{SF}	I_{OUT} = 400mA,V_{IN} = 0V			1.7	V

Figure 1 Current drain vs Supply Voltage

Figure 4 Current drain vs Ambient Temperature

Figure 2 Output on Voltage
vs Output Current

Figure 5 Output on Voltage(single)
vs Ambient Temperature

Figure3 InputCurrent
vs Input Voltage

Figure6 Output on Voltage(paralell)
vs Ambient Temperature

Figure 7 Output on Voltage
vs Ambient Temperature
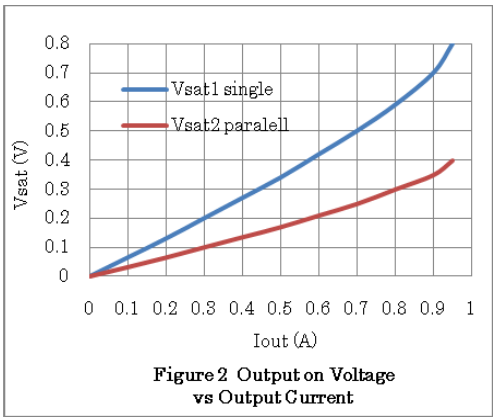
Pin function

Pin No.	Pin name	Pin function	Equivalent Circuit
1	V$_{CC}$	Power-supply voltage pin. V$_{CC}$ 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).	
4	IN1	Motor drive control input pin. Driving control input pin of OUT1 (8pin) and OUT2 (7pin). It combines with IN2 pin (5pin) 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.	
5	IN2	Motor drive control input pin. Driving control input pin of OUT1 (8pin) and OUT2 (7pin). It combines with IN1 pin (4pin) 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 (9pin) and OUT4 (10pin). It combines with IN4 pin (2pin) 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 (9pin) and OUT4 (10pin). It combines with IN3 pin (3pin) and it uses it. PWM can be input. With built-in pull-down resistance.	
6	GND	Ground pin.	
10	OUT4	Driving output pin. The motor coil is connected between terminal OUT3 (9pin).	
9	OUT3	Driving output pin. The motor coil is connected between terminal OUT4 (10pin).	
7	OUT2	Driving output pin. The motor coil is connected between terminal OUT1 (8pin).	
8	OUT1	Driving output pin. The motor coil is connected between terminal OUT2 (7pin).	

Operation explanation

1. LB1973M 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 LB1973M is stopped.

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

Figure . Latch valve sequence timing chart
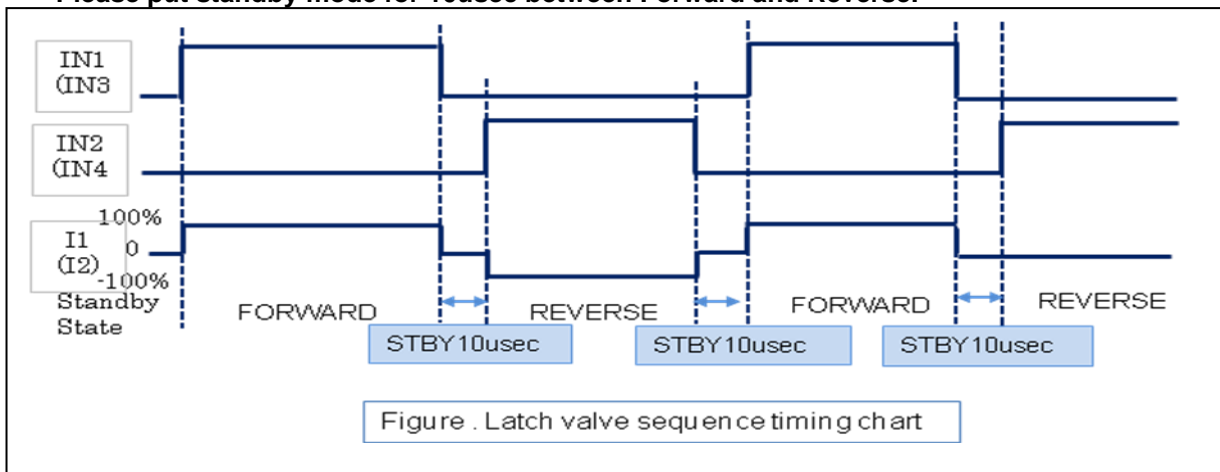
3. Stepping motor operation sequence

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

2 phase excitation

1-2 phase excitation
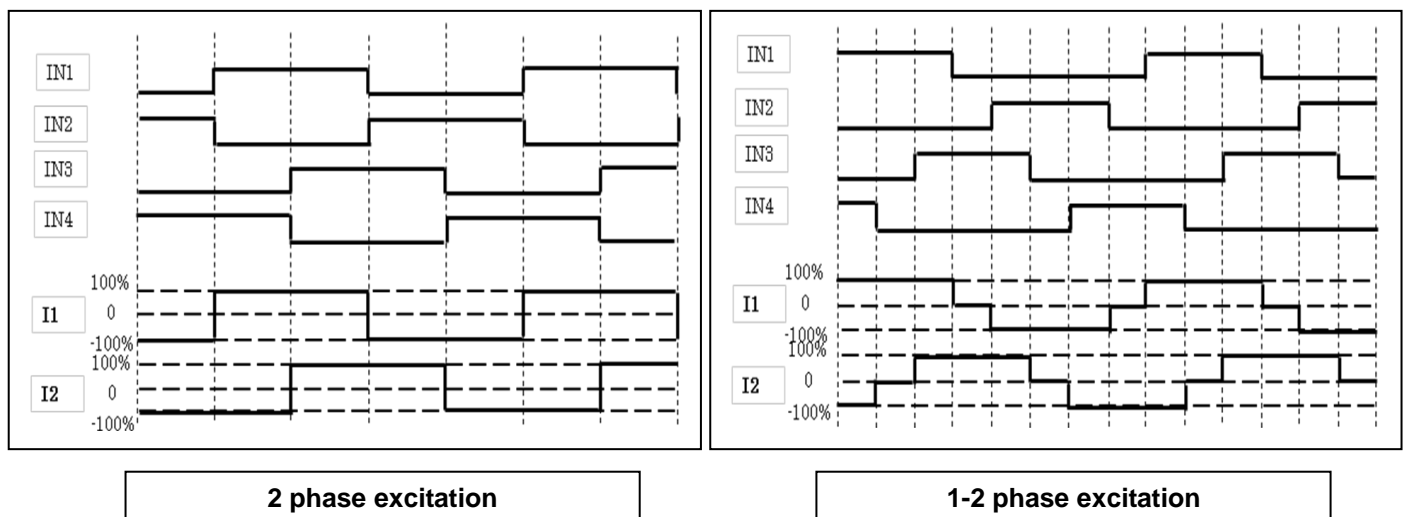
4. Theory

• Full-Step MODE

The motor moves 90 degrees in an electric corner when I input 1Step.
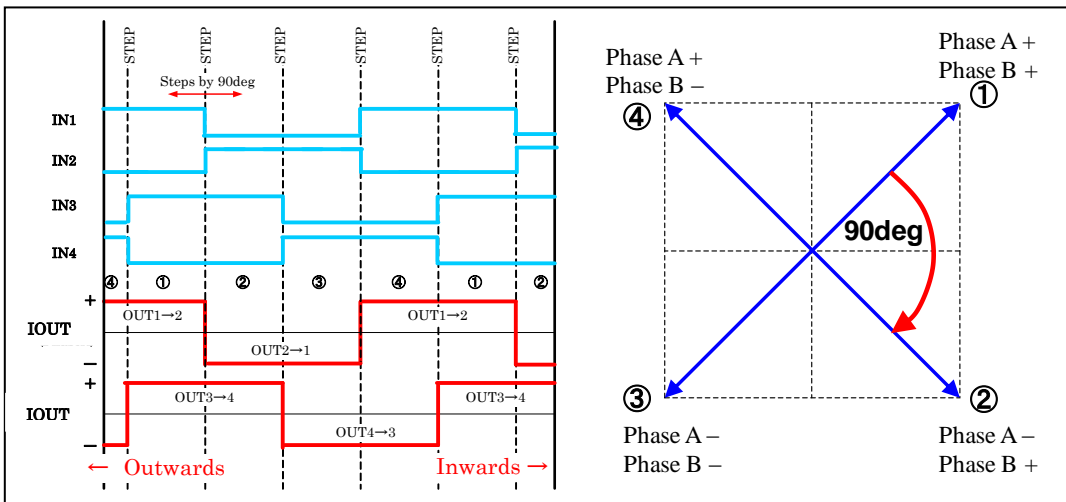
▪ Half-Step MODE

The motor moves 45 degrees in an electric corner when I input 1Step
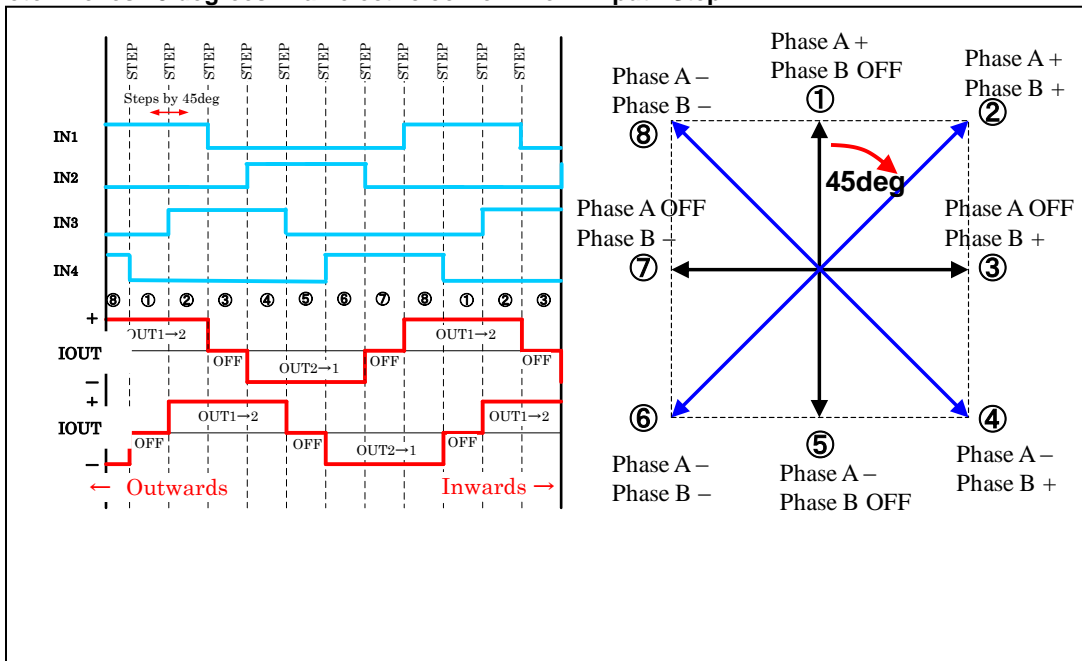
5. Thermal Shutdown circuit

The thermal shutdown circuit in incorporated and the output is turned off when junction temperature Tj exceeds 140°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°C (typ)

ΔTSD = 20°C (typ)

Application Circuit Another Example

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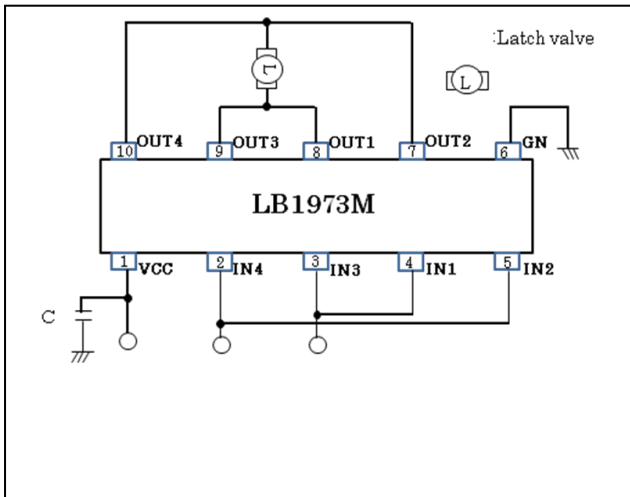
Eva-Board Manual

1. Eva-Board circuit diagram
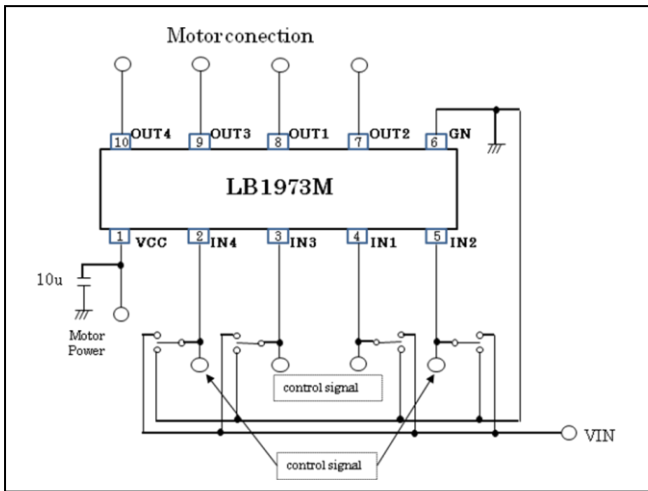
Bill of Materials for LB1973M Evaluation Board

Designator	Qty	Description	Value	Tol	Footprint	Manufacturer	Manufacturer Part Number	Substitution Allowed	Lead Free
IC1	1	Motor Driver			MFP10S (225mil)	SANYO semiconductor	LB1973M	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

2-1. Eva-Board photograph
(1)Two latch valve drive
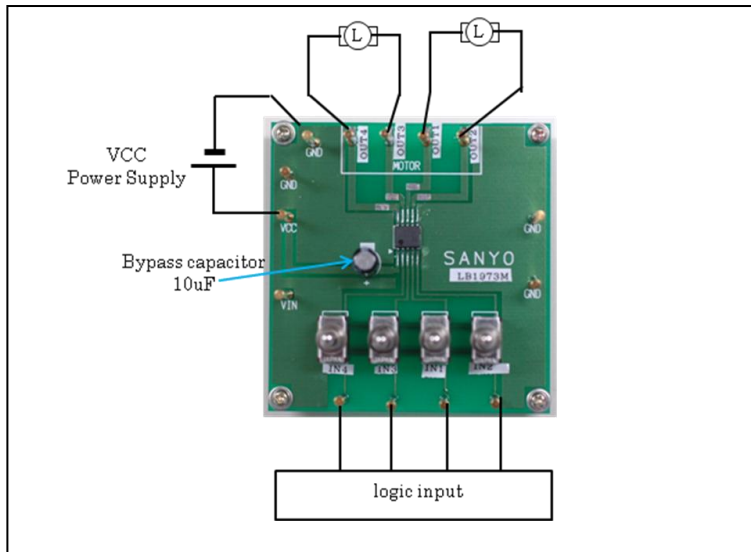
- Connect OUT1 and OUT2, OUT3 and OUT4 to a Latch valve each.
- Connect the motor power supply with the terminal VCC, the control power supply with the terminal VIN. Connect the GND line with the terminal GND.
- Latch valve becomes the predetermined output state corresponding to the input state by inputting an input signal such as the following truth value table into IN1~IN4.

Waveform of LB1973M evaluation board when driving Latch valve.
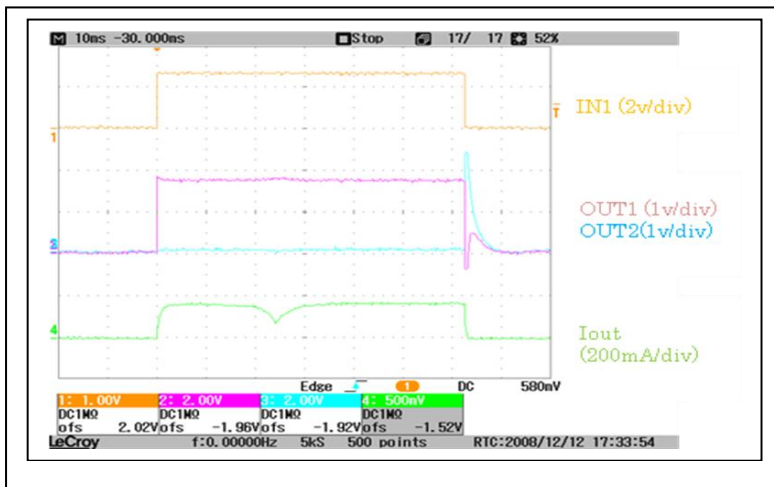
(2) One stepping motor drive
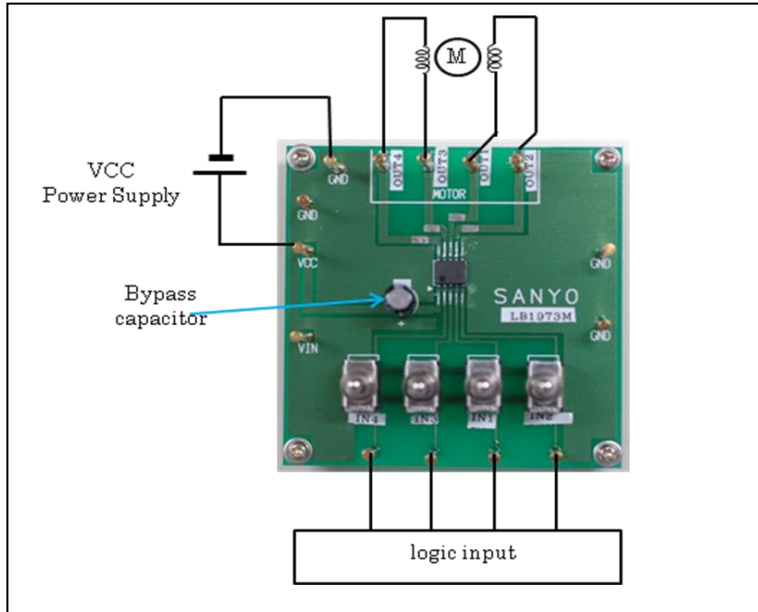
- Connect a stepping motor with OUT1, OUT2, OUT3 and OUT4.
- Connect the motor power supply with the terminal VCC, the control power supply with the terminal VIN. Connect the GND line with the terminal GND.
- STP motor drives it in an 2 phase excitation, 1-2 phase excitation by inputting an input signal such as follows into IN1~IN4.

Waveform of LB1973M evaluation board when driving stepping motor
- Full-Step Drive   VCC=5V, 1000pps
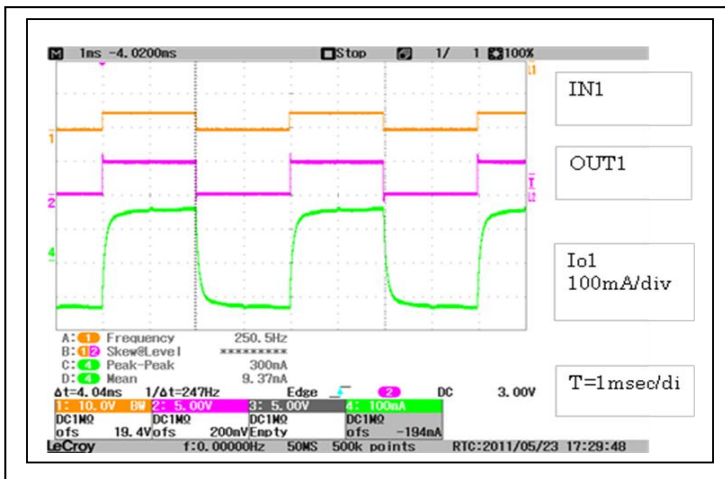
•Half-Step Drive　VCC=5V, 1600pps

This catalog provides information as of May, 2011. Specifications and information herein are subject to change without notice.