

# DRV5021-Q1 車載用の低電圧、ユニポーラ、デジタル・スイッチのホール・エフェクト・センサ

## 1 特長

- 車載アプリケーションに対応
- 下記内容で AEC-Q100 認定済み
  - デバイス温度グレード 0: 動作時周囲温度範囲  $-40^{\circ}\text{C} \sim 150^{\circ}\text{C}$
  - デバイス HBM ESD 分類レベル 3A
  - デバイス CDM ESD 分類レベル C6
- デジタル・ユニポーラ・スイッチのホール・センサ
- 2.5V~5.5V の  $V_{CC}$  範囲で動作
- 磁気感度オプション ( $B_{OP}$ 、 $B_{RP}$ )
  - DRV5021A1-Q: 2.9mT、1.8mT
  - DRV5021A2-Q: 9.2mT、7.0mT
  - DRV5021A3-Q: 17.9mT、14.1mT
- 高速な 30kHz センシング帯域幅
- オープン・ドレイン出力能力 20mA
- 最適化された低電圧アーキテクチャ
- 内蔵ヒステリシスによりノイズ耐性が向上
- 標準の産業用パッケージ
  - 表面実装 SOT-23

## 2 アプリケーション

- 車載用変速装置、ボディ・クロージャ
- リミット・スイッチ
- 汎用近接センシング
- ブラシ付き DC モータ・フィードバック
- ドアの開閉検出
- バルブの位置決め
- パルスのカウント

## 3 概要

DRV5021-Q1 デバイスは、高速車載アプリケーション用の低電圧、デジタル・スイッチ、ホール・エフェクト・センサです。このデバイスは 2.5V~5.5V の電源電圧で動作し、磁束密度を検出して、事前定義された磁気スレッショルドに基づいてデジタルで出力します。

このデバイスは、パッケージの表面に垂直な磁界を検出します。印加された磁束密度が磁気動作ポイント( $B_{OP}$ )スレッショルドを超える場合、デバイスのオープン・ドレイン出力が LOW 電圧を駆動します。磁束密度が磁気リリース・ポイント( $B_{RP}$ )スレッショルドより低下した場合、出力は高インピーダンスに移行します。 $B_{OP}$  と  $B_{RP}$  を別々にしていることでヒステリシスが設定され、入力ノイズによる出力エラーの発生を防止します。この構成により、システム設計がノイズ干渉に対して強固になります。

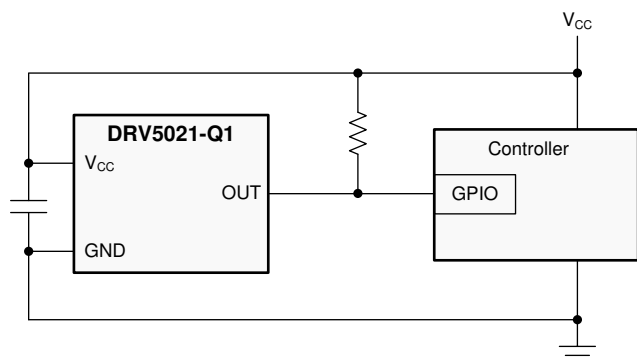
このデバイスは、 $-40^{\circ}\text{C} \sim +150^{\circ}\text{C}$  の広い周囲温度範囲で一貫した動作を行います。

### 製品情報<sup>(1)</sup>

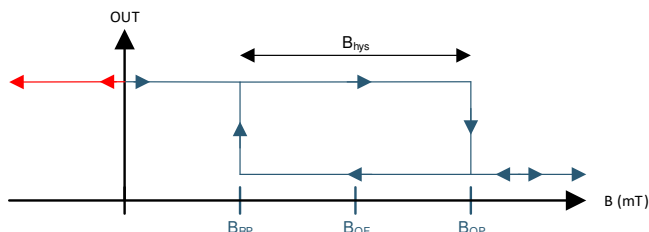
型番	パッケージ	本体サイズ(公称)
DRV5021-Q1	SOT-23 (3)	2.90mmx1.30mm

(1) 利用可能なすべてのパッケージについては、このデータシートの末尾にあるパッケージ・オプションについての付録を参照してください。

標準アプリケーション回路図



磁気応答



## 目次

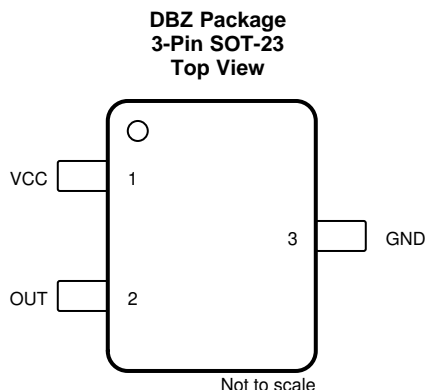
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## 4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

日付	リビジョン	注
2019年2月	*	初版

## 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-μF (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 (VCC)	-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)

		VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human body model (HBM), per AEC Q100-002 <sup>(1)</sup>	±6000
		Charged device model (CDM), per AEC Q100-011	±1000

(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 <sub>CC</sub>	Power supply voltage range	2.5	5.5	V
V <sub>O</sub>	Output pin voltage	0	5.5	V
I <sub>OUT</sub>	Output sinking current	0	20	mA
T <sub>A</sub>	Operating ambient temperature	–40	150	°C

### 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		DRV5021-Q1		UNIT
		SOT-23 (DBZ)		
		3 PINS		
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	356		°C/W
R <sub>θJC(top)</sub>	Junction-to-case (top) thermal resistance	128		°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	94		°C/W
Y <sub>JT</sub>	Junction-to-top characterization parameter	11.4		°C/W
Y <sub>JB</sub>	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<sub>CC</sub> = 2.5 V to 5.5 V, over operating free-air temperature range (unless otherwise noted)

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

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

### 6.6 Magnetic Characteristics

 at V<sub>CC</sub> = 2.5 V to 5.5 V, over operating free-air temperature range (unless otherwise noted)

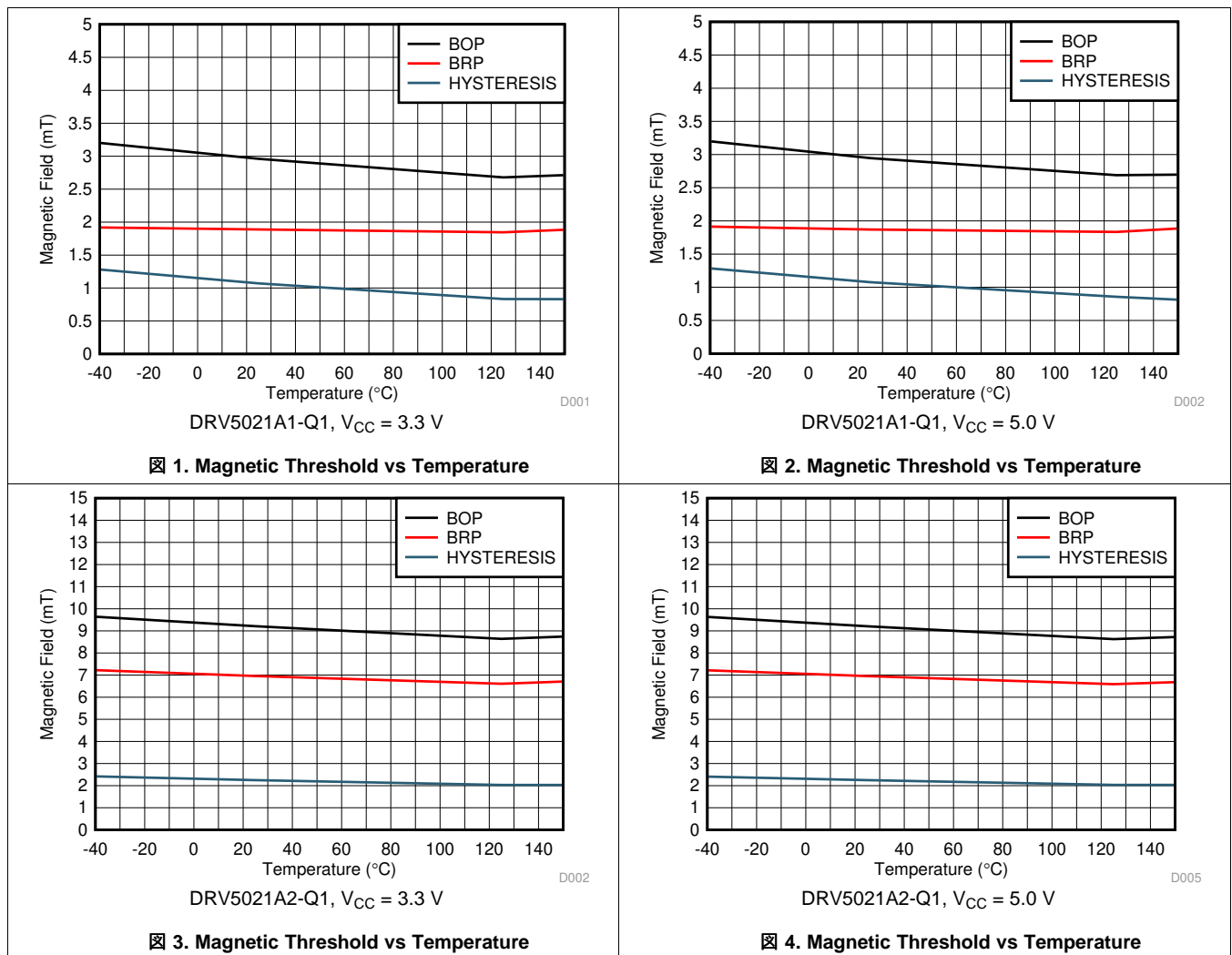
PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
<b>DRV5021A1-Q1, DRV5021A2-Q1, DRV5021A3-Q1</b>						
f <sub>BW</sub>	Sensing bandwidth			30		kHz
<b>DRV5021A1-Q1</b>						
B <sub>OP</sub>	Magnetic threshold Operate Point	T <sub>A</sub> = –40°C to +125°C	1.3	2.9	4.4	mT
		T <sub>A</sub> = –40°C to +150°C	1.1	2.9	4.7	mT
B <sub>RP</sub>	Magnetic threshold Release Point	T <sub>A</sub> = –40°C to +125°C	0.2	1.8	3.0	mT
		T <sub>A</sub> = –40°C to +150°C	0.1	1.8	3.3	mT
B <sub>HYS</sub>	Magnetic hysteresis:  B <sub>OP</sub> – B <sub>RP</sub>	T <sub>A</sub> = –40°C to +125°C	0.1	1.1	2.5	mT
B <sub>HYS</sub>	Magnetic hysteresis:  B <sub>OP</sub> – B <sub>RP</sub>	T <sub>A</sub> = –40°C to +150°C	0.1	1.1	2.8	mT
<b>DRV5021A2-Q1</b>						
B <sub>OP</sub>	Magnetic threshold Operate Point	T <sub>A</sub> = –40°C to +125°C	5.0	9.2	13.0	mT
		T <sub>A</sub> = –40°C to +150°C	4.5	9.2	14.0	mT
B <sub>RP</sub>	Magnetic threshold Release Point	T <sub>A</sub> = –40°C to +125°C	3.2	7.0	10.0	mT
		T <sub>A</sub> = –40°C to +150°C	2.7	7.0	11.0	mT

### Magnetic Characteristics (continued)

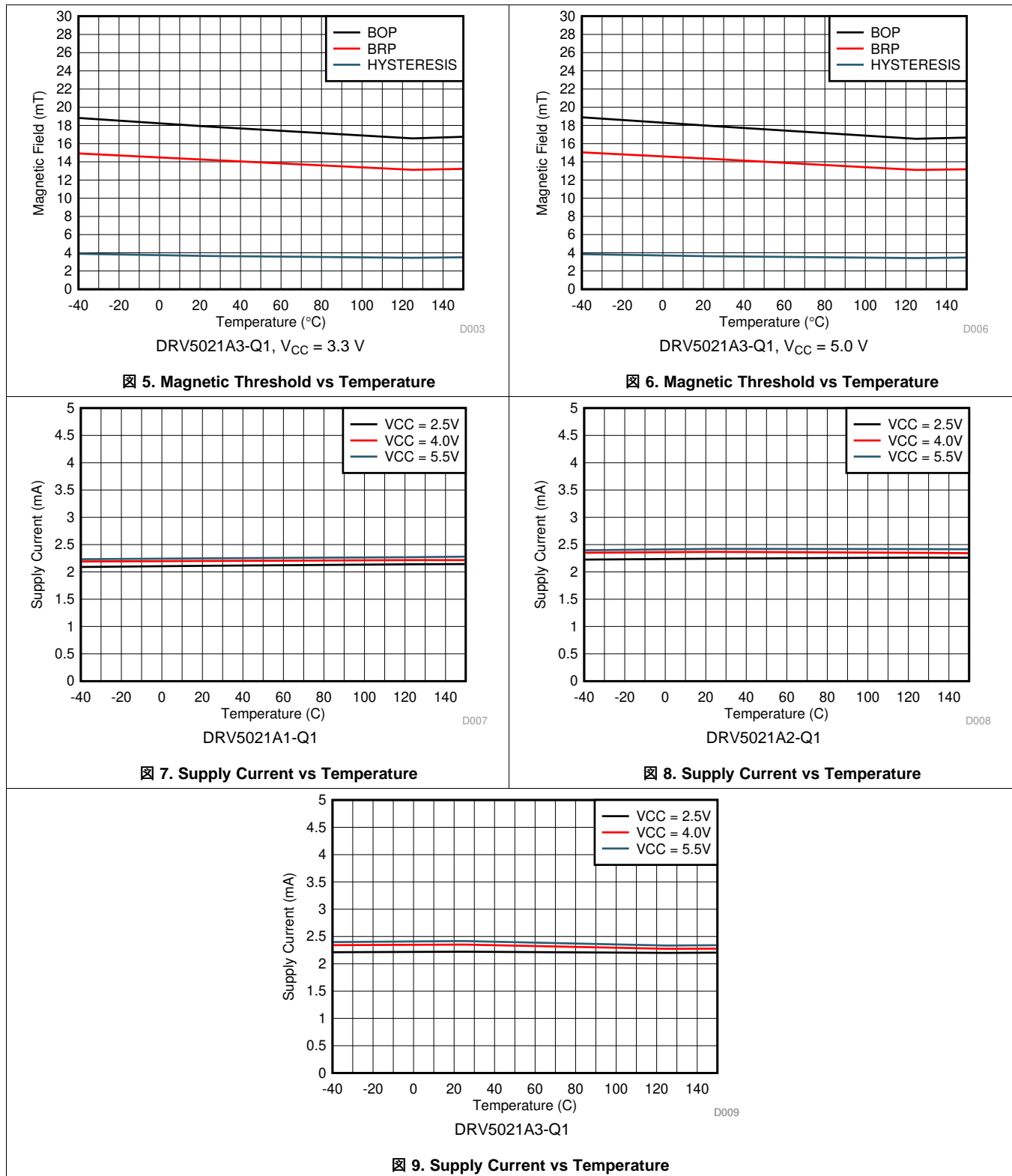
at  $V_{CC} = 2.5\text{ V to }5.5\text{ V}$ , over operating free-air temperature range (unless otherwise noted)

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	mT
		$T_A = -40^\circ\text{C to }+150^\circ\text{C}$	7.7	17.9	25.4	mT
$B_{RP}$	Magnetic threshold Release Point	$T_A = -40^\circ\text{C to }+125^\circ\text{C}$	6.2	14.1	18.8	mT
		$T_A = -40^\circ\text{C to }+150^\circ\text{C}$	5.1	14.1	20.8	mT
$B_{HYS}$	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 (continued)**



## 7 Detailed Description

### 7.1 Overview

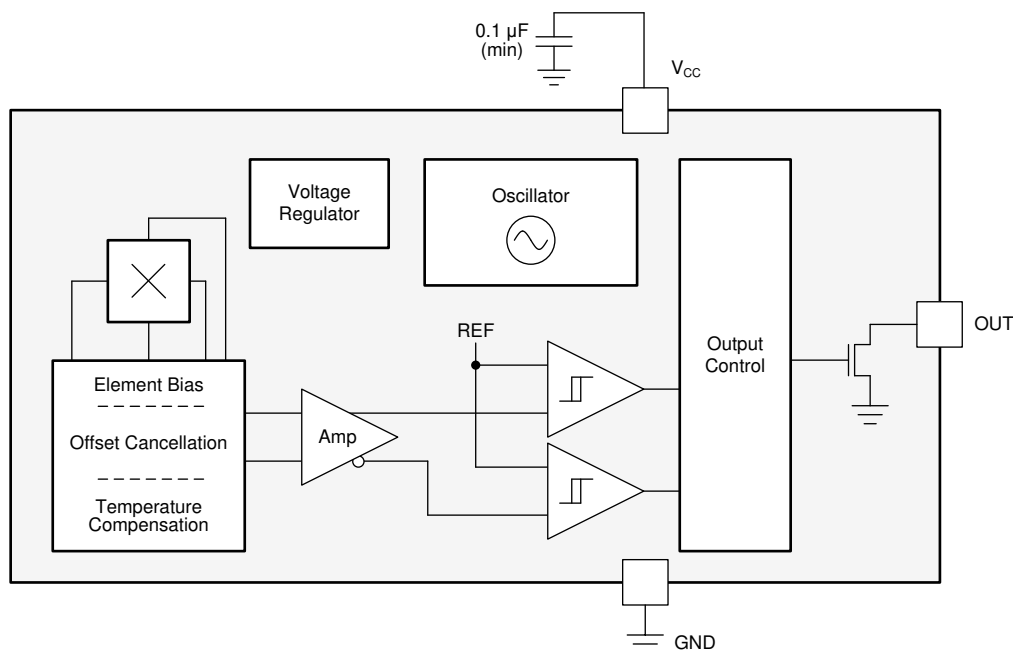
The DRV5021-Q1 device is a spinning-current Hall sensor with a digital output for magnetic-sensing applications. The DRV5021-Q1 can be powered with a supply voltage between 2.5 V and 5.5 V.

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.

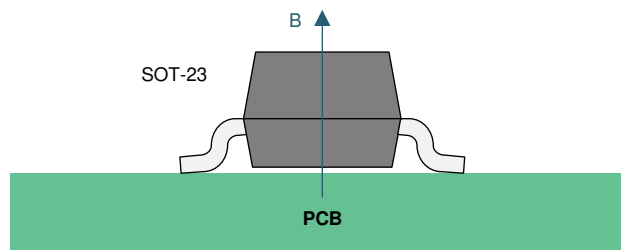
### 7.2 Functional Block Diagram



### 7.3 Feature Description

#### 7.3.1 Field Direction Definition

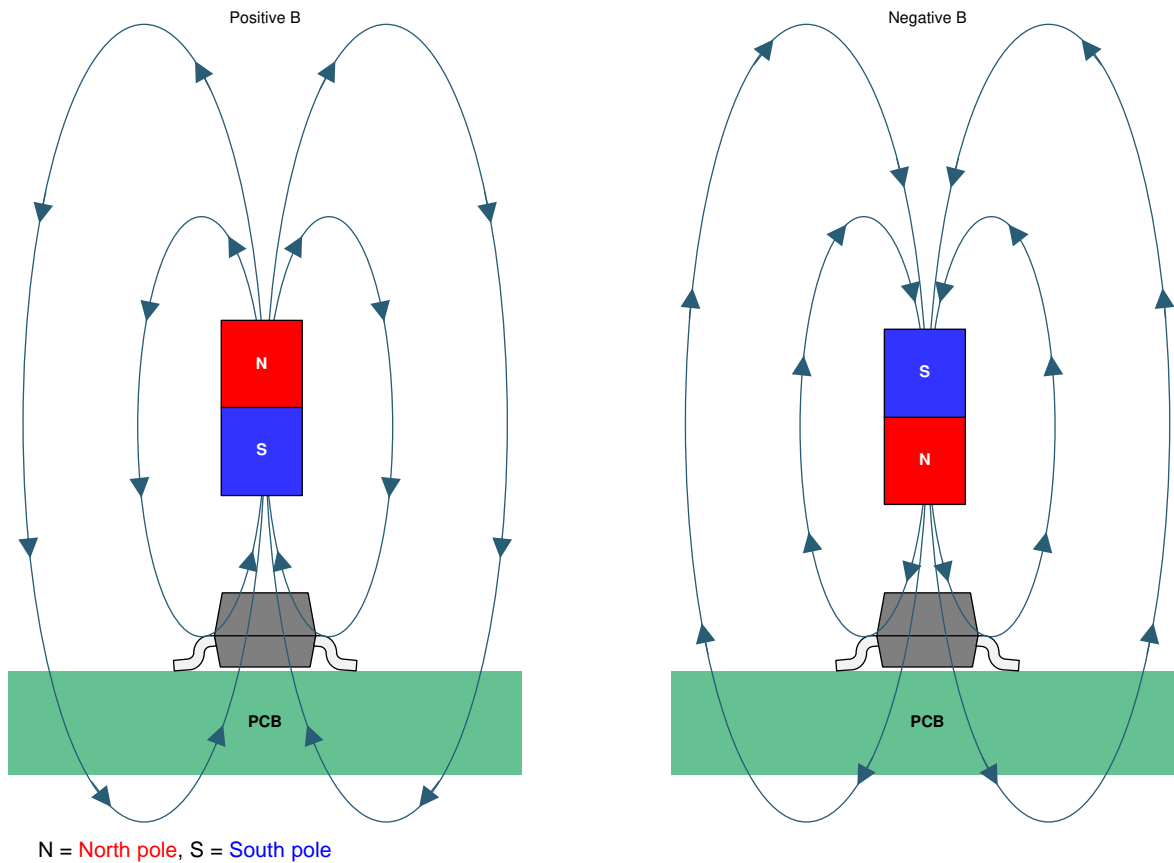
As shown in [Figure 10](#), the DRV5021-Q1 is sensitive to the magnetic field component that is perpendicular to the top of the package.



**Figure 10. Direction of Sensitivity**

**Feature Description (continued)**

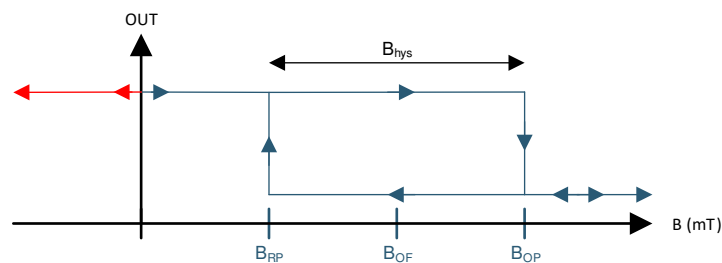
Figure 11 shows that a positive magnetic field is defined as a south pole near the marked side of the package.



**Figure 11. Field Direction Definition**

**7.3.2 Device Output**

If the device is powered on with a magnetic field strength between  $B_{RP}$  and  $B_{OP}$ , then the device output is indeterminate. If the field strength is greater than  $B_{OP}$ , then the output is pulled low. If the field strength is less than  $B_{RP}$ , then the output is released.



**Figure 12. Output State**



## Feature Description (continued)

### 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 (Figure 13) and case 2 (Figure 14), the output is defined assuming that magnetic field  $B_{APPLIED} > B_{OP}$ , and  $B_{APPLIED} < B_{RP}$ , respectively.

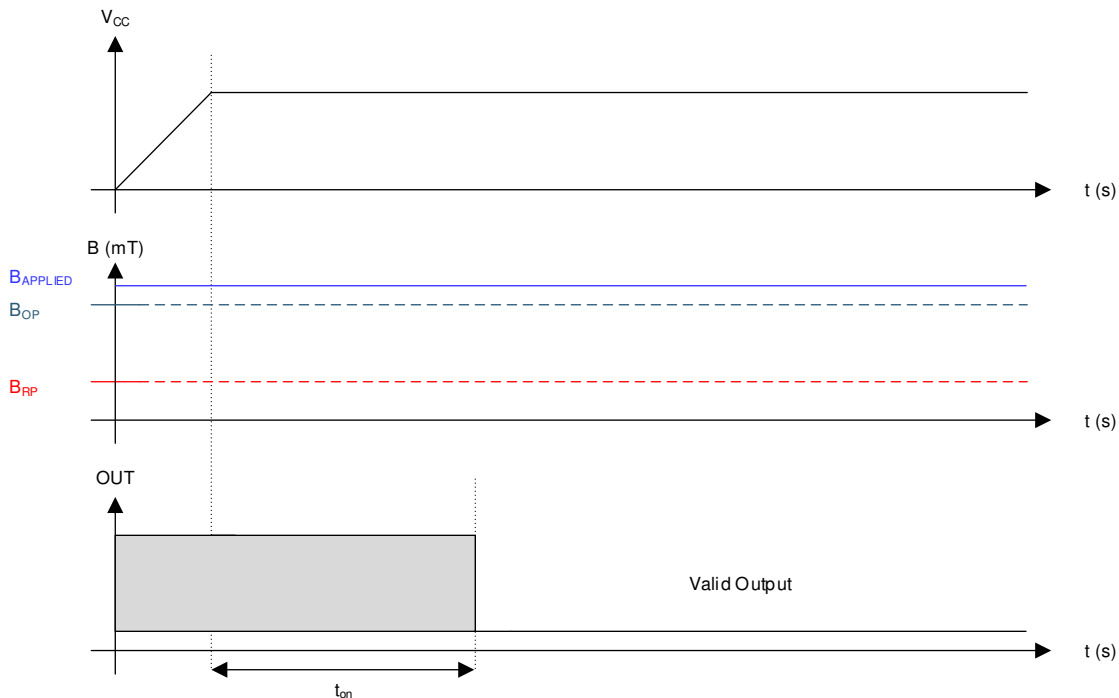


Figure 13. Case 1: Power On When  $B > B_{OP}$

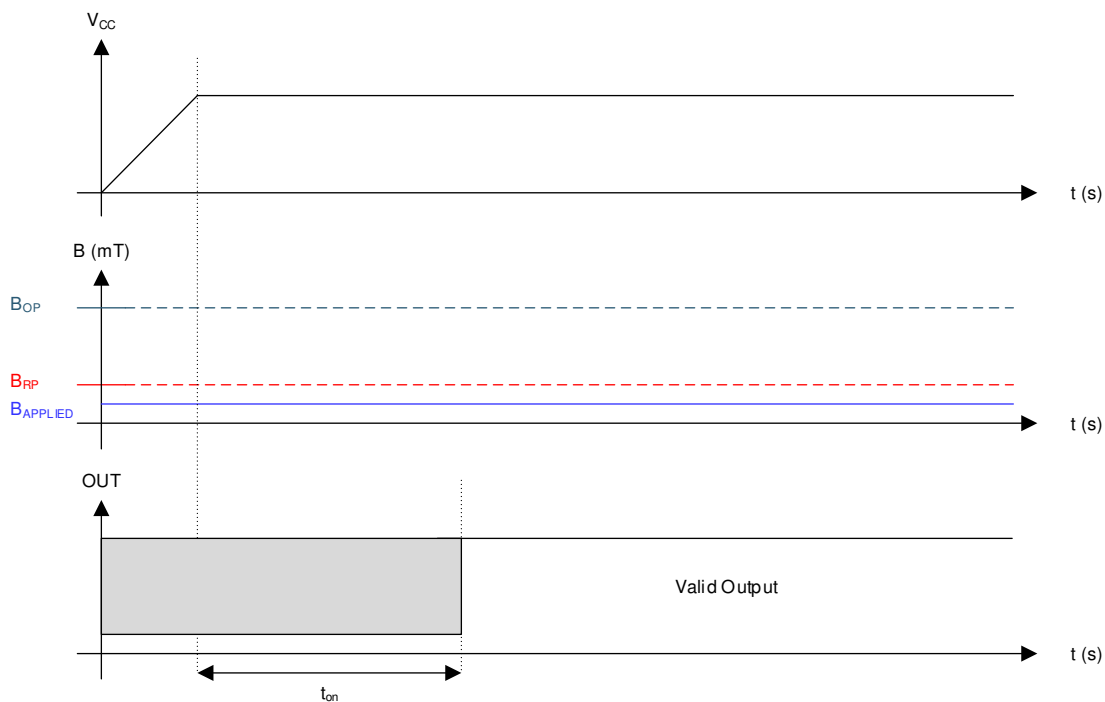
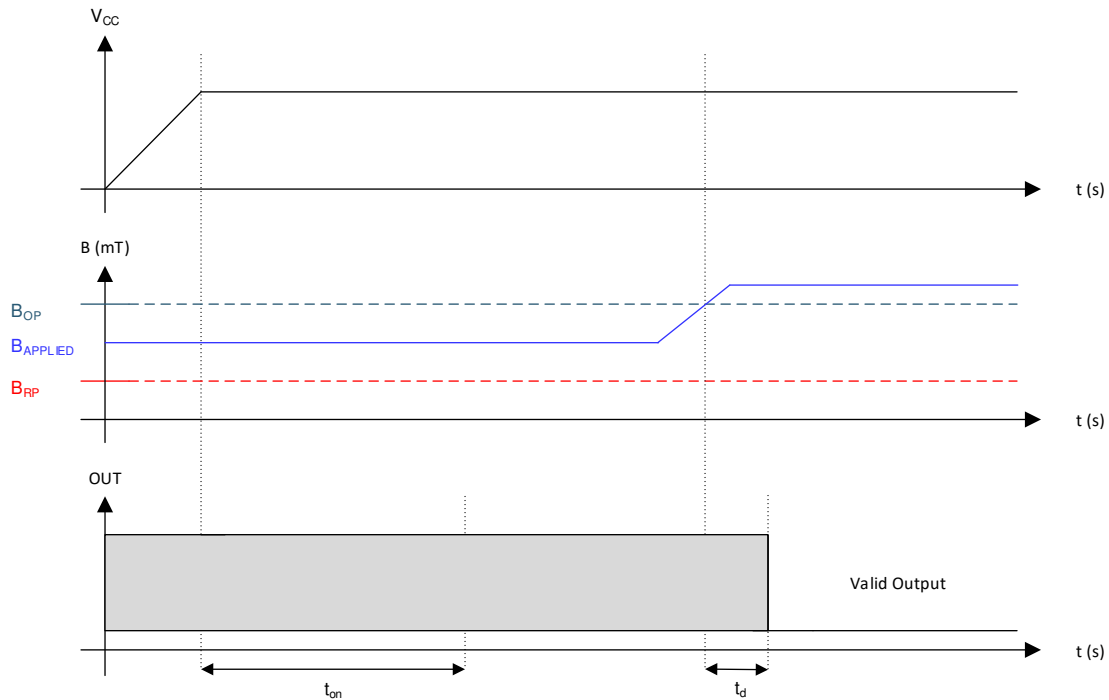


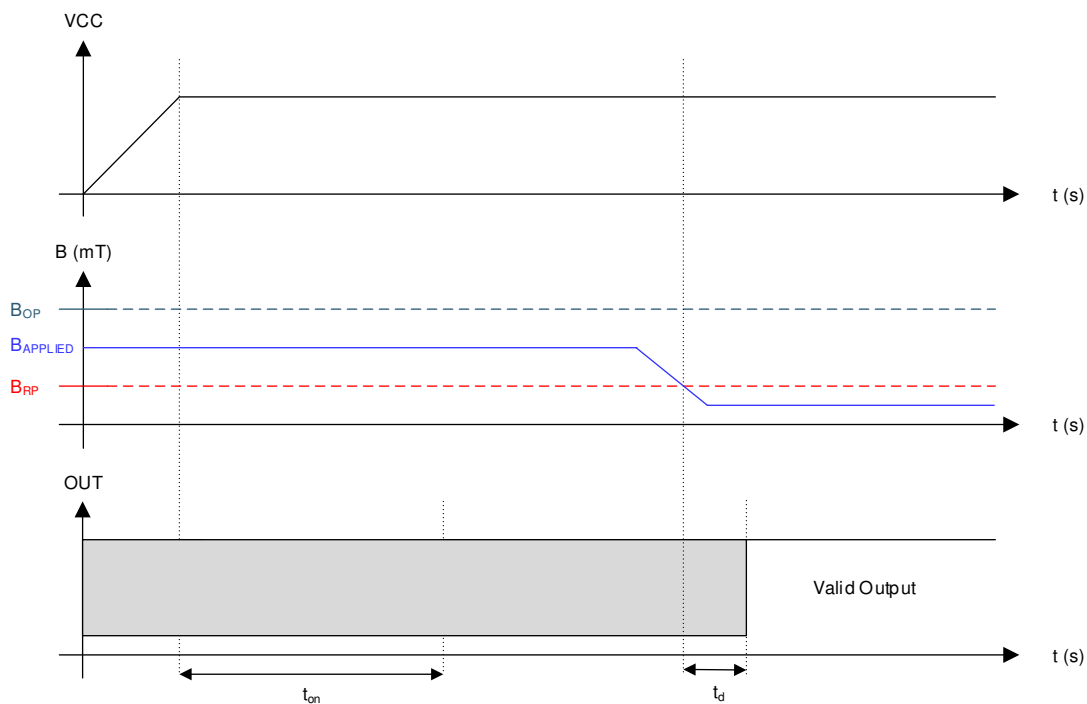
Figure 14. Case 2: Power On When  $B < B_{RP}$

**Feature Description (continued)**

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 (☒ 15) and case 4 (☒ 16) show examples of this behavior.



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

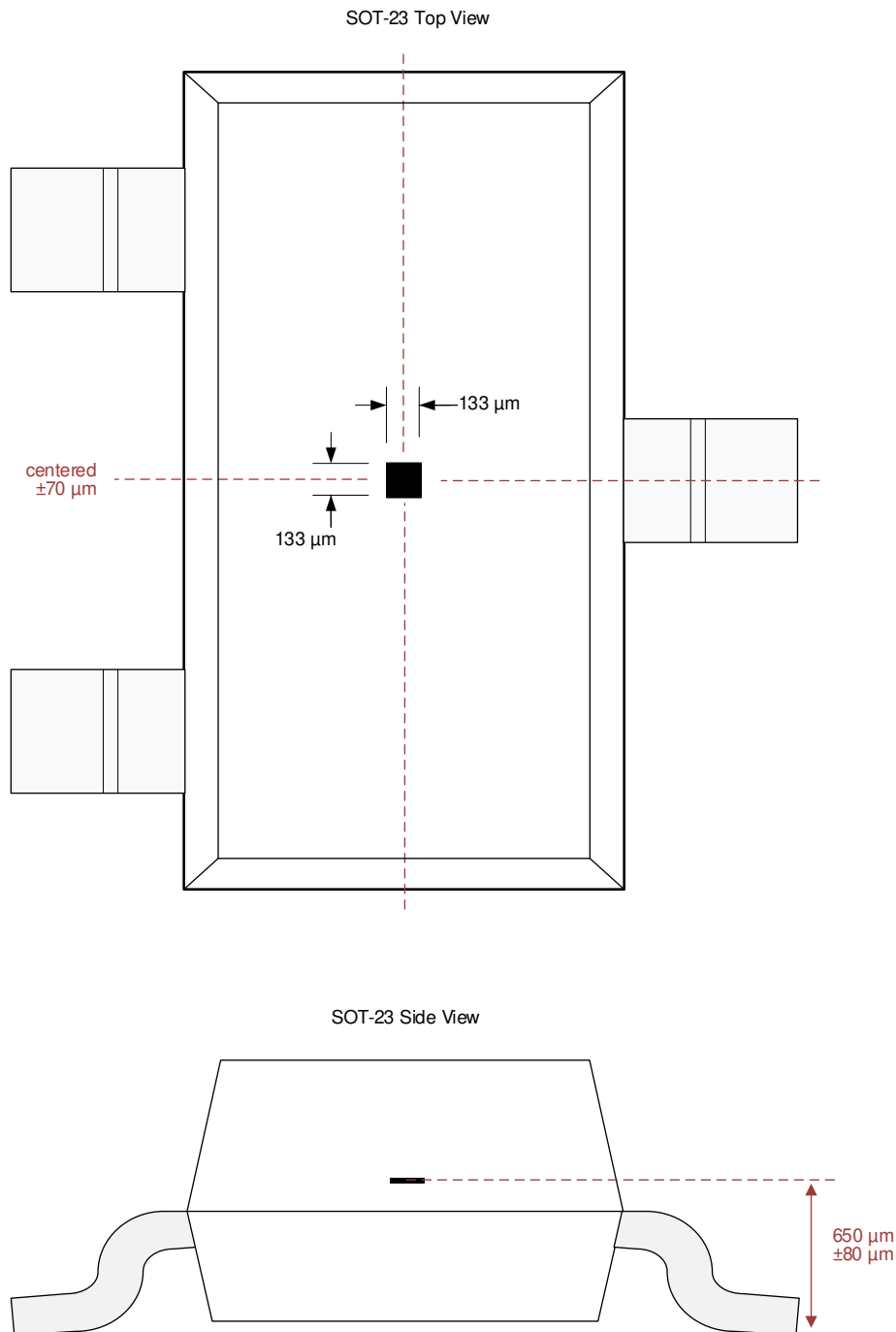


☒ 16. Case 4: Power On When  $B_{RP} < B < B_{OP}$ , Followed by  $B < B_{RP}$

## Feature Description (continued)

### 7.3.4 Hall Element Location

The sensing element inside the device is in the center of both packages when viewed from the top. [Figure 17](#) shows the tolerances and side-view dimensions.



**Figure 17. Hall Element Location**

## Feature Description (continued)

### 7.3.5 Propagation Delay

The DRV5021-Q1 samples the Hall element at a nominal sampling period of 16.67  $\mu\text{s}$  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.

Figure 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.

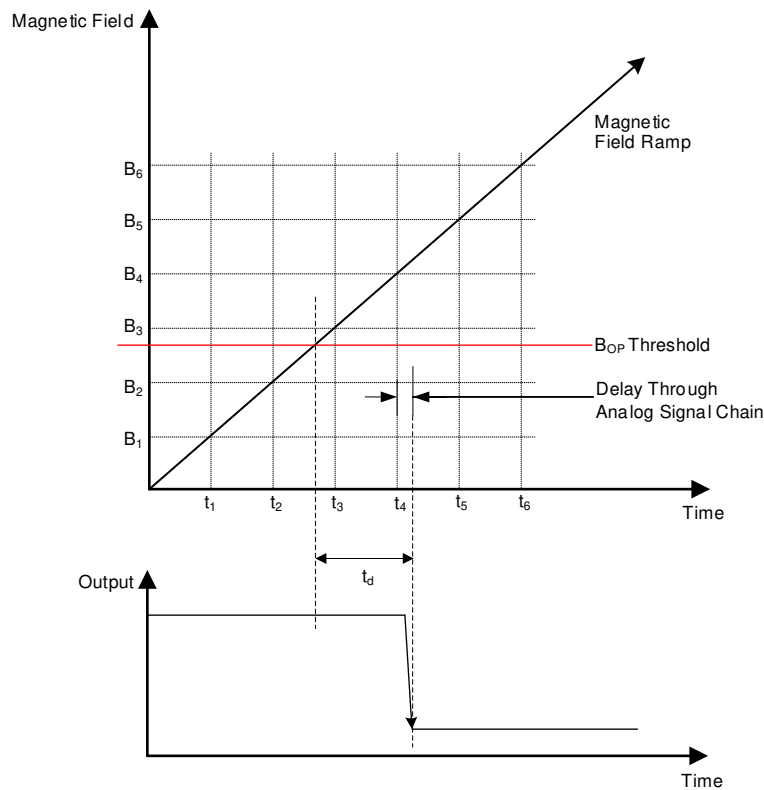


Figure 18. Propagation Delay

## Feature Description (continued)

### 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 式 1.

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

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 Ω in order to make sure that the output driver can pull the OUT pin close to GND.

注

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

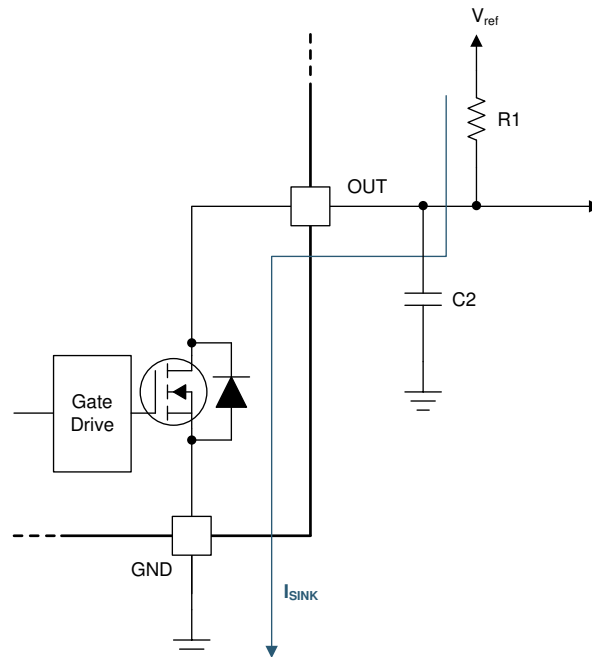


図 19. Open-Drain Output

Select a value for C2 based on the system bandwidth specifications shown in 式 2.

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

Most applications do not require this C2 filtering capacitor.

## 7.4 Device Functional Modes

The DRV5021-Q1 device is active only when  $V_{\text{CC}}$  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

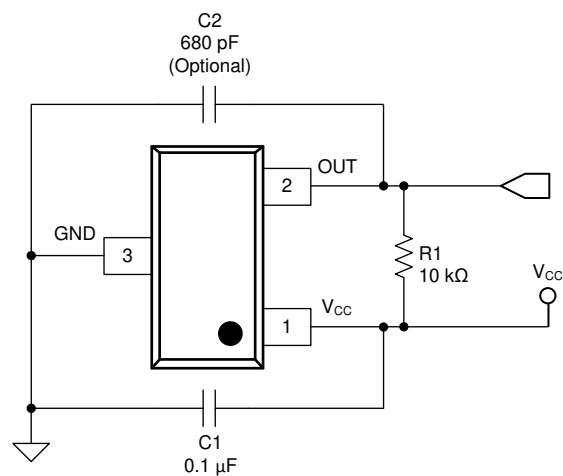


图 20. Proximity Sensing Circuit

##### 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 式 3 to calculate the allowable range for R1.

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

For this design example, use 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 (式 5), select a value between 500  $\Omega$  and 32 k $\Omega$  for R1.

Assuming a system bandwidth of 10 kHz, use 式 6 to calculate the value of C2.

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

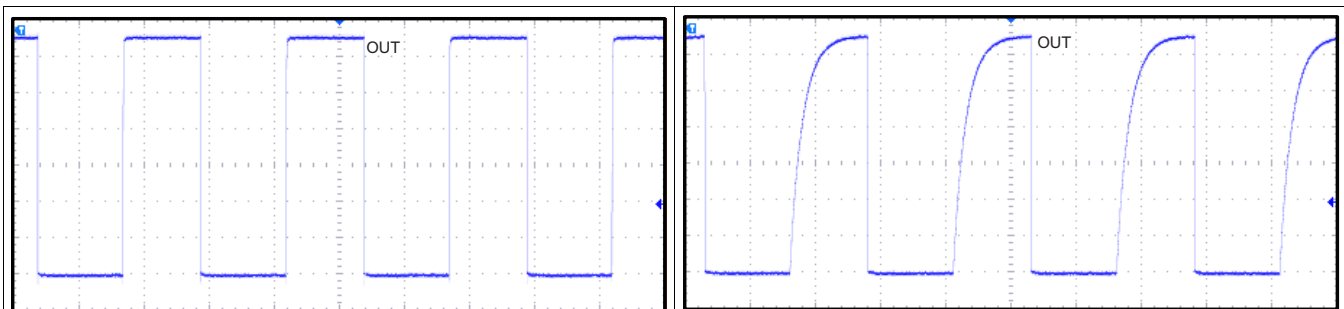
For this design example, use 式 7 to calculate the value of C2.

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

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

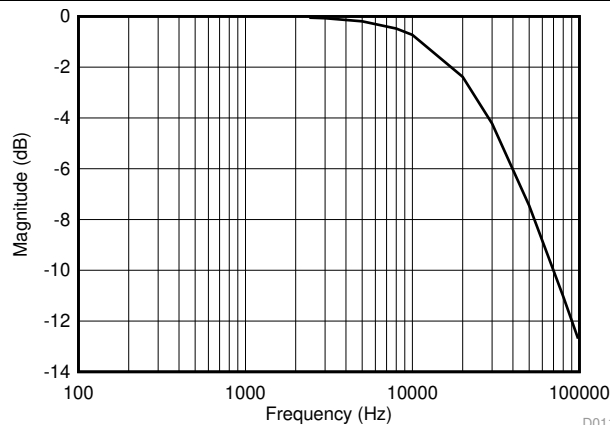


R1 = 10-k $\Omega$  pullup resistor, no C2 capacitor

图 21. 10-kHz Switching Magnetic Field

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

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.

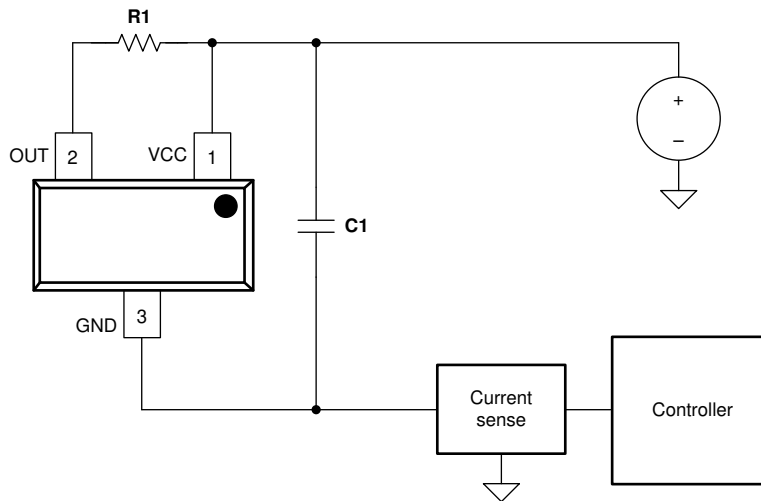


图 24. 2-Wire Application

#### 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  $V_{CC}$  must be placed as close to the DRV5021-Q1 device as possible.

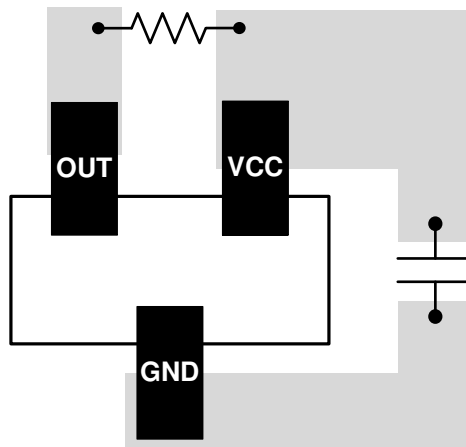
## 10 Layout

### 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



☒ 25. DRV5021-Q1 Layout Example

## 11 デバイスおよびドキュメントのサポート

### 11.1 ドキュメントのサポート

#### 11.1.1 関連資料

関連資料については、以下を参照してください。

- テキサス・インスツルメンツ、[『HALL-ADAPTER-EVM』ユーザー・ガイド](#)
- テキサス・インスツルメンツ、[『ホール効果センサのデータシートの理解と適用』アプリケーション・レポート](#)

### 11.2 ドキュメントの更新通知を受け取る方法

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### 11.3 コミュニティ・リソース

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

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### 11.6 Glossary

**SLYZ022** — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 12 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DRV5021A1EDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 150	211Z	<a href="#">Samples</a>
DRV5021A2EDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 150	212Z	<a href="#">Samples</a>
DRV5021A3EDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 150	213Z	<a href="#">Samples</a>

(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.

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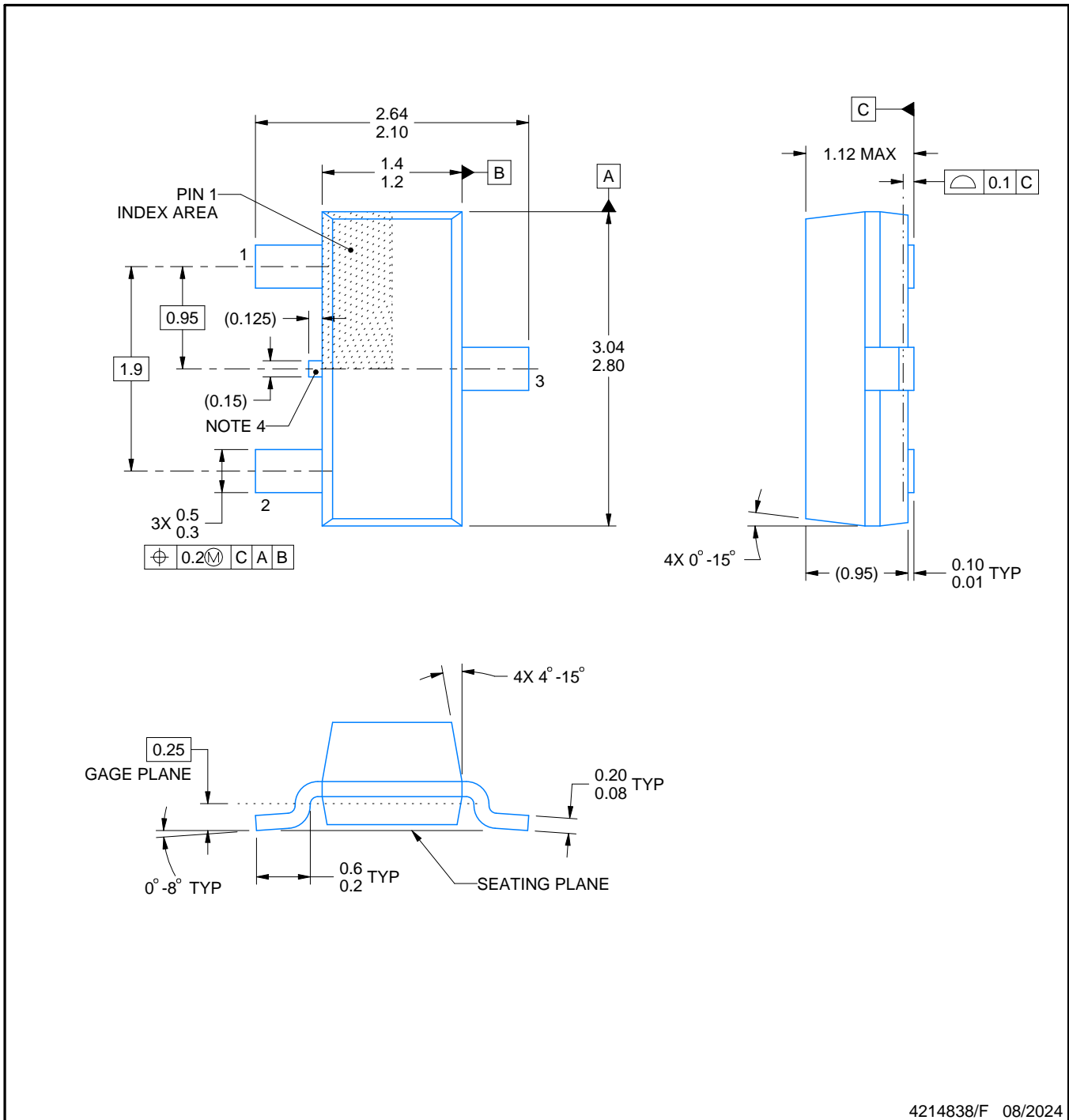
# DBZ0003A



# PACKAGE OUTLINE

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



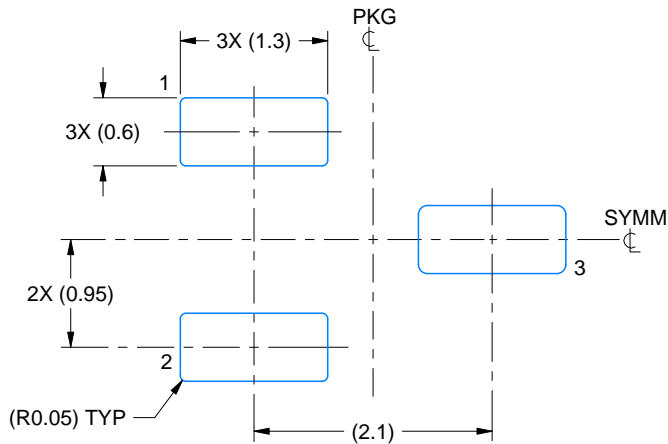
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# EXAMPLE BOARD LAYOUT

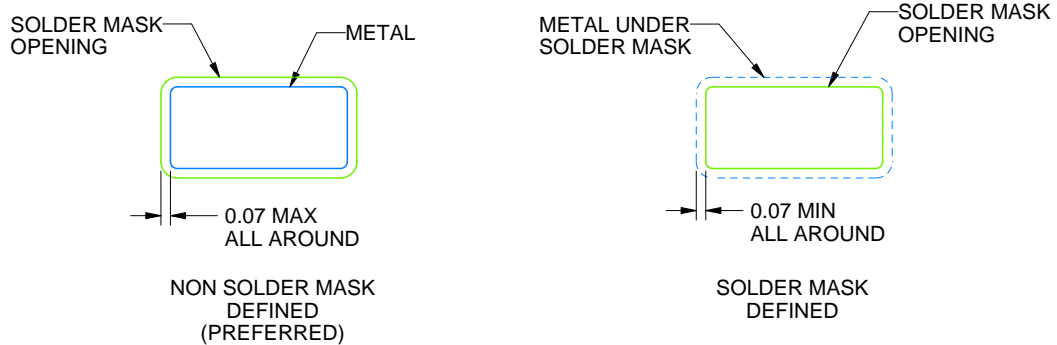
DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
SCALE:15X



SOLDER MASK DETAILS

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NOTES: (continued)

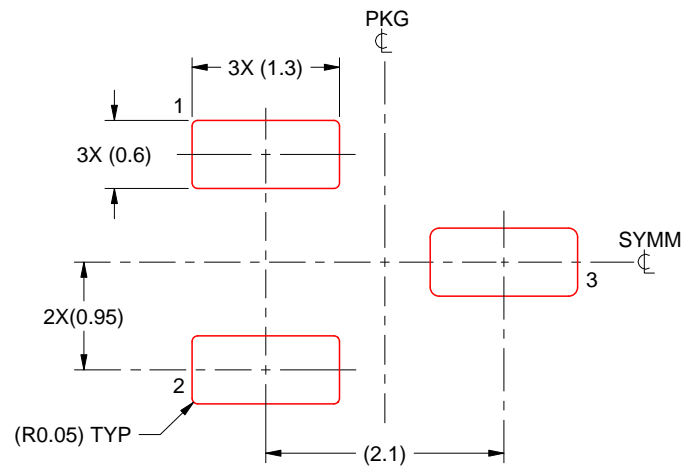
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# 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

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NOTES: (continued)

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

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