LB1848MC

Monolithic Digital IC

ON Semiconductor®

http://onsemi.com

Low-Voltage/Low Saturation Voltage Type Bidirectional Motor Driver

Application Note

Overview

The LB1848MC is a 2-channel low-voltage, low saturation voltage type bidirectional motor driver IC that is optimal for use as 2-phase stepping motor driver in printers, floppy disk drives, cameras and other portable equipments. The output circuits are of the bipolar type, with pnp transistors in the upper side and npn transistors in the lower side, and they achieve low saturation output and low power characteristics despite being provided in a miniature package.

The LB1848MC can directly control a motor from signals from a microcontroller. The LB1848M is optimal for 2-phase excitation drive for 2-phase stepping motors using 3-input logic (ENA, IN1, and IN2).

The LB1848MC has a built-in thermal shutdown circuit to protect itself from operating at exceedingly high temperature even if the IC outputs are shorted. Additionally, the MFP-10S miniature package used supports reduced-space mounting.

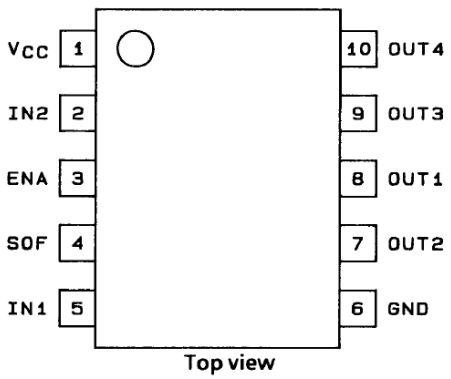
Function

- Optimal for 2 phase excitation drive for 2-phase stepping motor
- Low saturation voltage. VO(sat) = 0.55 V typical at IO = 400 mA
- Standby current: zero
- Thermal shutdown circuit
- Miniature package: MFP-10S (6.5 x 5.1 mm2)
- Through-current prevention circuit
- “Soft off” function that reduces power supply line noise when switching from drive to standby modes. (Requires the use of one external capacitor.)
- No limitations on the magnitude relationship between the power supply voltage (VCC) and the input voltage (VIN)

Typical Applications

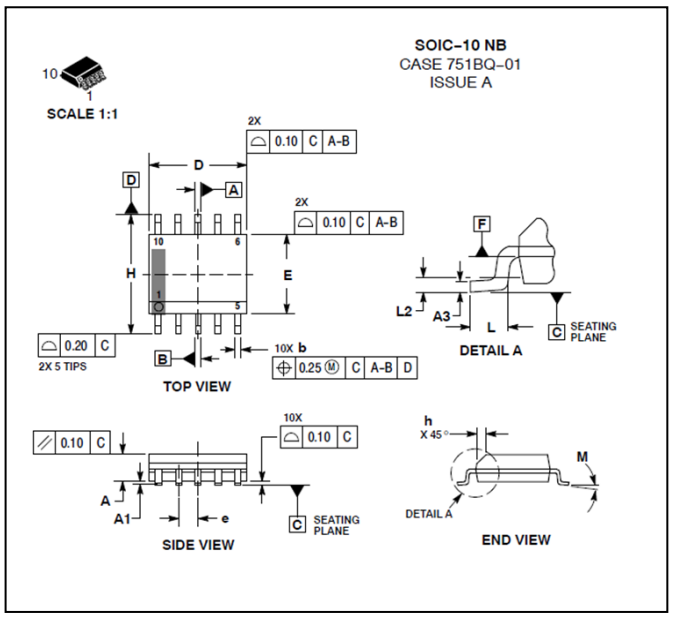
- Blu-ray pickup lens
- CCTV
- POS printer
- Security camera
- DSC

Pin Assignment

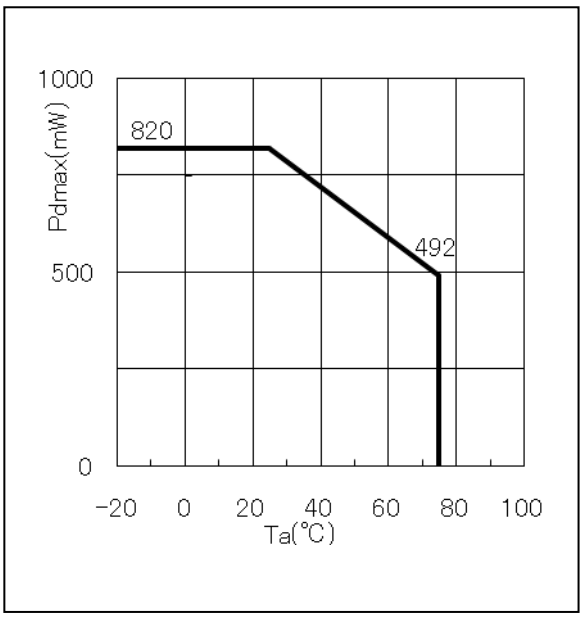


Package Dimensions

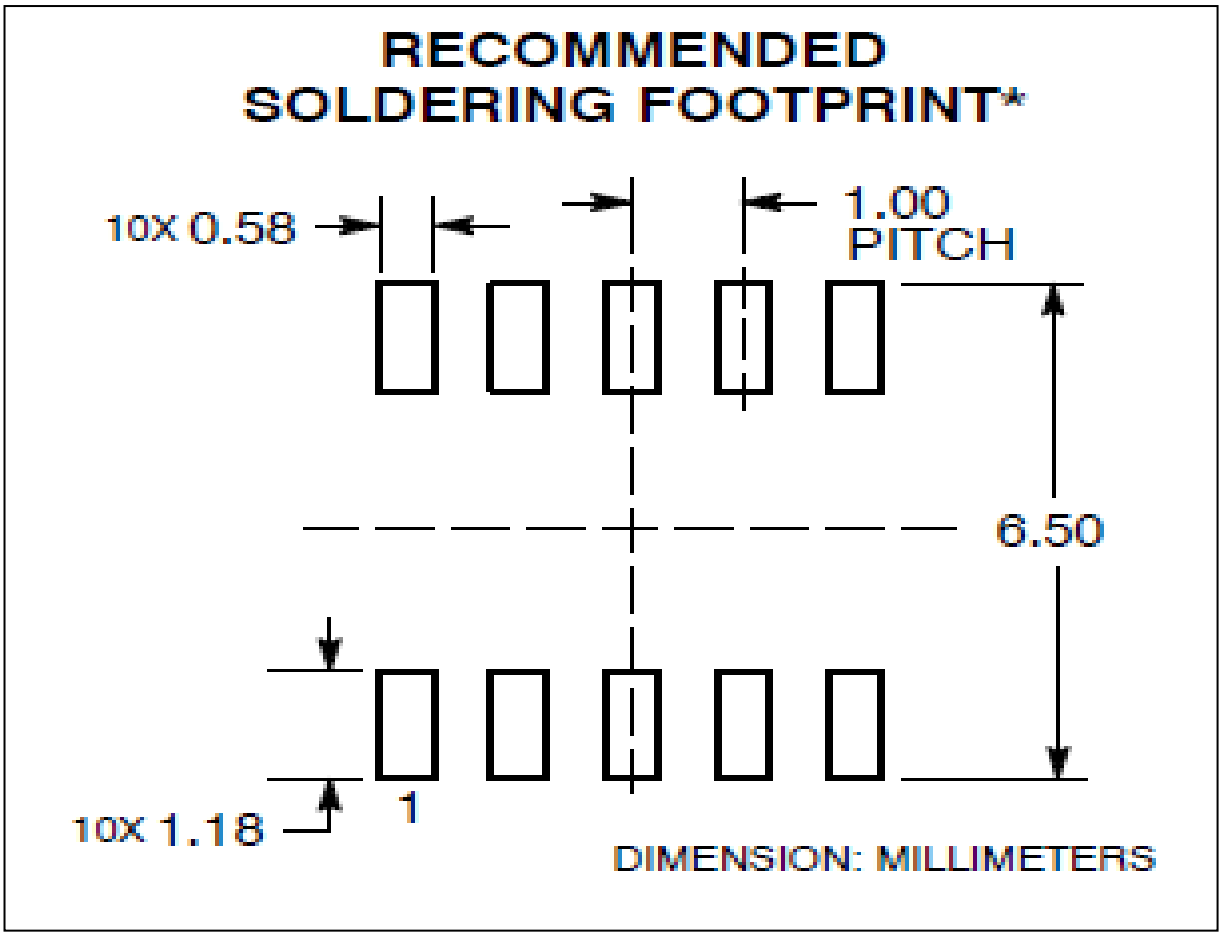
unit : mm (typ)



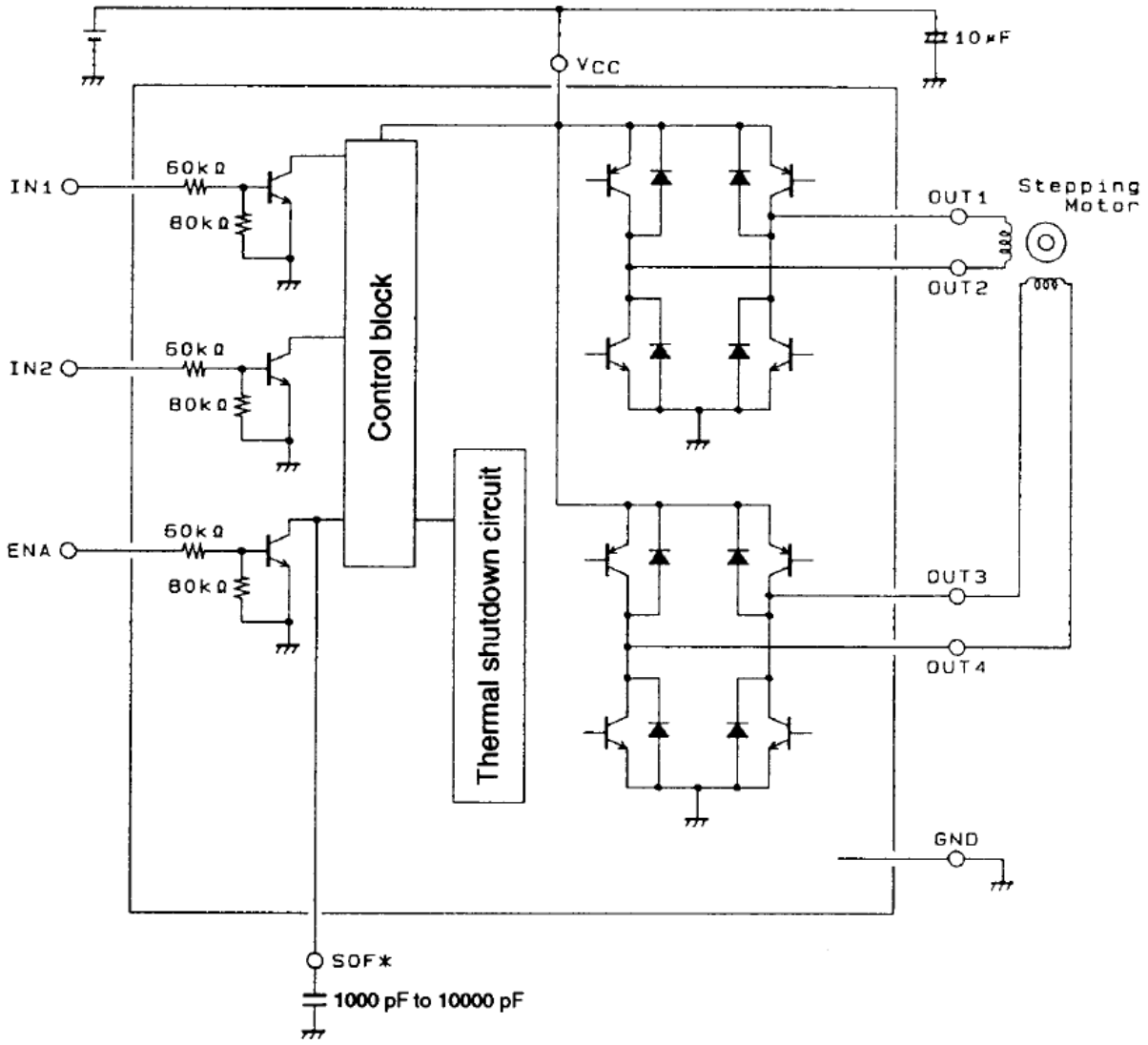
Pdmax-Ta



Recommended Soldering Footprint



Block Diagram



Note: When the “soft off” function is used, a capacitor must be connected to the SOF pin. If this function is not used, this pin must be left open with absolutely no signals or lines connected.

Notes on Wiring and Lines

Since large currents flow in the VCC and ground lines, oscillations may occur on these lines. The following points should be observed if such oscillations occur.

(1) Lower the line impedances by making them shorter and thicker.

(2) Attach capacitors close to the IC.

(3) If the controller (CPU) is mounted on a separate printed circuit board, insert series resistors (of about 10kohm) between the controller outputs and this IC.

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}		$V_{CC}+V_{SF}$	V
Input voltage	V_{IN}		-0.3 to +8.0	V
Ground pin outflow current	I_{GND}	Per channel	800	mA
Allowable power dissipation	Pd max1	Independent IC	350	mW
	Pd max2	When mounted.*	870	mW
Operating temperature	Topr		-20 to +75	°C
Storage temperature	Tstg		-40 to +150	°C

Note: * On the specified circuit board (114.3mm×76.2mm×1.5mm, glass epoxy printed circuit 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}		2.5		7.5	V
Input high-level voltage	V_{IH}		2.0		7.5	V
Input low-level voltage	V_{IL}		-0.3		+0.7	V

Electrical Characteristics at Ta = 25°C, V_{CC} = 5.0V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain	$I_{CC}0$	ENA = 0V, V_{IN} = 3V or 0V		0.1	10	μA
	$I_{CC}1$	ENA = 3V, V_{IN} = 3V or 0V		25	35	mA
Output saturation voltage	$V_{OUT}1$	ENA = 3V, V_{IN} = 3V or 0V, V_{CC} = 3 to 7.5V, I_{OUT} = 200mA		0.27	0.4	V
	$V_{OUT}2$	ENA = 3V, V_{IN} = 3V or 0V, V_{CC} = 4 to 7.5V, I_{OUT} = 400mA		0.55	0.8	V
Input current 1	I_{IN}	V_{IN} = 5V		75	100	μA
Input current 2	I_{ENA}	ENA = 5V		85	110	μA
Spark killer Diode						
Reverse current	I_S(leak)				30	μA
Forward voltage	V_{SF}	I_{OUT} = 400mA			1.7	V

Note: The thermal shutdown circuit function values are design guarantees, and are not tested.

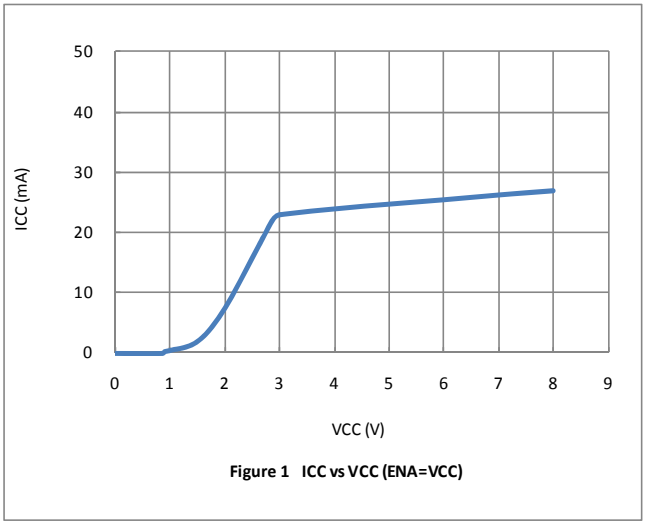


Figure 1 ICC vs VCC (ENA=VCC)

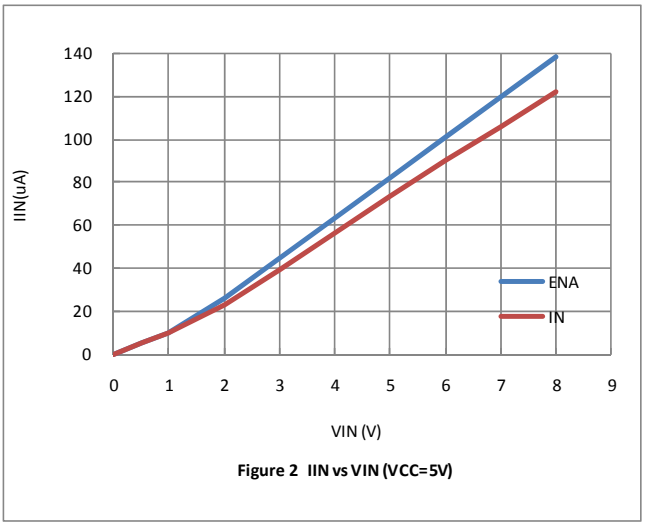


Figure 2 IIN vs VIN (VCC=5V)

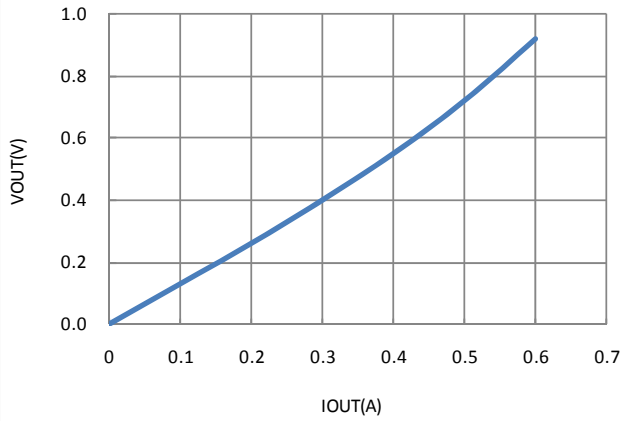


Figure 3 VOUT vs IOUT (VCC=VIN=4V)

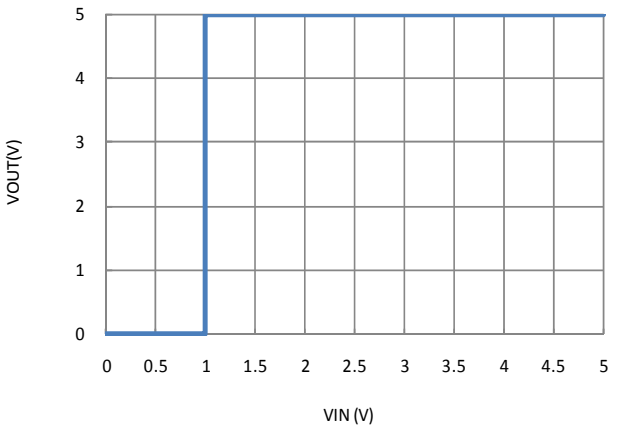


Figure 4 VOUT vs VIN (VCC=3.3V,VM=5V)

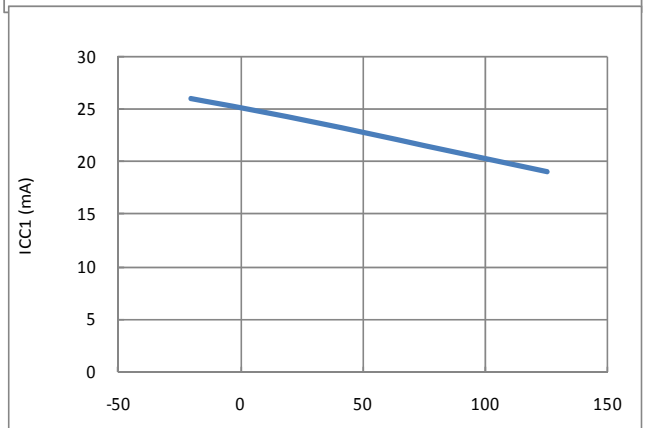


Figure 5 ICC1 vs Temperature (VCC=ENA=5V)

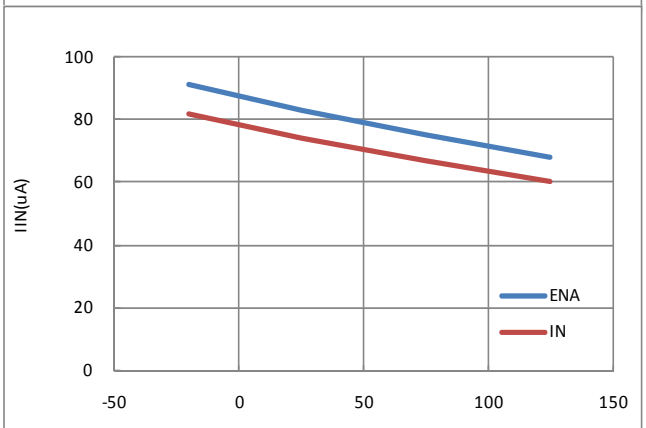


Figure 6 IIN vs Temperature (VCC=VIN=5V)

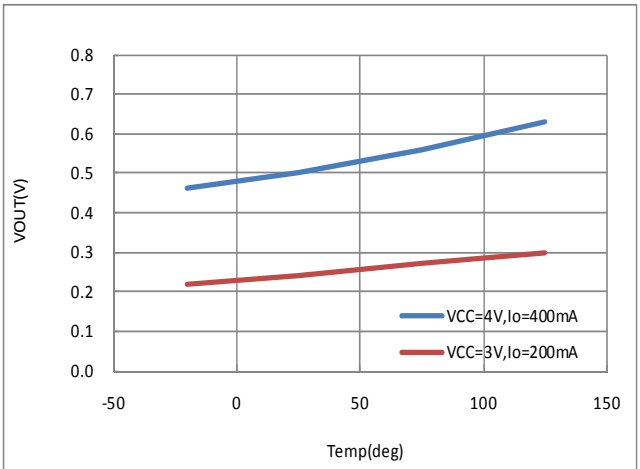
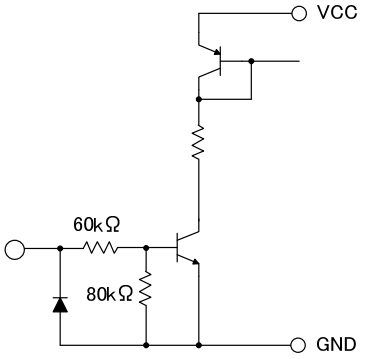
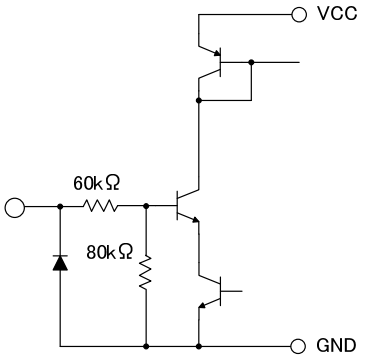
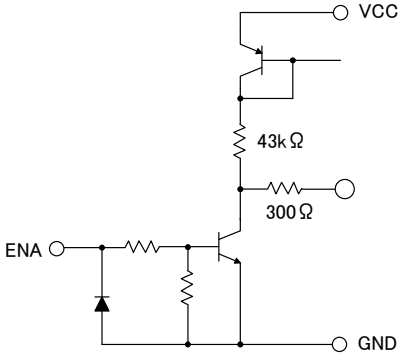
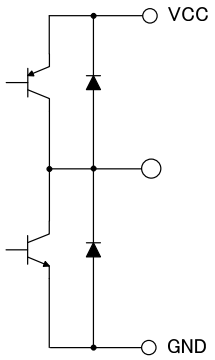


Figure 7 VOUT vs Temperature (VCC=VIN)

Pin Functions

Pin No.	Pin name	Pin Function	Equivalent Circuit
3	ENA	Control signal input pin	
5 2	IN1 IN2	Control signal input pin Control signal input pin	
4	SOF	Capacitor connection pin	
8 7 9 10	OUT1 OUT2 OUT3 OUT4	Outpin Outpin Outpin Outpin	
1	V_{CC}	Power supply voltage pin	
6	GND	Ground pin	

Truth Table

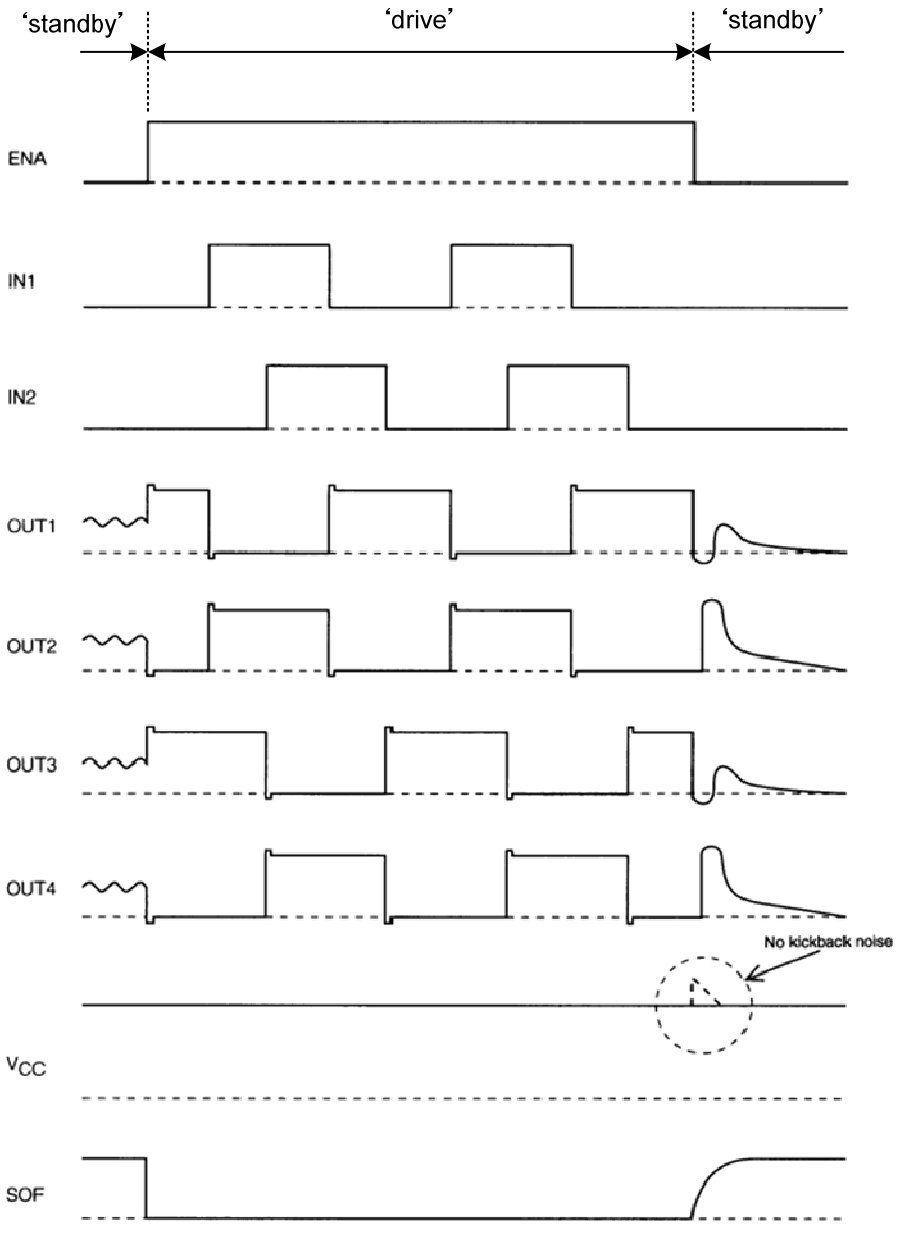
ENA	IN1	IN2	OUT1	OUT2	OUT3	OUT4	Notes
L	-	-	OFF	OFF	OFF	OFF	Standby
H	L	L	H	L	H	L	2-phase excitation
	L	H	H	L	L	H	
	H	H	L	H	L	H	
	H	L	L	H	H	L	

Note: " - " indicates a "don't care" input.

SOF Pin ("Soft Off" Function) Operation

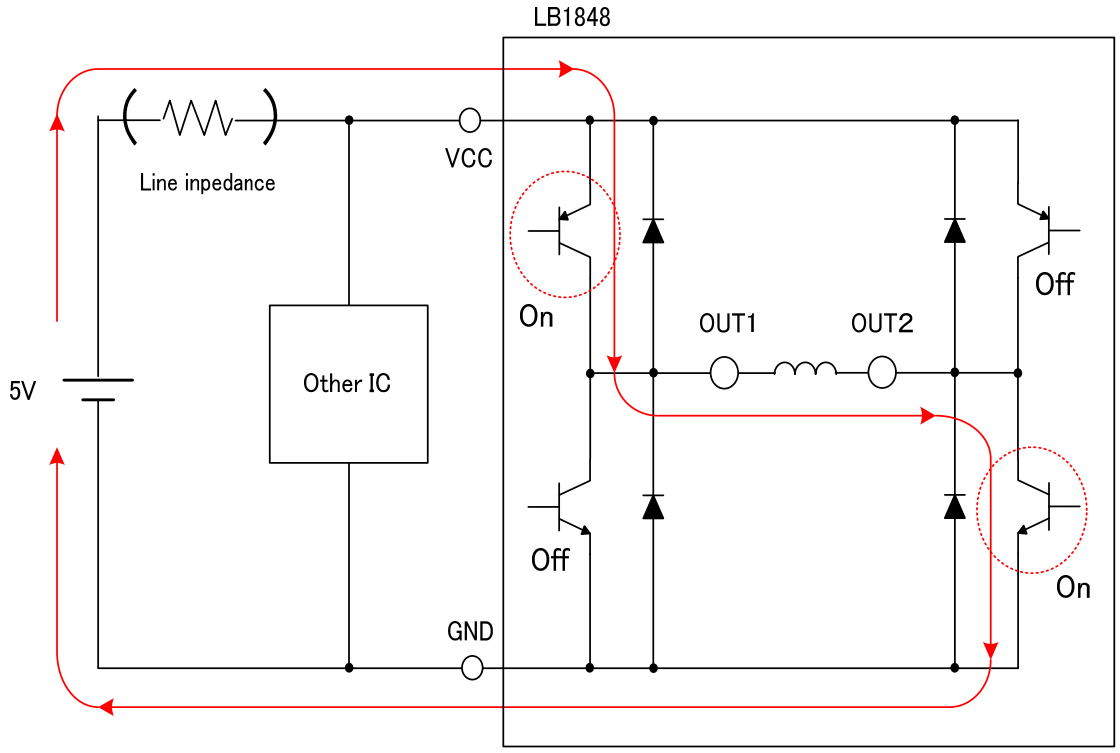
The soft off function reduces power supply line noise due to the kickback current generated when the stepping motor drive mode is switched from drive to standby. The "soft off" function provided by this IC operates when a capacitor (0.001 to 0.01 µF) is connected between the SOF pin and ground. (Leave the SOF pin open to disable the soft off function.)
The waveforms for each pin are shown below.

- Timing chart for stepping motor 2phase excitation

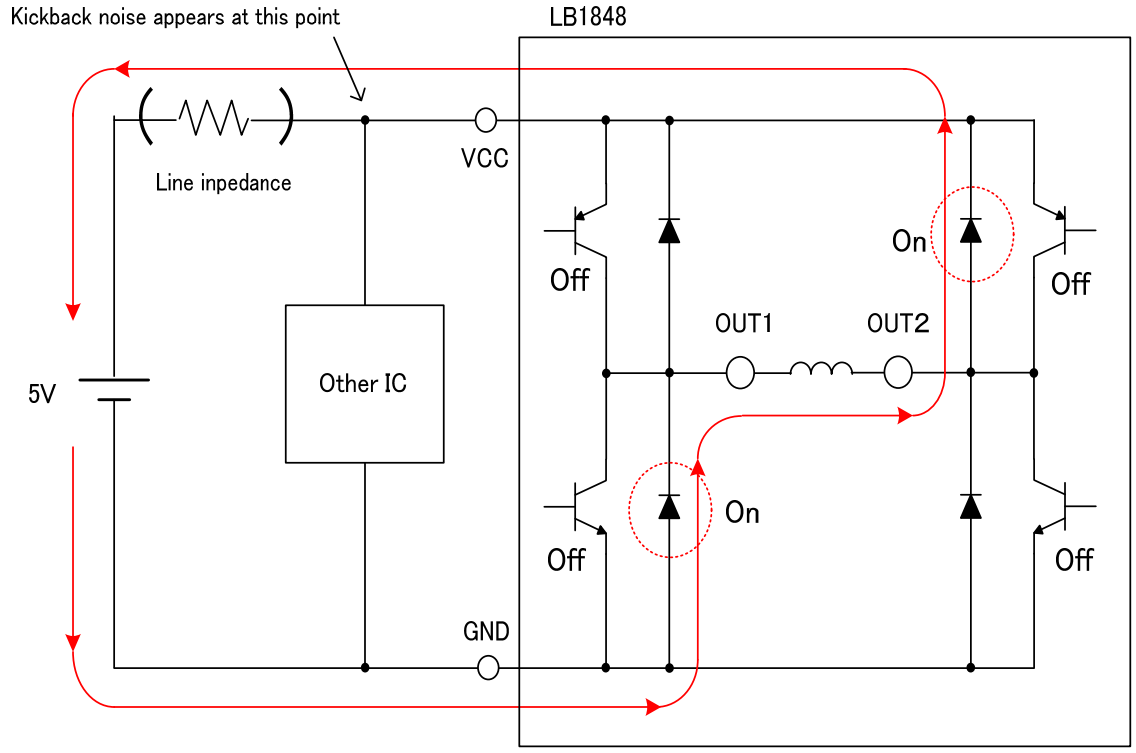


*Mechanism of the kickback noise generation

・Drive current path (in 'drive' mode)

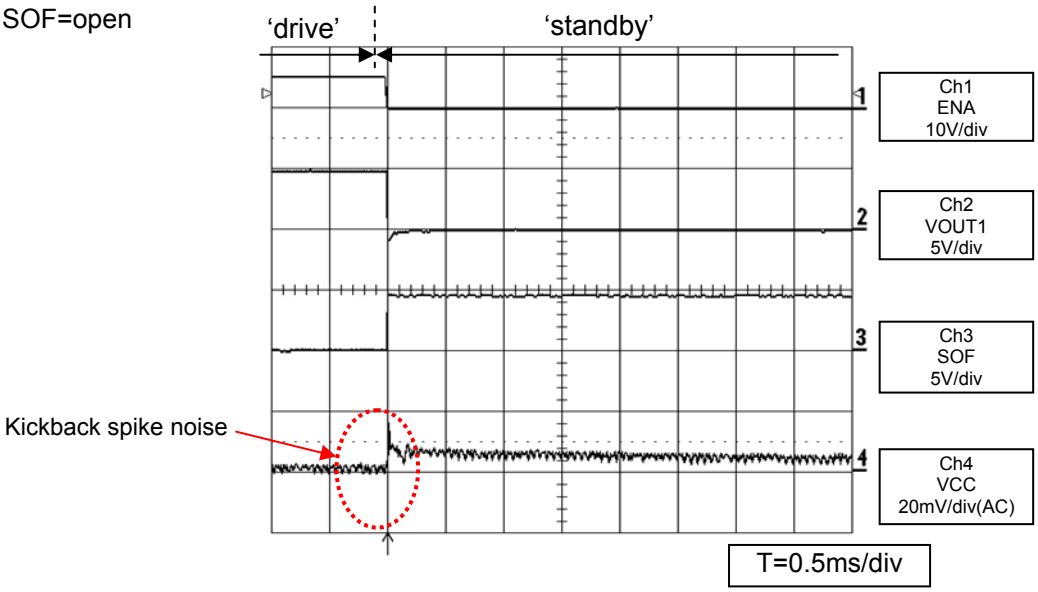


・Kickback current path (in 'standby' mode)



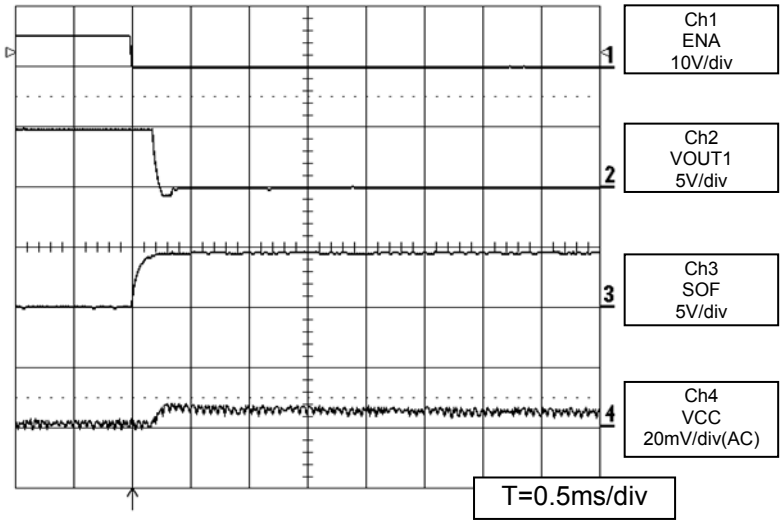
*) Effect of the SOF function

- SOF=open

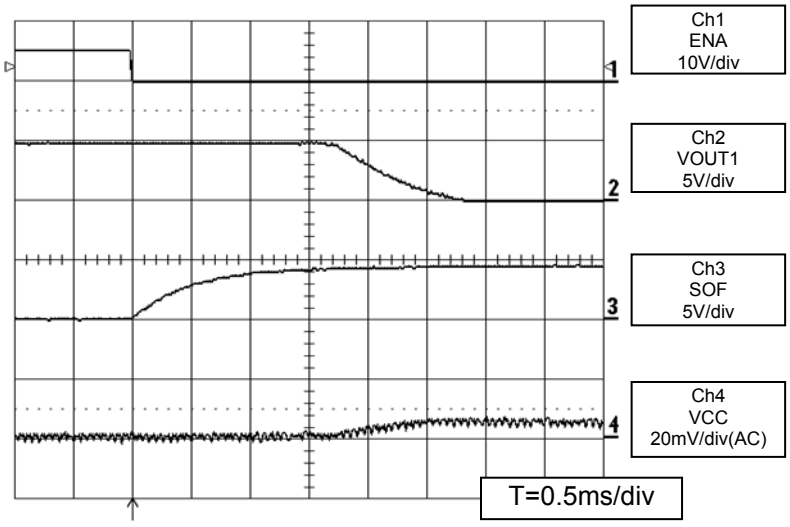


VCC=5V, 2phase excitation

- SOF-GND: 0.01uF



- SOF-GND: 0.1uF



Operation explanation

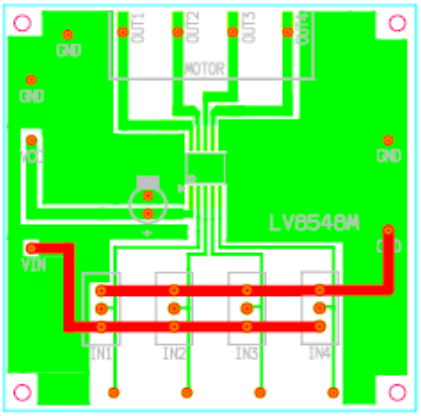
- Overheating protection function (Thermal Shutdown circuit)
  The device has a built-in overheating protection circuit that turns-off when the junction temperature (Tj) exceeds 180C. Once the temperature decreases below 140C, the device is turned on again (automatic restoration). The overheating protection circuit hysteresis is 40C.

  The overheating protection circuit doesn't secure protection and the destruction prevention of the set because it becomes operation by the area where ratings Tjmax = 150°C of the junction temperature was exceeded.

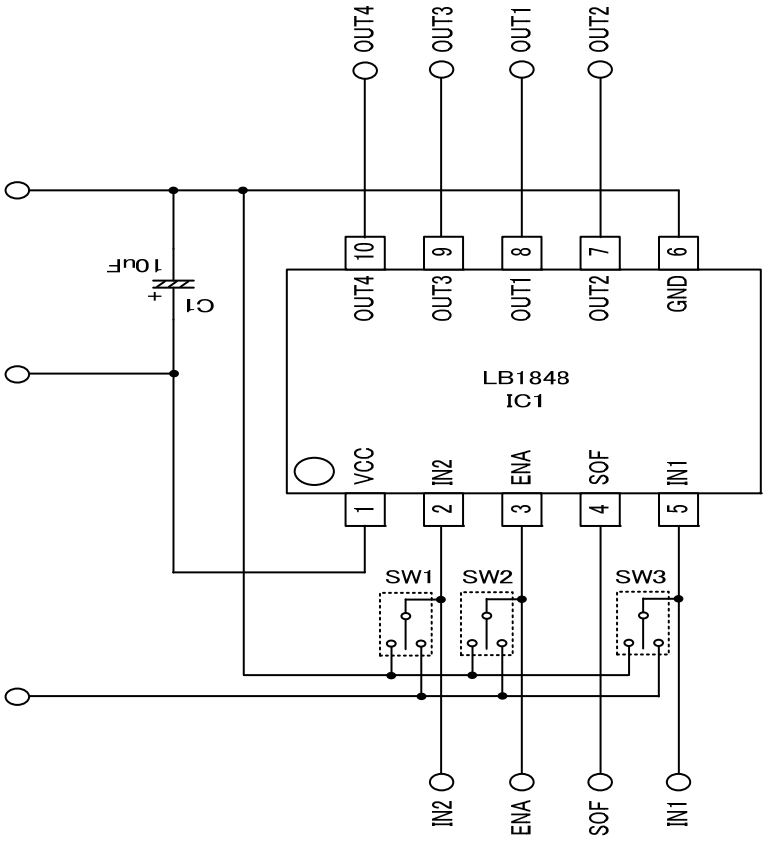
  TSD = 180°C (typ)
  ΔTSD = 40°C (typ)

Evaluation board manual

- Overview



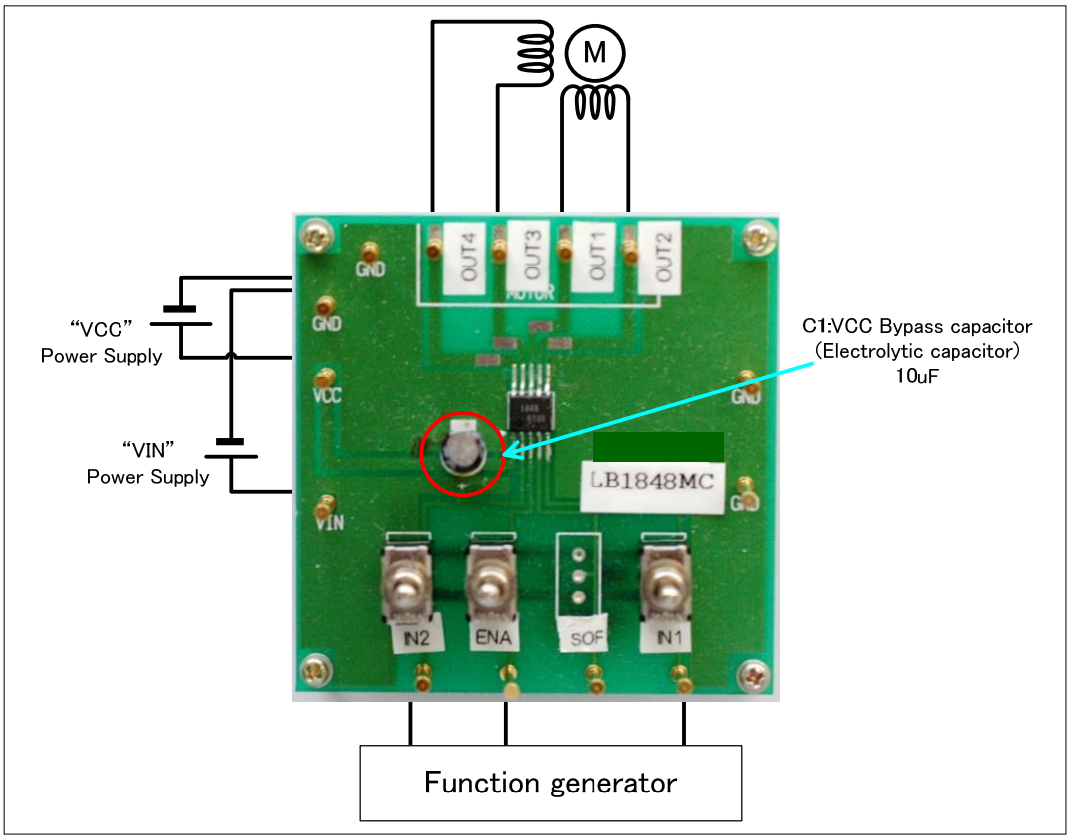
- Circuit diagram



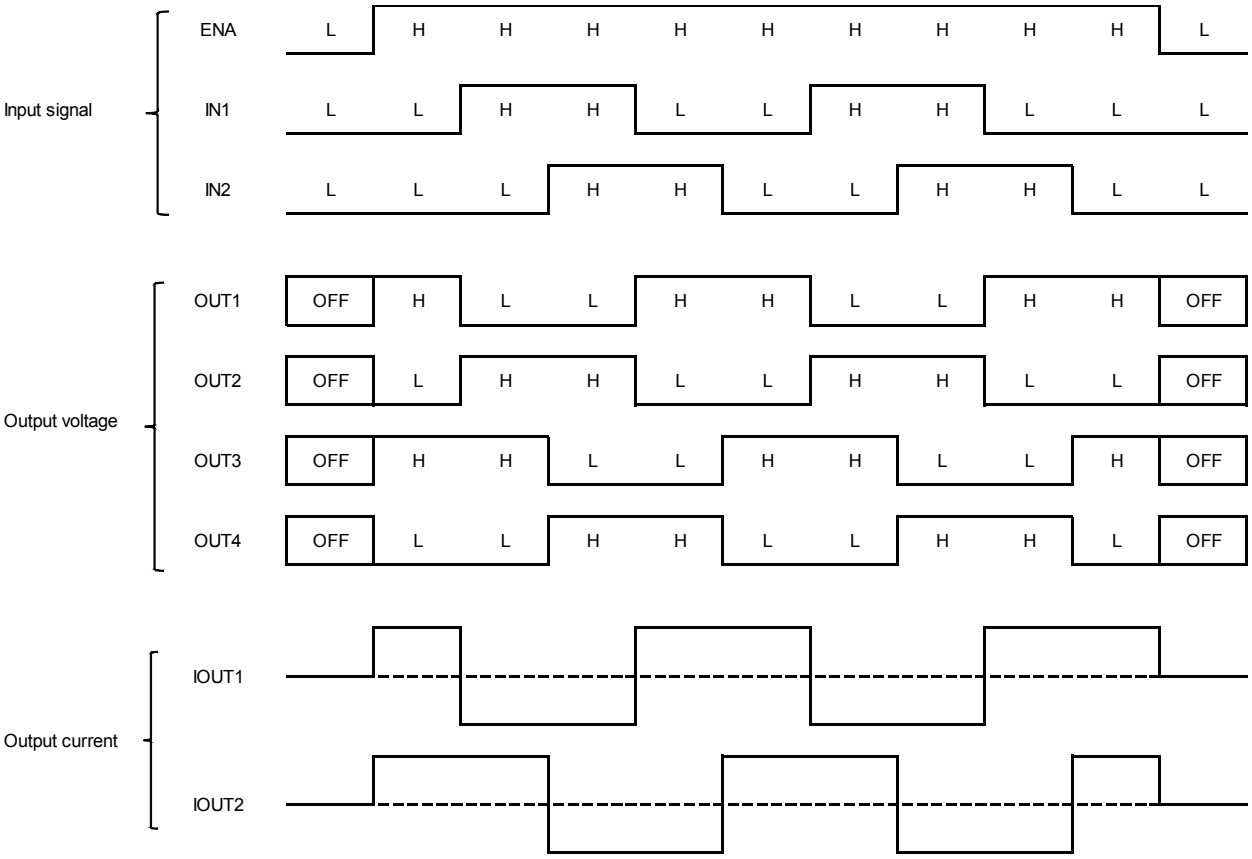
Bill of Materials for LB1848MC Evaluation Board

Designator	Qty	Description	Value	Tol	Footprint	Manufacturer	Manufacturer Part Number	Substitution Allowed	Lead Free
IC1	1	Motor Driver			MFP10S (225mil)	ON semiconductor	LB1848MC	No	Yes
C1	1	VCC Bypass capacitor	10μF 50V	±20%		SUN Electronic Industries	50ME10HC	Yes	Yes
SW1-SW3	3	Switch				MIYAMA Electric	MS-621C-A01	Yes	Yes
TP1-TP11	11	Test points				MAC8	ST-1-3	Yes	Yes

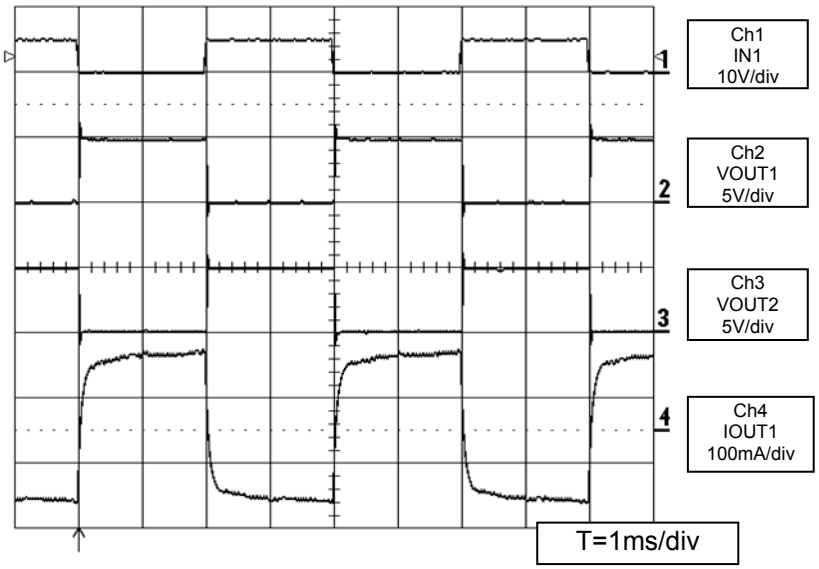
- Stepping motor driving method



- 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.
- The Stepping motor is drived in 2-phase excitation by inputting signals into ENA, IN1 and IN2(Refer to the waveform diagram below)
- Check the stepping motor is rotating.
- Check the waveform of the output voltage and current. (Please refer to the following waveform example.)



- Stepping motor driving waveform example



VCC=ENA=5V, SOF=open
2phase excitation, 1000pps