

# DRV5021-Q1 汽车用、低电压、单极、数字开关霍尔效应传感器

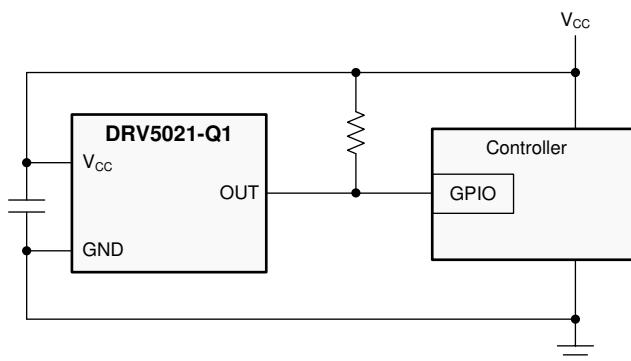
## 1 特性

- 适用于汽车电子应用
- 下列性能符合 AEC-Q100 标准:
  - 器件温度等级 0:  $-40^{\circ}\text{C}$  至  $150^{\circ}\text{C}$  环境工作温度范围
  - 器件 HBM ESD 分类等级 3A
  - 器件 CDM ESD 分类等级 C6
- 数字单极开关霍尔传感器
- 2.5V 至 5.5V 工作  $V_{\text{CC}}$  范围
- 磁性灵敏度选项 ( $B_{\text{OP}}$ ,  $B_{\text{RP}}$ ):
  - DRV5021A1-Q1: 2.9mT, 1.8mT
  - DRV5021A2-Q1: 9.2mT, 7.0mT
  - DRV5021A3-Q1: 17.9mT, 14.1mT
- 30kHz 高速感应带宽
- 漏极开路输出电流高达 20mA
- 经过优化的低电压架构
- 具有集成迟滞特性，可增强抗噪能力
- 标准行业封装:
  - 表面贴装 SOT-23

## 2 应用

- 汽车变速器、车身外壳
- 限位开关
- 一般接近感应
- 刷式直流电机反馈
- 门开关检测
- 阀定位
- 脉冲计数

典型应用电路原理图



## 3 说明

DRV5021-Q1 是一款低电压数字开关霍尔效应传感器，适用于高速汽车应用。该器件由 2.5V 至 5.5V 的电源供电，可以检测磁通量密度并根据预定义的磁性阈值提供数字输出。

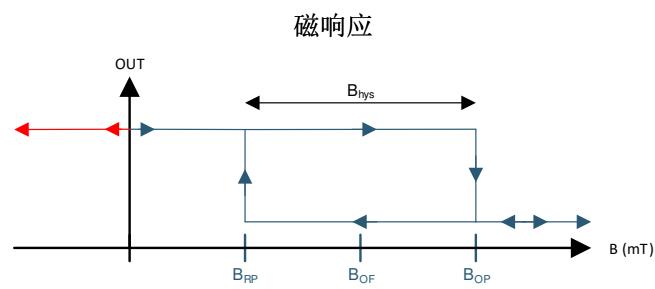
该器件会检测垂直于封装面的磁场。当施加的磁通量密度超过磁运行点  $B_{\text{OP}}$  阈值时，器件的漏极开路输出将驱动低电压。当磁通量密度降至磁释放点 ( $B_{\text{RP}}$ ) 阈值时，输出会变为高阻抗。 $B_{\text{OP}}$  和  $B_{\text{RP}}$  的分离所产生的滞后有助于防止输入噪声引起的输出误差。这种配置使得系统设计能够更加稳健地抵抗噪声干扰。

该器件可在  $-40^{\circ}\text{C}$  至  $+150^{\circ}\text{C}$  的宽环境温度范围内保持稳定的优异性能。

### 器件信息<sup>(1)</sup>

| 器件型号       | 封装         | 封装尺寸（标称值）       |
|------------|------------|-----------------|
| DRV5021-Q1 | SOT-23 (3) | 2.90mm x 1.30mm |

(1) 如需了解所有可用封装，请参阅数据表末尾的封装选项附录。



本文档旨在为方便起见，提供有关 TI 产品中文版本的信息，以确认产品的概要。有关适用的官方英文版本的最新信息，请访问 [www.ti.com](http://www.ti.com)，其内容始终优先。TI 不保证翻译的准确性和有效性。在实际设计之前，请务必参考最新版本的英文版本。

## 目录

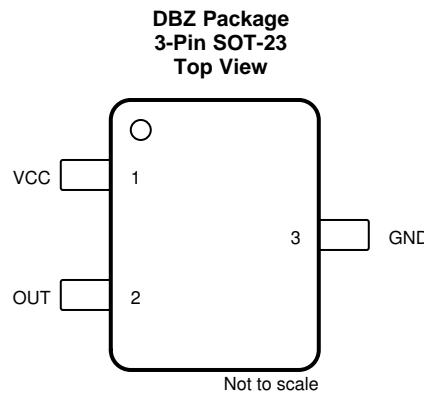
|     |  |   |      |                                       |    |
|-----|--|---|------|---------------------------------------|----|
| 1   | 特性                                     | 1 | 7.4  | Device Functional Modes               | 13 |
| 2   | 应用                                     | 1 | 8    | <b>Application and Implementation</b> | 14 |
| 3   | 说明                                     | 1 | 8.1  | Application Information               | 14 |
| 4   | 修订历史记录                                 | 2 | 8.2  | Typical Applications                  | 14 |
| 5   | <b>Pin Configuration and Functions</b> | 3 | 9    | <b>Power Supply Recommendations</b>   | 17 |
| 6   | <b>Specifications</b>                  | 3 | 10   | <b>Layout</b>                         | 17 |
| 6.1 | Absolute Maximum Ratings               | 3 | 10.1 | Layout Guidelines                     | 17 |
| 6.2 | ESD Ratings                            | 3 | 10.2 | Layout Example                        | 17 |
| 6.3 | Recommended Operating Conditions       | 4 | 11   | 器件和文档支持                               | 18 |
| 6.4 | Thermal Information                    | 4 | 11.1 | 文档支持                                  | 18 |
| 6.5 | Electrical Characteristics             | 4 | 11.2 | 接收文档更新通知                              | 18 |
| 6.6 | Magnetic Characteristics               | 4 | 11.3 | 社区资源                                  | 18 |
| 6.7 | Typical Characteristics                | 5 | 11.4 | 商标                                    | 18 |
| 7   | <b>Detailed Description</b>            | 7 | 11.5 | 静电放电警告                                | 18 |
| 7.1 | Overview                               | 7 | 11.6 | 术语表                                   | 18 |
| 7.2 | Functional Block Diagram               | 7 | 12   | 机械、封装和可订购信息                           | 18 |
| 7.3 | Feature Description                    | 7 |      |                                       |    |

## 4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

| 日期      | 修订版本 | 说明     |
|---------|------|--------|
| 2019年2月 | *    | 初始发行版。 |

## 5 Pin Configuration and Functions



### Pin Functions

| PIN             |     | TYPE   | DESCRIPTION   |
|-----------------|-----|--------|---|
| NAME            | DBZ |        |   |
| GND             | 3   | GND    | Ground pin  |
| OUT             | 2   | Output | Hall sensor open-drain output. The open drain requires a pullup resistor.   |
| V <sub>CC</sub> | 1   | Power  | 2.5-V to 5.5-V power supply. Bypass this pin to the GND pin with a 0.1- $\mu$ F (minimum) ceramic capacitor rated for V <sub>CC</sub> . |

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|  | MIN  | MAX       | UNIT |
|--|------|-----------|------|
| Power supply voltage (V <sub>CC</sub> )        | -0.3 | 6.0       | V    |
| Output voltage (OUT)                           | -0.3 | 6.0       | V    |
| Output current (OUT)                           |      | 30        | mA   |
| Magnetic flux density, B <sub>MAX</sub>        |      | Unlimited | T    |
| Operating junction temperature, T <sub>J</sub> | -40  | 170       | °C   |
| Storage temperature, T <sub>stg</sub>          | -65  | 150       | °C   |

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

### 6.2 ESD Ratings

over operating free-air temperature range (unless otherwise noted)

| V <sub>(ESD)</sub> | Electrostatic discharge | Human body model (HBM), per AEC Q100-002 <sup>(1)</sup> | VALUE | UNIT |
|--------------------|-------------------------|---|-------|------|
|                    |                         | Charged device model (CDM), per AEC Q100-011            |       |      |

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

## 6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

|           |                               | MIN | MAX | UNIT |
|-----------|-------------------------------|-----|-----|------|
| $V_{CC}$  | Power supply voltage range    | 2.5 | 5.5 | V    |
| $V_O$     | Output pin voltage            | 0   | 5.5 | V    |
| $I_{OUT}$ | Output sinking current        | 0   | 20  | mA   |
| $T_A$     | Operating ambient temperature | -40 | 150 | °C   |

## 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |  | DRV5021-Q1   | UNIT |
|-------------------------------|--|--------------|------|
|                               |  | SOT-23 (DBZ) |      |
|                               |  | 3 PINS       |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 356          | °C/W |
| $R_{\theta JC(\text{top})}$   | Junction-to-case (top) thermal resistance    | 128          | °C/W |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 94           | °C/W |
| $Y_{JT}$                      | Junction-to-top characterization parameter   | 11.4         | °C/W |
| $Y_{JB}$                      | Junction-to-board characterization parameter | 92           | °C/W |

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics application report](#).

## 6.5 Electrical Characteristics

at  $V_{CC} = 2.5$  V to 5.5 V, over operating free-air temperature range (unless otherwise noted)

| PARAMETER           | TEST CONDITION                        | MIN  | TYP  | MAX | UNIT |
|---------------------|---------------------------------------|--|------|-----|------|
| $I_{CC}$            | Operating supply current              |  | 2.3  | 2.8 | mA   |
| $t_{ON}$            | Power-on time                         |  | 40   | 70  | μs   |
| $t_d$               | Propagation delay time <sup>(1)</sup> | $B = B_{RP} - 10 \text{ mT}$ to $B_{OP} + 10 \text{ mT}$ in 1 μs | 13   | 25  | μs   |
| $I_{OZ}$            | High-impedance output leakage current | 5.5 V applied to OUT, while OUT is high-impedance                |      | 100 | nA   |
| $V_{OL}$            | Low-level output voltage              | $I_{OUT} = 20 \text{ mA}$  | 0.15 | 0.4 | V    |
| $R_{DS(\text{on})}$ | Output FET resistance                 | $I_{OUT} = 5 \text{ mA}$ , $V_{CC} = 3.3 \text{ V}$              | 8    |     | Ω    |

(1) See the [Propagation Delay](#) section for more information.

## 6.6 Magnetic Characteristics

at  $V_{CC} = 2.5$  V to 5.5 V, over operating free-air temperature range (unless otherwise noted)

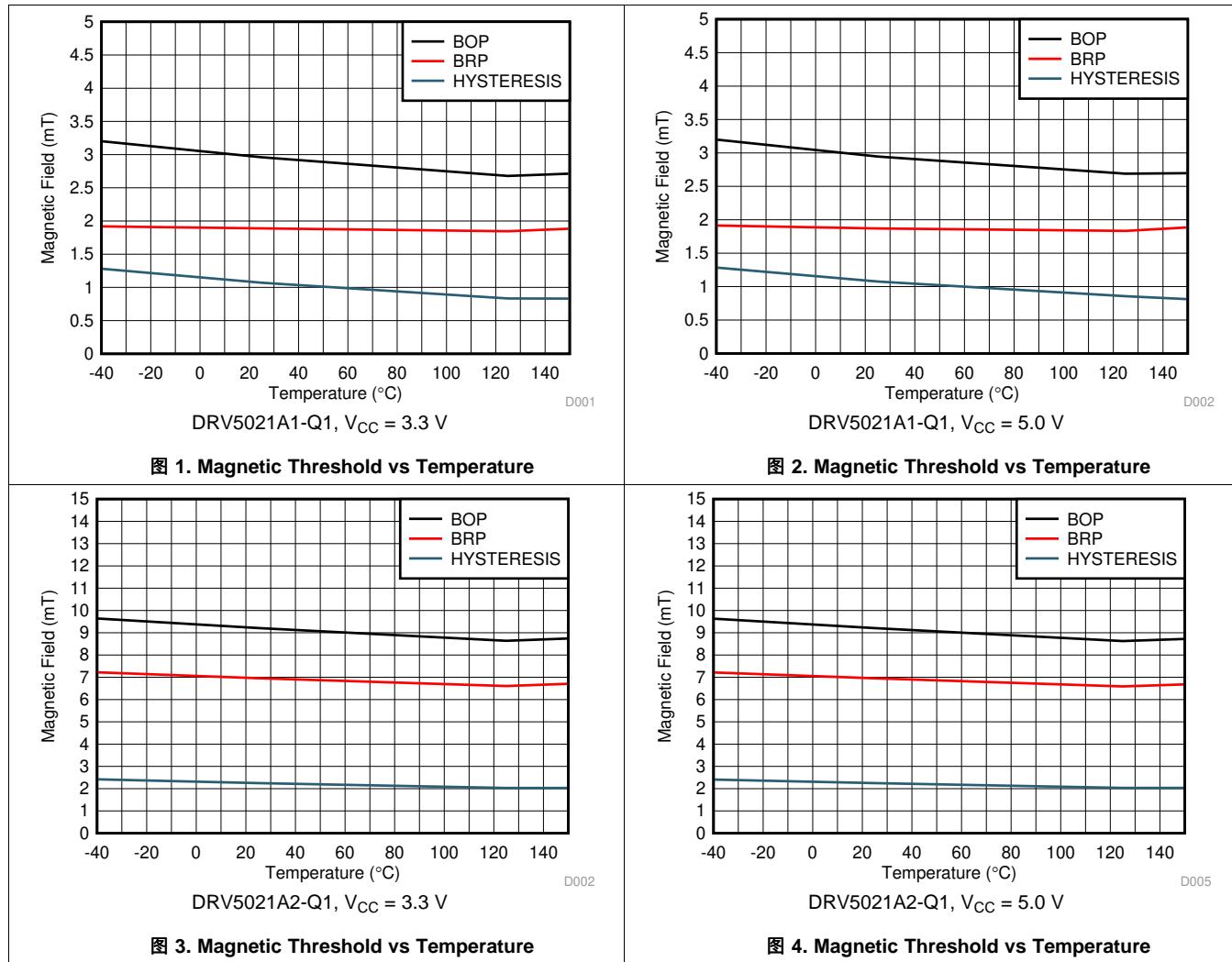
| PARAMETER                                       | TEST CONDITION                           | MIN   | TYP | MAX | UNIT |
|---|--|---|-----|-----|------|
| <b>DRV5021A1-Q1, DRV5021A2-Q1, DRV5021A3-Q1</b> |  |   |     |     |      |
| $f_{BW}$  | Sensing bandwidth                        |   | 30  |     | kHz  |
| <b>DRV5021A1-Q1</b>                             |  |   |     |     |      |
| $B_{OP}$  | Magnetic threshold Operate Point         | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | 1.3 | 2.9 | 4.4  |
|   |  | $T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$ | 1.1 | 2.9 | 4.7  |
| $B_{RP}$  | Magnetic threshold Release Point         | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | 0.2 | 1.8 | 3.0  |
|   |  | $T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$ | 0.1 | 1.8 | 3.3  |
| $B_{HYS}$                                       | Magnetic hysteresis: $ B_{OP} - B_{RP} $ | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | 0.1 | 1.1 | 2.5  |
| $B_{HYS}$                                       | Magnetic hysteresis: $ B_{OP} - B_{RP} $ | $T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$ | 0.1 | 1.1 | 2.8  |
| <b>DRV5021A2-Q1</b>                             |  |   |     |     |      |
| $B_{OP}$  | Magnetic threshold Operate Point         | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | 5.0 | 9.2 | 13.0 |
|   |  | $T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$ | 4.5 | 9.2 | 14.0 |
| $B_{RP}$  | Magnetic threshold Release Point         | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | 3.2 | 7.0 | 10.0 |
|   |  | $T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$ | 2.7 | 7.0 | 11.0 |

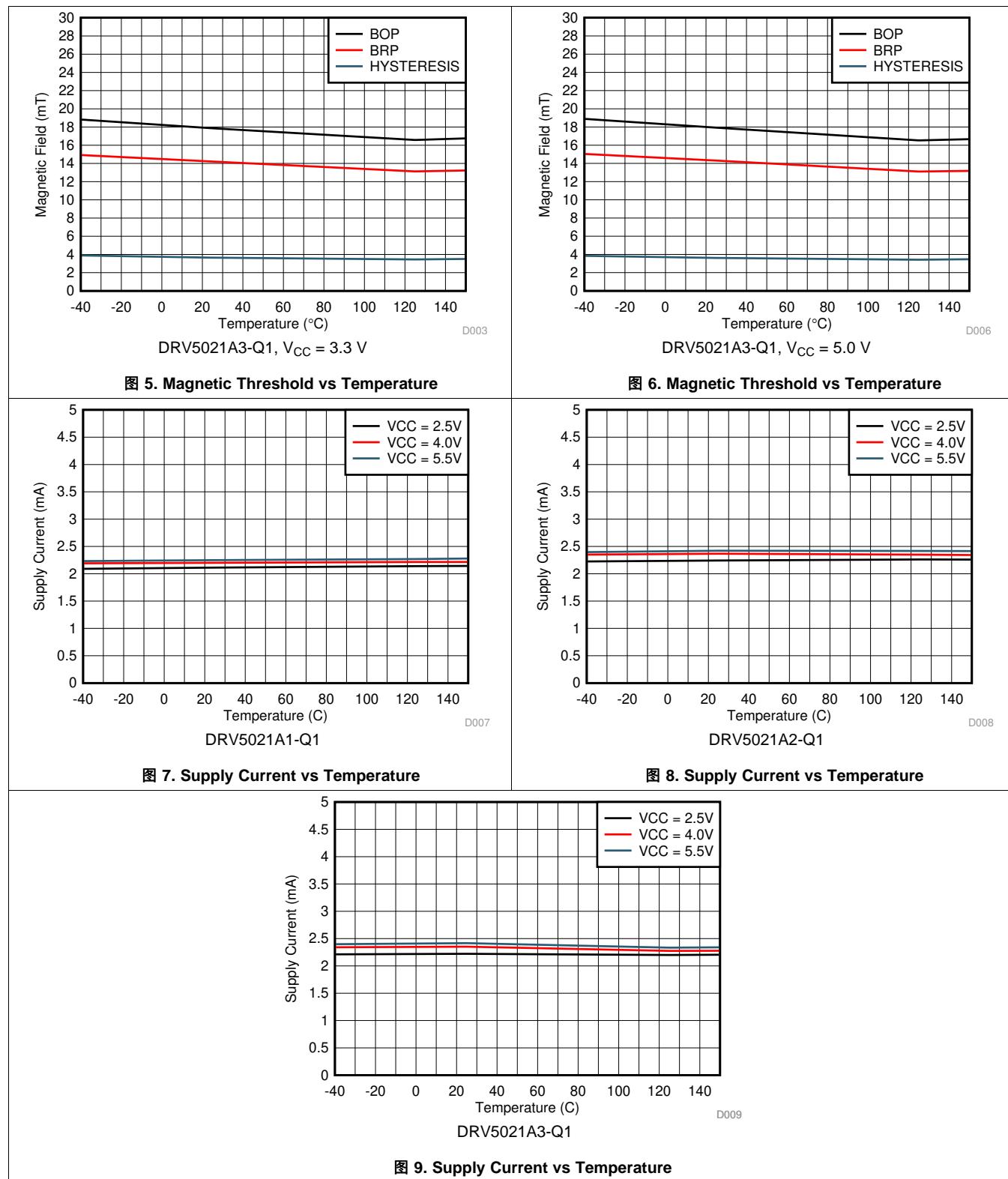
## Magnetic Characteristics (continued)

at  $V_{CC} = 2.5$  V to 5.5 V, over operating free-air temperature range (unless otherwise noted)

| PARAMETER           | TEST CONDITION   | MIN   | TYP | MAX  | UNIT |
|---------------------|--|---|-----|------|------|
| $B_{HYS}$           | Magnetic hysteresis: $ B_{OP} - B_{RP} $ $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | 0.9   | 2.2 | 4.5  | mT   |
| $B_{HYS}$           | Magnetic hysteresis: $ B_{OP} - B_{RP} $ $T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$ | 0.9   | 2.2 | 5.0  | mT   |
| <b>DRV5021A3-Q1</b> |  |   |     |      |      |
| $B_{OP}$            | Magnetic threshold Operate Point   | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | 8.8 | 17.9 | 23.4 |
|                     |  | $T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$ | 7.7 | 17.9 | 25.4 |
| $B_{RP}$            | Magnetic threshold Release Point   | $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | 6.2 | 14.1 | 18.8 |
|                     |  | $T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$ | 5.1 | 14.1 | 20.8 |
| $B_{HYS}$           | Magnetic hysteresis: $ B_{OP} - B_{RP} $ $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ | 1.5   | 3.8 | 6.2  | mT   |
| $B_{HYS}$           | Magnetic hysteresis: $ B_{OP} - B_{RP} $ $T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$ | 1.3   | 3.8 | 6.7  | mT   |

## 6.7 Typical Characteristics



**Typical Characteristics (接下页)**


## 7 Detailed Description

### 7.1 Overview

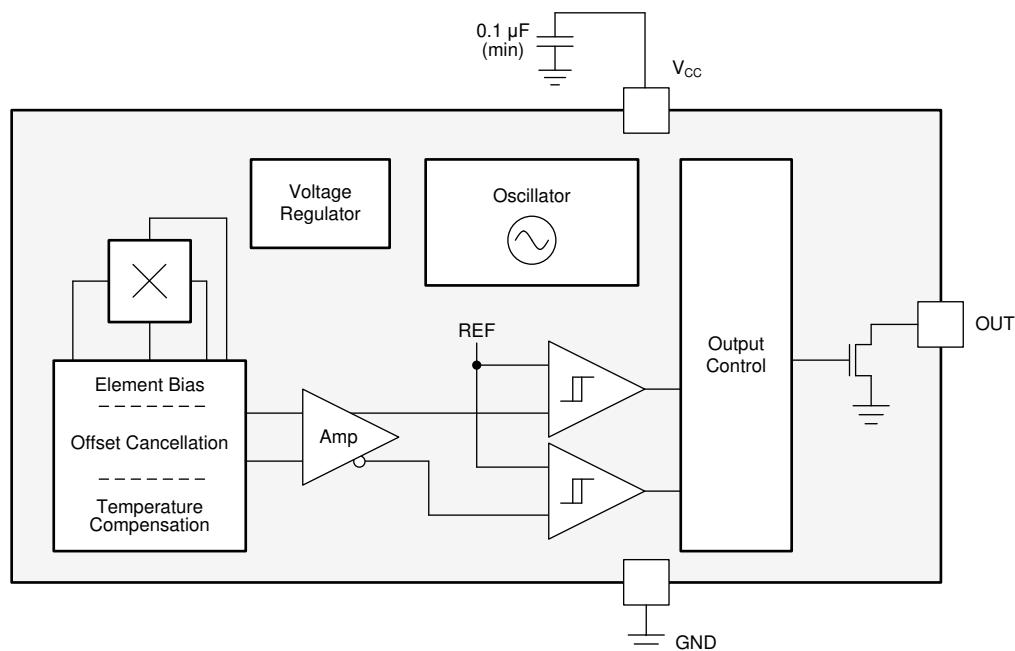
The DRV5021-Q1 device is a spinning-current Hall sensor with a digital output for magnetic-sensing applications. The DRV5021-Q1 can be powered with a supply voltage between 2.5 V and 5.5 V.

The field polarity is defined as follows: a **south pole** near the marked side of the package is a positive magnetic field. A **north pole** near the marked side of the package is a negative magnetic field. The output state depends on the magnetic field perpendicular to the package.

A strong **south pole** near the marked side of the package causes the output to pull low. A weak **south pole**, the absence of a field, or any north pole makes the output high impedance. Hysteresis is included in between the operate point and the release point to prevent toggling near the magnetic threshold.

An external pullup resistor is required on the OUT pin. The OUT pin can be pulled up to  $V_{CC}$ , or to a different voltage supply. This feature allows for easier interfacing with controller circuits.

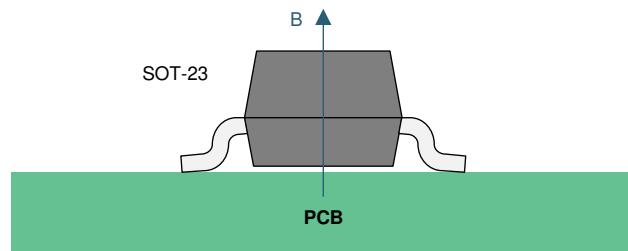
### 7.2 Functional Block Diagram



### 7.3 Feature Description

#### 7.3.1 Field Direction Definition

As shown in [图 10](#), the DRV5021-Q1 is sensitive to the magnetic field component that is perpendicular to the top of the package.



**图 10. Direction of Sensitivity**

## Feature Description (接下页)

图 11 显示了一个正的磁场被定义为靠近标记侧的 **南极**。

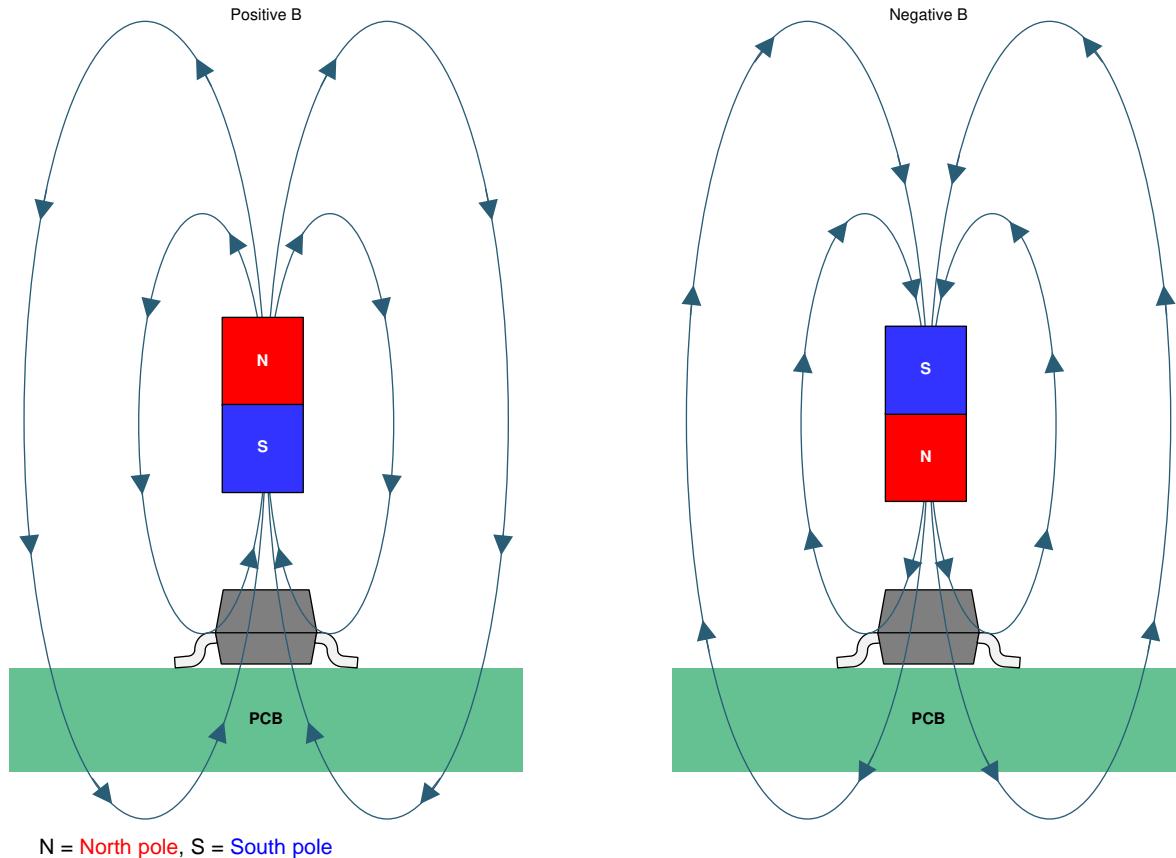


图 11. Field Direction Definition

### 7.3.2 Device Output

如果设备开启且磁场强度在  $B_{RP}$  和  $B_{OP}$  之间，则设备输出是不确定的。如果磁场强度大于  $B_{OP}$ ，则输出被拉低。如果磁场强度小于  $B_{RP}$ ，则输出被释放。

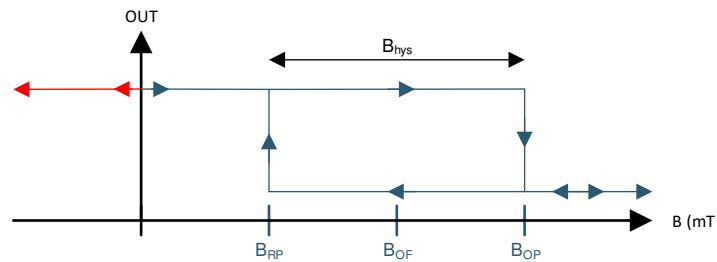


图 12. Output State

## Feature Description (接下页)

### 7.3.3 Power-On Time

After applying  $V_{CC}$  to the DRV5021-Q1,  $t_{on}$  must elapse before the OUT pin is valid. In case 1 (图 13) and case 2 (图 14), the output is defined assuming that magnetic field  $B_{APPLIED} > B_{OP}$ , and  $B_{APPLIED} < B_{RP}$ , respectively.

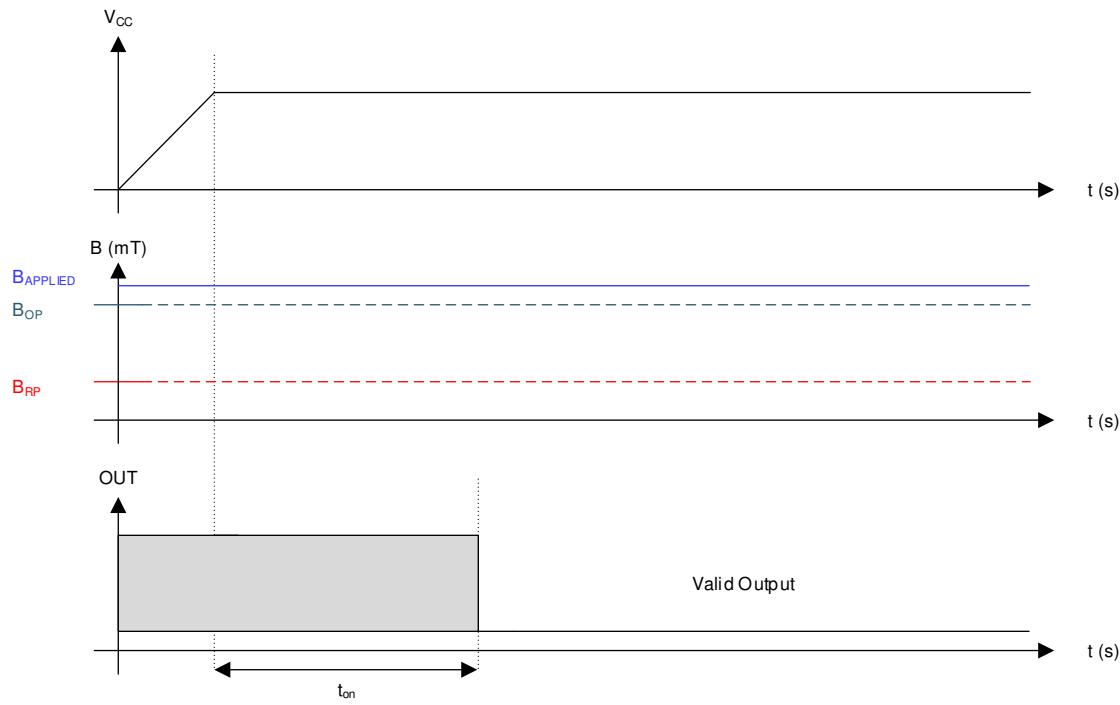


图 13. Case 1: Power On When  $B > B_{OP}$

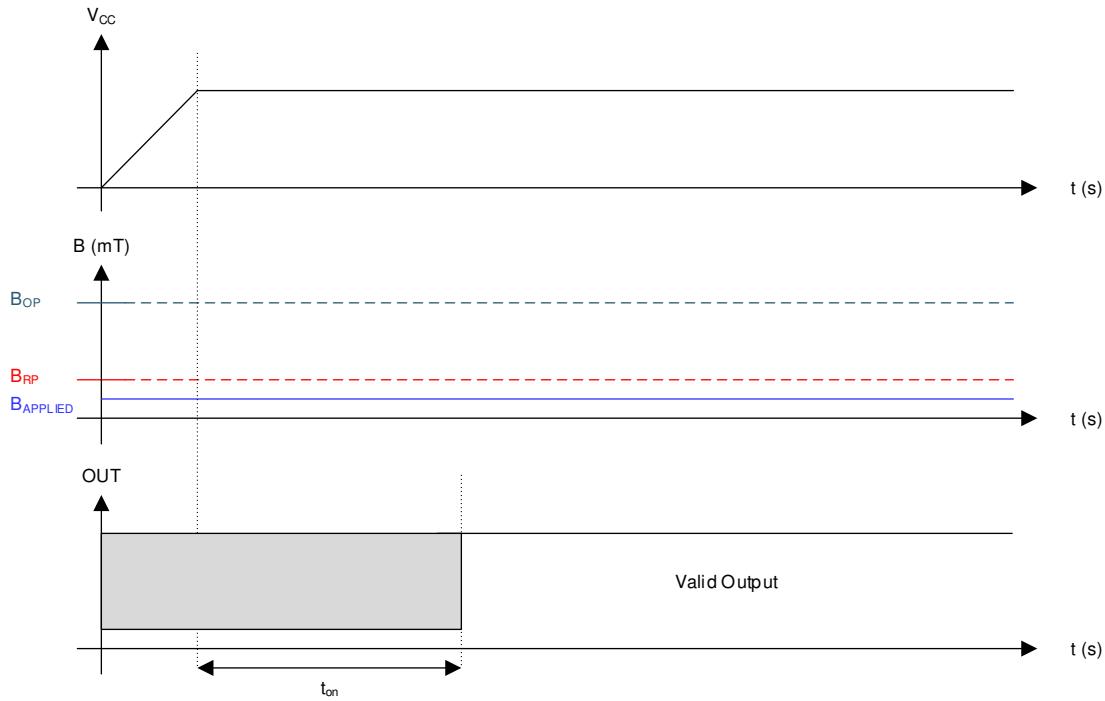


图 14. Case 2: Power On When  $B < B_{RP}$

## Feature Description (接下页)

If the device is powered on with  $B_{RP} < B_{APPLIED} < B_{OP}$ , then the device output remains in indeterminate state until the magnetic field changes. After the change in magnetic field results in a condition that meets either  $B_{OP} < B_{APPLIED}$  or  $B_{RP} > B_{APPLIED}$ , the output turns to valid state after  $t_d$  time elapses. Case 3 (图 15) and case 4 (图 16) show examples of this behavior.

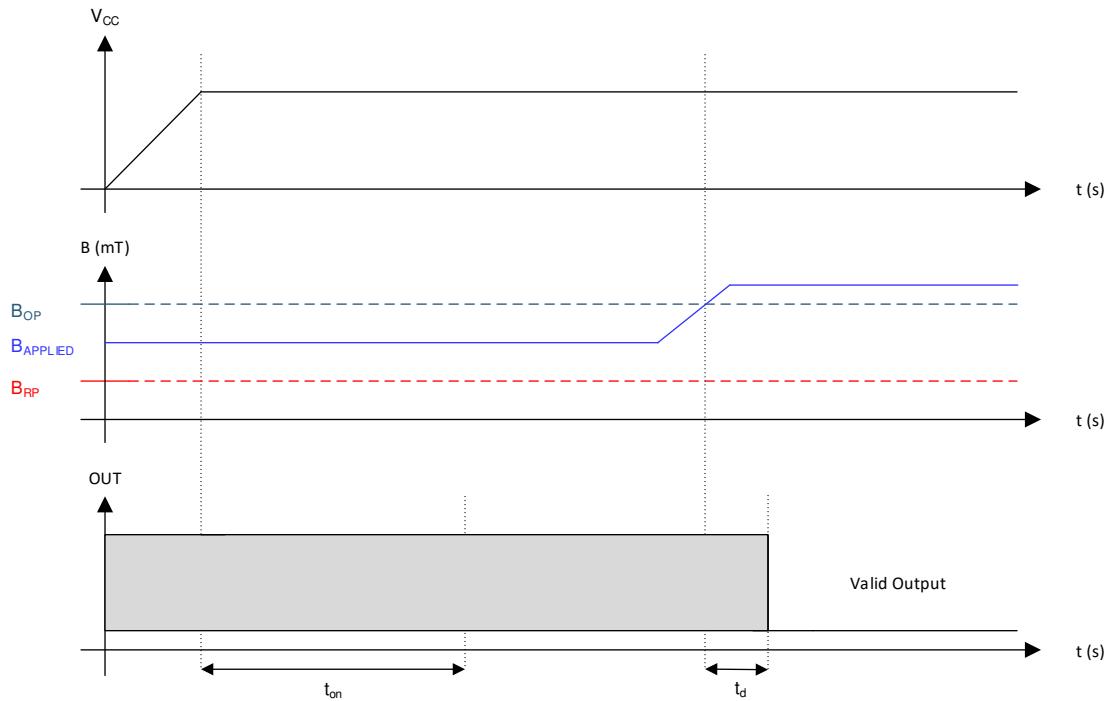


图 15. Case 3: Power On When  $B_{RP} < B < B_{OP}$ , Followed by  $B > B_{OP}$

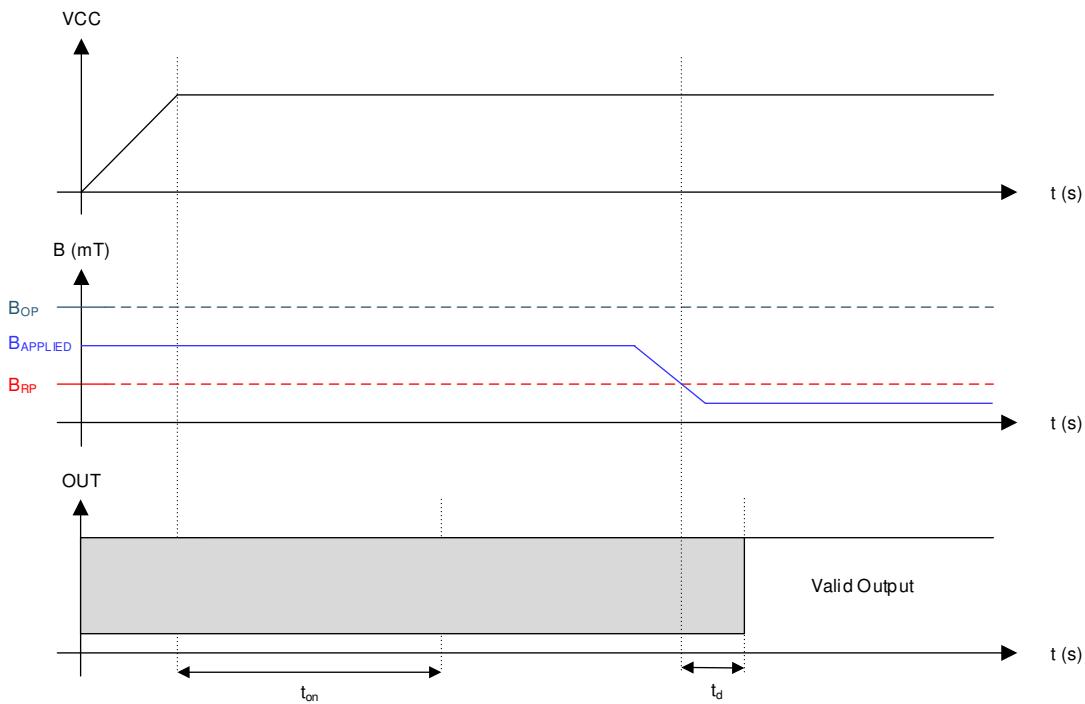


图 16. Case 4: Power On When  $B_{RP} < B < B_{OP}$ , Followed by  $B < B_{RP}$

## Feature Description (接下页)

### 7.3.4 Hall Element Location

The sensing element inside the device is in the center of both packages when viewed from the top. 图 17 shows the tolerances and side-view dimensions.

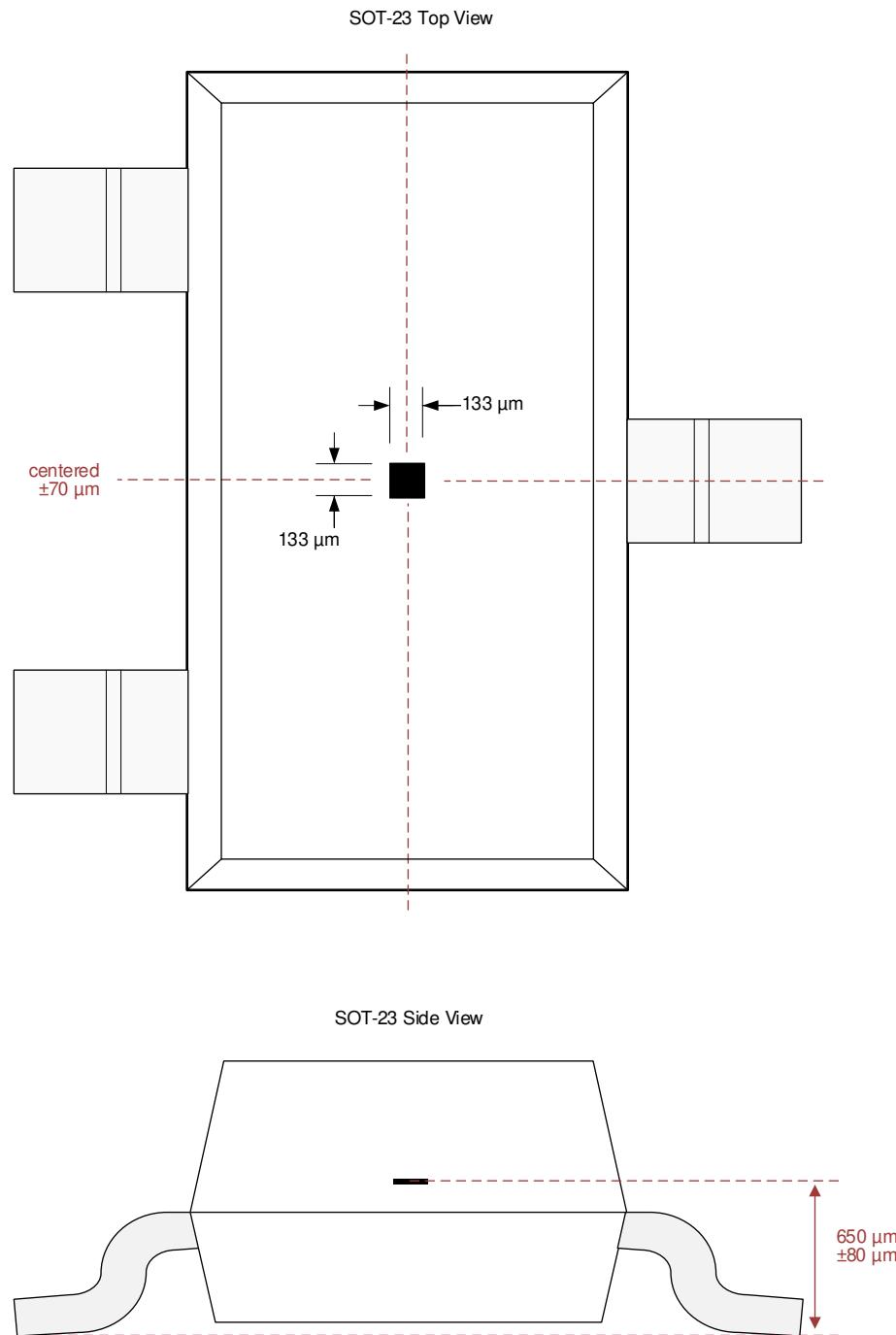


图 17. Hall Element Location

## Feature Description (接下页)

### 7.3.5 Propagation Delay

The DRV5021-Q1 samples the Hall element at a nominal sampling period of 16.67  $\mu$ s to detect the presence of a magnetic north or south pole. At each sampling point, the device takes the average of the current sampled value and immediately preceding sampled value of the magnetic field. If this average value crosses the  $B_{OP}$  or  $B_{RP}$  threshold, the device output changes according to the transfer function.

图 18 shows the DRV5021-Q1 propagation delay analysis in the proximity of a magnetic south pole. The Hall element of the DRV5021-Q1 experiences an increasing magnetic field as the magnetic south pole approaches near the device. At time  $t_2$ , the average magnetic field is  $(B_2 + B_1) / 2$ , which is less than the  $B_{OP}$  threshold of the device. At time  $t_3$ , the actual magnetic field has crossed the  $B_{OP}$  threshold. However, the average  $(B_3 + B_2) / 2$  is still less than the  $B_{OP}$  threshold. Thus, the device waits for next sample time,  $t_4$ , to start the output transition through the analog signal chain. The propagation delay,  $t_d$ , is measured as the delay from the time the magnetic field crosses the  $B_{OP}$  threshold to the time output transitions.

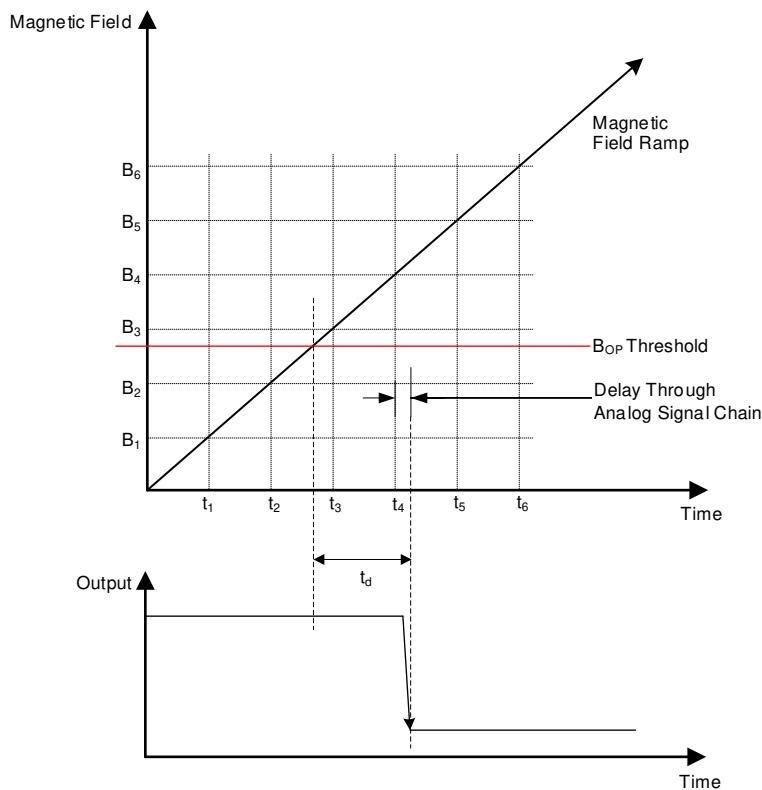


图 18. Propagation Delay

## Feature Description (接下页)

### 7.3.6 Output Stage

The DRV5021-Q1 output stage uses an open-drain NMOS transistor that is rated to sink up to 20 mA of current. For proper operation, calculate the value of pullup resistor R1 using [公式 1](#).

$$\frac{V_{ref\ max}}{20\ mA} \leq R1 \leq \frac{V_{ref\ min}}{100\ \mu A} \quad (1)$$

The size of R1 is a tradeoff between the OUT rise time and the current when OUT is pulled low. A lower current is generally better; however, faster transitions and bandwidth require a smaller resistor for faster switching.

In addition, the value of R1 must be  $> 500\ \Omega$  in order to make sure that the output driver can pull the OUT pin close to GND.

注

$V_{ref}$  is not restricted to  $V_{CC}$ . The allowable voltage range of this pin is specified in the [Recommended Operating Conditions](#).

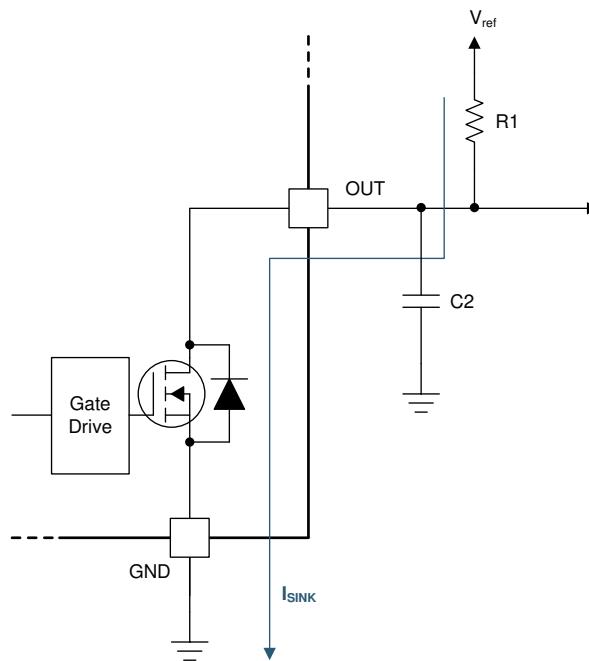


图 19. Open-Drain Output

Select a value for C2 based on the system bandwidth specifications shown in [公式 2](#).

$$2 \times f_{BW} \text{ (Hz)} < \frac{1}{2\pi \times R1 \times C2} \quad (2)$$

Most applications do not require this C2 filtering capacitor.

### 7.4 Device Functional Modes

The DRV5021-Q1 device is active only when  $V_{CC}$  is between 2.5 V and 5.5 V.

## 8 Application and Implementation

### 注

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 8.1 Application Information

The DRV5021-Q1 device is used in magnetic-field sensing applications.

### 8.2 Typical Applications

#### 8.2.1 Proximity Sensing Circuit

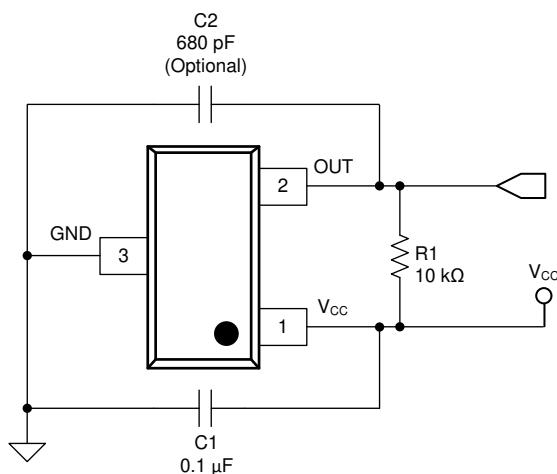


图 20. Proximity Sensing Circuit

##### 8.2.1.1 Design Requirements

For this design example, use the parameters listed in [表 1](#) as the input parameters.

表 1. Design Parameters

| DESIGN PARAMETER | REFERENCE | EXAMPLE VALUE  |
|------------------|-----------|----------------|
| Supply voltage   | $V_{CC}$  | 3.2 V to 3.4 V |
| System bandwidth | $f_{BW}$  | 10 kHz         |

##### 8.2.1.2 Detailed Design Procedure

[表 2](#) shows the external components needed to create this design example.

表 2. External Components

| COMPONENT | CONNECTED BETWEEN |                | RECOMMENDED   |
|-----------|-------------------|----------------|---|
| C1        | $V_{CC}$          | GND            | A 0.1- $\mu$ F ceramic capacitor rated for $V_{CC}$ |
| C2        | OUT               | GND            | Optional: Place a ceramic capacitor to GND          |
| R1        | OUT               | $V_{CC}^{(1)}$ | Requires a pullup resistor                          |

(1) Pullup resistor may be connected to a voltage source other than  $V_{CC}$ ; see the [Recommended Operating Conditions](#) for the valid range of the output pin voltage.

### 8.2.1.2.1 Configuration Example

In a 3.3-V system,  $3.2 \text{ V} \leq V_{\text{ref}} \leq 3.4 \text{ V}$ . Use [公式 3](#) to calculate the allowable range for R1.

$$\frac{V_{\text{ref}} \text{ max}}{20 \text{ mA}} \leq R1 \leq \frac{V_{\text{ref}} \text{ min}}{100 \text{ } \mu\text{A}} \quad (3)$$

For this design example, use [公式 4](#) to calculate the allowable range of R1.

$$\frac{3.4 \text{ V}}{20 \text{ mA}} \leq R1 \leq \frac{3.2 \text{ V}}{100 \text{ } \mu\text{A}} \quad (4)$$

Therefore:

$$170 \text{ } \Omega \leq R1 \leq 32 \text{ k}\Omega \quad (5)$$

After finding the allowable range of R1 ([公式 5](#)), select a value between 500  $\Omega$  and 32 k $\Omega$  for R1.

Assuming a system bandwidth of 10 kHz, use [公式 6](#) to calculate the value of C2.

$$2 \times f_{\text{BW}} \text{ (Hz)} < \frac{1}{2\pi \times R1 \times C2} \quad (6)$$

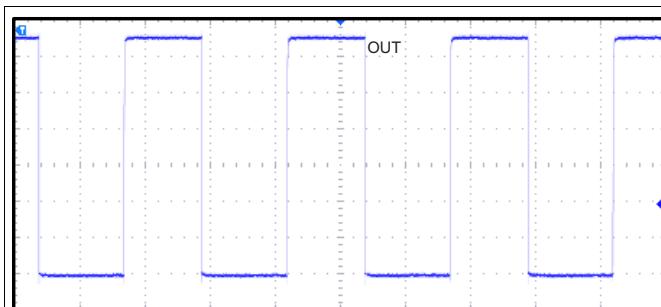
For this design example, use [公式 7](#) to calculate the value of C2.

$$2 \times 10 \text{ kHz} < \frac{1}{2\pi \times R1 \times C2} \quad (7)$$

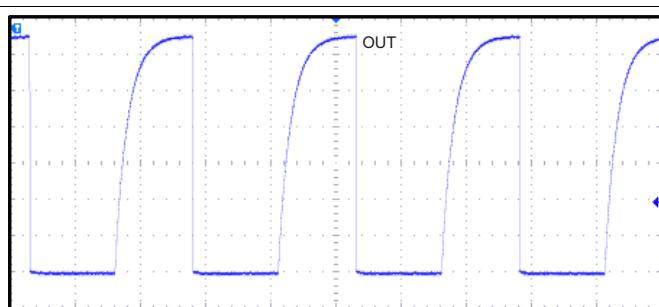
An R1 value of 10 k $\Omega$  and a C2 value less than 820 pF satisfy the requirement for a 10-kHz system bandwidth.

For R1 = 10 k $\Omega$  and C2 = 680 pF, the corner frequency for the low-pass filter is 23.4 kHz.

### 8.2.1.3 Application Curves



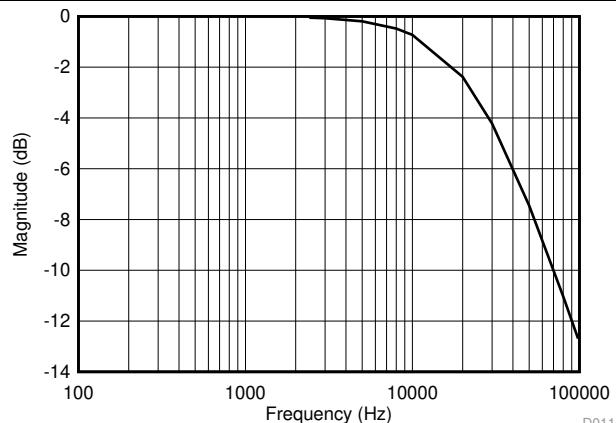
R1 = 10-k $\Omega$  pullup resistor, no C2 capacitor



R1 = 10-k $\Omega$  pullup, C2 = 680 pF

图 21. 10-kHz Switching Magnetic Field

图 22. 10-kHz Switching Magnetic Field



R1 = 10-k $\Omega$  pullup resistor, C2 = 680 pF

图 23. Low-Pass Filtering

## 8.2.2 Alternative Two-Wire Application

For systems that require a minimal wire count, connect the device output to  $V_{CC}$  through a resistor, and sense the total supplied current near the controller. Use a shunt resistor or other circuitry to sense the current.

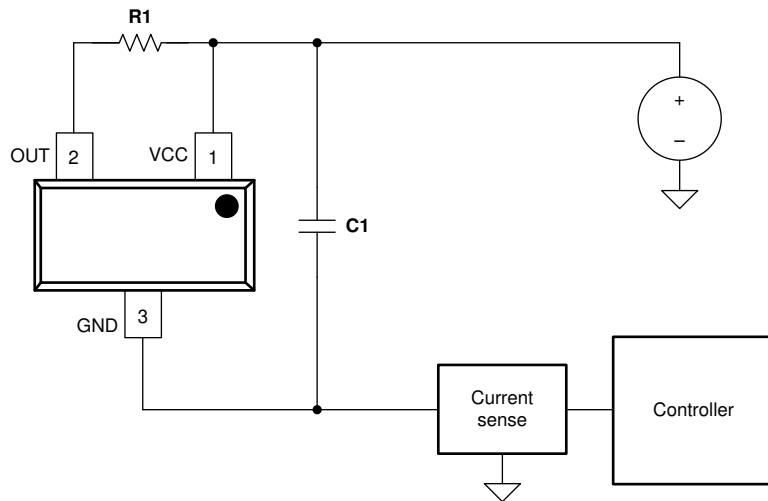


图 24. 2-Wire Application

### 8.2.2.1 Design Requirements

表 3 lists the related design parameters.

表 3. Design Parameters

| DESIGN PARAMETER          | REFERENCE     | EXAMPLE VALUE |
|---------------------------|---------------|---------------|
| Supply voltage            | $V_{CC}$      | 5 V           |
| OUT resistor              | R1            | 1 k $\Omega$  |
| Bypass capacitor          | C1            | 0.1 $\mu$ F   |
| Current when $B < B_{RP}$ | $I_{RELEASE}$ | About 2.3 mA  |
| Current when $B > B_{OP}$ | $I_{OPERATE}$ | About 7.3 mA  |

### 8.2.2.2 Detailed Design Procedure

When the open-drain output of the device is high-impedance, current through the path equals the  $I_{CC}$  of the device (approximately 2.3 mA).

When the output pulls low, a parallel current path is added, equal to  $V_{CC} / (R1 + r_{DS(on)})$ . Using 5 V and 1 k $\Omega$ , the parallel current is approximately 5 mA, making the total current approximately 7.3 mA.

Local bypass capacitor C1 must be at least 0.1  $\mu$ F. Use a larger value capacitor if there is high inductance in the power line interconnect.

## 9 Power Supply Recommendations

The DRV5021-Q1 device is designed to operate from an input voltage supply (VM) range between 2.5 V and 5.5 V. A 0.1- $\mu$ F (minimum) ceramic capacitor rated for V<sub>CC</sub> must be placed as close to the DRV5021-Q1 device as possible.

## 10 Layout

### 10.1 Layout Guidelines

Place the bypass capacitor near the DRV5021-Q1 device for efficient power delivery with minimal inductance. Place the external pullup resistor near the microcontroller input to provide the most stable voltage at the input. Alternatively, an integrated pullup resistor within the GPIO of the microcontroller can be used.

Generally, PCB copper planes underneath the DRV5021-Q1 have no effect on magnetic flux, and do not interfere with device performance because copper is not a ferromagnetic material. However, If nearby system components contain iron or nickel, they may redirect magnetic flux in unpredictable ways.

### 10.2 Layout Example

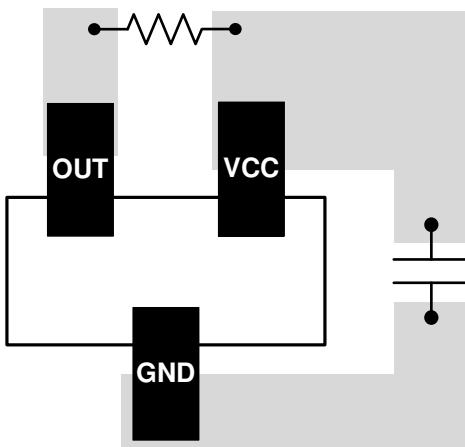


图 25. DRV5021-Q1 Layout Example

## 11 器件和文档支持

### 11.1 文档支持

#### 11.1.1 相关文档

请参阅如下相关文档：

- 德州仪器 (TI), 《霍尔适配器 EVM 用户指南》
- 德州仪器 (TI), 《了解和应用霍尔效应传感器数据表应用报告》

### 11.2 接收文档更新通知

要接收文档更新通知, 请导航至 [TI.com.cn](http://TI.com.cn) 上的器件产品文件夹。单击右上角的通知我 进行注册, 即可每周接收产品信息更改摘要。有关更改的详细信息, 请查看任何已修订文档中包含的修订历史记录。

### 11.3 社区资源

下列链接提供到 TI 社区资源的连接。链接的内容由各个分销商“按照原样”提供。这些内容并不构成 TI 技术规范, 并且不一定反映 TI 的观点; 请参阅 TI 的 [《使用条款》](#)。

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community.* Created to foster collaboration among engineers. At [e2e.ti.com](http://e2e.ti.com), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 11.4 商标

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

### 11.5 静电放电警告

 ESD 可能会损坏该集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理措施和安装程序, 可能会损坏集成电路。

 ESD 的损坏小至导致微小的性能降级, 大至整个器件故障。精密的集成电路可能更容易受到损坏, 这是因为非常细微的参数更改都可能导致器件与其发布的规格不相符。

### 11.6 术语表

[SLYZ022 — TI 术语表](#)。

这份术语表列出并解释术语、缩写和定义。

## 12 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更, 恕不另行通知, 且不会对此文档进行修订。如需获取此数据表的浏览器版本, 请查阅左侧的导航栏。

## 重要声明和免责声明

TI 均以“原样”提供技术性及可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证其中不含任何瑕疵，且不做任何明示或暗示的担保，包括但不限于对适销性、适合某特定用途或不侵犯任何第三方知识产权的暗示担保。

所述资源可供专业开发人员应用TI 产品进行设计使用。您将对以下行为独自承担全部责任：(1) 针对您的应用选择合适的TI 产品；(2) 设计、验证并测试您的应用；(3) 确保您的应用满足相应标准以及任何其他安全、安保或其他要求。所述资源如有变更，恕不另行通知。TI 对您使用所述资源的授权仅限于开发资源所涉及TI 产品的相关应用。除此之外不得复制或展示所述资源，也不提供其它TI 或任何第三方的知识产权授权许可。如因使用所述资源而产生任何索赔、赔偿、成本、损失及债务等，TI 对此概不负责，并且您须赔偿由此对TI 及其代表造成的损害。

TI 所提供产品均受TI 的销售条款 (<http://www.ti.com.cn/zh-cn/legal/termsofsale.html>) 以及ti.com.cn 上或随附TI 产品提供的其他可适用条款的约束。TI 提供所述资源并不扩展或以其他方式更改TI 针对TI 产品所发布的可适用的担保范围或担保免责声明。

邮寄地址：上海市浦东新区世纪大道 1568 号中建大厦 32 楼，邮政编码：200122  
Copyright © 2020 德州仪器半导体技术（上海）有限公司

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples   |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|---|
| DRV5021A1EDBZRQ1 | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 150   | 211Z                    | <span style="background-color: red; color: white; padding: 2px;">Samples</span> |
| DRV5021A2EDBZRQ1 | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 150   | 212Z                    | <span style="background-color: red; color: white; padding: 2px;">Samples</span> |
| DRV5021A3EDBZRQ1 | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 150   | 213Z                    | <span style="background-color: red; color: white; padding: 2px;">Samples</span> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.



www.ti.com

## PACKAGE OPTION ADDENDUM

10-Dec-2020

---

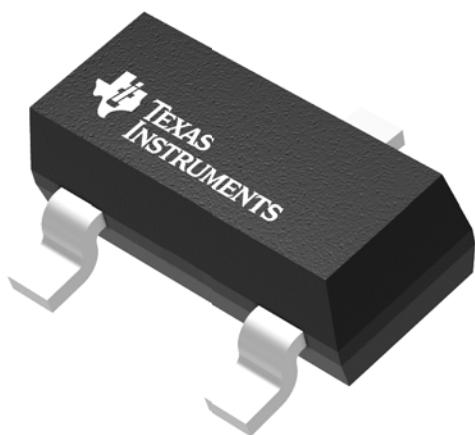
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

## GENERIC PACKAGE VIEW

DBZ 3

**SOT-23 - 1.12 mm max height**

SMALL OUTLINE TRANSISTOR



Images above are just a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.

4203227/C

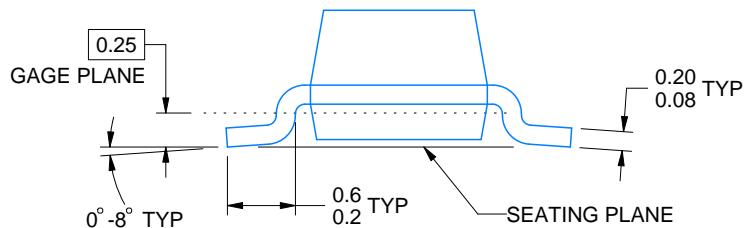
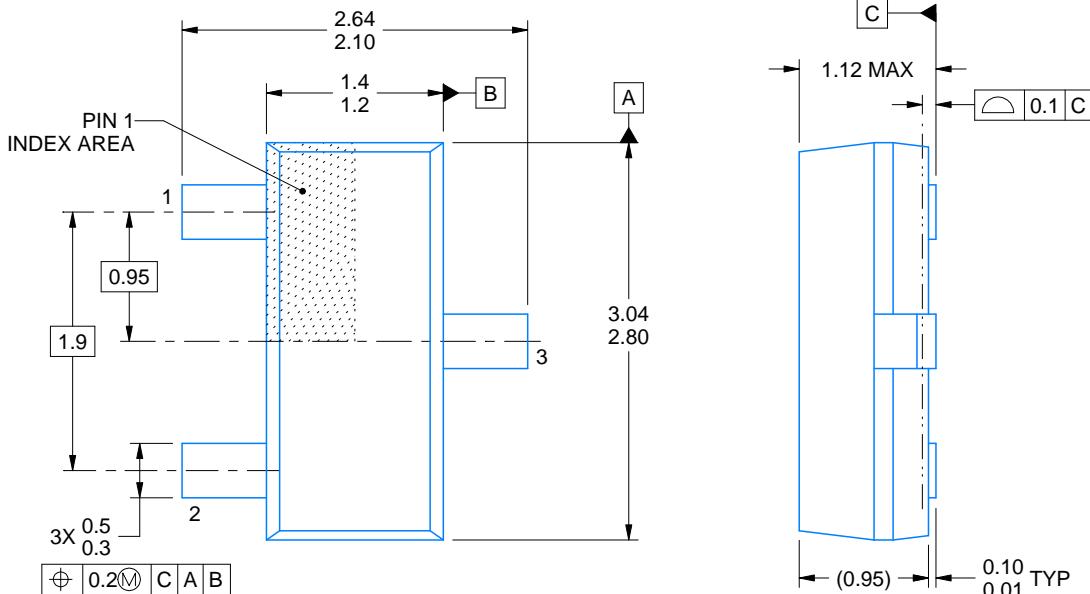
# PACKAGE OUTLINE

DBZ0003A



SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



4214838/C 04/2017

## NOTES:

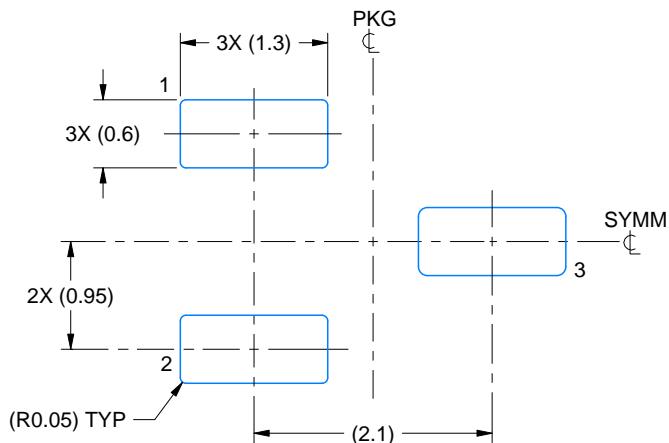
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-236, except minimum foot length.

# EXAMPLE BOARD LAYOUT

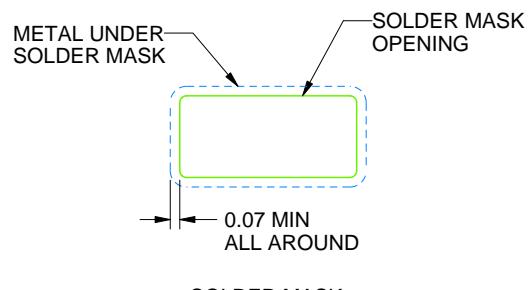
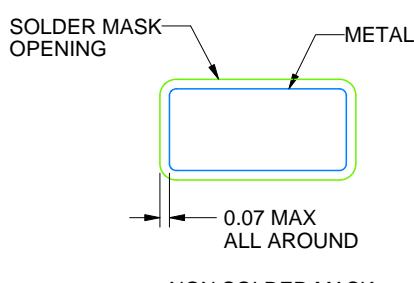
DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
SCALE:15X



SOLDER MASK DETAILS

4214838/C 04/2017

NOTES: (continued)

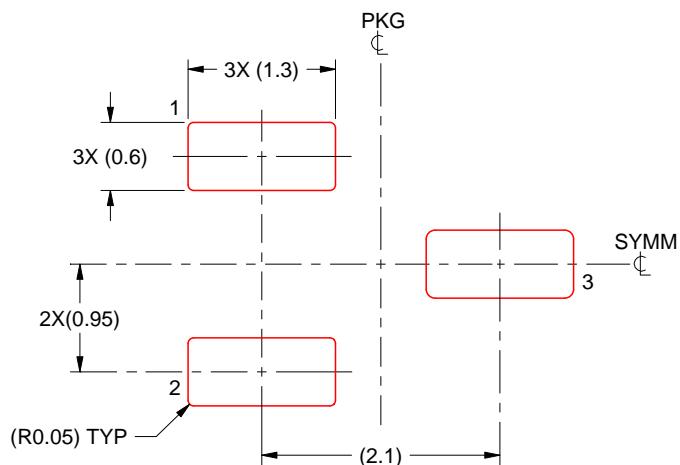
4. Publication IPC-7351 may have alternate designs.
5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE  
BASED ON 0.125 THICK STENCIL  
SCALE:15X

4214838/C 04/2017

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
7. Board assembly site may have different recommendations for stencil design.

## 重要声明和免责声明

TI 均以“原样”提供技术性及可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证其中不含任何瑕疵，且不做任何明示或暗示的担保，包括但不限于对适销性、适合某特定用途或不侵犯任何第三方知识产权的暗示担保。

所述资源可供专业开发人员应用TI 产品进行设计使用。您将对以下行为独自承担全部责任：(1) 针对您的应用选择合适的TI 产品；(2) 设计、验证并测试您的应用；(3) 确保您的应用满足相应标准以及任何其他安全、安保或其他要求。所述资源如有变更，恕不另行通知。TI 对您使用所述资源的授权仅限于开发资源所涉及TI 产品的相关应用。除此之外不得复制或展示所述资源，也不提供其它TI 或任何第三方的知识产权授权许可。如因使用所述资源而产生任何索赔、赔偿、成本、损失及债务等，TI 对此概不负责，并且您须赔偿由此对TI 及其代表造成的损害。

TI 所提供产品均受TI 的销售条款 (<http://www.ti.com.cn/zh-cn/legal/termsofsale.html>) 以及ti.com.cn 上或随附TI 产品提供的其他可适用条款的约束。TI 提供所述资源并不扩展或以其他方式更改TI 针对TI 产品所发布的可适用的担保范围或担保免责声明。

邮寄地址：上海市浦东新区世纪大道 1568 号中建大厦 32 楼，邮政编码：200122  
Copyright © 2020 德州仪器半导体技术（上海）有限公司