

Specifications

Absolute Maximum Ratings at Ta = 25°C (Note 1)

Parameter	Symbol	Conditions	Ratings	Unit
Maximum power supply voltage	V _{CC} max	VCC	-0.3 to +20	V
Output impression voltage	V _{OUT}	OUT1 , OUT2 , OUT3 , OUT4	-0.3 to +20	V
Input impression voltage	V _{IN}	IN1 , IN2 , IN3 , IN4	-0.3 to +6	V
GND pin outflow current	IGND	Per ch	1.0	A
Allowable Power dissipation	Pd max	(Note 2)	1.0	W
Operating temperature	Topr		-30 to +85	°C
Storage temperature	Tstg		-40 to +150	°C

1. Stresses exceeding those listed in the Absolute Maximum Rating table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

Recommendation Operating Conditions at Ta = 25°C (Note 3)

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	V _{CC}	VCC	4.0 to 16	V
Input "H" level voltage	V _{INH}	IN1 , IN2 , IN3 , IN4	+1.8 to +5.5	V
Input "L" level voltage	V _{INL}		-0.3 to +0.7	V

3. Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

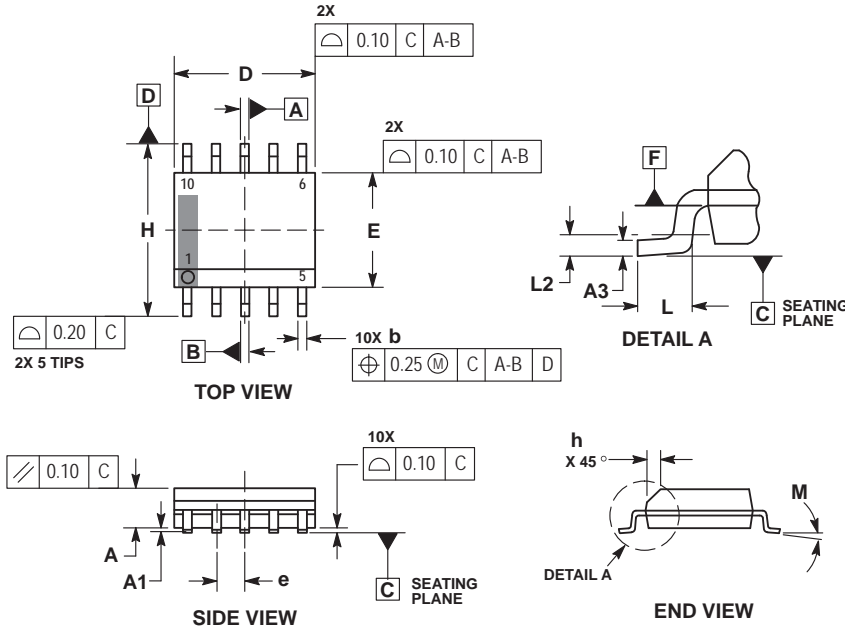
Electrical Characteristics at Ta = 25°C, V_{CC} = 12V (Note 4)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply voltage	I _{CC0}	Standby mode IN1=IN2=IN3=IN4="LOW"			1	μA
	I _{CC1}	It is "High" from IN1 as for either of IN4. Load opening		1.7	2.3	mA
Input current	I _{IN}	V _{IN} =5V	35	50	65	μA
Thermal shutdown operating temperature	T _{tsd}	Design certification	150	180	210	°C
Width of temperature hysteria	ΔT _{tsd}	Design certification		40		°C
Low voltage protection function operation voltage	V _{th} V _{CC}		3.3	3.5	3.65	V
Release voltage	V _{thret}		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 _{Oleak}	V _O =16V			10	μA
Diode forward voltage	V _D	I _D =1.0A		1.0	1.2	V

4. Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

Package Dimensions

SOIC-10 NB
CASE 751BQ-01
ISSUE A

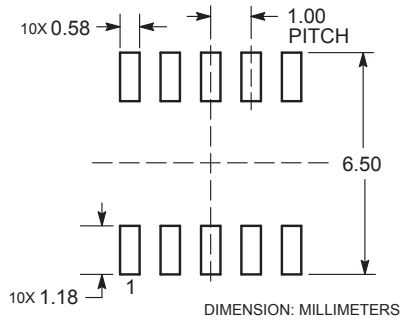


NOTES:

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.

DIM	MILLIMETERS	
	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°

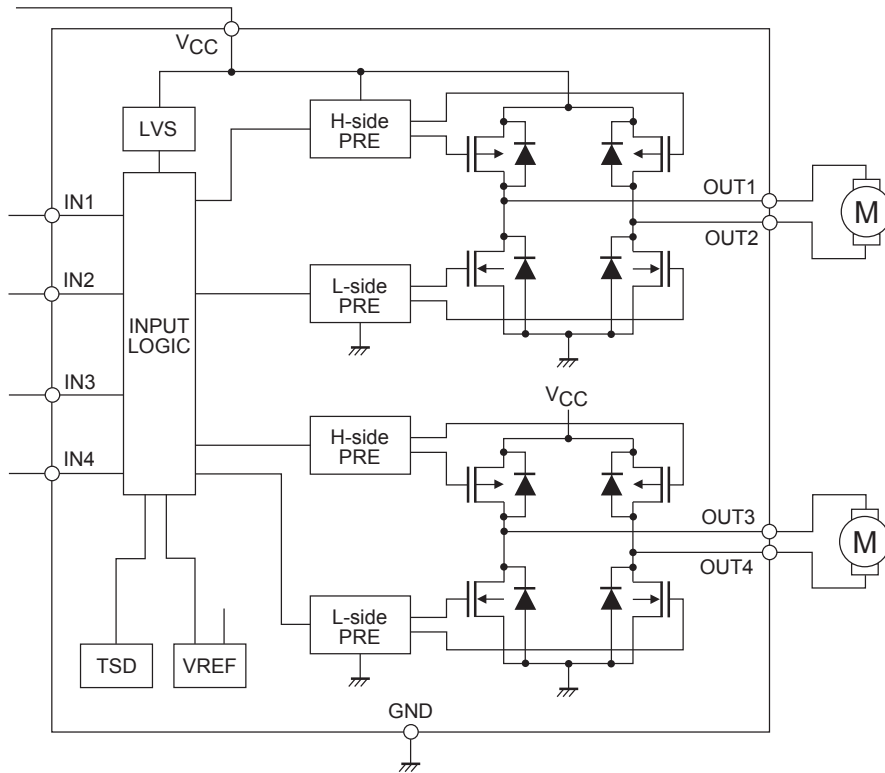
RECOMMENDED SOLDERING FOOTPRINT*



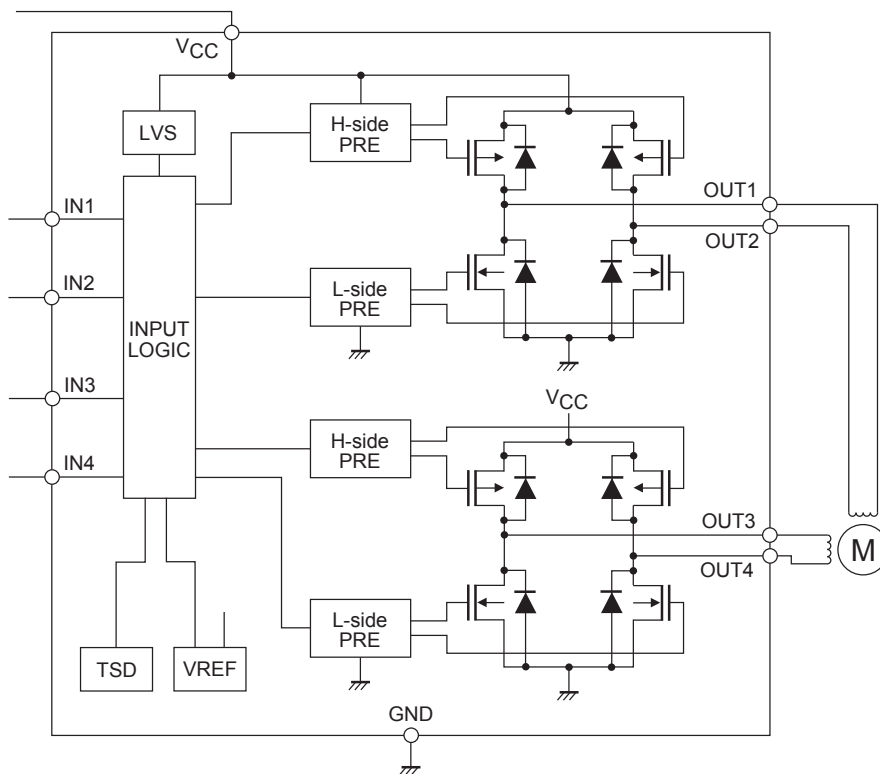
*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

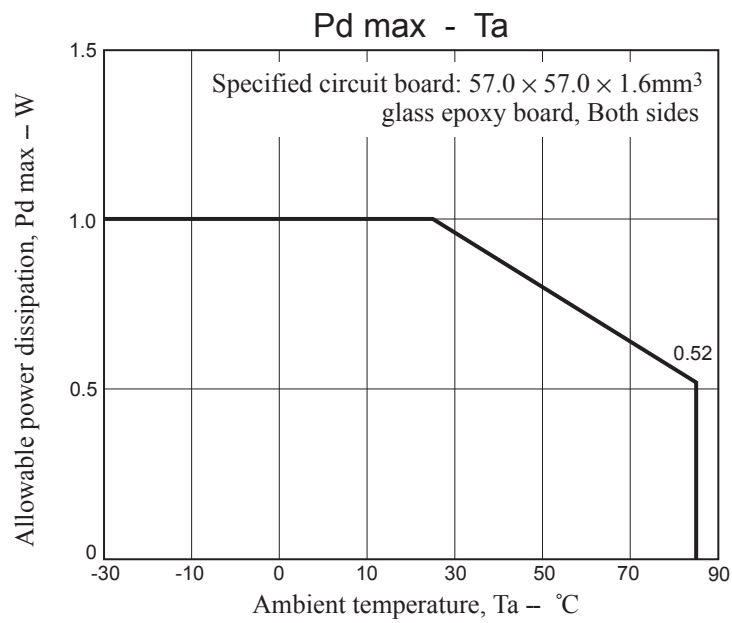
Block Diagram

1. At two DC motor drive

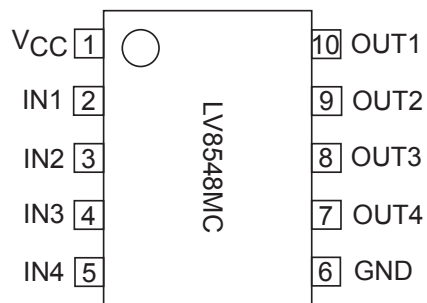


2. At one stepper motor drive

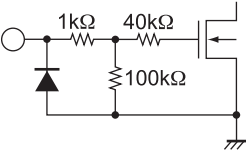
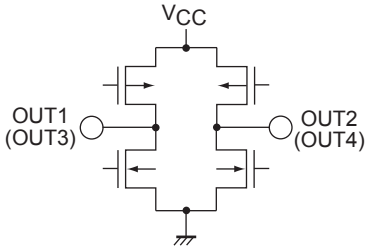




Pin Assignment



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	IN1	Motor drive control input pin. Driving control input pin of OUT1 (10pin) and OUT2 (9pin). It is used in combination with IN2 pin (3pin). For the digital input, range of the "L" level is 0 to 0.7(V), range of the "H" level is from 1.8 to 5.5(V). PWM can be input. Pull-down resistance 100(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.	
3	IN2	Motor drive control input pin. Driving control input pin of OUT1 (10pin) and OUT2 (9pin). It is used in combination with IN1 pin (2pin). PWM can be input. With built-in pull-down resistance.	
4	IN3	Motor drive control input pin. Driving control input pin of OUT3 (8pin) and OUT4 (7pin). It is used in combination with IN4 pin (5pin). PWM can be input. With built-in pull-down resistance.	
5	IN4	Motor drive control input pin. Driving control input pin of OUT3 (8pin) and OUT4 (7pin). It is used in combination with IN3 pin (4pin). PWM can be input. With built-in pull-down resistance.	
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

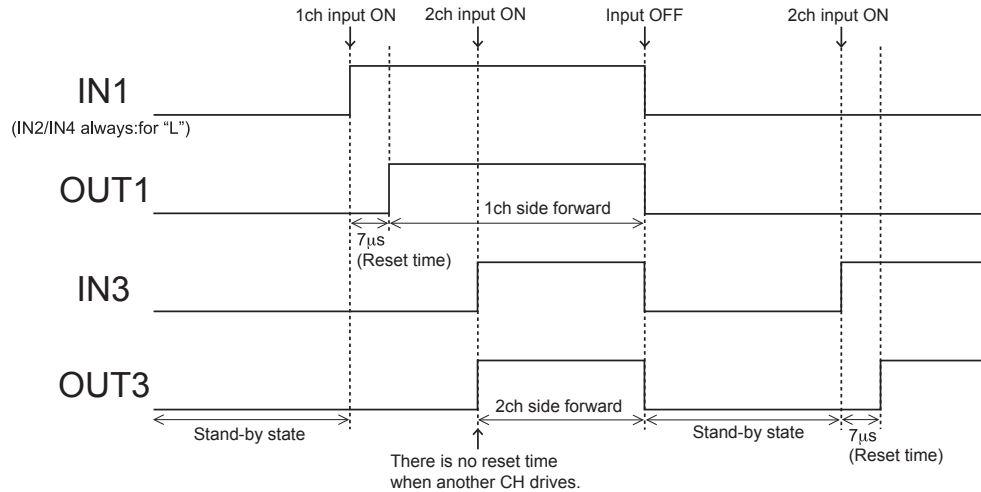
1. DCM output control logic

Input				Output				Remarks
IN1	IN2	IN3	IN4	OUT1	OUT2	OUT3	OUT4	
L	L	L	L	OFF	OFF	OFF	OFF	Stand-by
L	L			OFF	OFF			Stand-by
H	L			H	L			Forward
L	H			L	H			Reverse
H	H			L	L			Brake
		L	L			OFF	OFF	Stand-by
		H	L			H	L	Forward
		L	H			L	H	Reverse
		H	H			L	L	Brake

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

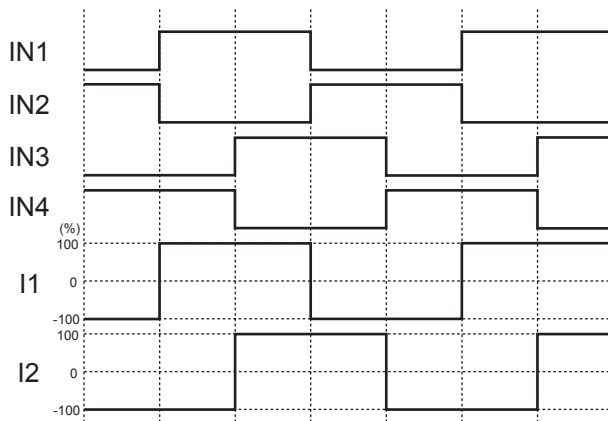
When IN1, IN2, IN3, IN4 are "L", this IC has completely stopped operating. After the time of reset of about $7\mu\text{s}$ of an internal setting, it shifts to a prescribed output status corresponding to the state of the input when the signal enters the input terminal.

Reset of about $7\mu\text{s}$ doesn't hang even if the motor is driven from the stand-by state when either CH drives and the output becomes an output status corresponding to the state of the input. As for full power TR between the reset time, turning off is maintained.

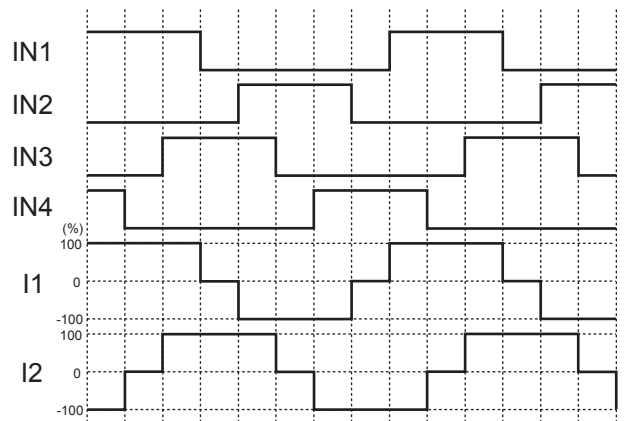


3. Example of current wave type in each excitation mode when stepper motor parallel input is controlled.

• Full-step mode



• Half-step mode



4. Thermal shutdown function

The thermal shutdown circuit is incorporated and the output is turned off when junction temperature T_j exceeds 180°C . As the temperature falls by hysteresis, the output turned on again (automatic restoration).

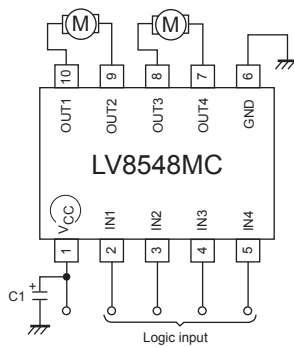
The thermal shutdown circuit does not guarantee the protection of the final product because it operates when the temperature exceed the junction temperature of $T_{j\text{max}}=150^\circ\text{C}$.

$T_{SD} = 180^\circ\text{C}$ (typ)

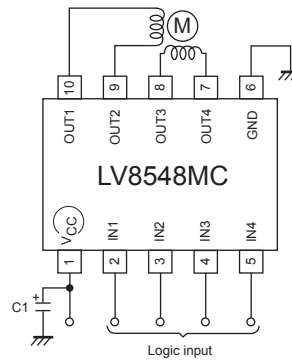
$\Delta T_{SD} = 40^\circ\text{C}$ (typ)

Application Circuit Example

1. Example of applied circuit when two DC motor driving

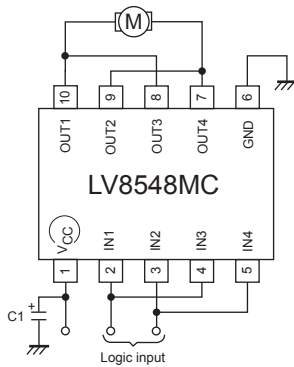


2. Example of applied circuit when one stepper motor driving



3. Example of applied circuit when connecting it in parallel

The use likened to H bridge 1ch is shown possible in the figure below by connecting IN1 with IN3, IN2 with IN4, OUT1 with OUT3, OUT2, and OUT4. ($I_O \text{ max}=2.0\text{A}$, Upper and lower total $R_{ON}=0.5\Omega$)



* Bypass capacitor (C1) connected between VCC-GND of all examples of applied circuit recommends the electric field capacitor of $0.1\mu\text{A}$ to $10\mu\text{A}$.

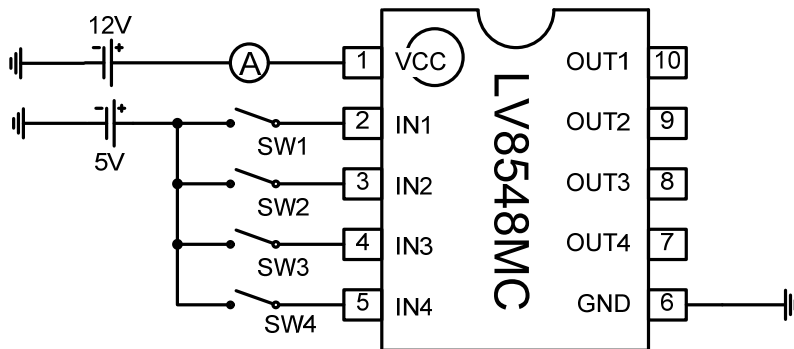
Confirm there is no problem in operation in the state of the motor load including the temperature property about the value of the capacitor.

Mount the position where the capacitor is mounted on nearest IC.

Measurement connection diagram

(1) Current consumption when standing by I_{CC0}

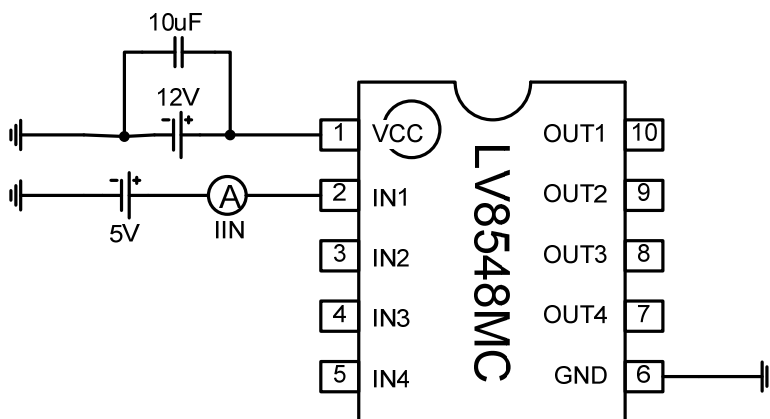
Current consumption I_{CC1}



Measure I_{CC0} with all SW OFF.

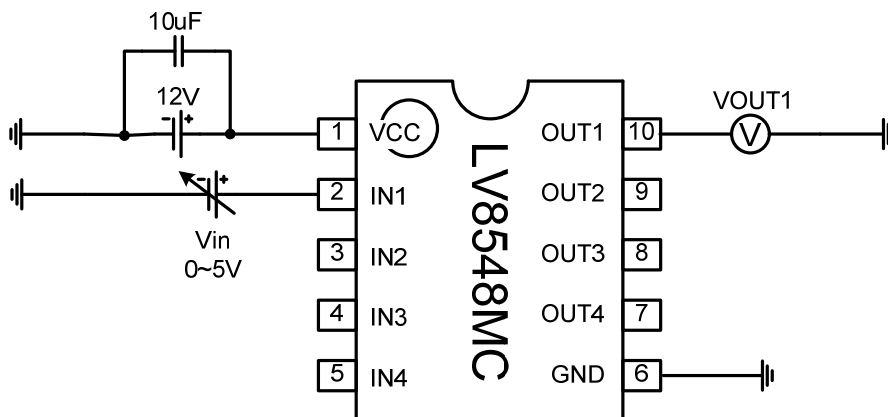
Measure I_{CC1} with any of the SW1-4 ON.

(2) Input current I_{IN}



This is about the measurement of IN1 pin. Measure the other IN2-4 pins as is this case.

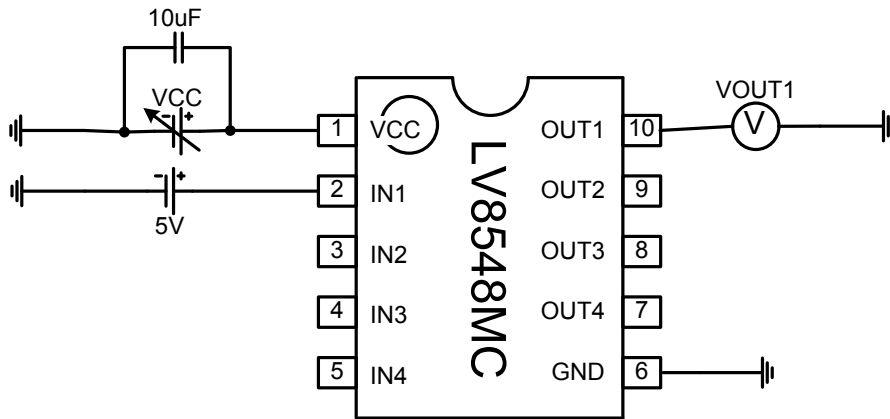
(3) Input "H" level voltage V_{INH}



Measure the V_{in} value at the time V_{OUT1} changes to "H" while varying V_{in} 0-5V.

This is about the measurement of IN1 pin. Measure the other IN2-4 pins as is this case.

(4) Low voltage protection function operation voltage $V_{th}V_{CC}$ / Release voltage V_{thret}



Low voltage protection function

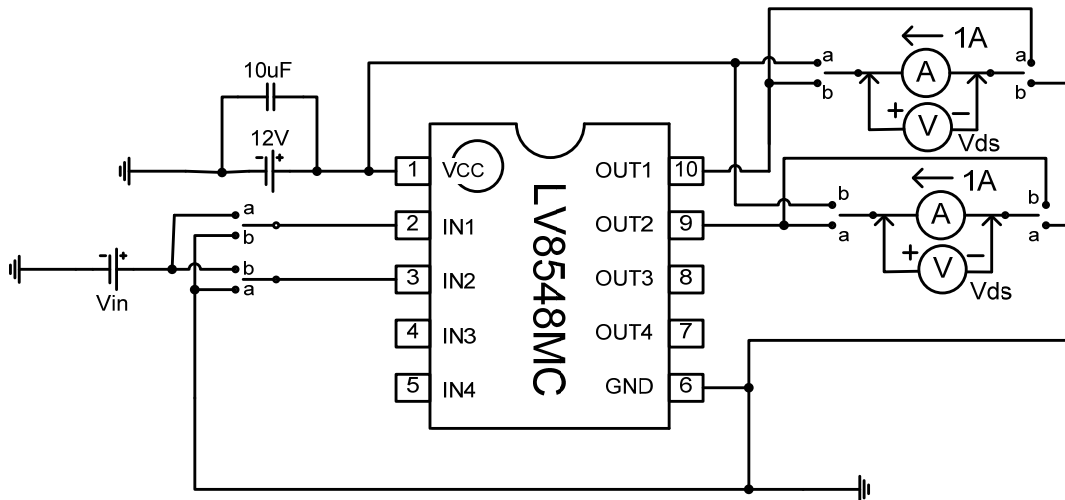
Operation voltage : $V_{CC}=12V$ to $0V$

Release voltage : $V_{CC}=0V$ to $12V$

To measure the operating voltage of the reduced voltage protection, measure the V_{CC} value at the time V_{OUT1} becomes "L" while varying V_{CC} from $12V$ to $0V$.

To measure the release voltage of the reduced voltage protection, measure the V_{CC} value at the time V_{OUT1} becomes "H" while varying V_{CC} from $0V$ to $12V$.

(5) Output ON resistance R_{on}



SW_a side :

OUT1 Upper-side/OUT2 Lower-side

OUT3 Upper-side/OUT4 Lower-side

SW_b side :

OUT1 Lower-side/OUT2 Upper-side

OUT3 Lower-side/OUT4 Upper-side

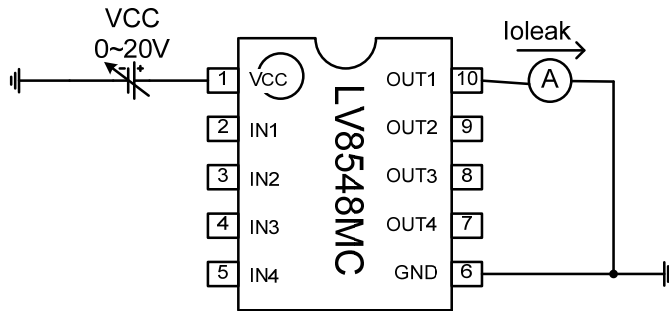
Measure OUT1 upper side and OUT2 lower side FET with the SW set to "a".

Measure OUT1 lower side and OUT2 upper side FET with the SW set to "b".

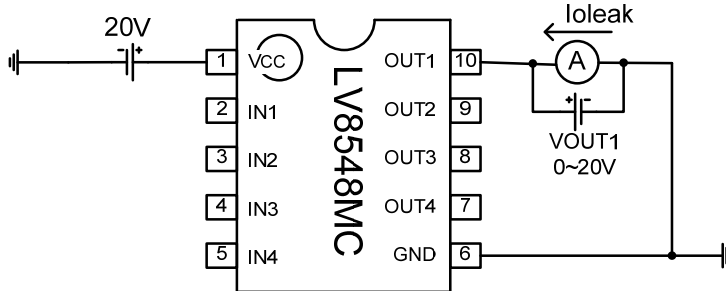
Measure OUT3 and OUT4 as are the cases of OUT1 and OUT2.

(6) Output leak current I_{oleak}

<Each OUT Upper-side>



<Each OUT Lower-side>

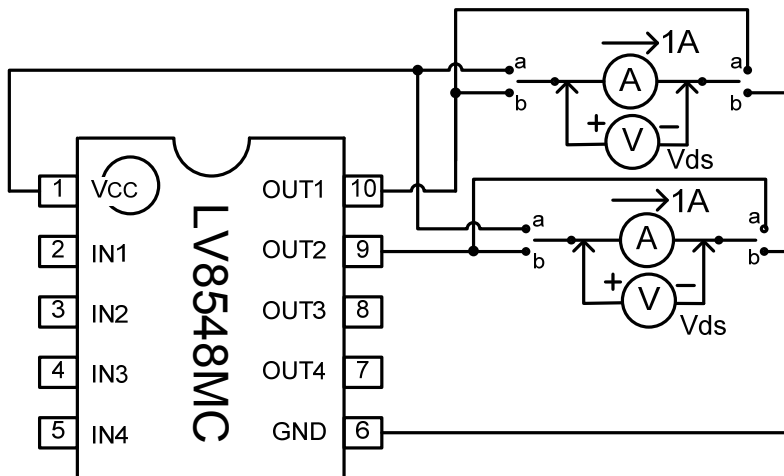


To measure the upper FET output leak current, set the OUT to 0V and measure the OUT current while varying VCC from 0 to 20V.

To measure the lower FET output leak current, set the VCC to 20V and measure the OUT current while varying OUT from 0 to 20V.

This is about the measurement of OUT1 pin. Measure the other OUT2-4 pins as is this case.

(7) Diode forward voltage V_D



SW_a side : Each OUT Upper-side

SW_b side : Each OUT Lower-side

Measure OUT1 and OUT2 upper FET with the SW set to "a".

Measure OUT1 and OUT2 lower FET with the SW set to "b".

Measure OUT3 and OUT4 as are the cases/connections of OUT1 and OUT2.

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