LV8549MC

ON Semiconductor®

http://onsemi.com

Bi-CMOS integrated circuit

12V Low Saturation Voltage Drive
Stepper Motor Driver
Application Note

Overview

The LV8549MC is a 2-channel low saturation voltage stepper motor driver IC. It is optimal for Full step motor drive in 12V system products.

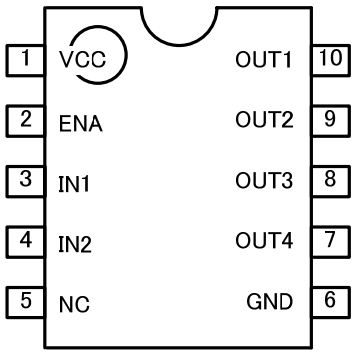
Function

- DMOS output transistor adoption (Upper and lower total RON=1Ω typ)
- The compact package (SOIC10) is adopted.
- V_{CC} max=20v, I_O max=1A
- For one power supply (The control system power supply is unnecessary.)
- Current consumption 0 when standing by

Typical Applications

- Refrigerators
- Time Recorder
- Label Printer
- Vacuum cleaner
- POS Printer
- TOY

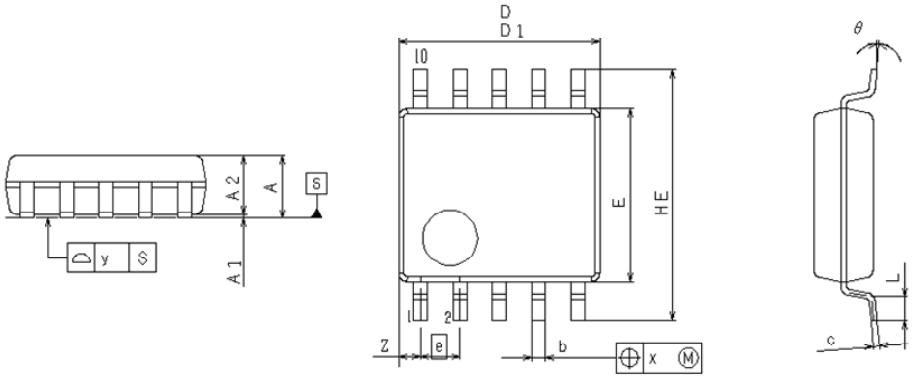
Pin Assignment



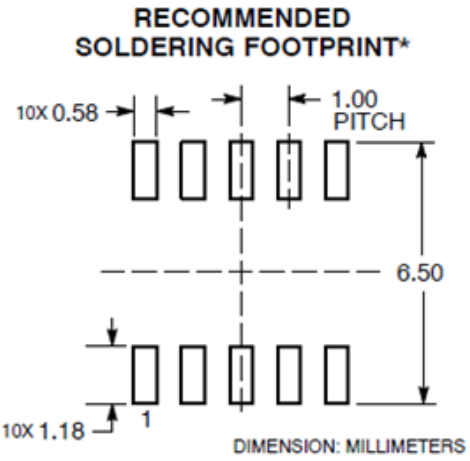
LV8549M

(Top View)

Package Dimensions



	SOIC10		
symbol	MIN.	NOM.	MAX.
D			
D1	4.80	<4.90>	5.00
A			1.75
A1	0.10	<0.175>	0.25
A2	1.25		1.75
e		1.00	
L	0.40	<0.835>	1.27
b	0.31	<0.41>	0.51
c	0.17	<0.21>	0.25
x		0.25	
y		0.10	
HE	5.80	<6.00>	6.20
E	3.80	<3.90>	4.00
Θ	0.00		8.00
Z			



Caution: The package dimension is a reference value, which is not a guaranteed value.

Block Diagram

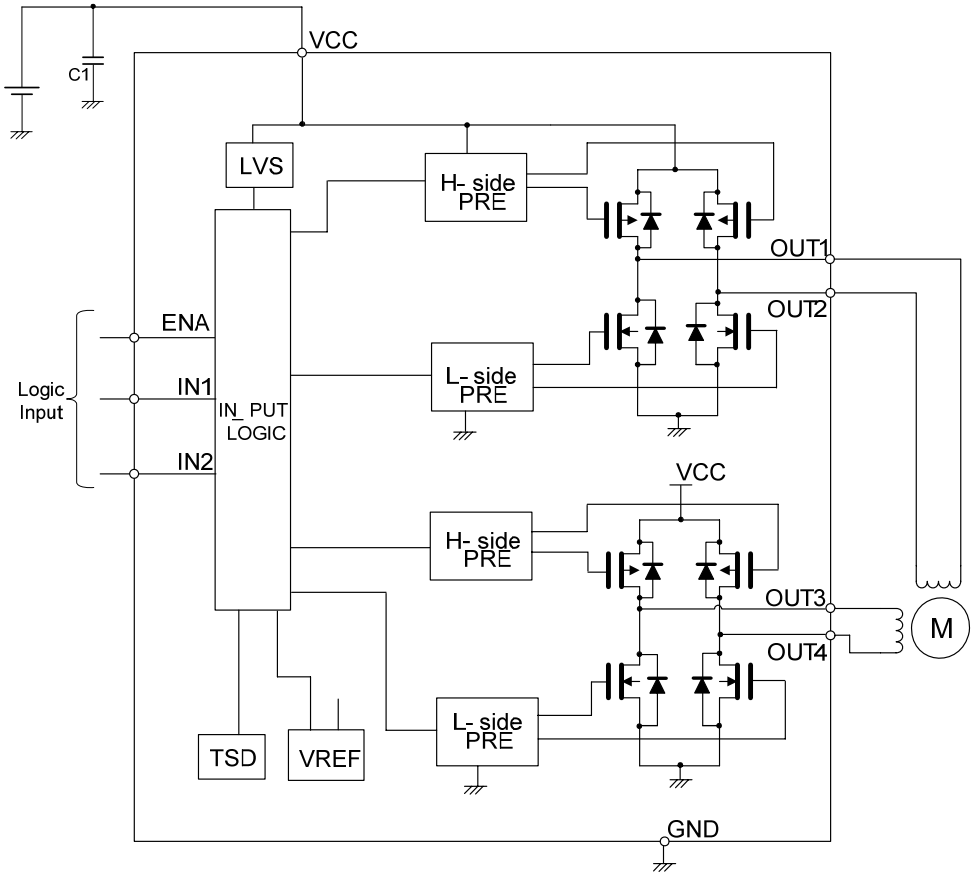


Figure1 One stepper motor drive

Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum power supply voltage	V_{CC} max		-0.3 to +20	V
Output impression voltage	VOUT		-0.3 to +20	V
Input impression voltage	V_{IN}		-0.3 to +6	V
GND pin outflow current	IGND	For ch	1.0	A
Allowable Power dissipation	Pd max	*	1.05	W
Operating temperature	Topr		-30 to +85	°C
Storage temperature	Tstg		-40 to +150	°C

*: When mounted on the specified printed circuit board (57.0mm ×57.0mm × 1.6mm), glass epoxy, both sides

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 Condition at Ta = 25°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply voltage	V_{CC}		4		16	V
Input “H” level voltage	$V_{IN}H$		+1,8		+5.5	V
Input “L” level voltage	$V_{IN}L$		-0.3		+0.7	V

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

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply voltage	$I_{CC}0$	Standby mode ENA=L			1	μA
	$I_{CC}1$	ENA=H		1.7	2.3	mA
Input current	I_{IN}	V_{IN}=5V	30	50	65	μA
Thermal shutdown operating temperature	Ttsd	Design certification	150	180	210	°C
Width of temperature hysteria	ΔTtsd	Design certification		40		°C
Low voltage protection function operation voltage	VthV_{CC}		3.3	3.5	3.65	V
Release voltage	Vthret		3.55	3.8	3.95	V
Output ON resistance (Upper and lower total)	R_{ON}	I_{OUT}=1.0A	0.7	1	1.25	Ω
Output leak current	$I_O$leak	V_O=16V			10	μA
Diode forward voltage	VD	ID=1.0A		1.0	1.2	V

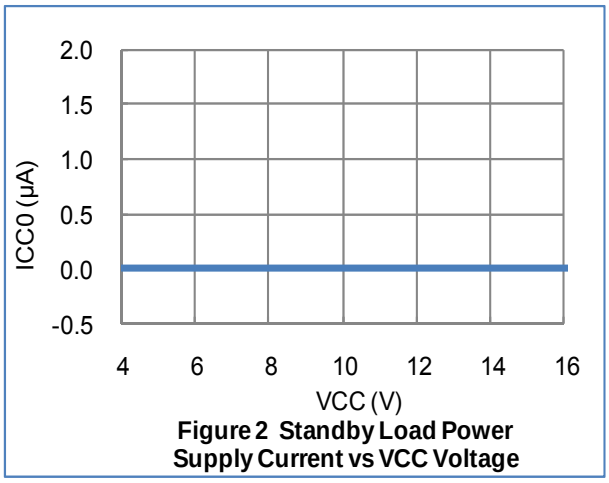


Figure 2 Standby Load Power Supply Current vs VCC Voltage

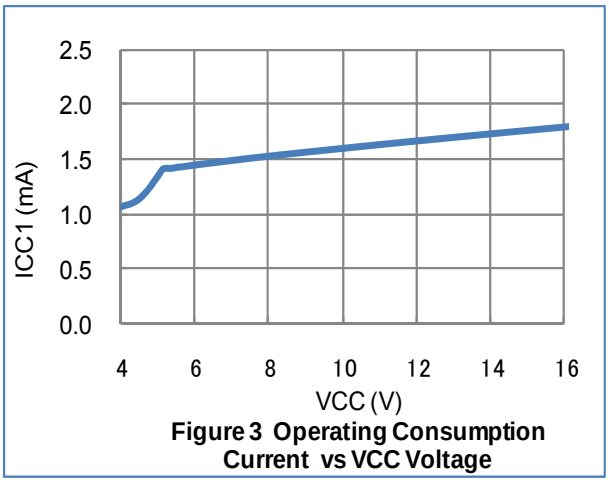


Figure 3 Operating Consumption Current vs VCC Voltage

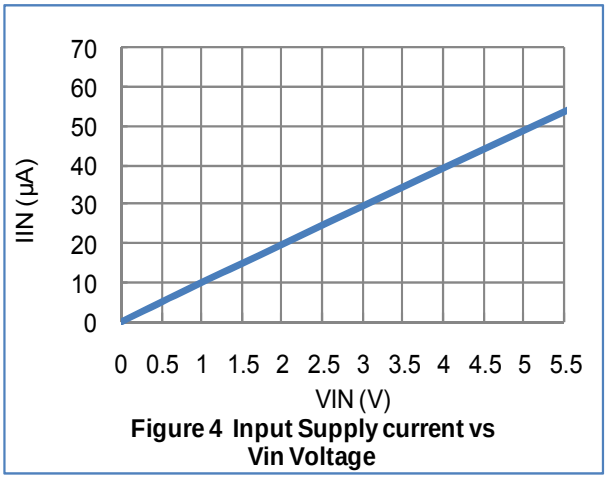


Figure 4 Input Supply current vs Vin Voltage

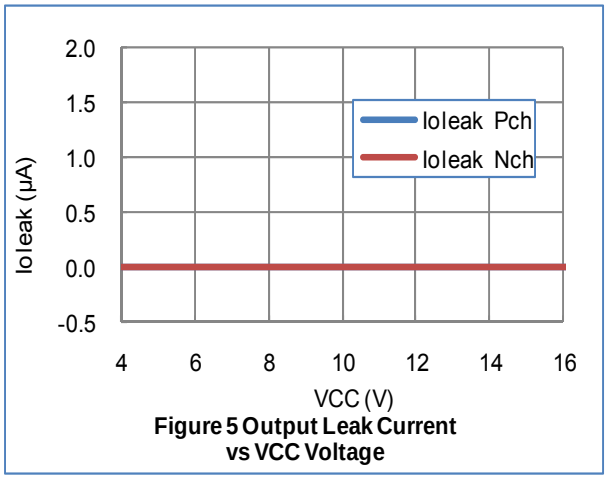


Figure 5 Output Leak Current vs VCC Voltage

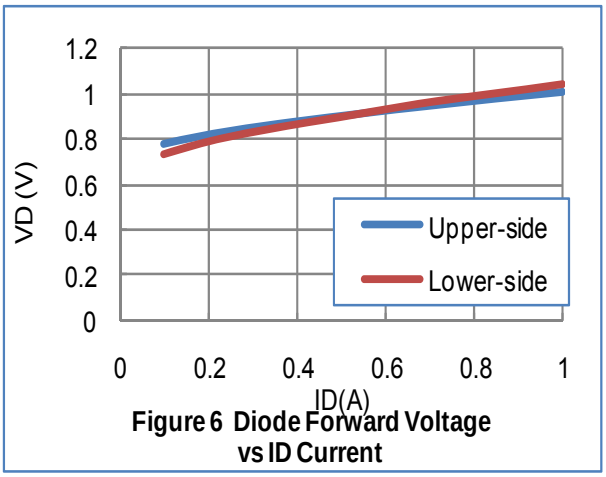


Figure 6 Diode Forward Voltage vs ID Current

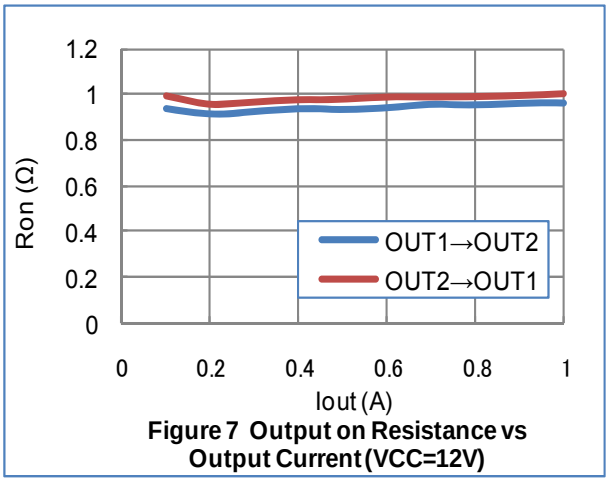


Figure 7 Output on Resistance vs Output Current (VCC=12V)

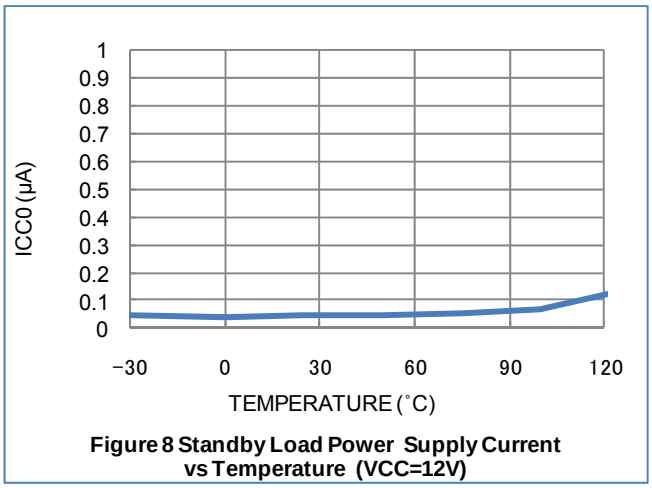


Figure 8 Standby Load Power Supply Current vs Temperature (VCC=12V)

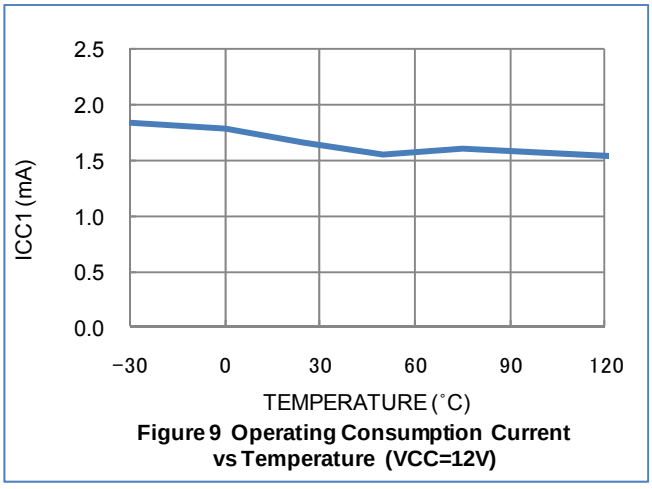


Figure 9 Operating Consumption Current vs Temperature (VCC=12V)

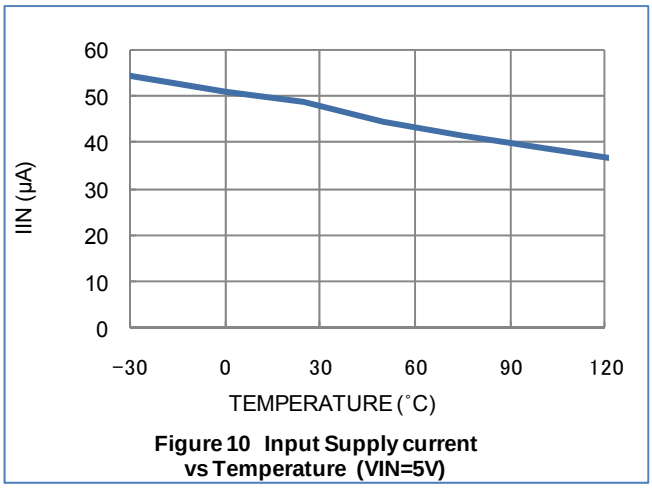


Figure 10 Input Supply current vs Temperature (VIN=5V)

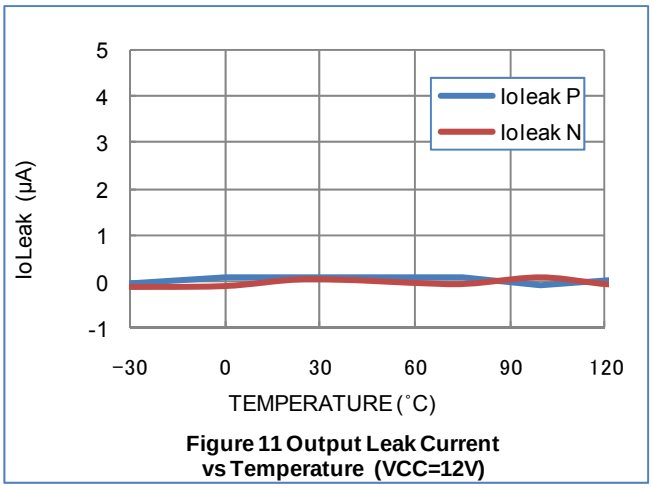


Figure 11 Output Leak Current vs Temperature (VCC=12V)

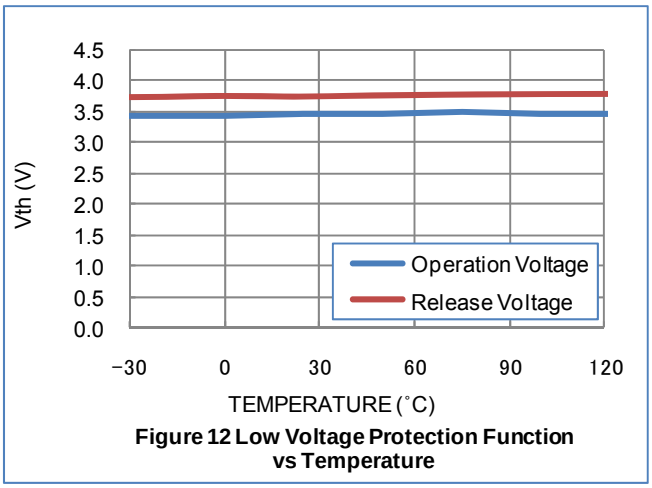


Figure 12 Low Voltage Protection Function vs Temperature

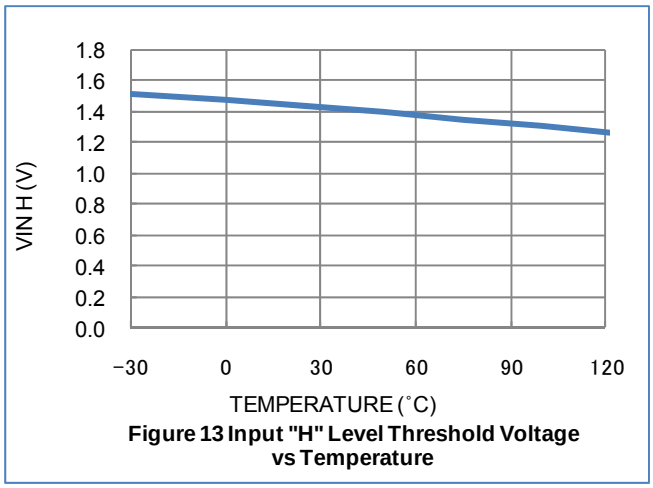


Figure 13 Input "H" Level Threshold Voltage vs Temperature

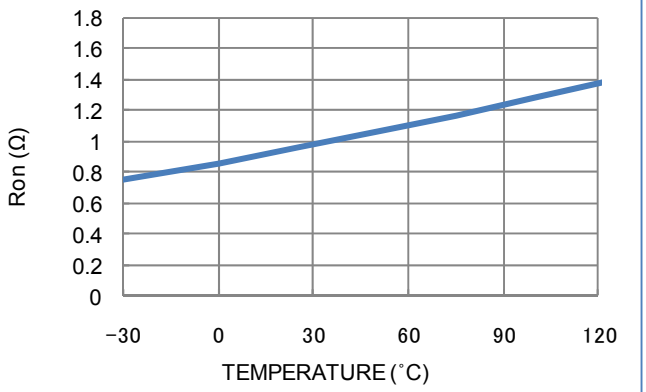


Figure 14 Output on Resistance vs Temperature (VCC=12V)

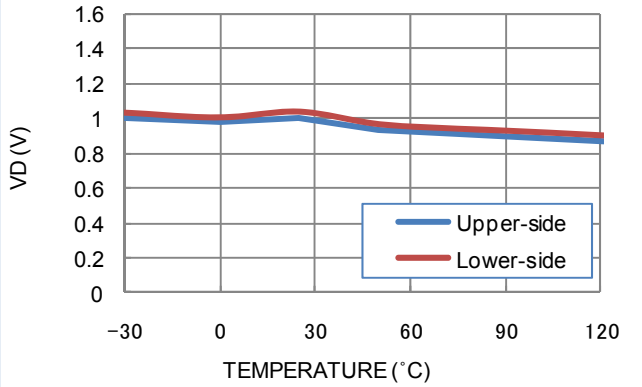
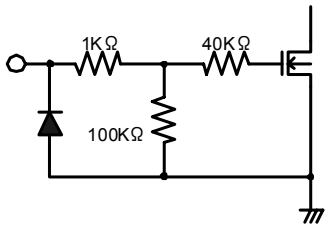
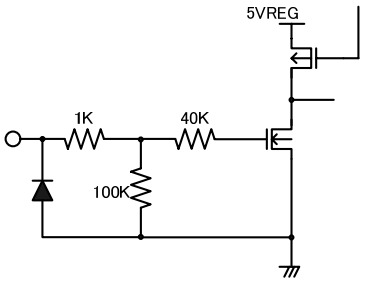
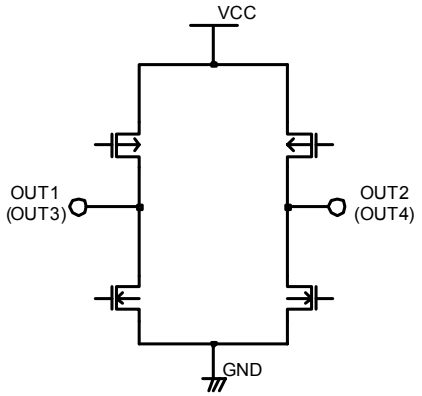


Figure 15 Diode Forward Voltage vs Temperature (VCC=12V)

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 4.0 to 16.0(V). The capacitor is connected for stabilization for GND pin (6pin).	
2	ENA	Motor drive control input pin. It shifts from the stand-by state to a prescribed output operation corresponding to the state of the input when the ENA pin becomes a standby mode by L, the circuit current can be adjusted to 0, and it makes it to H. It is a digital input, and the range of L level input is 0 to 0.7(V) and the range of H level input are 1.8 to 5.5(V). PWM can be input. Pull-down resistance 100(kΩ) is built into in the terminal.	
3	IN1	Motor drive control input pin. Driving control input pin of OUT1 (10pin) and OUT2 (9pin). PWM can be input. With built-in pull-down resistance.	
4	IN2	Motor drive control input pin. Driving control input pin of OUT3 (8pin) and OUT4 (7pin). PWM can be input. With built-in pull-down resistance.	
5	NC		
6	GND	Ground pin.	
7	OUT4	Driving output pin. The motor coil is connected between terminal OUT3 (8pin).	
8	OUT3	Driving output pin. The motor coil is connected between terminal OUT4 (7pin).	
9	OUT2	Driving output pin. The motor coil is connected between terminal OUT1 (10pin).	
10	OUT1	Driving output pin. The motor coil is connected between terminal OUT2 (9pin).	

Operation explanation

1. STM output control logic

Input			Output				Function
ENA	IN1	IN2	OUT1	OUT2	OUT3	OUT4	
L	-	-	OFF	OFF	OFF	OFF	Standby
H	L	L	H	L	H	L	Step 1
	H	L	L	H	H	L	Step 2
	H	H	L	H	L	H	Step 3
	L	H	H	L	L	H	Step 4

2. About the switch time from the stand-by to the operation

When ENA pin are "L", this IC has completely stopped operating. After the time of reset (about 7μs of an internal setting) it shifts to a prescribed output status corresponding to the state of the input when the signal enters the ENA pin.

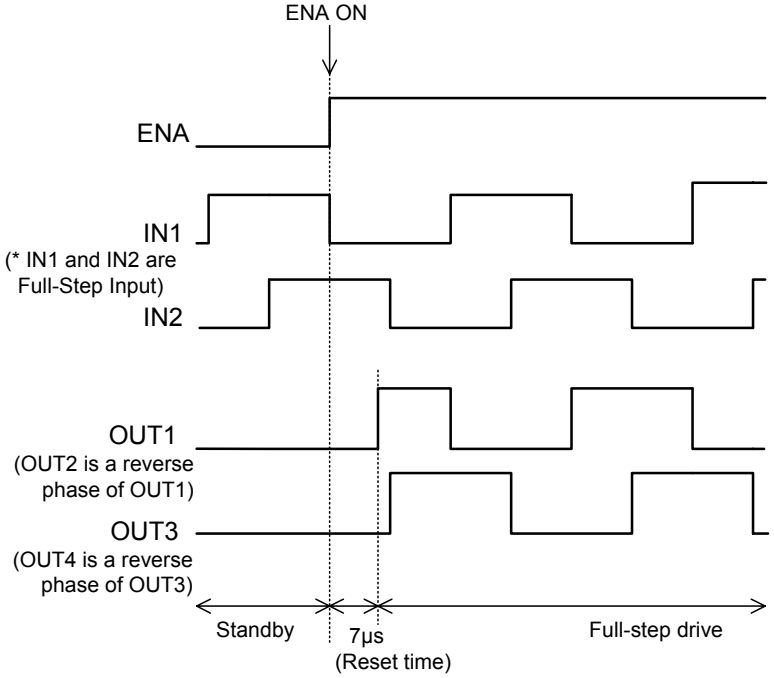


Figure16 Switch time from the stand-by to the operation

3. Thermal shutdown function

The thermal shutdown circuit is incorporated and the output is turned off when junction temperature Tj exceeds 180°C. As the temperature falls by hysteresis, the output turned on again (automatic restoration). The thermal shutdown circuit does not guarantee the protection of the final product because it operates when the temperature exceed the junction temperature of Tjmax=150°C.

TSD = 180°C (typ)
ΔTSD = 40°C (typ)

4. Low voltage protection function

When the power supply voltage is as follows typical 3.5V, the output does OFF.
When the power supply voltage is as above typical 3.8V, the IC outputs a set state.

Operation principal

- Full-Step Drive
  Motor advances 90 degree by inputting 1 step.

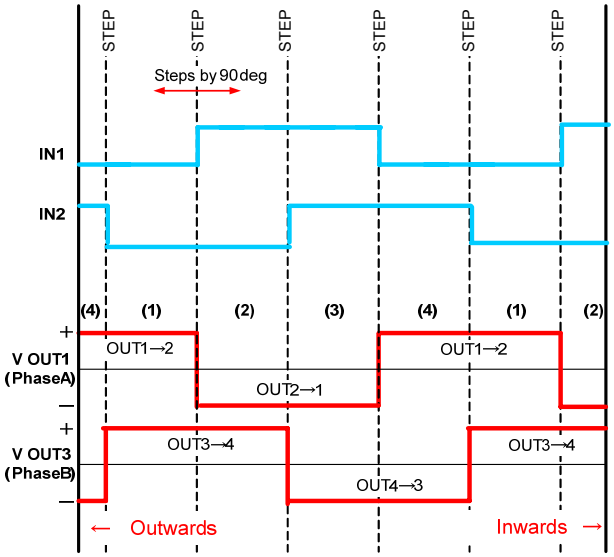


Figure 17. Full-Step Timing

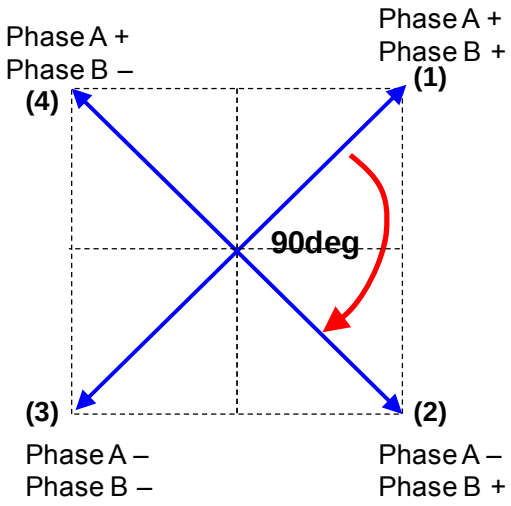
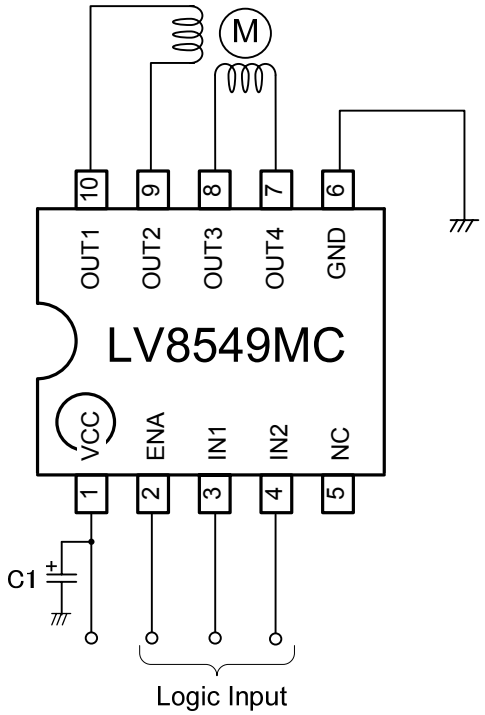


Figure 18. Motor electric angle (Full Step Drive)

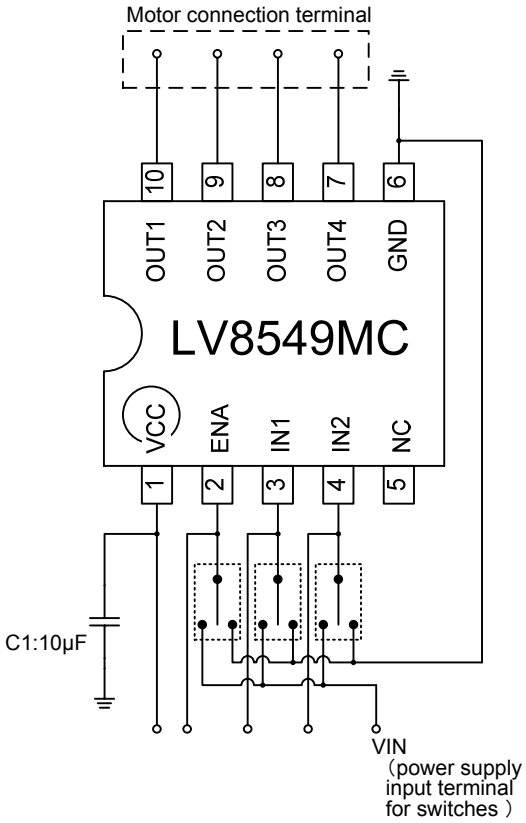
Application Circuit Example



* Bypass capacitor (C1) connected between V_{CC}-GND of all examples of applied circuit recommends the electric field capacitor of 0.1μA to 10μA.
  Confirm there is no problem in operation in the state of the motor load including the temperature property about the value of the capacitor.
  Mount the position where the capacitor is mounted on nearest IC.

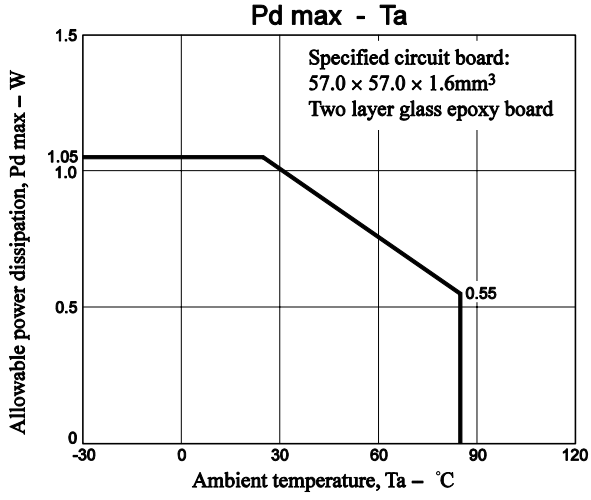
Eva-Board Manual

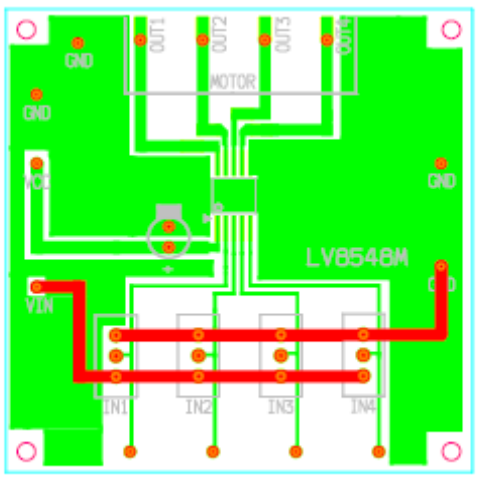
1. Eva-Board circuit diagram



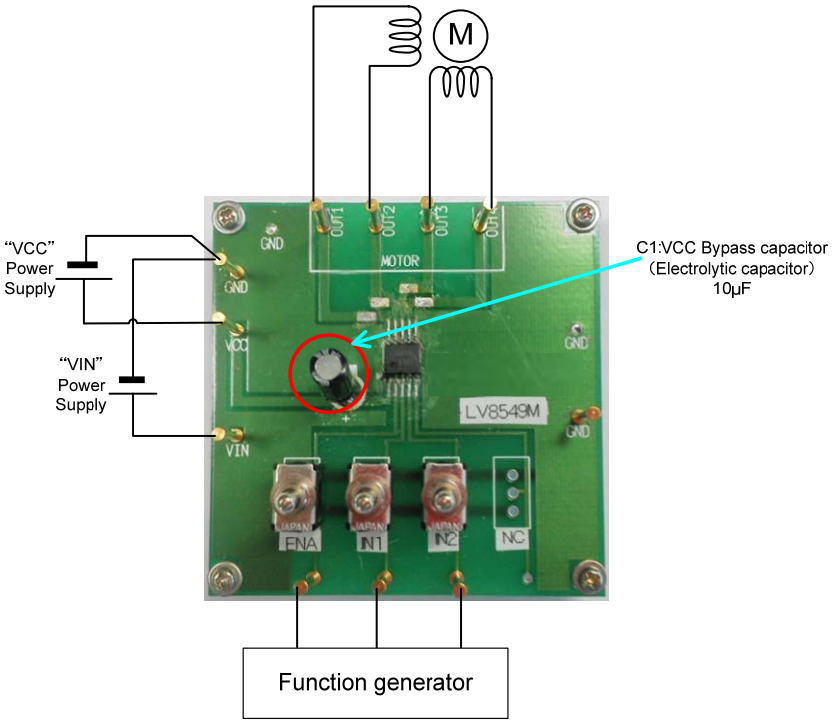
Bill of Materials for LV8549MC Evaluation Board

Designator	Qty	Description	Value	Tol	Footprint	Manufacturer	Manufacturer Part Number	Substitution Allowed	Lead Free
IC1	1	Motor Driver			SOIC10	ON semiconductor	LV8549MC	No	Yes
C1	1	VCC Bypass capacitor	10μF 50V	±20%		SUN Electronic Industries	50ME10HC	Yes	Yes
SW1-SW4	3	Switch				MIYAMA	MS-621-A01	Yes	Yes
TP1-TP11	11	Test points				MAC8	ST-1-3	Yes	Yes





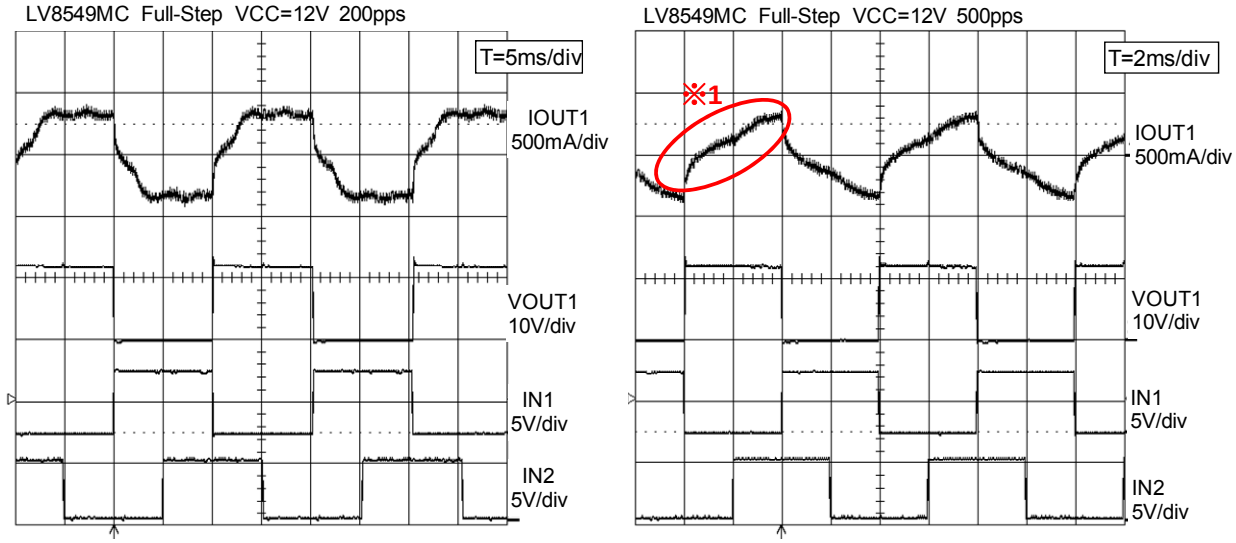
2. One stepper motor drive



- Connect a stepper 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 a Full step, by inputting an input signal such as follows into IN1/IN2.
- For input signal to function generator, refer to p.9.
  To reverse motor rotation, make sure to input signal to outward direction.

Waveform of LV8549MC evaluation board when driving stepper motor

- Full-Step Drive



*1. When the motor rotation is at a high speed, current gradient increases by the inductance of motor (L).

- IC surface temperature when a motor is in operation (reference)

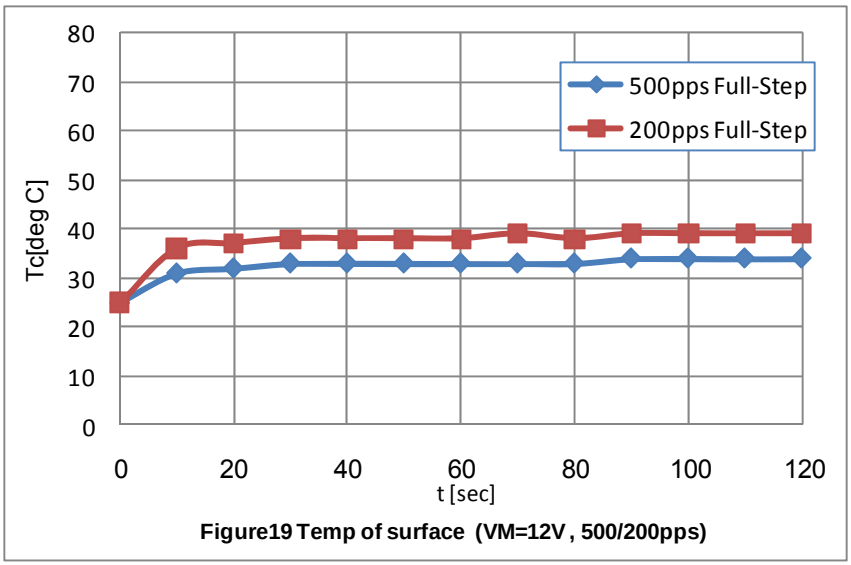


Figure19 Temp of surface (VM=12V , 500/200pps)



[Stepper motor driven by LV8549MC]
Motor diameter: 20.5mm
Coil resistance: 30.8Ω

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. 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.