AP1017

12V 1ch H-Bridge Motor driver

1. Genaral Description

The AP1017AEN is a 1 channel H-bridge Motor Driver corresponding to an operating voltage of 12V. It has a N-channel LDMOS FET for both high and low sides of output circuit, it is available in a small package. Additionally, the AP1017 has under voltage lock out and thermal shutdown circuits. It is suitable for driving various small motors.

2. Features

- Control Supply Voltage 2.7V ~ 3.6V
- Available for the input level of 1.8V
- Wide Motor Driver Operating Voltage 1.8V ~ 12V
- Maximum Output Current (DC) 1.56A@ Ta=25°C
- Maximum Output Current (Peak) 3.3A(Ta=25°C, within 5ms in each 200ms)
- H-Bridge On Resistance RON(TOP+BOT)=0.47Ω
- Built-in Under Voltage Lock Out circuit (UVLO)
- Built-in Thermal Shut Down circuit (TSD)
- Small Package 8-pin SON

3. Table of Contents

4. Block Diagram

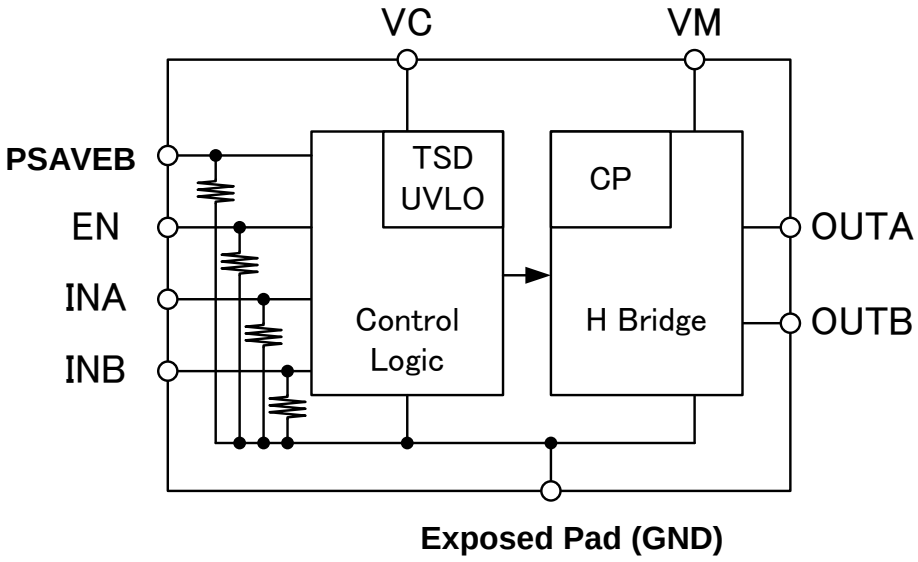


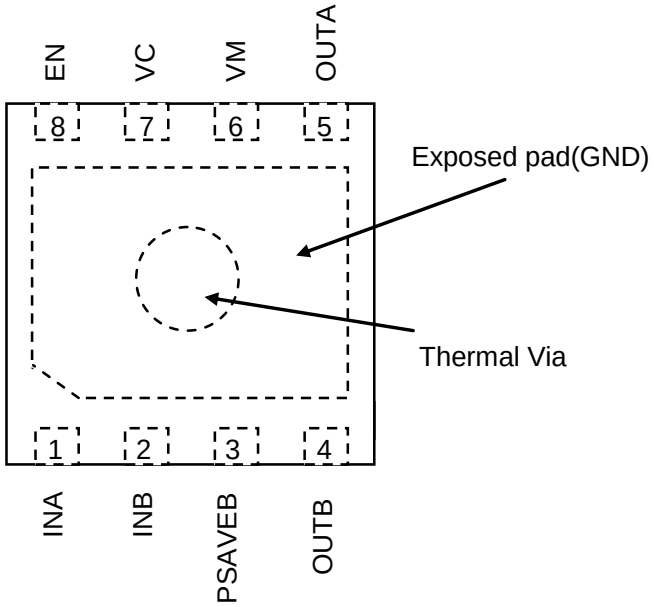
Figure 1. Block Diagram

5. Ordering Guide

AP1017AEN	-30°C ~+ 85°C	8-pin SON

6. Pin Configurations and Functions

■ Pin Configurations



(Top view)

■ Functions

Pin No.	Pin Name	I/O (Note 1)	Function	Description
1	INA	I	Control Signal Input Terminal	Internally pull-down by 200kΩ
2	INB	I	Control Signal Input Terminal	Internally pull-down by 200kΩ
3	PSAVEB	I	Power Save Input Terminal	Internally pull-down by 200kΩ
4	OUTB	O	Motor Driver Output Terminal	
5	OUTA	O	Motor Driver Output Terminal	
6	VM	P	Motor Driver Power Supply	Connect decoupling capacitor nearby.
7	VC	P	Control Power Supply	Connect decoupling capacitor nearby.
8	EN	I	Enable Signal Input Terminal	Internally pull-down by 200kΩ
Exposed Pad	GND	P	Ground Terminal	(Note 2)

Note 1. I (Input terminal), O (Output terminal) and P (Power terminal)
Note 2. Exposed pad must be connected to GND.

7. Absolute Maximum Ratings

Parameter	Symbol	min	max	Unit	Condition
Control Supply Voltage	VC	-0.5	6	V	
Motor Driver Operating Voltage	VM	-0.5	12	V	
VC level terminal voltage (PSAVEB, EN, INA, and INB)	Vterm1	-0.5	VC	V	
VM level terminal voltage (OUTA, OUTB)	Vterm2	-0.5	12	V	
Maximum DC output current	Iout1	−	1.56	A	Ta = 25°C
		−	1.29	A	Ta = 65°C
Maximum peak output current	Iout2	-	2.2	A	within 10msec in 200msec
		-	3.3	A	within 5msec in 200msec
Power Dissipation	PD1	−	1786	mW	(Note 4) Ta = 25°C
	PD2	−	1214	mW	(Note 4) Ta = 65°C
Maximum Junction Temperature	Tj	−	150	°C	
Storage Temperature Range	Tstg	-65	150	°C	

Note 3. All voltages respect to GND.
Note 4. When 4-layer board is used, this is calculated as θJA=70°C/W.
Note 5. The each power supply of VM and VC is sequence-free.

WARNING: Operation at or beyond these limits may result in permanent damage to the device.
Normal operation is not guaranteed at these extremes.

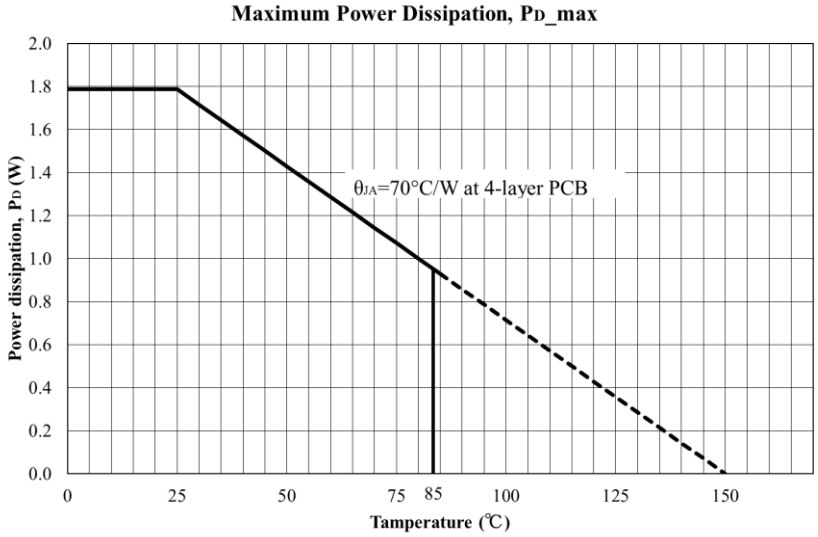


Figure 2. Maximum Power Dissipation

8. Recommended Operating Conditions

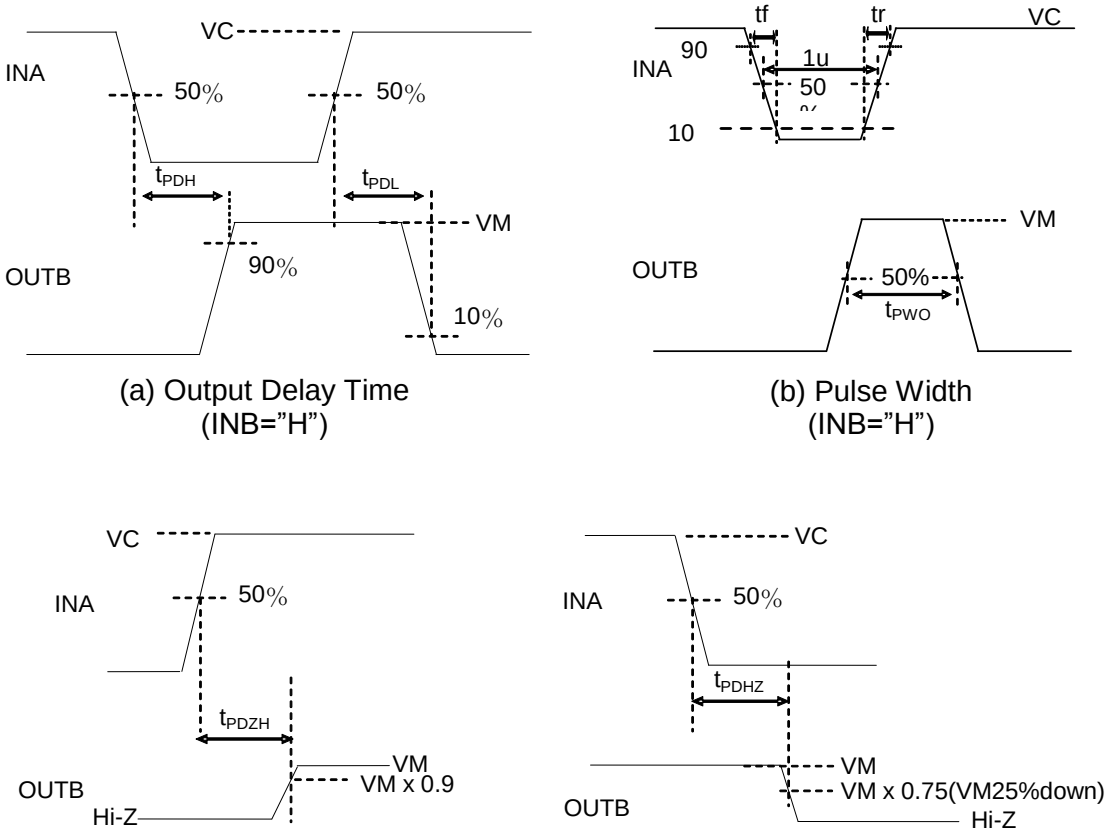
Parameter	Symbol	min	typ	max	Unit	Description
Control Supply Voltage	VC	2.7	3.3	3.6	V	
Motor Driver Operating Voltage	VM	1.8	-	12	V	
Input Frequency Range	f_{PWM}	-	-	200	kHz	
Operating Temperature Range	Ta	-30	-	85	°C	

9. Electrical Characteristics

(Ta = 25°C, VM=7.2V and VC = 3.3V, unless otherwise specified.)

Parameter	Symbol	Condition	min	typ	max	Unit
UVLO						
VC under voltage lock out voltage	VC_{UV}		1.8	2.1	2.4	V
Voltage hysteresis (Note 6)	VC_{UVHYS}		0.005	0.1	0.25	V
TSD						
Thermal shutdown temperature (Note 6)	T_{TSD}		150	175	200	°C
Temperature hysteresis (Note 6)	T_{TSDHYS}		20	30	40	°C
Quiescent Current						
VM quiescent current at power save	I_{VMPS}	PSAVEB= "L"	-	-	1	µA
VC quiescent current at power save	I_{VCPS}	PSAVEB= "L"	-	-	1	µA
VM quiescent current at no power	I_{VMNP}	VC=0V	-	-	1	µA
VM quiescent current at EN="L"	I_{VM}	EN="L", INA=INB= "L"	-	40	100	µA
VC quiescent current at EN="L"	I_{VC}	EN="L", INA=INB= "L"	-	230	500	µA
VC quiescent current at PWM operation	$I_{VC\ PWM}$	f_{PWM}=100kHz	-	0.5	0.8	mA
Motor Driver						
On-resistance 1 (High side + Low side)	R_{ON1}	VC=3.3V, Iout=100mA, Ta=25°C	-	0.47	0.54	Ω
On-resistance 2 (High side + Low side) (Note 6)	R_{ON2}	VC=3.3V, Iout=1.0A, Ta=25°C (Equivalent to Tj=75°C)	-	0.55	0.60	Ω
On-resistance 3 (High side + Low side) (Note 6)	R_{ON3}	VC=3.3V, Iout=1.29A, Ta=65°C (Equivalent to Tj=150°C)	-	0.64	0.73	Ω
Body diode forward voltage	V_F	I_F=100mA	-	0.8	1.2	V
Output delay time ("L"→"H")	tPDH	(Note 7, Figure 3)	-	0.45	1.0	µs
Output delay time ("H"→"L")	tPDL	(Note 7, Figure 3)	-	0.20	1.0	µs
Output delay time(Hi-Z→"H")(Note 6)	tPDZH	(Note 8, Figure 3)	-	0.33	1.0	µs
Output delay time("L"→Hi-Z)(Note 6)	tPDHZ	(Note 8, Figure 3)	-	0.50	2.0	µs
H-bridge output pulse width	tPWO	tPWI=1.0µs tr=rf=10ns, f_{PWM}=100kHz (Figure 3)	0.6	0.9	-	µs
Control Logic						
Input high level voltage (INA, INB, EN, PSAVEB)	V_{IH}		1.5	-	VC	V
Input low level voltage (INA, INB, EN, PSAVEB)	V_{IL}		GND	-	0.3	V
Input low level current (INA, INB, EN, PSAVEB)	I_{IL}		-	-	1	µA
Pull-down resistance	R_{PD}		133	200	300	kΩ

Note 6. Not tested in production.
Note 7. Connect 1kΩ between OUTA and OUTB.
Note 8. Connect 1kΩ between VM and OUTA/B, and OUTA/B and GND.



(a) Output Delay Time (INB="H")

(b) Pulse Width (INB="H")

(c) Hi-Z →"H" Delay Time (INB = "L")

(d) "H" →Hi-Z Delay Time (INB = "L")

Figure 3. Time Chart (Output delay time, pulse width)

10. Control Logic

The AP1017 is suitable to drive DC motor and voice coil motor. If the input signals are fed to INA and INB, the output signals, OUTA and OUTB are decided as Table 1.The AP1017 includes Under Voltage Lock Out (UVLO) and Thermal Shut Down (TSD) circuits. The UVLO circuit monitors the control voltage (VC). If the VC is less than the specified voltage, the output of the H-bridge goes to high impedance. The TSD circuit monitors the chip temperature. If the temperature of the chip exceeds specified temperature, the output of the H-bridge goes to high impedance. UVLO circuit and TSD circuit have hysteresis levels.

Table 1. Control logic truth table (X: don't care)

PSAVEB	EN	Input		Output		Operation (Note 9)
		INA	INB	OUTA	OUTB	
H	H	L	L	Hi-Z	Hi-Z	Standby(Coast)
H	H	H	L	H	L	Forward (CW)
H	H	L	H	L	H	Reverse (CCW)
H	H	H	H	L	L	Brake
H	L	X	X	L	L	Brake
L	X	X	X	Hi-Z	Hi-Z	Power save (Note 10)

Note 9. See Figure 4.
Note 10. TSD, UVLO, Internal charge pump and VREF circuit stop operation.

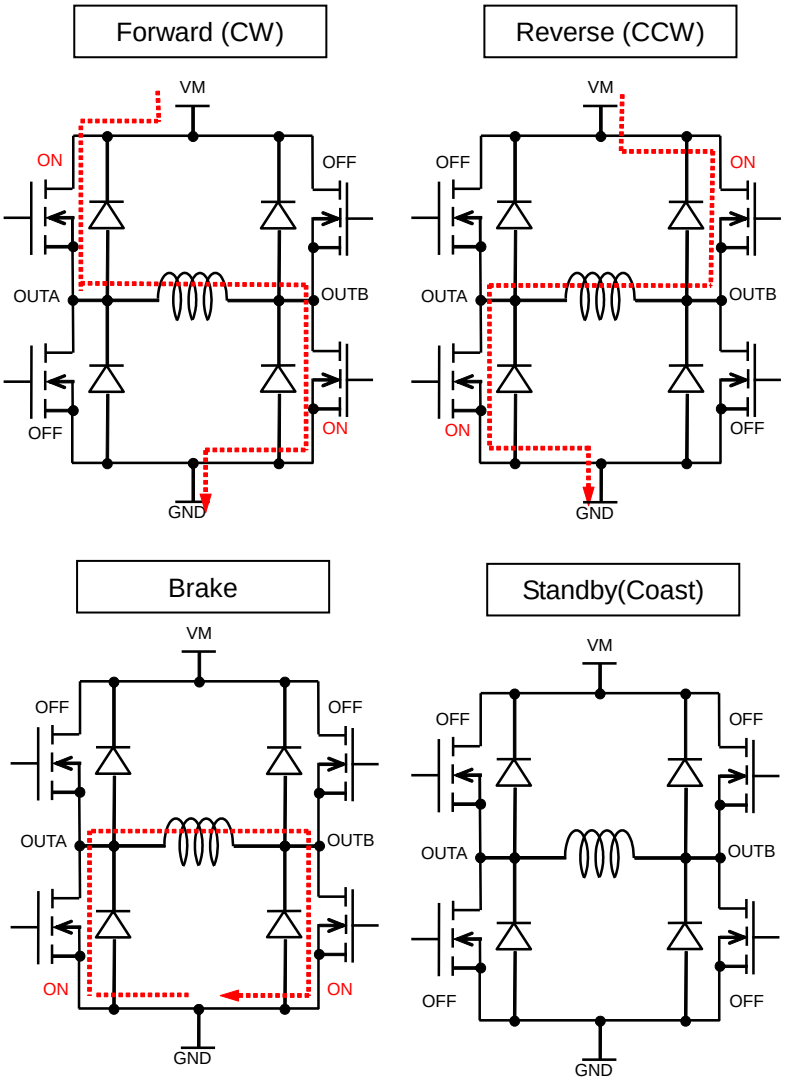


Figure 4. Direction of current

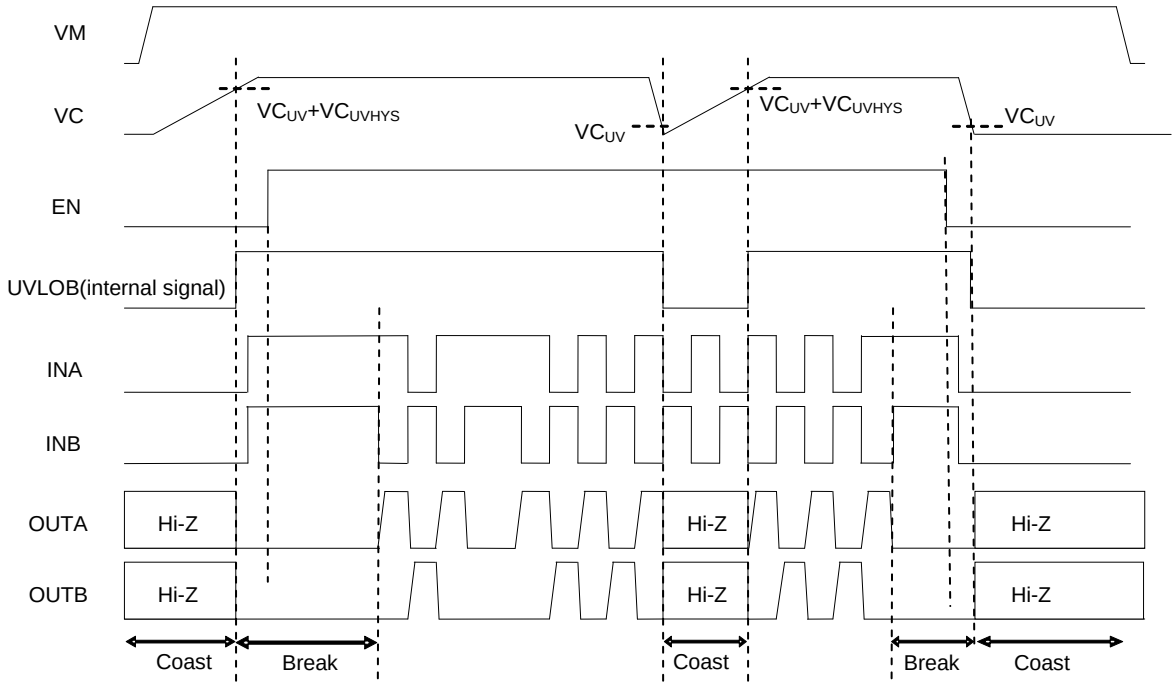


Figure 5. Time Chart (UVLO)

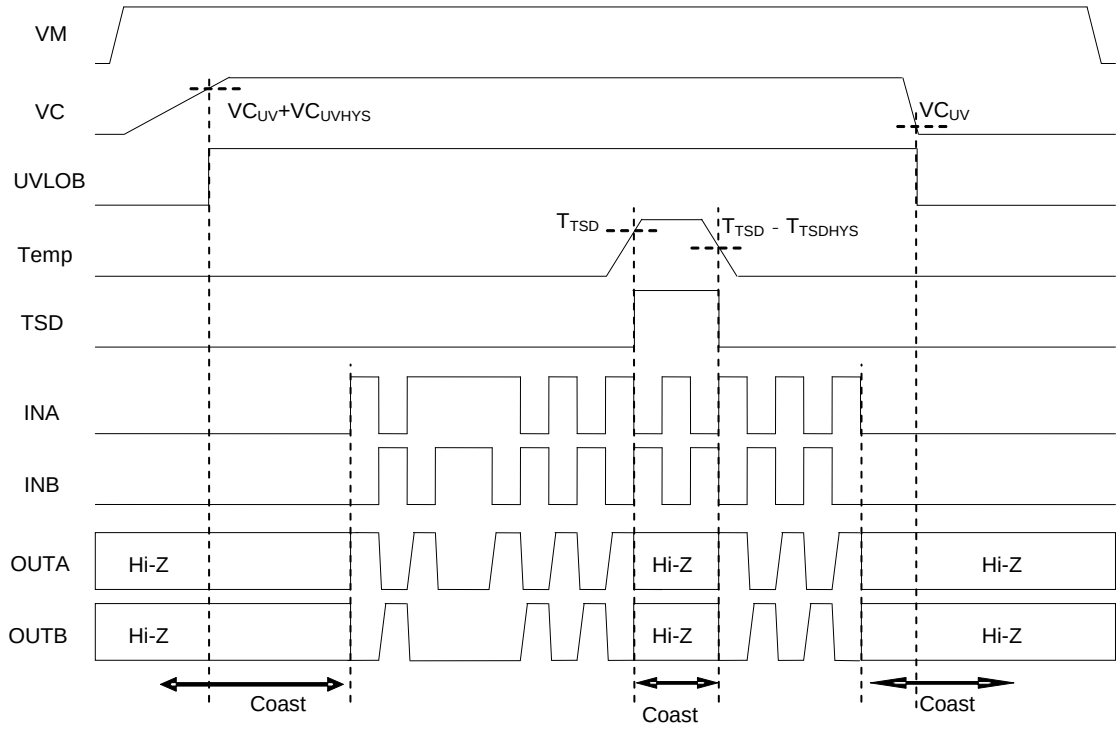


Figure 6. Time Chart (TSD)

11. Recommended External Circuits

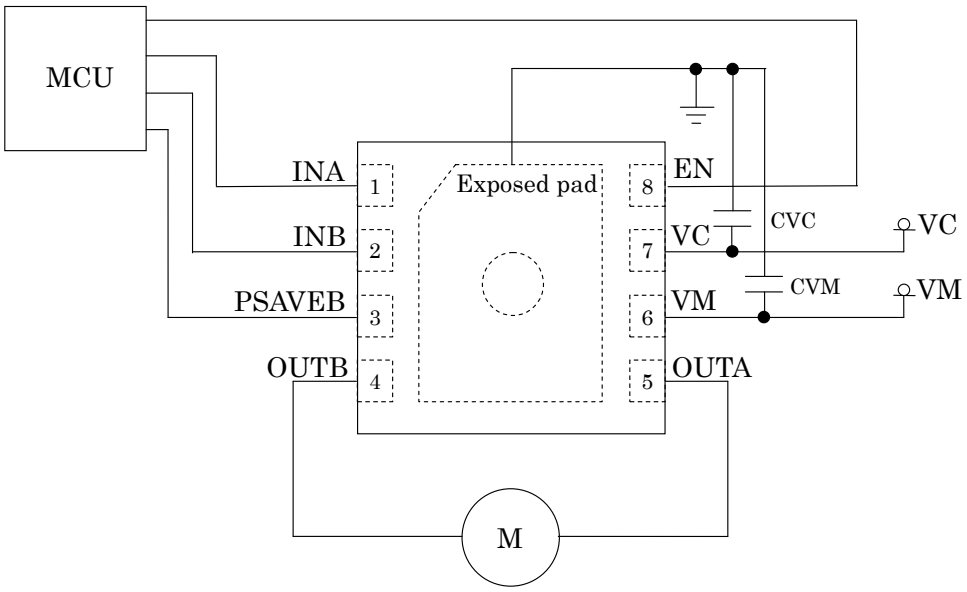


Figure 7. External circuit (Top view)

Table 2. Recommended External Parts

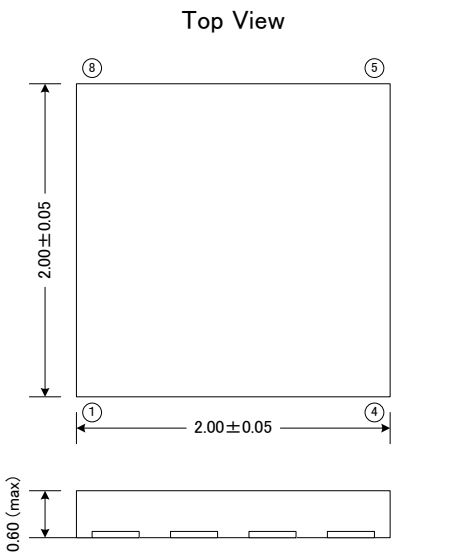
Parameter	Symbol	min	typ	max	Unit	Notes
Motor driver power supply (decoupling capacitor)	CVM	1.0	10	-	μF	(Note 11)
Control power supply (decoupling capacitor)	CVC	0.1	1.0	-	μF	(Note 11)

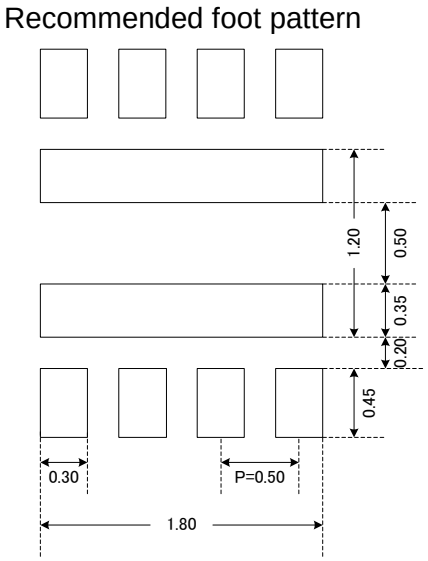
Note 11. Decoupling capacitors of CVM and CVC should be placed close to the each IC terminal. And these capacitor values should be determined in consideration of the load current profile, the load capacitance, the wiring resistance and etc. of the actual system board.

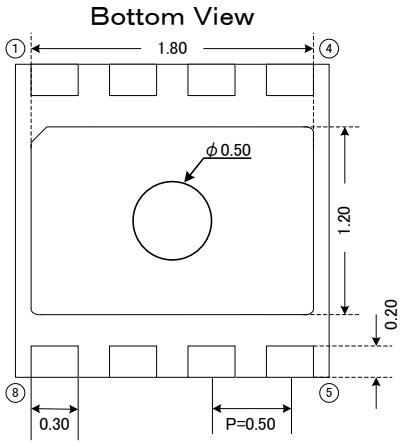
12. Package

■ Outline Dimensions

・8-pin SON (Unit: mm)



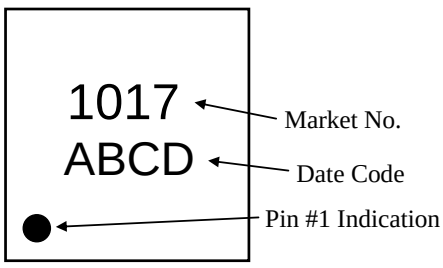




Note) Foot Pattern of Exposed pad must not surround the steam via hole.

Unit : mm

■ Marking



ABCD: Date code (4 digit)
A: Year code (last 1 digit)
BC: Week code
D: Management code

13. Revise History

Date (YY/MM/DD)	Revision	Page	Contents
15/03/31	00	-	First Edition

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