AH9281/82
TWO PHASE DUAL-COIL HIGH VOLTAGE SMART FAN MOTOR DRIVER WITH FG/RD

Description

The AH9281/82 is a one-chip solution for driving two-coil brushless DC motors and fans.

Based on the advanced CDMOS process, the IC contains a Hall-effect sensor, dynamic offset correction and powerful output drivers with 1200mA peak output current capability.

Specially designed for driving large fans, the device is optimized for low start-up voltage. Frequency Generator or Rotation Detection is available. The open drain output makes easier the connectivity with any external interface such as hardware monitoring or Super I/O IC.

The AH9281/82 is available in SOT-89-5 package.

Features

- High Sensitivity Integrated Hall Sensor
- Low Start-up Voltage
- 5V and 12V Operation
- Peak Output Current up to 1200mA
- Power Efficient CMOS and Power MOSFETs
- Built-in Output Protection Clamping Diode
- Locked Rotor Shutdown and Auto-Restart
- Integrated Tachometer (AH9281) or Alarm (AH9282) Signal Output
- ESD Rating: 6000V (Human Body Model) 400V (Machine Model)

Applications

- 5V/12V DC Brushless Motor/Fan
- PC, Server, Laptop Cooling Fan
- Power Supply Cooling Fan
- Large or Small Fans

Pin Assignments

(Top View)

DOB DO
VCC GND FG/RD
1 2 3 4 5
SOT-89-5
Typical Applications Circuit

Note 1:
1. D1 is an ordinary diode used to filter the noise from VCC and protect IC if VCC and GND are plugged reversed.
2. R1=47Ω typical.
3. C1=C2=C3=2.2μF typical, electrolytic capacitors are better. They should be fine tuned based on system design.
4. R2=R3=4.7Ω typical. They can be cancelled according to system requirement.
5. R_{PU}=4.7kΩ typical.
Typical Applications Circuit (Cont.)

Note 2:
1. D1 is an ordinary diode used to filter the noise from VCC and protect IC if VCC and GND are plugged reversed.
2. R1=47Ω typical.
3. C1=2.2μF typical, electrolytic capacitors are better. They should be fine tuned based on system design.
4. ZD1 and ZD2 breakdown voltage are 35V.
5. RPU=4.7kΩ typical.
**Pin Descriptions**

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Pin Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VCC</td>
<td>Power supply pin</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground pin</td>
</tr>
<tr>
<td>3</td>
<td>FG/RD</td>
<td>Frequency Generator (Rotation Detection) open drain output</td>
</tr>
<tr>
<td>4</td>
<td>DO</td>
<td>Output pin 1</td>
</tr>
<tr>
<td>5</td>
<td>DOB</td>
<td>Output pin 2</td>
</tr>
</tbody>
</table>

**Functional Block Diagram**

```
VCC
1

Regulator
Bias

Hall Sensor

Chop Amp

Schmitt

Lock Shutdown and Automatic Restart

Logic Control

4
DO

5
DOB

2
GND

3
FG/RD
```
## Absolute Maximum Ratings (Note 3, $T_A = +25^\circ C$)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CC}$</td>
<td>Supply Voltage</td>
<td>18</td>
<td>V</td>
</tr>
<tr>
<td>$I_{CC}$</td>
<td>Supply Current (Fault)</td>
<td>6</td>
<td>mA</td>
</tr>
<tr>
<td>$I_{OUT_P}$</td>
<td>Peak Output Current</td>
<td>1200</td>
<td>mA</td>
</tr>
<tr>
<td>$I_{OUT_C}$</td>
<td>Continuous Output Current</td>
<td>600</td>
<td>mA</td>
</tr>
<tr>
<td>$V_{FG/VRD}$</td>
<td>FG/RD Pull-up Voltage</td>
<td>28</td>
<td>V</td>
</tr>
<tr>
<td>$P_D$</td>
<td>Power Dissipation</td>
<td>800</td>
<td>mW</td>
</tr>
<tr>
<td>$\theta_{JA}$</td>
<td>Thermal Resistance (Junction to Ambient)</td>
<td>156</td>
<td>$^\circ$C/W</td>
</tr>
<tr>
<td>$T_{STG}$</td>
<td>Storage Temperature</td>
<td>-55 to +150</td>
<td>$^\circ$C</td>
</tr>
<tr>
<td>ESD</td>
<td>ESD (Human Body Model)</td>
<td>6000</td>
<td>V</td>
</tr>
<tr>
<td>ESD</td>
<td>ESD (Machine Model)</td>
<td>400</td>
<td>V</td>
</tr>
</tbody>
</table>

Note 3: 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

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CC}$</td>
<td>Supply Voltage</td>
<td>2.5</td>
<td>16</td>
<td>V</td>
</tr>
<tr>
<td>$T_A$</td>
<td>Operating Ambient Temperature</td>
<td>-40</td>
<td>+125</td>
<td>$^\circ$C</td>
</tr>
</tbody>
</table>
**Electrical Characteristics** *(V_{CC}=12V, T_A=+25^\circ C, unless otherwise specified.)*

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{CC}</td>
<td>Supply Voltage</td>
<td>Operating</td>
<td>2.5</td>
<td>12</td>
<td>16</td>
<td>V</td>
</tr>
<tr>
<td>I_{CC}</td>
<td>Supply Current</td>
<td>Average</td>
<td>–</td>
<td>4</td>
<td>6</td>
<td>mA</td>
</tr>
<tr>
<td>I_{OUT}</td>
<td>Output Current</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>500</td>
<td>mA</td>
</tr>
<tr>
<td>I_{LEAKAGE}</td>
<td>Output Leakage Current</td>
<td>–</td>
<td>–</td>
<td>0.1</td>
<td>10</td>
<td>μA</td>
</tr>
<tr>
<td>V_{SAT}</td>
<td>Saturation Voltage</td>
<td>I_{OUT}=350mA</td>
<td>–</td>
<td>600</td>
<td>1000</td>
<td>mV</td>
</tr>
<tr>
<td>I_{ON}</td>
<td>Output ON Time</td>
<td>–</td>
<td>–</td>
<td>0.8</td>
<td>–</td>
<td>s</td>
</tr>
<tr>
<td>I_{OFF}</td>
<td>Output OFF Time</td>
<td>–</td>
<td>–</td>
<td>5</td>
<td>–</td>
<td>s</td>
</tr>
<tr>
<td>V_{FGL/VRD}</td>
<td>FG/RD Output Low Voltage</td>
<td>I_{FG}=5mA</td>
<td>–</td>
<td>0.1</td>
<td>0.2</td>
<td>V</td>
</tr>
<tr>
<td>I_{FGLK/I_{RDLK}}</td>
<td>FG/RD Output Leakage Current</td>
<td>V_{FG}/V_{RD}=12V</td>
<td>–</td>
<td>0.1</td>
<td>10</td>
<td>μA</td>
</tr>
<tr>
<td>I_{FGLIM/I_{RDLM}}</td>
<td>FG/RD Output Current Limit</td>
<td>V_{FG}/V_{RD}=12V</td>
<td>–</td>
<td>30</td>
<td>–</td>
<td>mA</td>
</tr>
<tr>
<td>V_{Z}</td>
<td>Output Zener Break-down Voltage</td>
<td>–</td>
<td>–</td>
<td>35</td>
<td>–</td>
<td>V</td>
</tr>
</tbody>
</table>

**Magnetic Characteristics** *(V_{CC}=12V, T_A=+25^\circ C, unless otherwise specified.)*

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B_{OP}</td>
<td>Operating Point</td>
<td>0</td>
<td>20</td>
<td>50</td>
<td>Gauss</td>
</tr>
<tr>
<td>B_{RP}</td>
<td>Releasing Point</td>
<td>-50</td>
<td>-20</td>
<td>0</td>
<td>Gauss</td>
</tr>
<tr>
<td>B_{HYS}</td>
<td>Hysteresis</td>
<td>–</td>
<td>40</td>
<td>–</td>
<td>Gauss</td>
</tr>
</tbody>
</table>
Test Circuit

Basic Test Circuit

V_{DO} vs. Magnetic Flux Density

V_{DOB} vs. Magnetic Flux Density

Magnetic Flux Density B (GS)

Magnetic Flux Density B (GS)
Performance Characteristics

Supply Current vs. Supply Voltage

Supply Current vs. Ambient Temperature

BOP/BRP/BHYS vs. Supply Voltage

BOP/BRP/BHYS vs. Ambient Temperature

Saturation Voltage vs. Ambient Temperature

Saturation Voltage vs. Output Current
Performance Characteristics (Cont.)

Power Dissipation vs. Ambient Temperature

[Graph showing Power Dissipation (mW) vs. Ambient Temperature (°C) for Package: SOT-89-5]

PART OBSOLETE – NO ALTERNATE PART

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### Ordering Information

<table>
<thead>
<tr>
<th>Package</th>
<th>Temperature Range</th>
<th>Output Signal</th>
<th>Part Number</th>
<th>Marking ID</th>
<th>Packing</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOT-89-5</td>
<td>-40 to +125°C</td>
<td>FG</td>
<td>AH9281RTR-G1</td>
<td>G41C</td>
<td>Tape &amp; Reel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RD</td>
<td>AH9282RTR-G1</td>
<td>G41D</td>
<td>Tape &amp; Reel</td>
</tr>
</tbody>
</table>
PART OBSOLETE – NO ALTERNATE PART

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

(1) Package Type: SOT-89-5

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**Package Sensor Location**

(For Hall IC)

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**Dimensions**

- 1.550 (0.061) REF
- 4.400 (0.173) REF
- 1.030 (0.041) REF
- 0.900 (0.035)
- 1.100 (0.043)
- 3.950 (0.156)
- 4.250 (0.167)
- 2.140 (0.084)
- 0.320 (0.013)
- 0.520 (0.020)
- 0.480 (0.019)
- 3.000 (0.118)
- 1.840 (0.072)
- 2.140 (0.084)
- 1.400 (0.055)
- 1.700 (0.067)
- 0.320 (0.013)
- 0.520 (0.020)
- 1.400 (0.055)
- 1.600 (0.063)
- 0.350 (0.014)
- 0.450 (0.018)
- 0.150 (0.006)
- 2.210 (0.087) REF
- 1.500 (0.059)
- 1.800 (0.071)
- 0.320 (0.013) REF
- 1.620 (0.064) REF
- 1.070 (0.042)
- 0.700 (0.028)
- 2.140 (0.084)

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