SINGLE PHASE LOW NOISE SMART MOTOR DRIVER



## Description

The AH9479/80/81 is a single chip solution for driving single coil brushless DC motors. It combines a motor driver with a high sensitivity Hall sensor, which simplifies the PCB design and makes the fabrication of small-size motors possible.

The AH9480 has an open-drain tachometer output FG that follows the Hall sensor latching output. The AH9481 has an open-drain rotation detection output RD that is active low when the motor is spinning and goes high when blocked.

When there is no motion about 0.4 second, the IC will automatically detect the locked rotor conditions, and enter protection mode, shutting off the motor driver for 4 seconds. Then, the IC will turn on the motor driver for 0.4 second to detect whether there is rotation condition, if fails, the IC will shut off motor driver for four seconds again. This sequence will be repeated until rotation condition is detected, and the IC enters normal operation. This feature can effectively prevent the IC from overheating and damage due to long-time locked rotor condition. “Soft-switch” is used to reduce the vibration and acoustic noise. Thermal-shutdown protection ensures that the motor driver operates under specified temperature ranges.

The AH9479 is packaged in TO-94, and the AH9480/81 is packaged in MSOP-8.

## Features

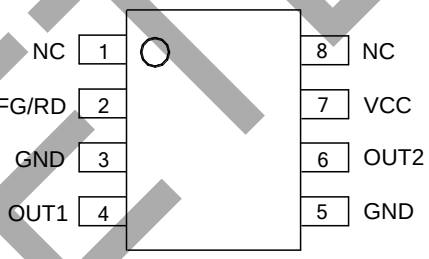
- Full Bridge Driver
- High Sensitivity Integrated Hall Sensor
- Soft-Switching for Low Noise
- Low Supply Voltage: 2.5V
- Locked Rotor Protection and Auto-Restart
- Thermal Protection
- Output Over-Current Protection
- Short Circuit Protection
- Tachometer Output Signal (AH9480)
- Alarm Output Signal (AH9481)

## Pin Assignments

**(Top View)**


**TO-94 (For AH9479)**

**(Top View)**

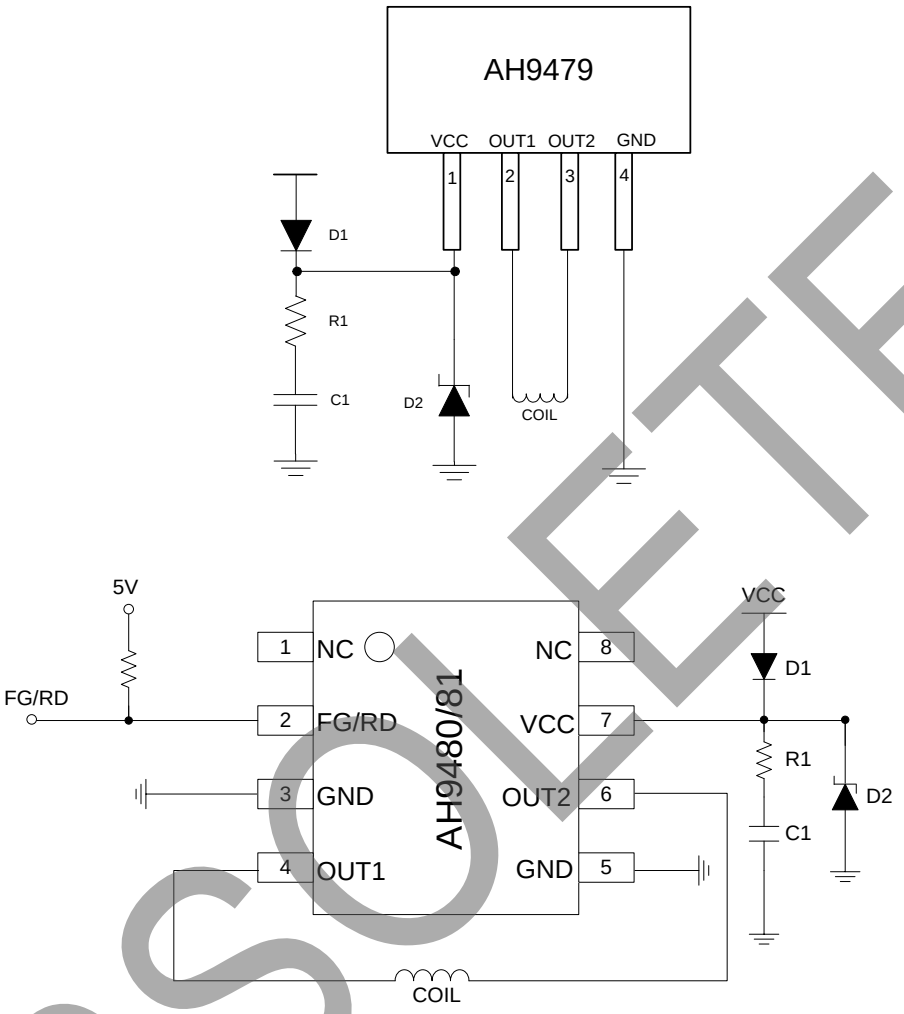



**MSOP-8 (For AH9480/81)**

## Applications

- 5V/12V Low Noise BLDC Cooling Fans
- Low Voltage / Low Power BLDC Motors
- Notebook DC Fans / Blowers
- Automotive Low Noise Climate Control Fans
- Micro-Motors

## Typical Applications Circuit

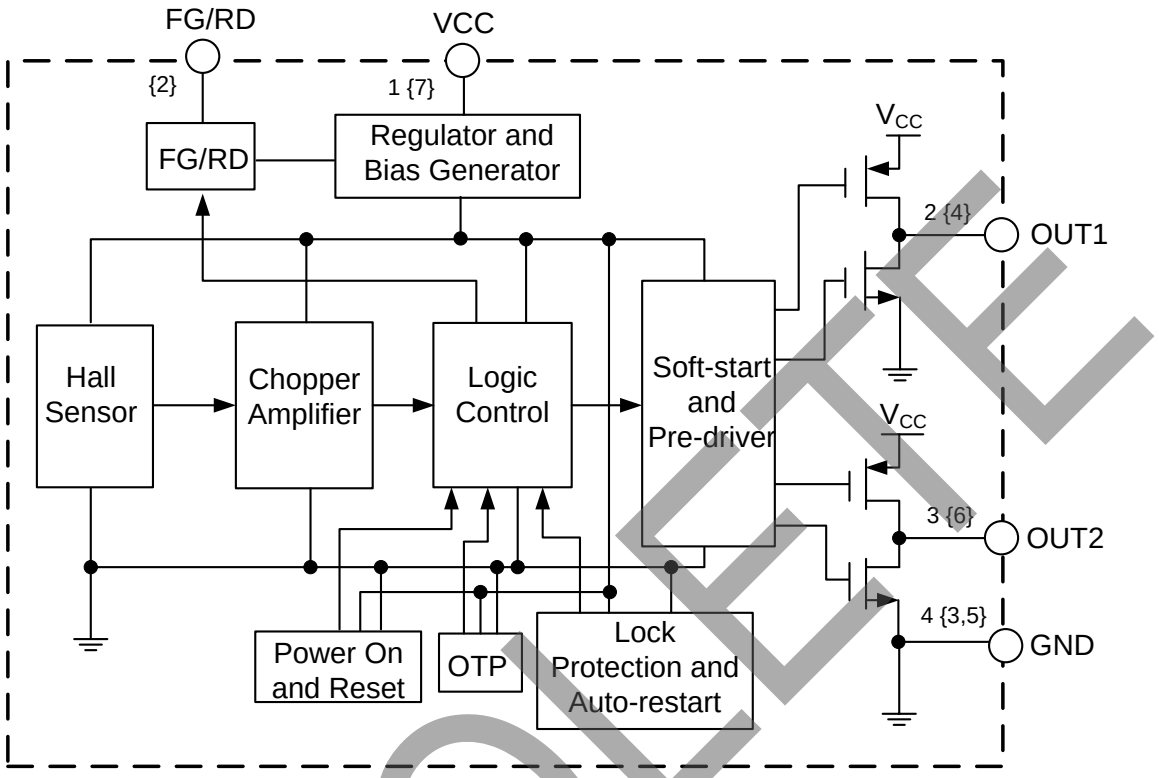



Note 1: C1 should be at least larger than 2.2μF, R1=0 to 10Ω

## Pin Descriptions

| Pin Number | | Pin Name | Function |
|---|---|---|---|
| TO-94 | MSOP-8 | | |
| _ | 2 | FG/RD | Frequency generator (rotation detection) open drain output |
| 1 | 7 | VCC | Power supply pin |
| 2 | 4 | OUT1 | Output pin 1 |
| 3 | 6 | OUT2 | Output pin 2 |
| 4 | 3, 5 | GND | Ground pin |
| _ | 1, 8 | NC | No connection |

## Functional Block Diagram




A {B}
A for TO-94
B for MSOP-8

## Absolute Maximum Ratings (Note 2)

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 18 | | V |
| $I_{OUT\_P}$ | Peak Output Current | 500 | | mA |
| $I_{OUT\_C}$ | Continuous Output Current | 300 | | mA |
| $V_{FG}/V_{RD}$ | FG/RD Pull-up Voltage | 18 | | V |
| $I_{FG}/I_{RD}$ | FG/RD Output Current | 10 | | mA |
| $P_D$ | Power Dissipation | TO-94 | 550 | mW |
| | | MSOP-8 | 585 | |
| $T_A$ | Operating Ambient Temperature | -40 to +85 | | °C |
| $T_{STG}$ | Storage Temperature | -55 to +150 | | °C |
| $\theta_{JA}$ | Thermal Resistance (Junction to Ambient) | TO-94 | 227 | °C/W |
| | | MSOP-8 | 214 | |
| ESD | ESD (Human Body Model) | 6000 | | V |
| ESD | ESD (Machine Model) | 200 | | V |

Note 2: 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.

## Recommended Operating Conditions

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 2.5 | 16 | V |
| $T_A$ | Operating Ambient Temperature | -40 | +85 | °C |

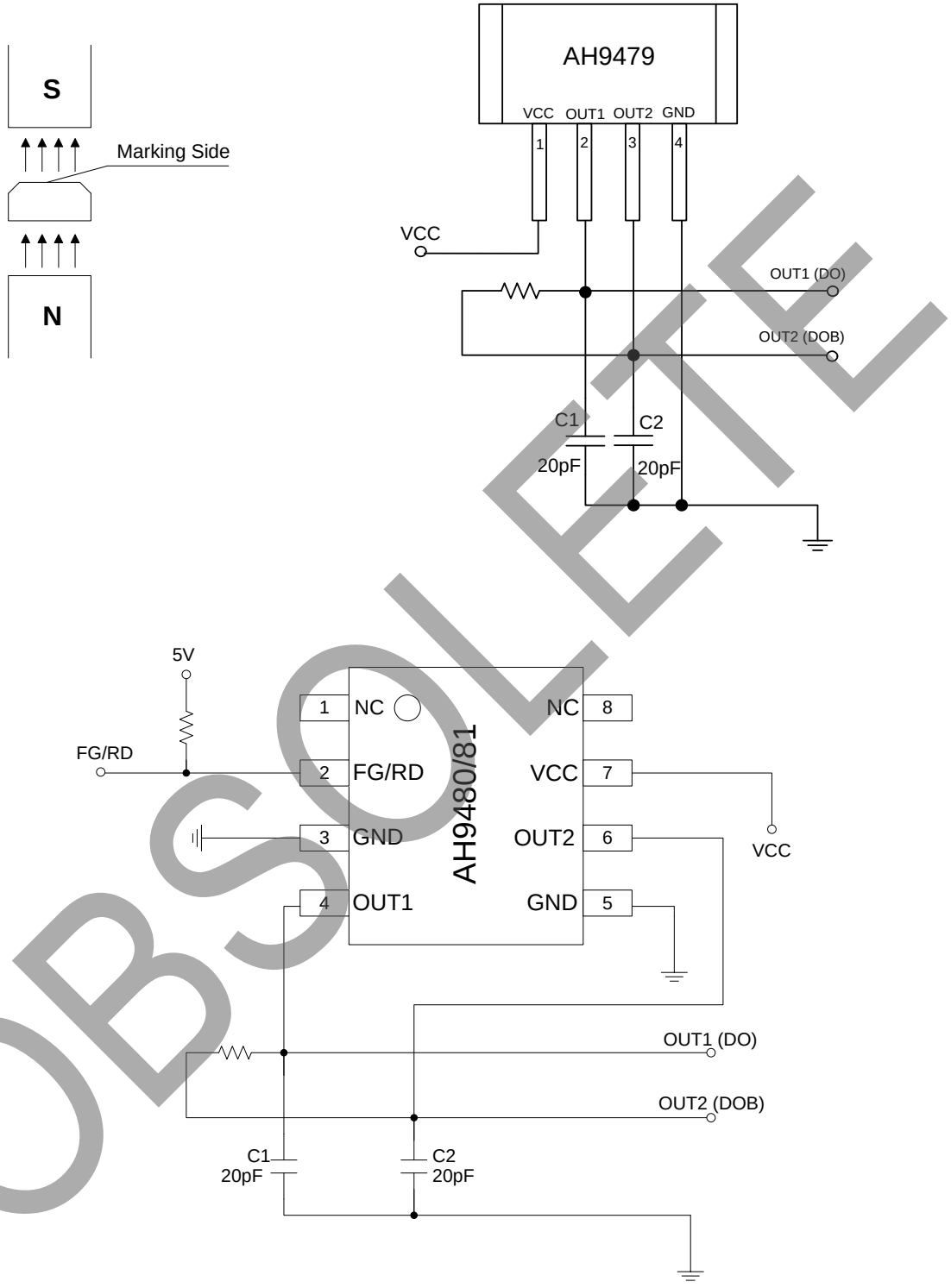
## Electrical Characteristics ($V_{CC}$=12V, $T_A$=+25°C, unless otherwise specified.)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | Operating, $R_{COIL}$=100Ω | 2.5 | _ | 16 | V |
| $I_{CC}$ | Supply Current | _ | _ | 4.3 | 12 | mA |
| $R_{DSON1\_2}$ | ON Resistance ($R_{PMOS}$+$R_{NMOS}$=$R_S$) | $V_{CC}$=12V, $T_A$=+25°C, $I_{OUT}$=300mA | _ | 3.3 | _ | Ω |
| | | $V_{CC}$=12V, $T_J$=+125°C, $I_{OUT}$=300mA | _ | 3.3 | _ | Ω |
| $V_{OL}$ | FG/RD Output Low Voltage | $I_{OL}$=5mA | _ | 0.18 | 0.5 | V |
| $I_{LEAKAGE}$ | FG/RD Output Leakage Current | $V_{FG}$ ($V_{RD}$)=5V | _ | 0.15 | 10 | μA |
| $t_{ON}$ | Locked Rotor Period (ON) | $V_{CC}$>7V | _ | 0.4 | _ | s |
| $t_{OFF}$ | Locked Rotor Period (OFF) | $V_{CC}$>7V | _ | 4 | _ | s |
| $T_{OTP}$ | Protection Temperature | _ | _ | +175 | _ | °C |

## Magnetic Characteristics ($V_{CC}$=12V, $T_A$=+25°C, unless otherwise specified.)

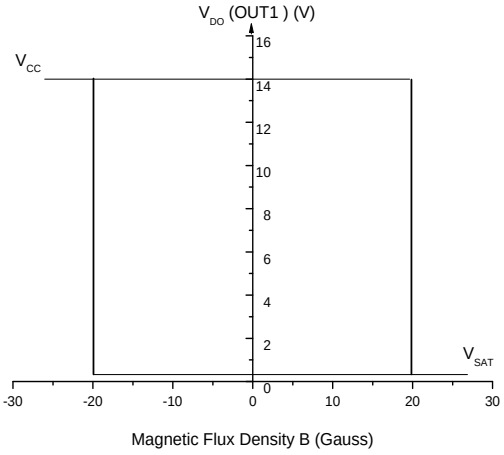
| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $B_{OP}$ | Operating Point | 0 | 20 | 50 | Gauss |
| $B_{RP}$ | Releasing Point | -50 | -20 | 0 | Gauss |
| $B_{HYS}$ | Hysteresis | _ | 40 | _ | Gauss |

## Test Circuit

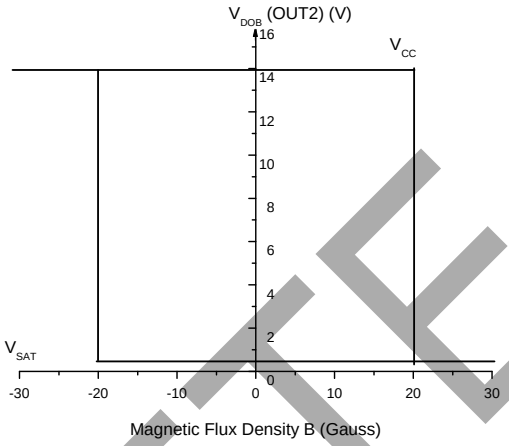



**Basic Test Circuit**

## Hysteresis Characteristics



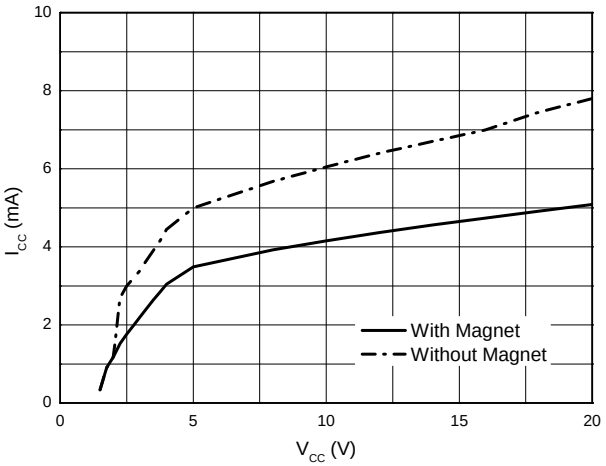

**$V_{DO}$ vs. Magnetic Flux Density**



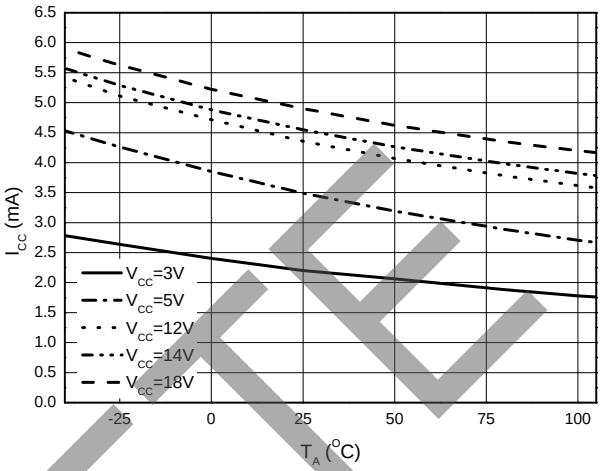

**$V_{DOB}$ vs. Magnetic Flux Density**

## Performance Characteristics

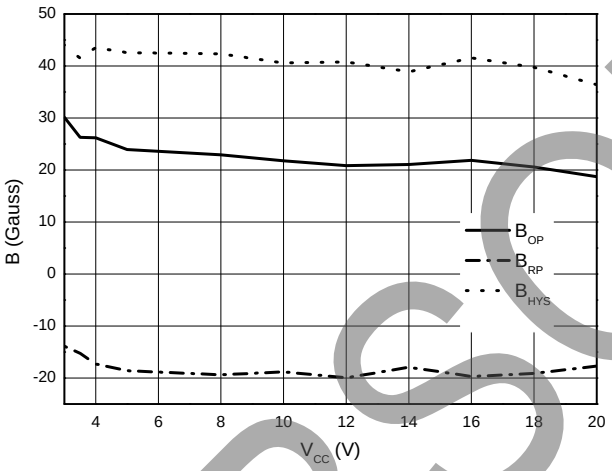
### $I_{CC}$ vs. $V_{CC}$



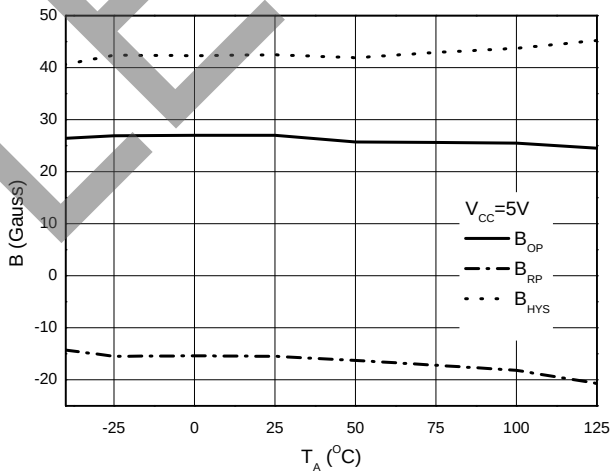

### $I_{CC}$ vs. $T_A$



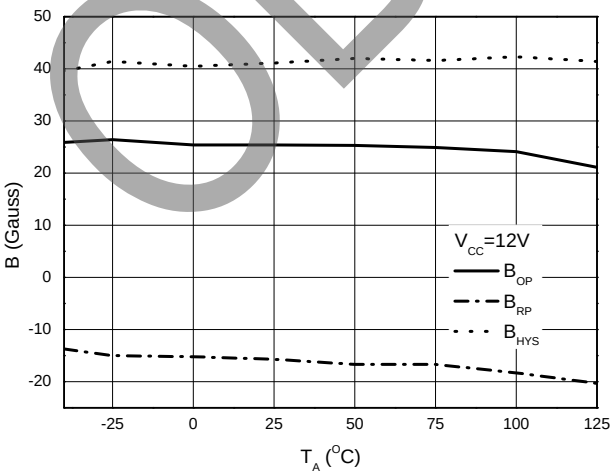

### $B_{OP}/B_{RP}/B_{HYS}$ vs. $V_{CC}$



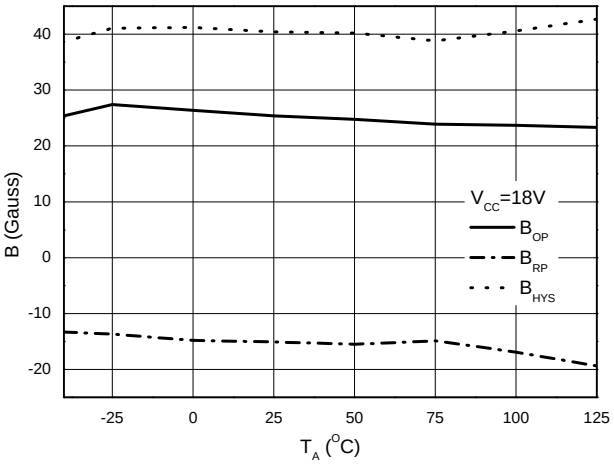

### $B_{OP}/B_{RP}/B_{HYS}$ vs. $T_A$ ($V_{CC}$=5V)




### $B_{OP}/B_{RP}/B_{HYS}$ vs. $T_A$ ($V_{CC}$=12V)

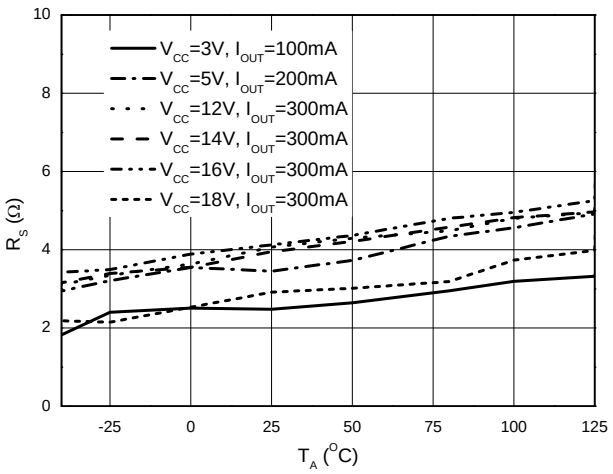



### $B_{OP}/B_{RP}/B_{HYS}$ vs. $T_A$ ($V_{CC}$=18V)

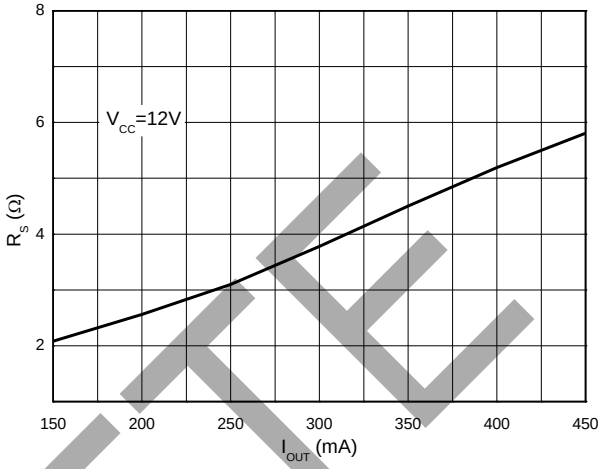


## Performance Characteristics (Cont..)

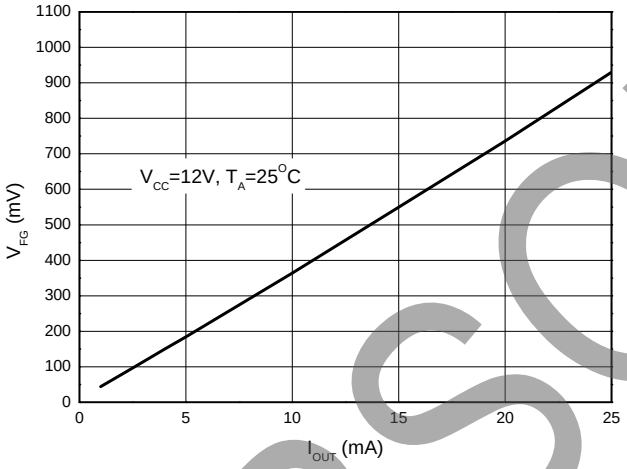
**$R_S$ vs. $T_A$**



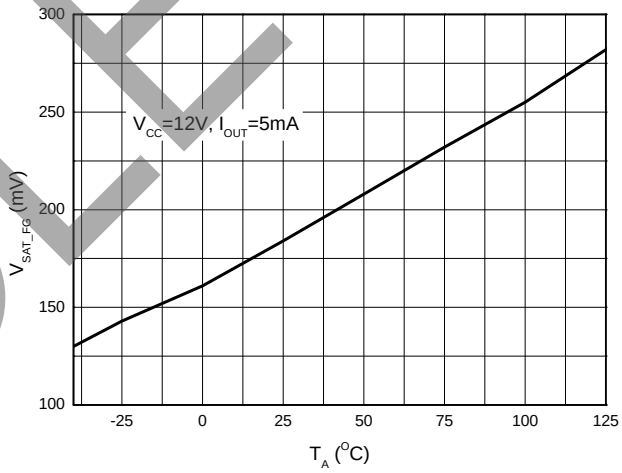

**$R_S$ vs. $I_{OUT}$**



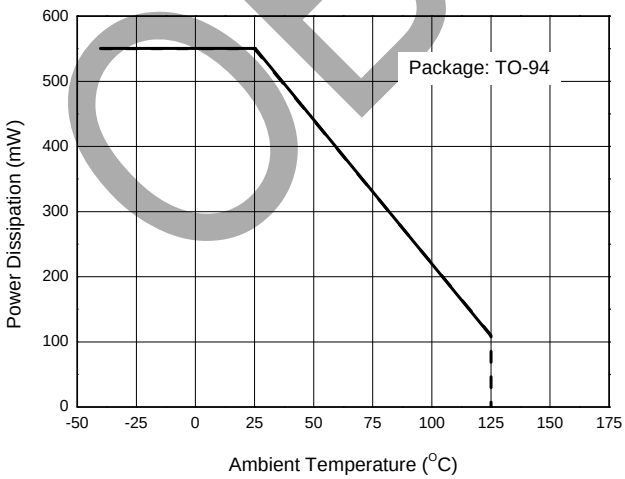

**$V_{FG}$ vs. $I_{OUT}$**



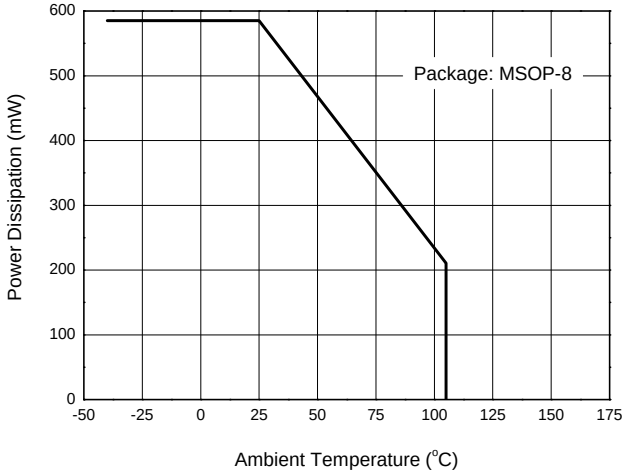

**$V_{SAT\_FG}$ vs. $T_A$**



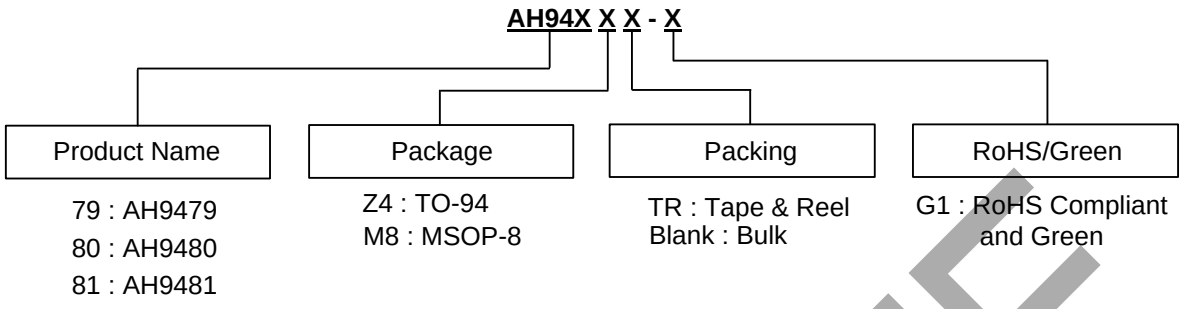

**Power Dissipation vs. $T_A$**




**Power Dissipation vs. $T_A$**



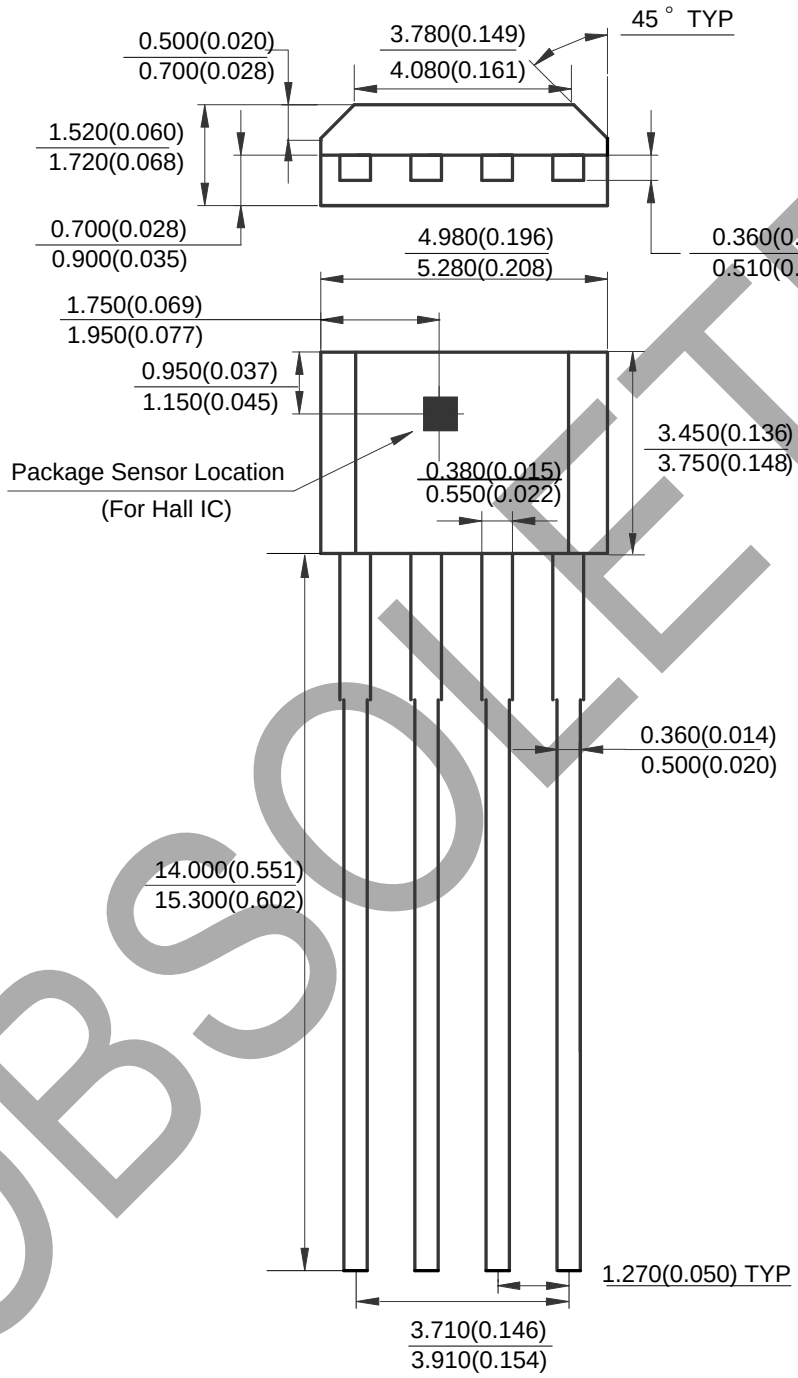
## Ordering Information




| Package | Temperature Range | Output Signal | Part Number | Marking ID | Packing |
|---|---|---|---|---|---|
| TO-94 | -40 to +85°C | _ | AH9479Z4-G1 | 9479Z4-G1 | Bulk |
| MSOP-8 | | FG | AH9480M8TR-G1 | 9480M8-G1 | Tape & Reel |
| | | RD | AH9481M8TR-G1 | 9481M8-G1 | Tape & Reel |

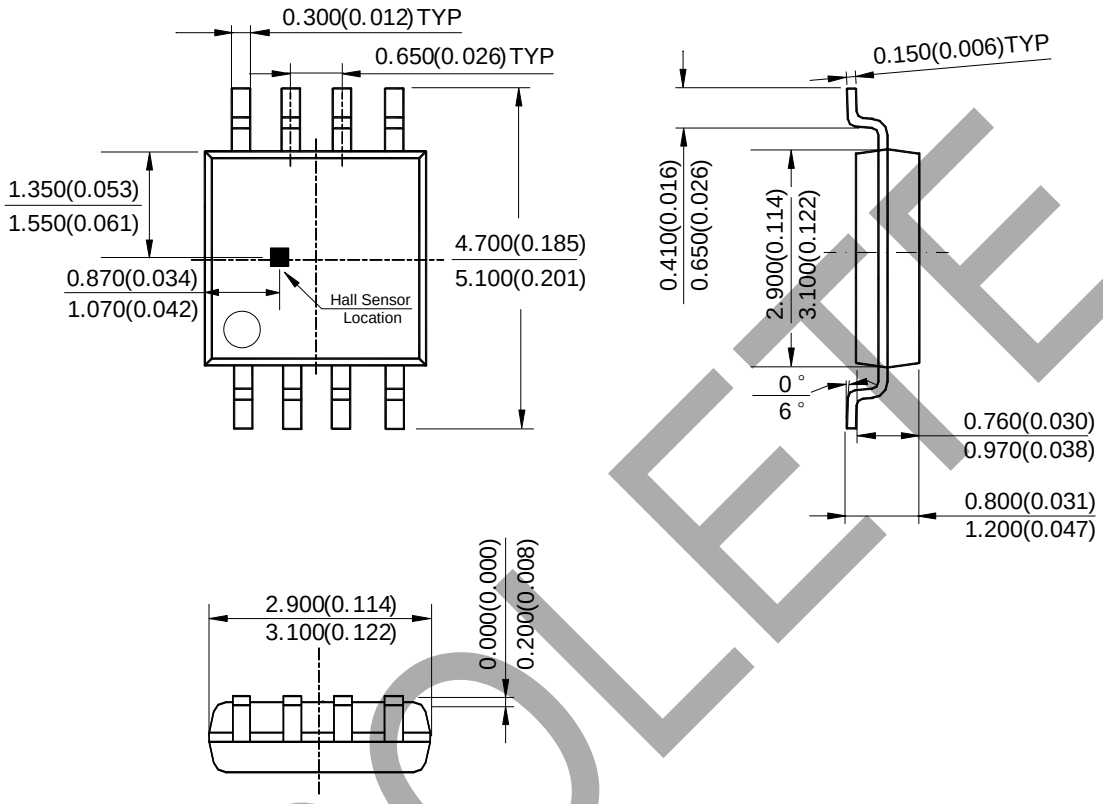
## Package Outline Dimensions (All dimensions in mm(inch).)

**(1) Package Type: TO-94**



## Package Outline Dimensions (Cont. All dimensions in mm(inch).)

**(2) Package Type: MSOP-8**




Note: Eject hole , oriented hole and mold mark is optional

**IMPORTANT NOTICE**

DIODES INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. Diodes Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does Diodes Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold Diodes Incorporated and all the companies whose products are represented on Diodes Incorporated website, harmless against all damages.

Diodes Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel. Should Customers purchase or use Diodes Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold Diodes Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.

This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes Incorporated.

**LIFE SUPPORT**

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:

1. are intended to implant into the body, or
2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.



**www.diodes.com**