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1. General 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

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4. Block Diagram

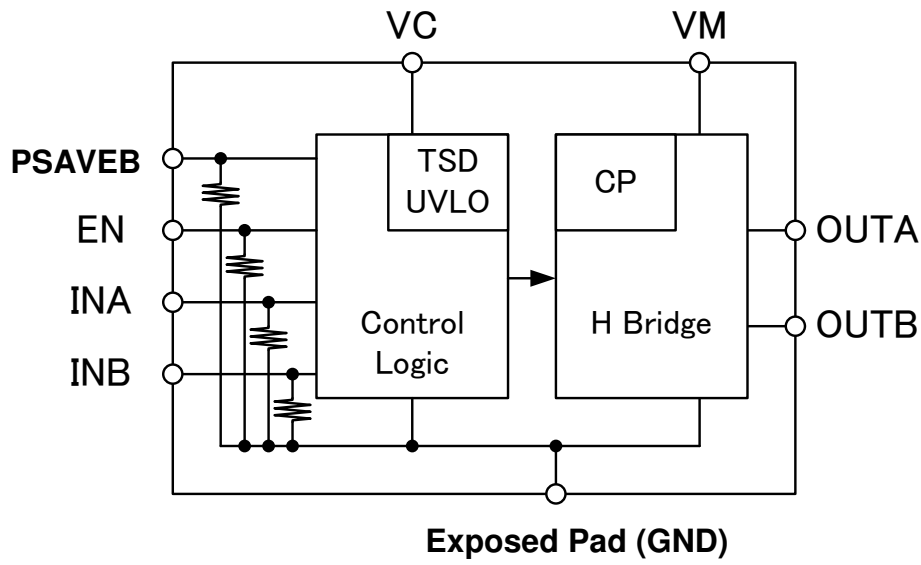


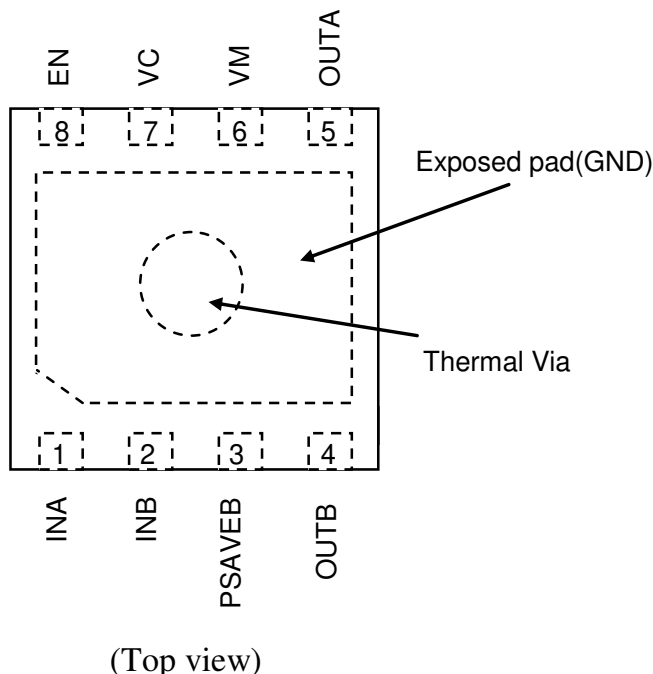
Figure 1. Block Diagram

5. Ordering Guide

AP1017AEN -30°C ~+ 85°C 8-pin SON

6. Pin Configurations and Functions

■ Pin Configurations



■ 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 $\theta_{JA}=70^{\circ}\text{C}/\text{W}$.

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.

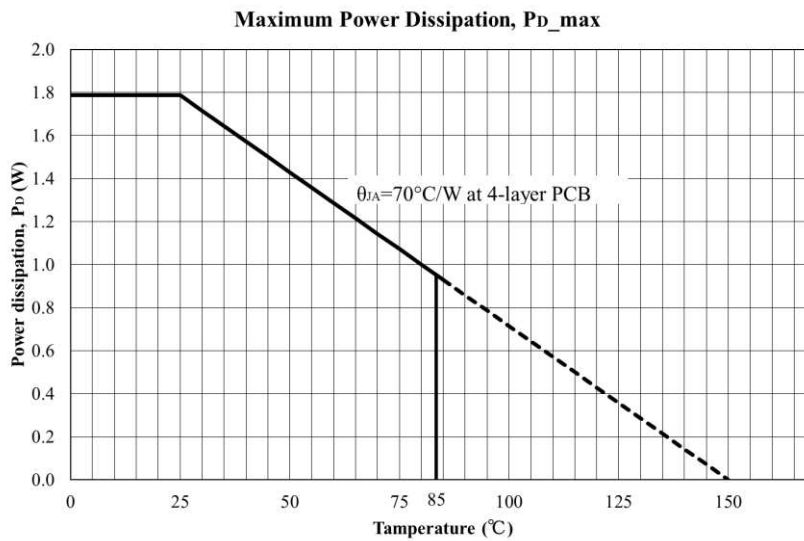


Figure 2. Maximum Power Dissipation

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, I _{out} =100mA, Ta=25°C | - | 0.47 | 0.54 | Ω |
| On-resistance 2 (High side + Low side) (Note 6) | R _{ON2} | VC=3.3V, I _{out} =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, I _{out} =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") | t _{PDH} | (Note 7, Figure 3) | - | 0.45 | 1.0 | μs |
| Output delay time ("H"→"L") | t _{PDL} | (Note 7, Figure 3) | - | 0.20 | 1.0 | μs |
| Output delay time(Hi-Z→"H")(Note 6) | t _{PDZH} | (Note 8, Figure 3) | - | 0.33 | 1.0 | μs |
| Output delay time("L"→Hi-Z)(Note 6) | t _{PDHZ} | (Note 8, Figure 3) | - | 0.50 | 2.0 | μs |
| H-bridge output pulse width | t _{PWO} | t _{PWI} =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.

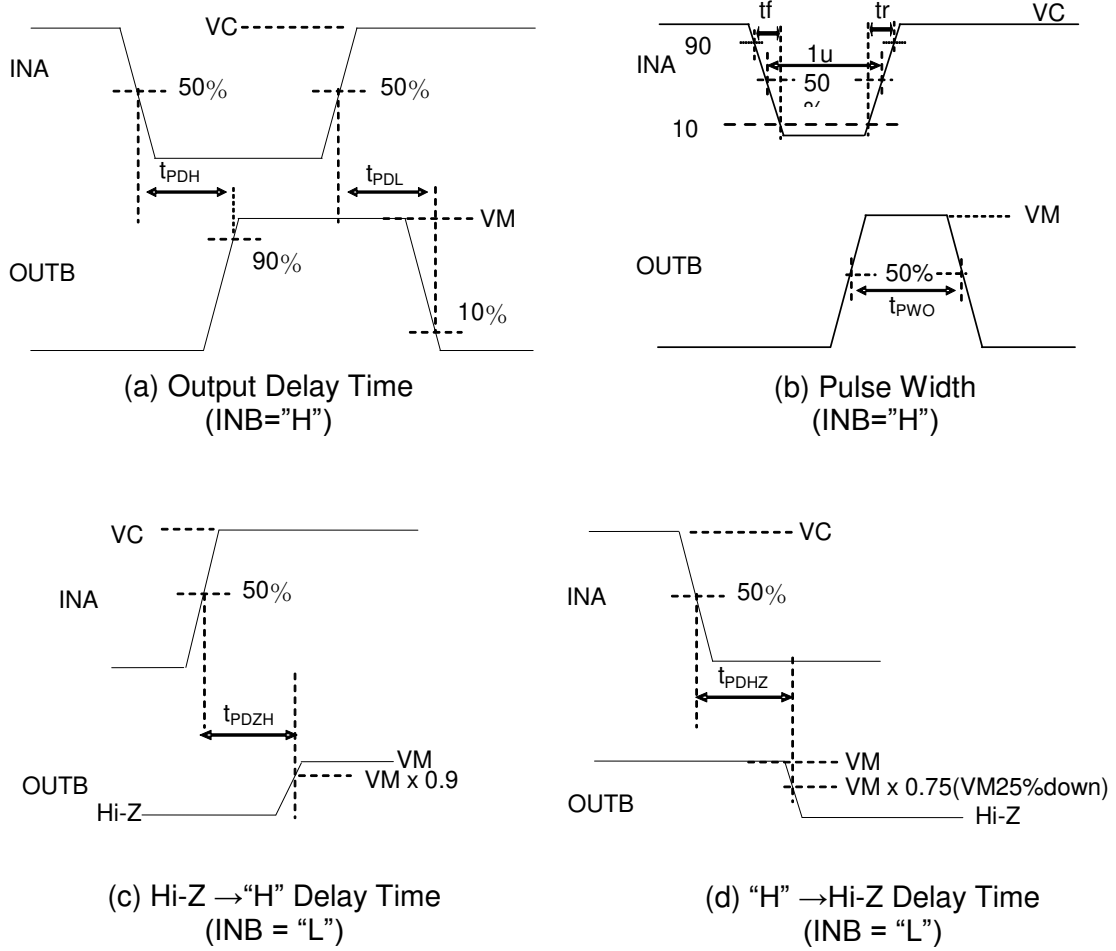


Figure 3. Time Chart (Output delay time, pulse width)

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.

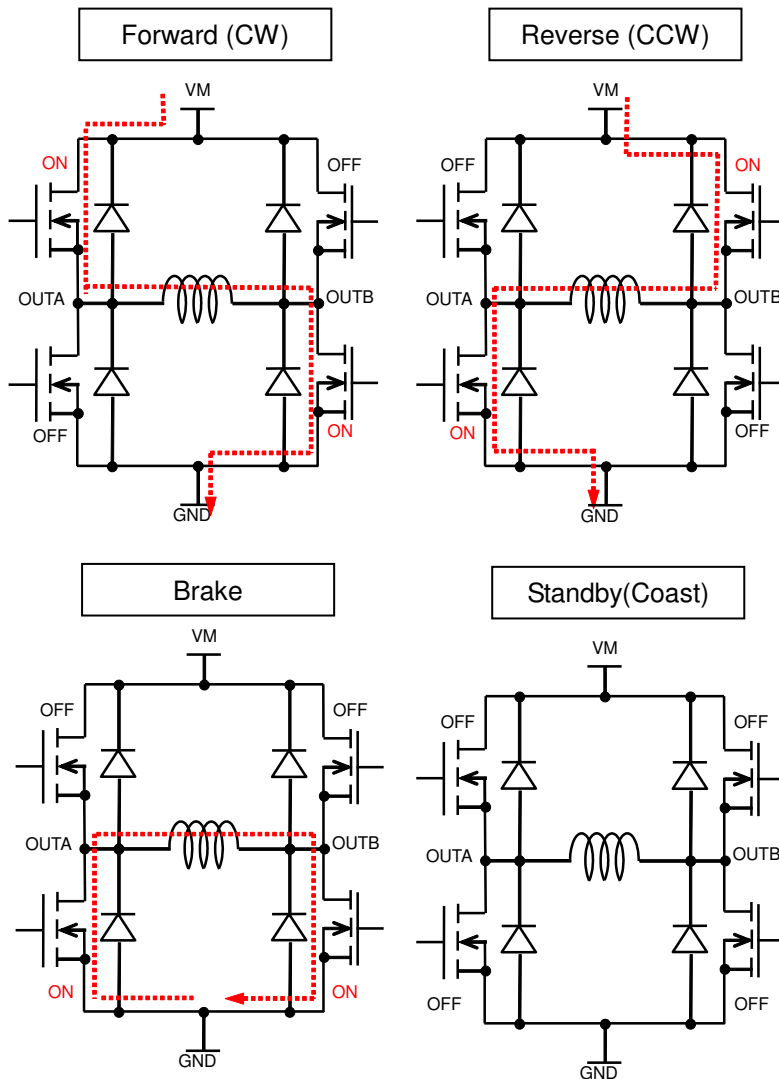


Figure 4. Direction of current

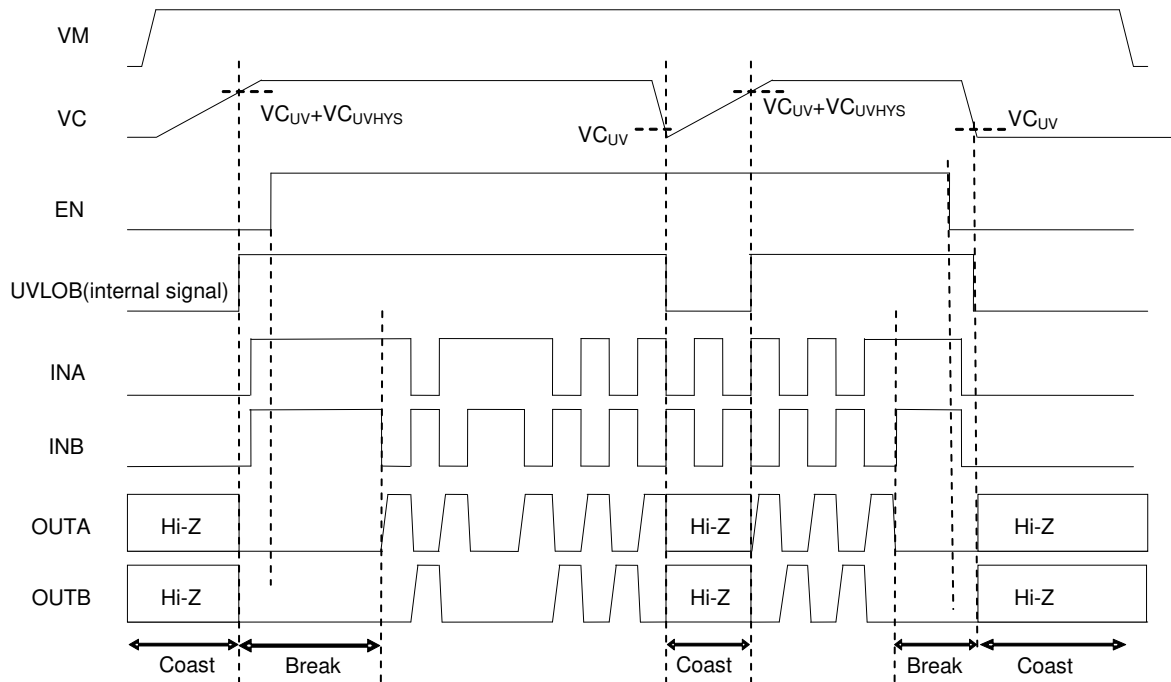


Figure 5. Time Chart (UVLO)

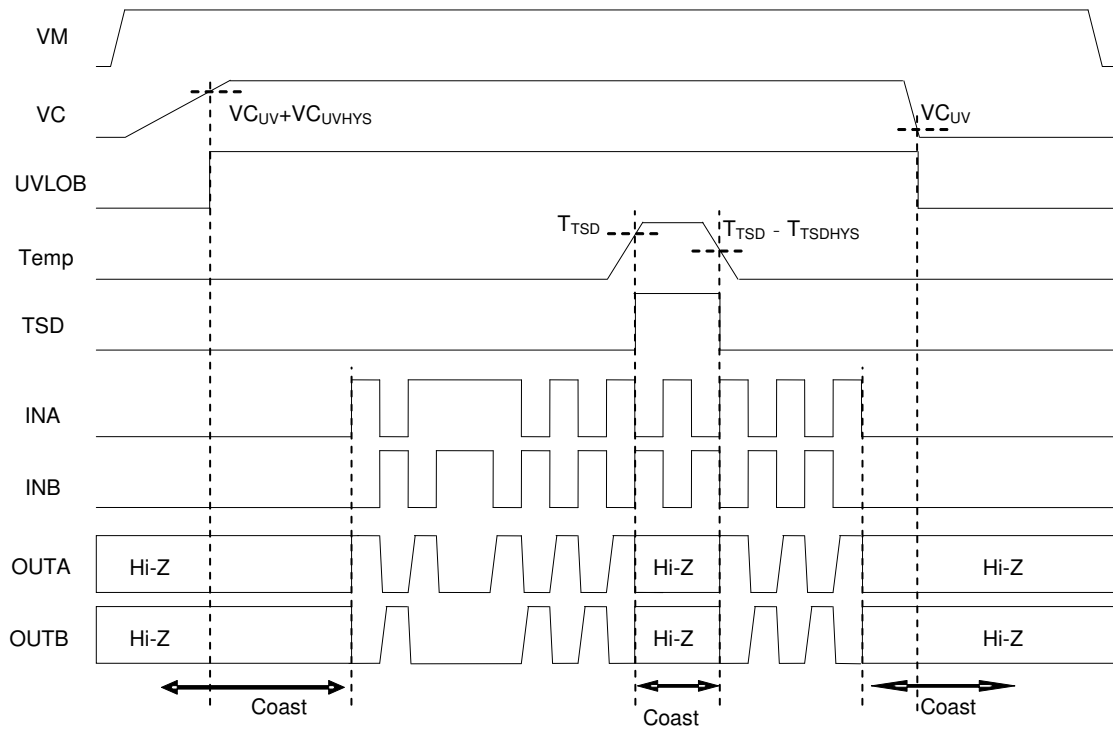


Figure 6. Time Chart (TSD)

11. Recommended External Circuits

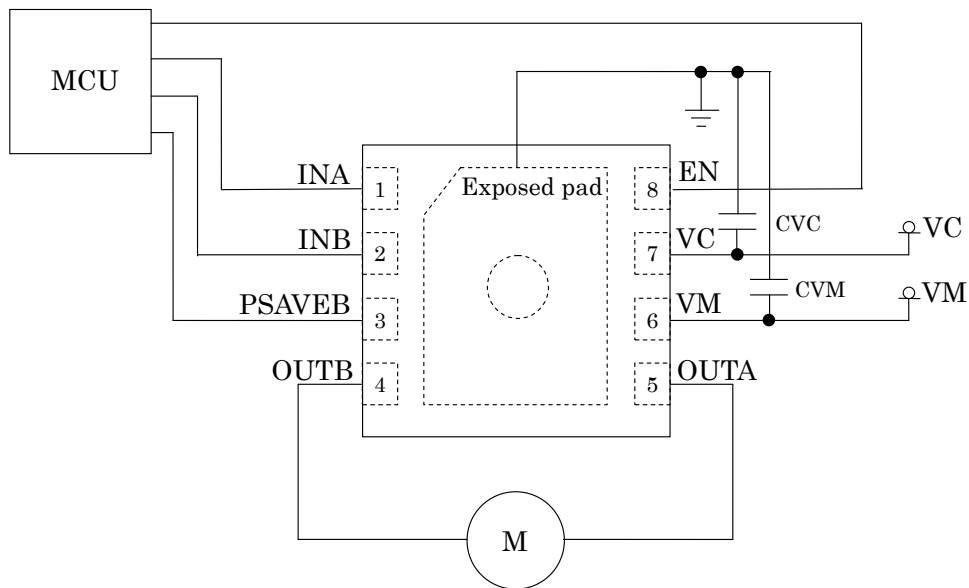


Figure 7. External circuit (Top view)

Table 2. Recommended External Parts

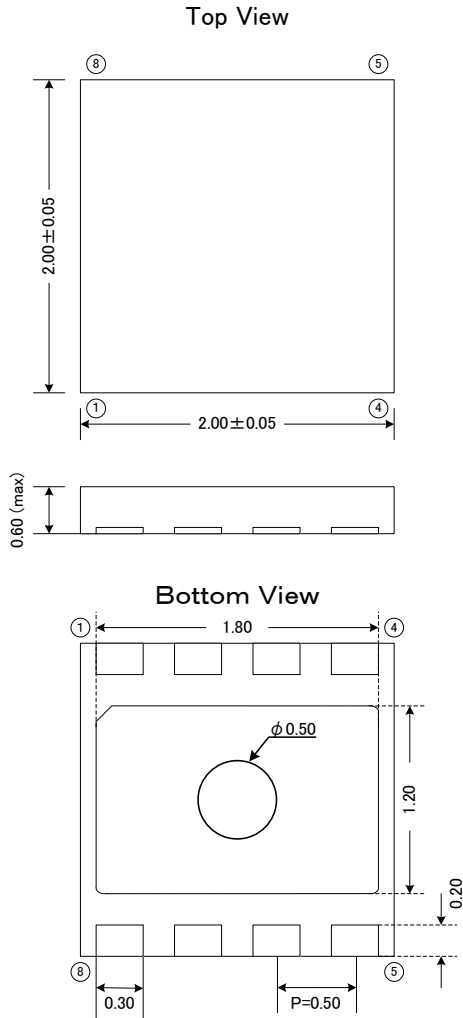
| Parameter | Symbol | min | typ | max | Unit | Notes |
|--|--------|-----|-----|-----|------|-----------|
| Motor driver power supply (decoupling capacitor) | CVM | 1.0 | 10 | - | μF | (Note 11) |
| Control power supply (decoupling capacitor) | CVC | 0.1 | 1.0 | - | μF | (Note 11) |

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)

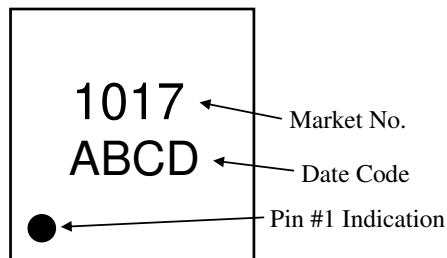


Recommended foot pattern

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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