

Description

The AH9485 and AH9486 are single chip solutions for driving a single phase (coil) brushless DC motors. It integrates the motor driver and the high sensitivity Hall effect sensor to simplify the system circuit and PCB design for simpler solutions.

Rotor lock-detect, shutdown and auto-restart functions help to prevent the motor from over-heating when rotor is locked and restarts the motor after the lock is removed.

The AH9485 and AH9486 have built-in open drain tachometer frequency generator (FG) and rotation detection (RD) outputs to allow external interface to monitor motor rotation, speed or rotor locks conditions easily. The FG provides magnetic change frequency while the RD provides the rotor status.

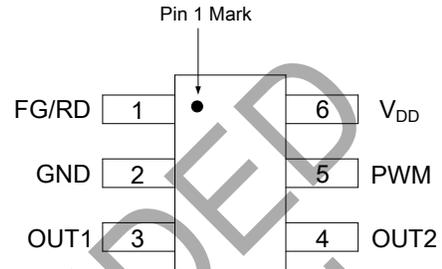
The full bridge output stage uses "soft-switching" technique to minimize the audible switching noise (vibration and acoustic noise) and electromagnetic interference (EMI) providing a low noise solution.

Over-temperature shutdown provides thermal protection for the device. An external DC voltage or a PWM (pulse-width modulation) signal on the PWM pin can be used to control the motor speed.

The AH9485 and AH9486 are packaged in TSOT26F.

Pin Assignments

(Top View)



TSOT26F

Features

- Internal Full Bridge Driver
- High Sensitivity Integrated Hall Sensor
- Low and Wide Supply Voltage Range of 2V to 6V
- Soft Switching for Low Noise
- Rotor Lock Protection and Auto-Restart
- DC Voltage or PWM Signal Speed Control
- Thermal Protection
- Tachometer FG Output(AH9485) or Rotor Lock Alarm RD Output (AH9486)
- Operating Temperature Range of -40°C to +105°C
- Flat Pin TSOT26F Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

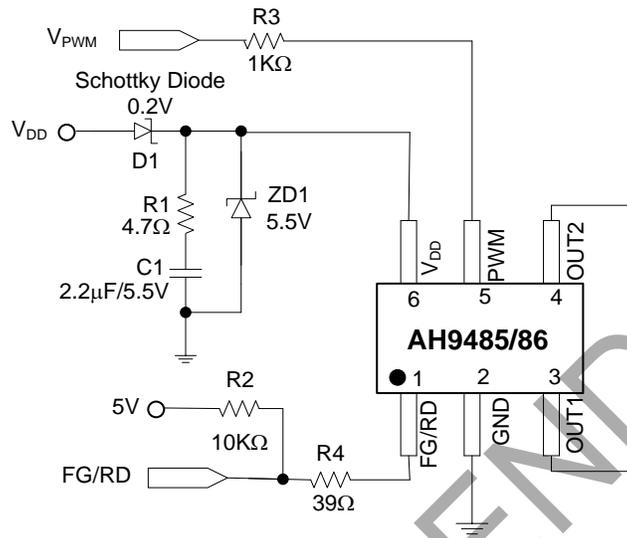
Applications

- 5V Low Noise BLDC Cooling Fans
- Low Voltage / Low Power BLDC Motors
- Notebook / VGA DC Fans / Blowers
- Micro-Motors

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Typical Applications Circuit (Note 4)

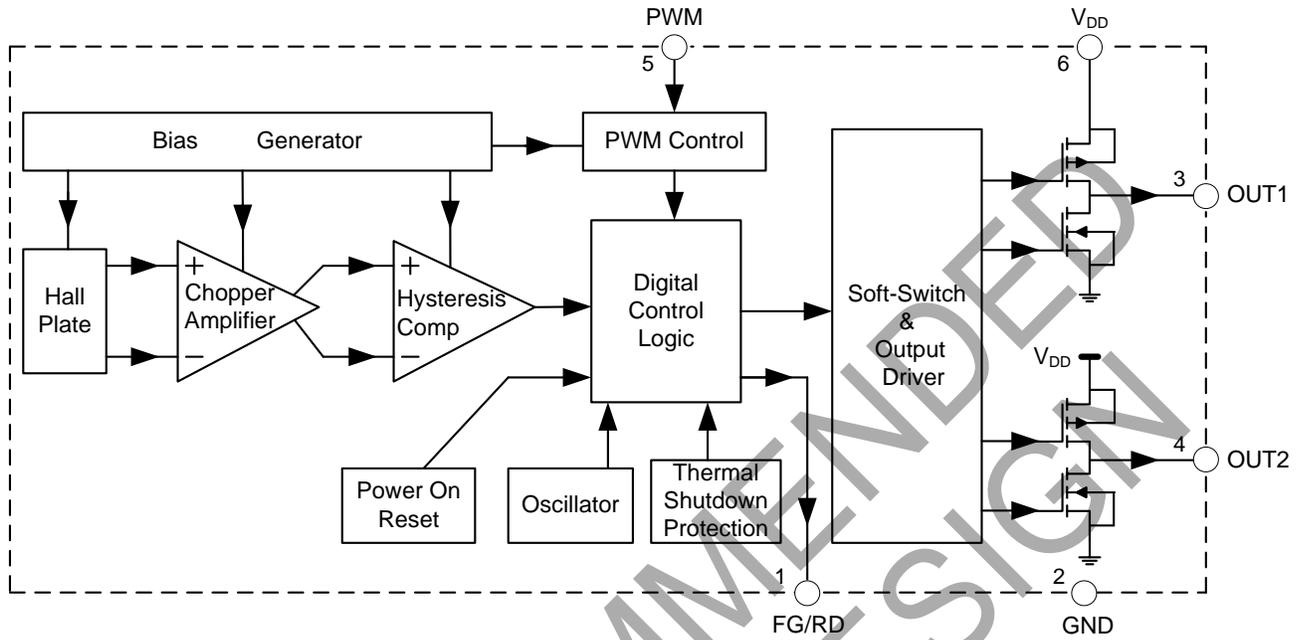


Note 4: Must use C1 capacitor for the decoupling between V_{DD} and GND and place the capacitor as close to the IC as possible.
 ZD1: V_{DD} over-voltage stress protection diode.
 R2: current limit resistor for Open Drain RD output.
 R3: de-coupling resistor for long-distance signal transmission.

Pin Descriptions

| Pin Number | Pin Name | Function |
|------------|-----------------|---|
| 1 | FG/RD | FG(AH9485) or RD(AH9486) |
| 2 | GND | Ground pin |
| 3 | OUT1 | Output pin 1 |
| 4 | OUT2 | Output pin 2 |
| 5 | PWM | DC voltage or Pulse width modulation signal speed control pin |
| 6 | V _{DD} | Power supply pin |

Functional Block Diagram



NOT RECOMMENDED FOR NEW DESIGN

Absolute Maximum Ratings (Notes 5 and 6) (@T_A=+25°C, unless otherwise specified.)

| Symbol | Parameter | Rating | Unit |
|--------------------|---|----------------------|------|
| V _{DD} | Supply Voltage | 7 | V |
| I _{OUP} | Peak Output Current | 500 | mA |
| I _{OUTC} | Continuous Output Current | 300 | mA |
| V _{FG/RD} | FG/RD Pull-up Voltage | 7 or V _{DD} | V |
| I _{FG/RD} | FG/RD Current | 20 | mA |
| P _D | Power Dissipation | 520 | mW |
| θ _{JA} | Thermal Resistance (Junction to Ambient) | 141 | °C/W |
| T _{STG} | Storage Temperature | -55 to +150 | °C |
| ESD | ESD (Human Body Model) (Note 7) | 2000 | V |

- Note:
- Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.
 - The absolute maximum V_{DD} of 7V is a transient stress rating and is not meant as a functional operating condition. It is not recommended to operate the device at the absolute maximum rated conditions for any period of time.
 - Electronic semiconductor products are sensitive to Electro Static Discharge (ESD). Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

Recommended Operating Conditions

| Symbol | Parameter | Min | Max | Unit |
|-----------------|---------------------|-----|------|------|
| V _{DD} | Supply Voltage | 2 | 6 | V |
| T _A | Ambient Temperature | -40 | +105 | °C |

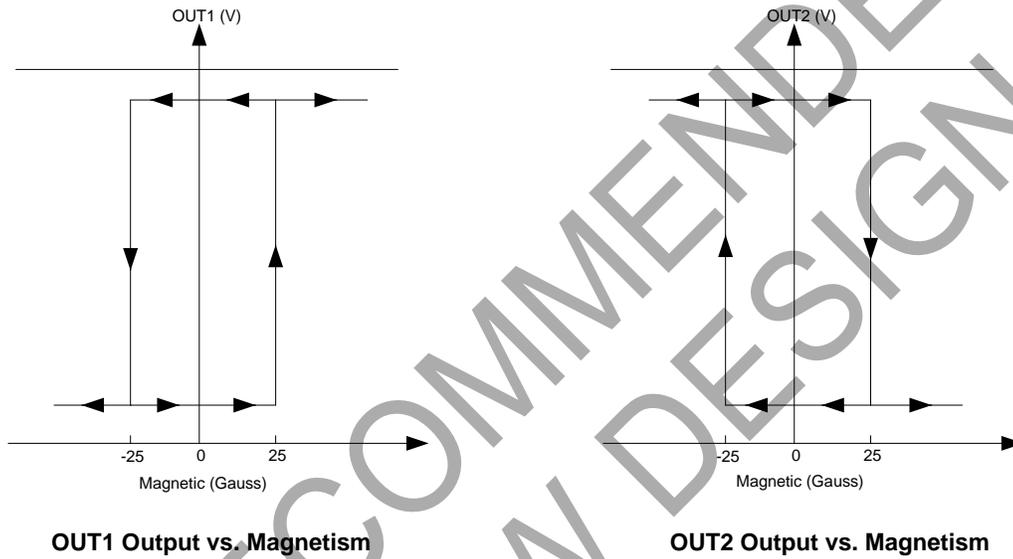
Electrical Characteristics (@V_{DD} = 5V, T_A=+25°C, unless otherwise specified.)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|----------------------|---|---|----------------------|------|-----------------------|------|
| I _{DD} | Supply Current | – | – | 1.8 | 3 | mA |
| R _{DS(ON)1} | ON Resistance (R _{PMOS} +R _{NMOS}) | I _{OUT} = 300mA | – | 2 | – | Ω |
| R _{DS(ON)2} | OUT1, OUT2 ON Resistance | T _J = +125°C, I _{OUT} = 300mA | – | 3 | – | Ω |
| V _{OL} | FG/RD Output Low Voltage | I _{OL} = 10mA | – | 0.33 | 0.5 | V |
| I _{LEAK} | FG/RD Output Leakage Current | V _{FG} (V _{RD}) = 5V | – | 0.15 | 10 | μA |
| t _{ON} | Locked Rotor Period | – | – | 0.25 | – | s |
| t _{OFF} | | – | – | 1.5 | – | s |
| PWM _{HIGH} | PWM Voltage Range | – | >0.5×V _{DD} | – | V _{DD} | V |
| PWM _{LOW} | | – | 0 | – | <0.14×V _{DD} | V |

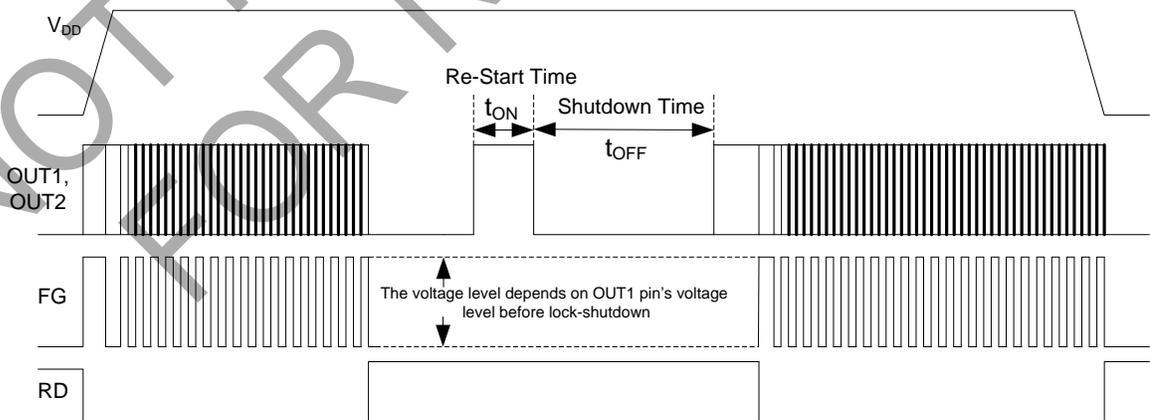
Magnetic Characteristics (@ $V_{DD} = 5V$, $T_A = +25^\circ C$, unless otherwise specified.)

| Symbol | Parameter | Min | Typ | Max | Unit |
|-----------|-----------------|-----|-----|-----|-------|
| B_{OP} | Operating Point | 0 | 25 | 50 | Gauss |
| B_{RP} | Releasing Point | -50 | -25 | 0 | Gauss |
| B_{HYS} | Hysteresis | - | 50 | - | Gauss |

Magnetic Hysteresis Characteristics

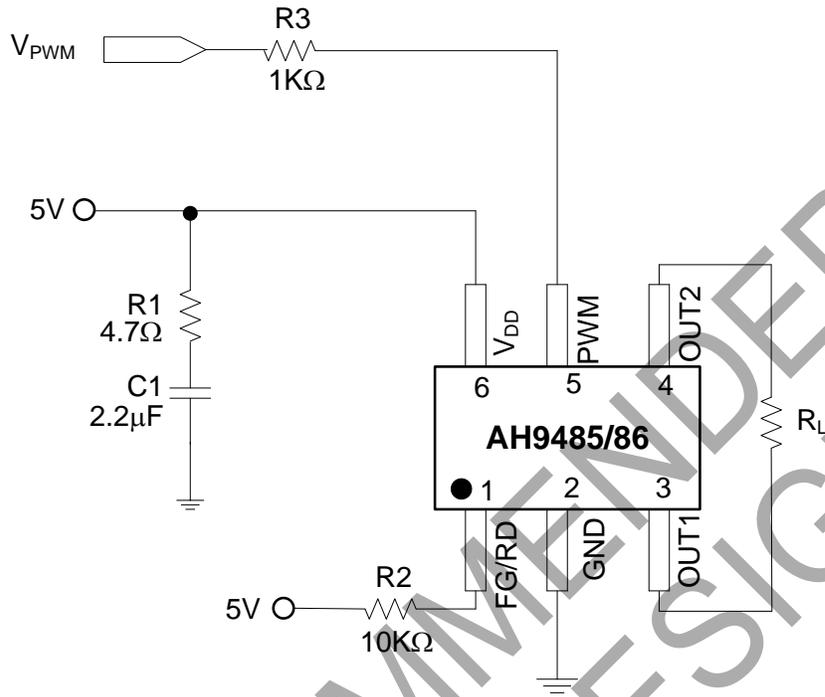


Output Waveforms Description (Notes 8 and 9)



- Notes: 8. RD and FG are open drain outputs and the high level of the signal depends on the external supply voltage.
9. The on torque time of motor is same as the re-start time.

Test Circuit



NOT RECOMMENDED
FOR NEW DESIGN

Application Note (Notes 10, 11 and 12)

DC Supply Voltage Speed Control

Motor speed can be controlled by varying the V_{DD} supply voltage while PWM pin is tied to V_{DD} pin.

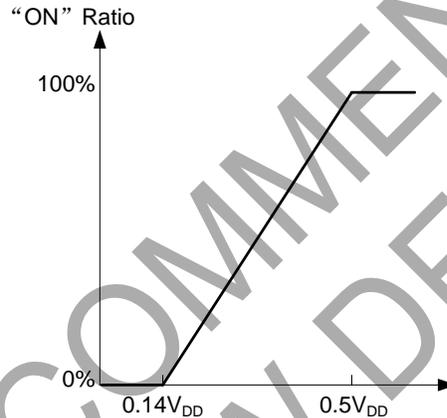
PWM Pin Speed Control

PWM (pulse width modulation) pin can be used to control the motor speed. There are two types of speed control using PWM pin:

- a) DC Voltage Mode
- b) Pulse Width Mode

a) DC Voltage Mode PWM:

DC voltage signal (V_{PWM}) on the PWM pin can be used to control the motor speed. Applying a DC voltage to the PWM pin will generate an internal PWM pulses with the "ON" duty cycle based on the applied DC voltage according to the diagram below. The internal duty ratio generated will change from 0% duty at $V_{PWM} = 0.14V_{DD}$ typically to 100% at $V_{PWM} = 0.5V_{DD}$.



- Notes:
- 10. While using pulse mode PWM, the "High" value of the input pulse should be higher than $0.5 \times V_{DD}$ and the "Low" value should be lower than $0.14 \times V_{DD}$.
 - 11. The lower-limit for the PWM pulse frequency is 200Hz, and the recommended frequency range is higher than 30kHz where the PWM input pulses will not generate acoustic noise.
 - 12. The "PWM" pin contains an internal pull-up resistor, so the AH9485/86 will rotate at full-speed (100% ON) when this pin is left un-connected (floating).

b) Pulse Mode PWM:

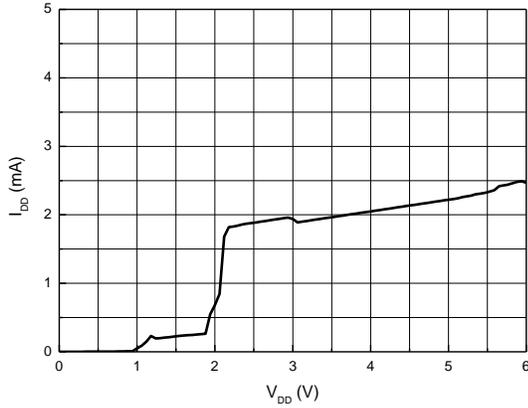
External PWM pulses can be applied directly to the PWM pin to control the speed. The AH9485/86 will pass this pulse to the coil driver with the original duty-cycle ratio. While using pulse mode PWM, the "High" value of the input pulse should be higher than $0.5 \times V_{DD}$ and the "Low" value should be lower than $0.14 \times V_{DD}$. The lower-limit for the PWM pulse frequency is 200Hz, and the recommended frequency range is higher than 30kHz to help prevent acoustic noise related to the switching.

Soft Switching

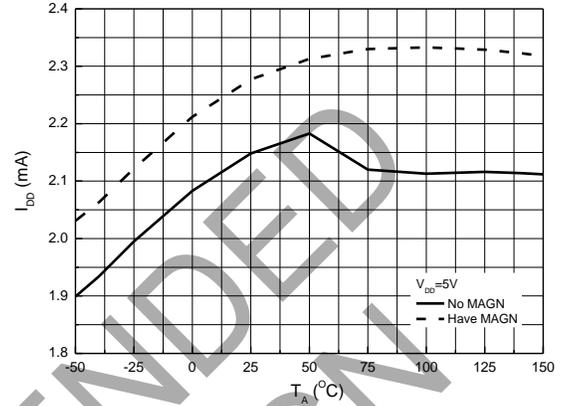
AH9485/86 use soft switching of the motor coil current during commutation to minimize audible switching noise and electromagnetic Interference (EMI) to provide a low noise solution.

Performance Characteristics

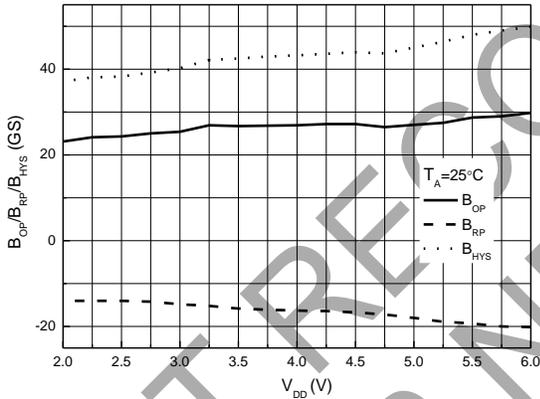
Supply Current I_{DD} vs. Supply Voltage V_{DD}



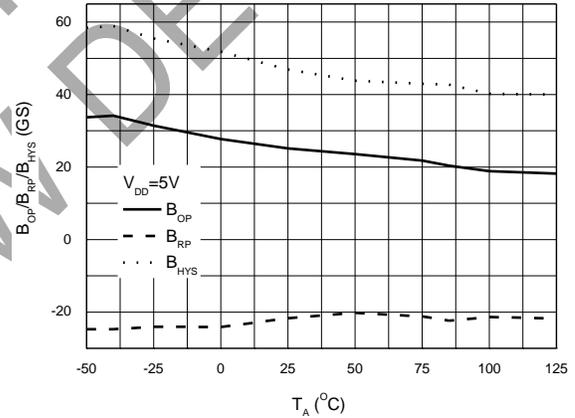
Supply Current I_{DD} vs. Operating Temperature T_A



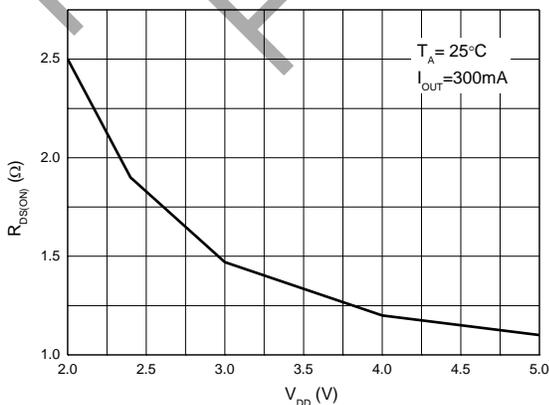
Operating Switch Points B_{OP} , B_{RP} & B_{HYS} vs. Supply Voltage V_{DD}



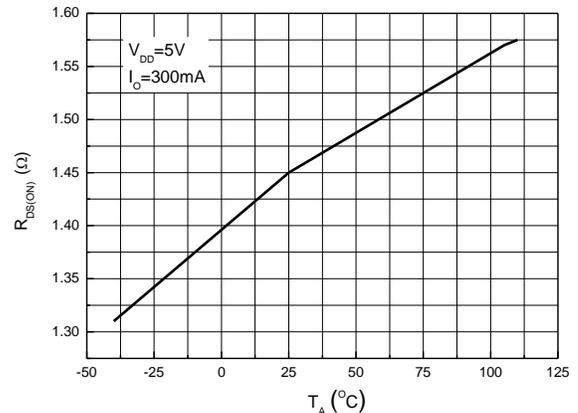
Operating Switch Points B_{OP} , B_{RP} & B_{HYS} vs. Operating Temperature T_A



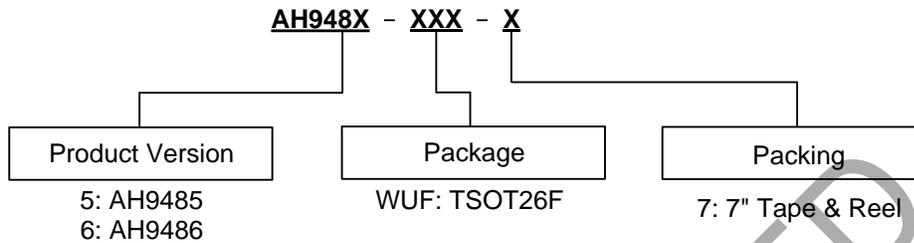
High+Low Side $R_{DS(ON)}$ vs. Supply Voltage V_{DD}



High+Low Side $R_{DS(ON)}$ vs. Operating Temperature T_A



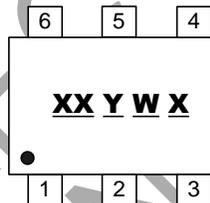
Ordering Information



| Part Number | Package Code | Packaging | 7" Tape and Reel | |
|--------------|--------------|-----------|------------------|--------------------|
| | | | Quantity | Part Number Suffix |
| AH9485-WUF-7 | WUF | TSOT26F | 3000/Tape & Reel | -7 |
| AH9486-WUF-7 | WUF | TSOT26F | 3000/Tape & Reel | -7 |

Marking Information

(Top View)



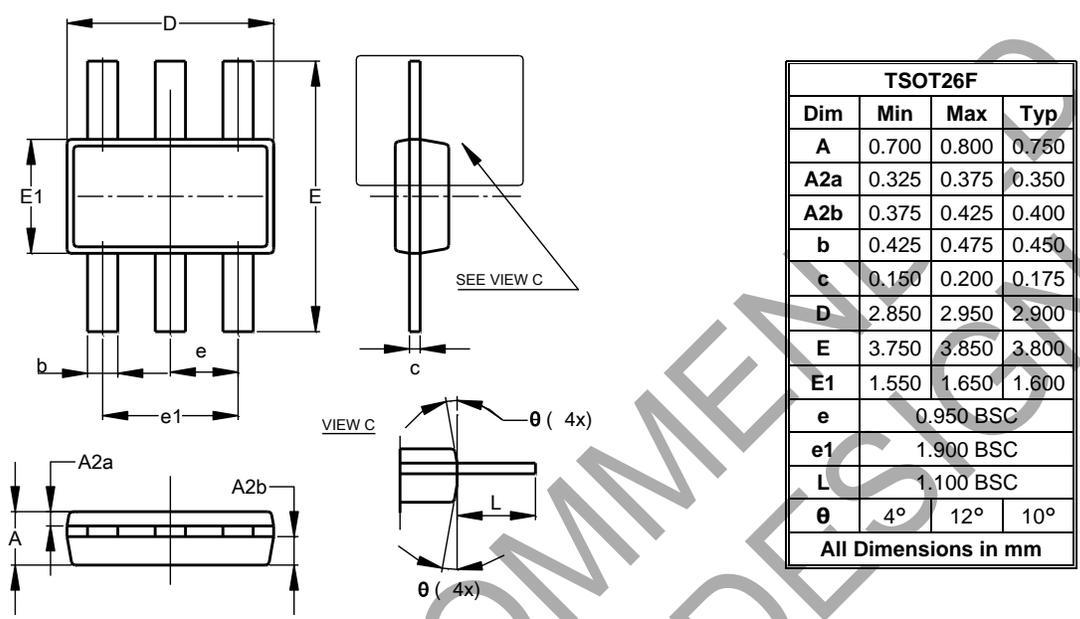
- XX** : Identification Code
- Y** : Year 0~9
- W** : Week : A~Z : 1~26 Week;
a~z : 27~52 Week;
z Represents 52 and 53 Week
- X** : Internal Code

| Part Number | Package | Identification Code |
|--------------|---------|---------------------|
| AH9485-WUF-7 | TSOT26F | H5 |
| AH9486-WUF-7 | TSOT26F | H6 |

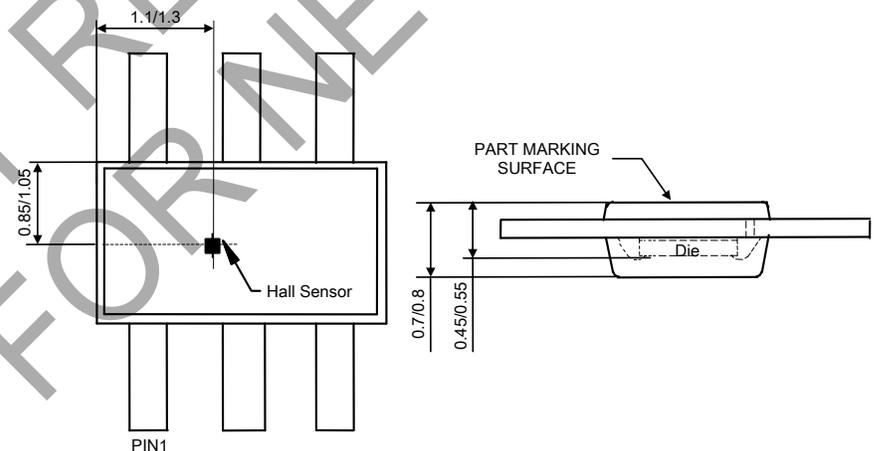
Package Outline Dimensions (All dimensions in mm.)

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(1) Package Type: TSOT26F

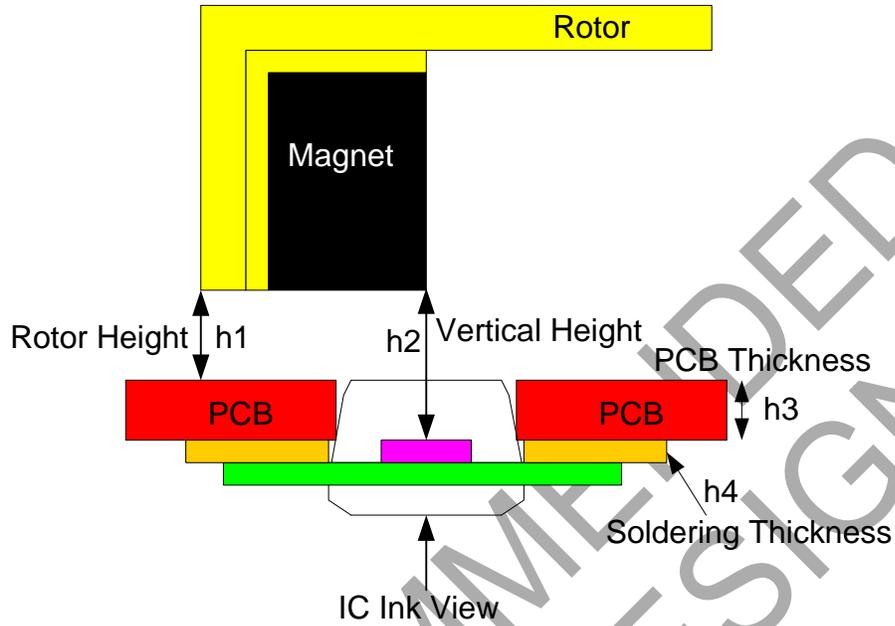


Min/Max(in mm)



Sensor Location

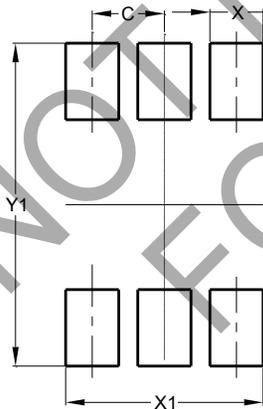
Mechanical Structure



Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(1) Package Type: TSOT26F



| Dimensions | Value (in mm) |
|------------|---------------|
| C | 0.950 |
| X | 0.700 |
| X1 | 2.600 |
| Y | 1.000 |
| Y1 | 4.220 |

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