# DRV5056 ユニポーラ・レシオメトリック・リニア・ホール効果センサ

## 1 特長

- ユニポーラのリニア・ホール効果磁気センサ
- 3.3V および 5V の電源で動作
- 0.6V の静止オフセット付きのアナログ出力
  - 電圧スイングの最大化により高精度
- 磁気感度オプション ($V_{CC}$ = 5V 時)：
  - A1：200mV/mT、20mT 範囲
  - A2：100mV/mT、39mT 範囲
  - A3：50mV/mT、79mT 範囲
  - A4：25mV/mT、158mT 範囲
  - A6：100mV/mT、39mT 範囲
- 高速な 20kHz センシング帯域幅
- ±1mA 駆動の低ノイズ出力
- 磁石の温度ドリフトの補償
- 標準の産業用パッケージ：
  - 表面実装 SOT-23
  - スルーホール TO-92

## 2 アプリケーション

- 高精度の位置センシング
- 産業用オートメーションおよびロボティクス
- 家電製品
- ゲームパッド、ペダル、キーボード、トリガ
- 高さレベリング、傾き、重量の測定
- 液体の流量測定
- 医療機器
- 電流センシング

## 3 概要

DRV5056はリニア・ホール効果センサで、磁界のS極の磁束密度に比例して応答します。このデバイスは、広範なアプリケーションにおいて、正確な位置センシングに使用できます。

ユニポーラの磁気応答が特徴で、アナログ入力は磁界が存在しないとき0.6Vに駆動され、磁界のS極が印加されると増大します。この応答により、1つの磁極を検出するアプリケーションで、出力のダイナミック・レンジが最大化されます。4つの感度オプションにより、必要なセンシング範囲に基づいて、さらに出力スイングを最大化できます。

このデバイスは、3.3Vまたは5Vの電源で動作します。パッケージの上面に垂直な磁束が検出され、2つのパッケージ・オプションでセンシング方向が異なります。

デバイスは、レシオメトリック・アーキテクチャを使用し、外部のアナログ/デジタル・コンバータ(ADC)が基準として同じ$V_{CC}$を使用しているとき、$V_{CC}$の許容範囲からの誤差を最小化できます。さらに、本デバイスには磁石温度補償が搭載されており、磁石のドリフトを補償することで、の広い温度範囲にわたって線形性を実現します。

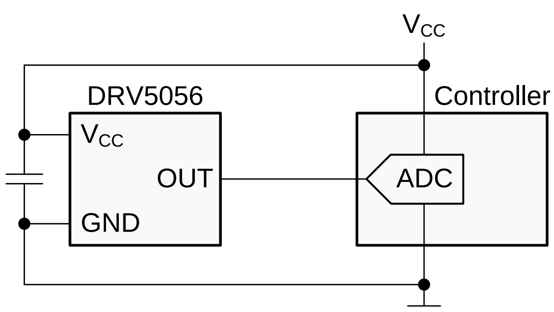
A1～A4 バージョンは –40°C～+125°C の温度範囲に対応します。A6 バージョンは 0°C～85°C の温度範囲に対応します。

**製品情報(1)**

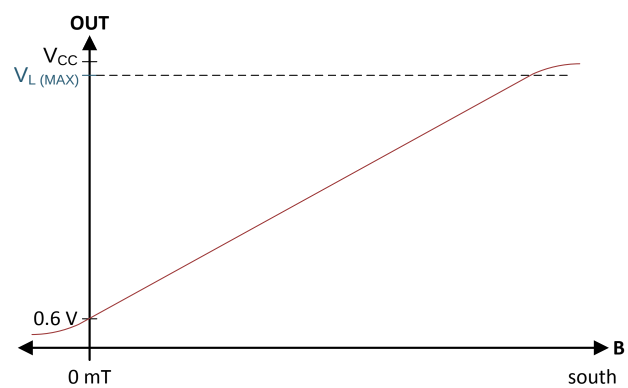
| 型番 | パッケージ | 本体サイズ(公称) |
|---|---|---|
| DRV5056 | SOT-23 (3) | 2.92mm×1.30mm |
| | TO-92 (3) | 4.00mm × 3.15mm |

(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。

**代表的な回路図**




**磁気応答**



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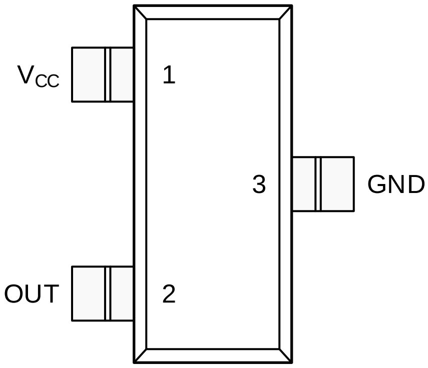
## 4 改訂履歴

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。

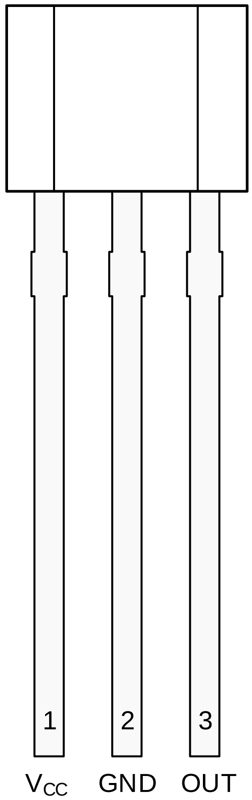
| **2018年4月**発行のものから更新 | **Page** |
|---|---|
| • データシートに新しい A6 磁気感度オプションを 追加 | 1 |

# 5 Pin Configuration and Functions

**DBZ Package**
**3-Pin SOT-23**
**Top View**




**LPG Package**
**3-Pin TO-92**
**Top View**




**Pin Functions**

| PIN | | | I/O | DESCRIPTION |
|---|---|---|---|---|
| NAME | SOT-23 | TO-92 | | |
| GND | 3 | 2 | — | Ground reference |
| OUT | 2 | 3 | O | Analog output |
| $V_{CC}$ | 1 | 1 | — | Power supply. TI recommends connecting this pin to a ceramic capacitor to ground with a value of at least 0.1 µF. |

# 6 Specifications

## 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

| | | MIN | MAX | UNIT |
|---|---|---|---|---|
| Power supply voltage | $V_{CC}$ | –0.3 | 7 | V |
| Output voltage | OUT | –0.3 | $V_{CC}$ + 0.3 | V |
| Magnetic flux density, $B_{MAX}$ | | Unlimited | | T |
| Operating junction temperature, $T_J$ | | –40 | 150 | °C |
| Storage temperature, $T_{stg}$ | | –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

| | | | VALUE | UNIT |
|---|---|---|---|---|
| $V_{(ESD)}$ | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 (1) | ±2500 | V |
| | | Charged-device model (CDM), per JEDEC specification JESD22-C101 (2) | ±750 | |

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

## 6.3 Recommended Operating Conditions

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

| | | MIN | MAX | UNIT |
|---|---|---|---|---|
| $V_{CC}$ | Power supply voltage (1) | 3 | 3.6 | V |
| | | 4.5 | 5.5 | |
| $I_O$ | Output continuous current | –1 | 1 | mA |
| $T_A$ | A1-A4 versions operating ambient temperature (2) | –40 | 125 | °C |
| $T_A$ | A6 version operating ambient temperature (2) | 0 | 85 | °C |

(1) There are two isolated operating $V_{CC}$ ranges. For more information see the *Operating $V_{CC}$ Ranges* section.
(2) Power dissipation and thermal limits must be observed.

## 6.4 Thermal Information

| THERMAL METRIC (1) | | DRV5056 | | UNIT |
|---|---|---|---|---|
| | | SOT-23 (DBZ) | TO-92 (LPG) | |
| | | 3 PINS | 3 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 170 | 121 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 66 | 67 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 49 | 97 | °C/W |
| $Y_{JT}$ | Junction-to-top characterization parameter | 1.7 | 7.6 | °C/W |
| $Y_{JB}$ | Junction-to-board characterization parameter | 48 | 97 | °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

for $V_{CC}$ = 3 V to 3.63 V and 4.5 V to 5.5 V, over operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS (1) | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $I_{CC}$ | Operating supply current | | | | 6 | 10 | mA |
| $t_{ON}$ | Power-on time (see 図 19) | B = 0 mT, no load on OUT | | | 150 | 300 | µs |
| $f_{BW}$ | Sensing bandwidth | | | | 20 | | kHz |
| $t_d$ | Propagation delay time | From change in B to change in OUT | | | 10 | | µs |
| $B_{ND}$ | Input-referred RMS noise density | $V_{CC}$ = 5 V | | | 130 | | $nT/\sqrt{Hz}$ |
| | | $V_{CC}$ = 3.3 V | | | 215 | | |
| $B_N$ | Input-referred noise | $B_{ND} \times 6.6 \times \sqrt{20\ kHz}$ | $V_{CC}$ = 5 V | | 0.12 | | $mT_{PP}$ |
| | | | $V_{CC}$ = 3.3 V | | 0.2 | | |
| $V_N$ | Output-referred noise (2) | $B_N \times S$ | DRV5056A1 | | 24 | | $mV_{PP}$ |
| | | | DRV5056A2, DRV5056A6 | | 12 | | |
| | | | DRV5056A3 | | 6 | | |
| | | | DRV5056A4 | | 3 | | |

(1) B is the applied magnetic flux density.
(2) $V_N$ describes voltage noise on the device output. If the full device bandwidth is not needed, noise can be reduced with an RC filter.

## 6.6 Magnetic Characteristics

for $V_{CC}$ = 3 V to 3.63 V and 4.5 V to 5.5 V, over operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS(1) | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_Q$ | Quiescent voltage | B = 0 mT, $T_A$ = 25°C | DRV5056A1 | 0.535 | 0.6 | 0.665 | V |
| | | | DRV5056A2, DRV5056A6 | 0.54 | 0.6 | 0.66 | |
| | | | DRV5056A3, DRV5056A4 | 0.55 | 0.6 | 0.65 | |
| $V_{Q\Delta T}$ | Quiescent voltage temperature drift | B = 0 mT, $T_A$ = –40°C to 125°C versus 25°C | $V_{CC}$ = 5 V | | 0.08 | | V |
| | | | $V_{CC}$ = 3.3 V | | 0.04 | | |
| $V_{Q\Delta L}$ | Quiescent voltage lifetime drift | High-temperature operating stress for 1000 hours | | | < 0.5% | | |
| S | Sensitivity | $V_{CC}$ = 5 V, $T_A$ = 25°C | DRV5056A1 | 190 | 200 | 210 | mV/mT |
| | | | DRV5056A2, DRV5056A6 | 95 | 100 | 105 | |
| | | | DRV5056A3 | 47.5 | 50 | 52.5 | |
| | | | DRV5056A4 | 23.8 | 25 | 26.2 | |
| | | $V_{CC}$ = 3.3 V, $T_A$ = 25°C | DRV5056A1 | 114 | 120 | 126 | |
| | | | DRV5056A2, DRV5056A6 | 57 | 60 | 63 | |
| | | | DRV5056A3 | 28.5 | 30 | 31.5 | |
| | | | DRV5056A4 | 14.3 | 15 | 15.8 | |
| $B_L$ | Linear magnetic sensing range(2) | $V_{CC}$ = 5 V, $T_A$ = 25°C | DRV5056A1 | 20 | | | mT |
| | | | DRV5056A2, DRV5056A6 | 39 | | | |
| | | | DRV5056A3 | 79 | | | |
| | | | DRV5056A4 | 158 | | | |
| | | $V_{CC}$ = 3.3 V, $T_A$ = 25°C | DRV5056A1 | 19 | | | |
| | | | DRV5056A2, DRV5056A6 | 39 | | | |
| | | | DRV5056A3 | 78 | | | |
| | | | DRV5056A4 | 155 | | | |
| $V_L$ | Linear range of output voltage(3) | | | $V_Q$ | | $V_{CC}$ – 0.2 | V |
| $S_{TC}$ | Sensitivity temperature compensation for magnets(4) | DRV5056A6 | | 0.05 | 0.12 | 0.19 | %/°C |
| $S_{TC}$ | Sensitivity temperature compensation for magnets(4) | DRV5056A1, DRV5056A2, DRV5056A3, DRV5056A4 | | | 0.12 | | %/°C |
| $S_{LE}$ | Sensitivity linearity error(3) | $V_{OUT}$ is within $V_L$ | | | ±1% | | |
| $S_{RE}$ | Sensitivity ratiometry error(5) | $T_A$ = 25°C, with respect to $V_{CC}$ = 3.3 V or 5 V | | -2.5% | | 2.5% | |
| $S_{\Delta L}$ | Sensitivity lifetime drift | High-temperature operating stress for 1000 hours | | | < 0.5% | | |

(1) B is the applied magnetic flux density.
(2) $B_L$ describes the minimum linear sensing range at 25°C taking into account the maximum $V_Q$ and Sensitivity tolerances.
(3) See the *Sensitivity Linearity* section.
(4) $S_{TC}$ describes the rate the device increases Sensitivity with temperature. For more information, see the *Sensitivity Temperature Compensation For Magnets* section.
(5) See the *Ratiometric Architecture* section.

## 6.7 Typical Characteristics

at $T_A$ = 25°C (unless otherwise noted)

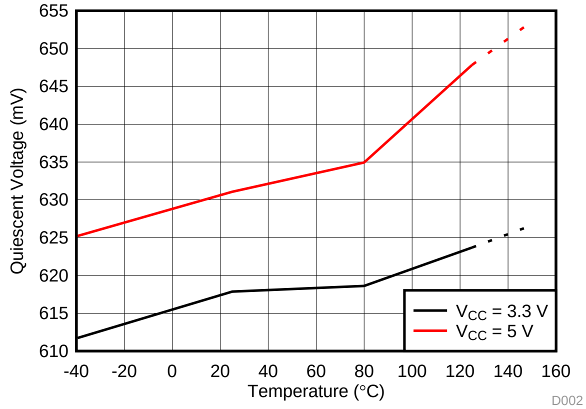



図 1. Quiescent Voltage vs Temperature

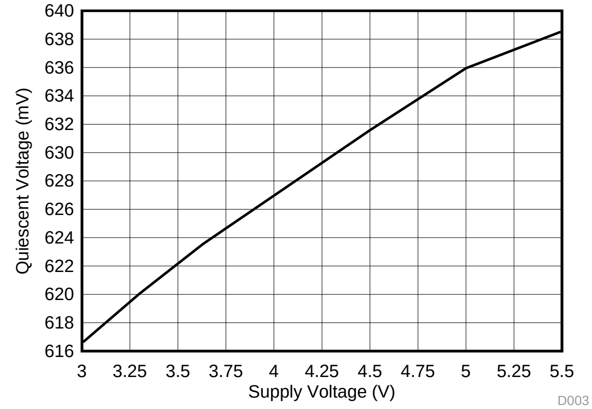
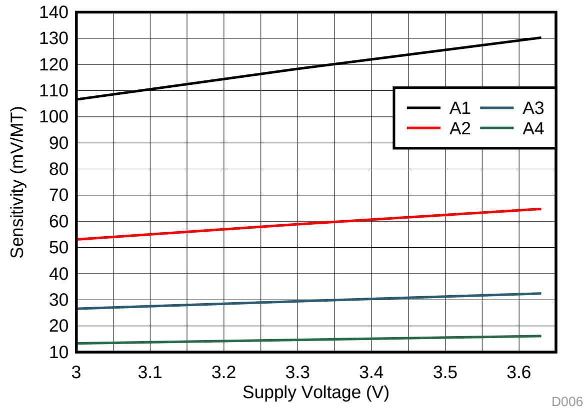
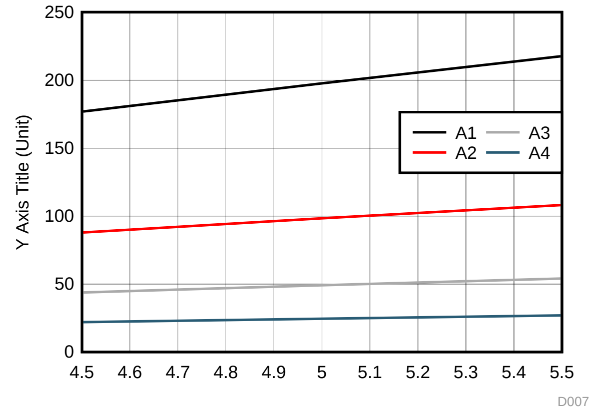



図 2. Quiescent Voltage vs Supply Voltage




$V_{CC}$ = 3.3 V

図 3. Sensitivity vs Supply Voltage




$V_{CC}$ = 5 V

図 4. Sensitivity vs Supply Voltage

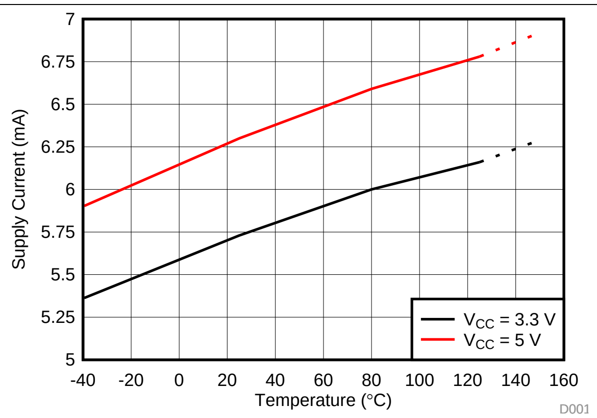
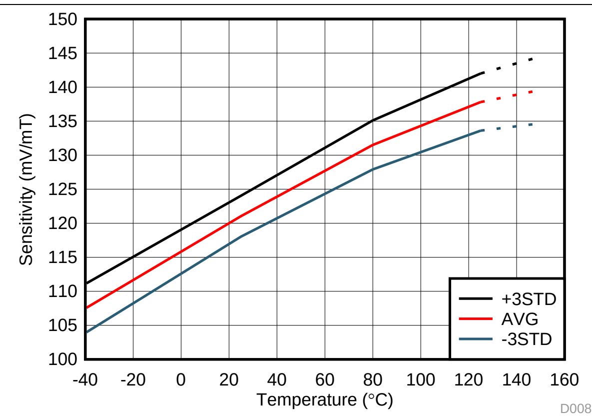



図 5. Supply Current vs Temperature

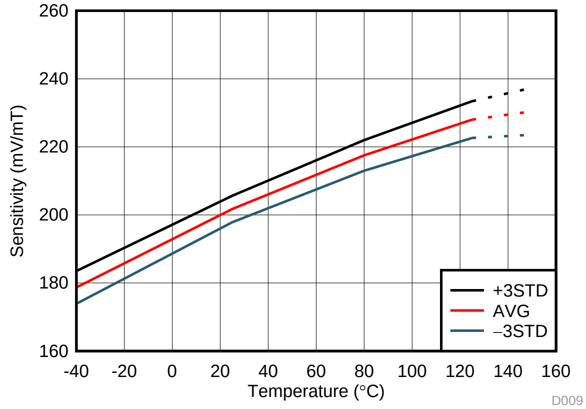



DRV5056A1, $V_{CC}$ = 3.3 V

図 6. Sensitivity vs Temperature

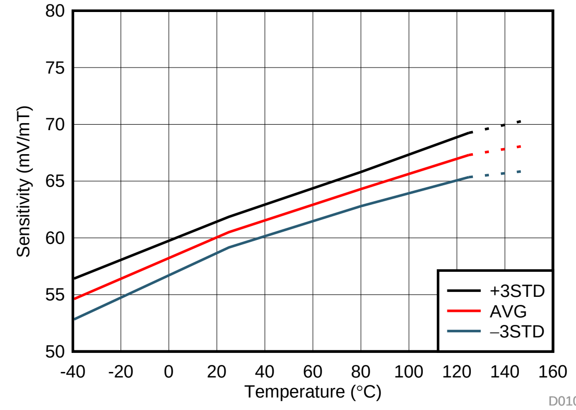
## Typical Characteristics (continued)

at $T_A$ = 25°C (unless otherwise noted)



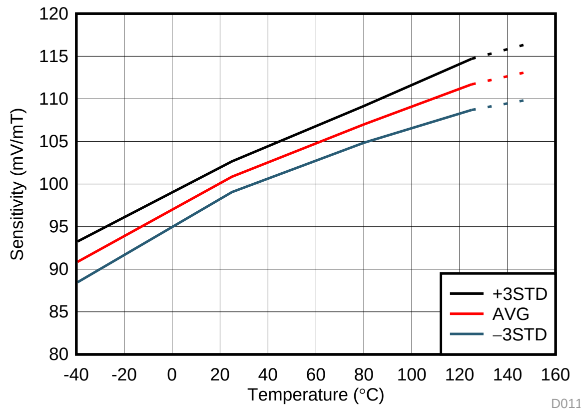

DRV5056A1, $V_{CC}$ = 5.0 V

**図 7. Sensitivity vs Temperature**



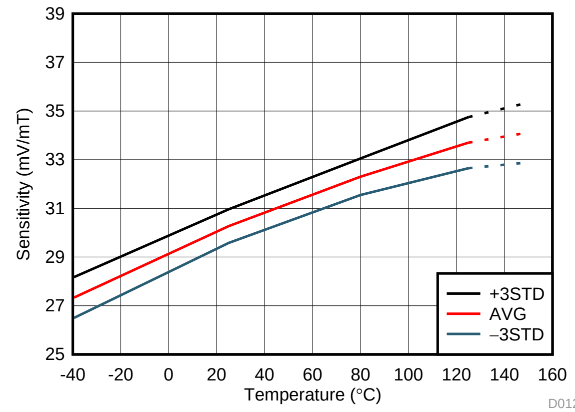

DRV5056A2, $V_{CC}$ = 3.3 V

**図 8. Sensitivity vs Temperature**



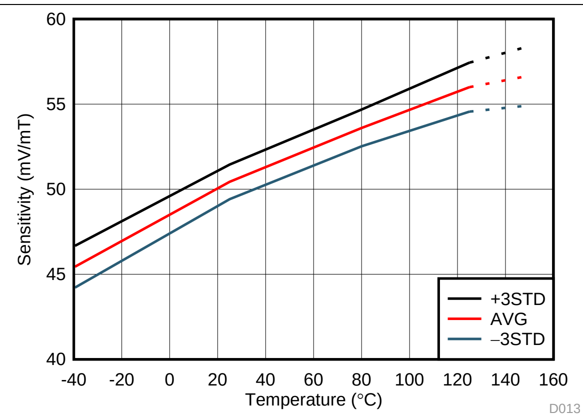

DRV5056A2, $V_{CC}$ = 5.0 V

**図 9. Sensitivity vs Temperature**



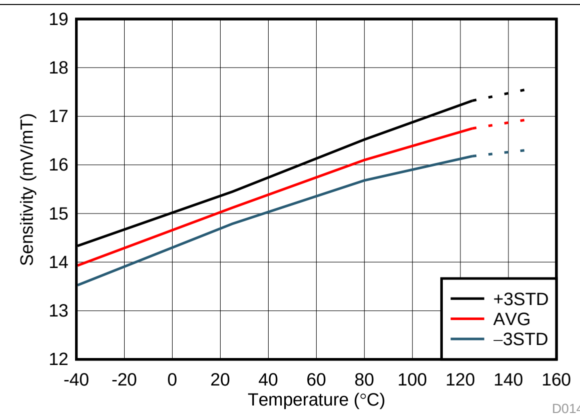

DRV5056A3, $V_{CC}$ = 3.3 V

**図 10. Sensitivity vs Temperature**




DRV5056A3, $V_{CC}$ = 5.0 V

**図 11. Sensitivity vs Temperature**

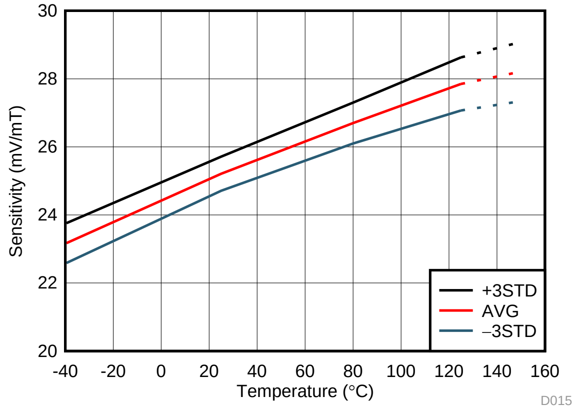



DRV5056A4, $V_{CC}$ = 3.3 V

**図 12. Sensitivity vs Temperature**

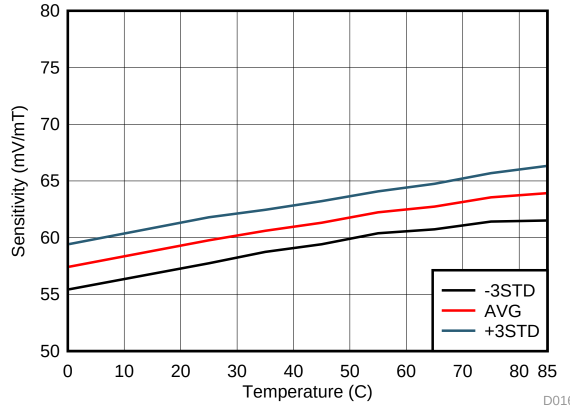
## Typical Characteristics (continued)

at $T_A$ = 25°C (unless otherwise noted)



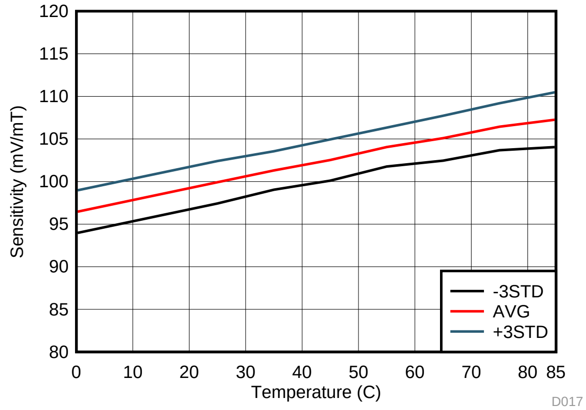

DRV5056A4, $V_{CC}$ = 5.0 V

**図 13. Sensitivity vs Temperature**




DRV5056A6, $V_{CC}$ = 3.3 V

**図 14. Sensitivity vs Temperature**




DRV5056A6, $V_{CC}$ = 5.0 V

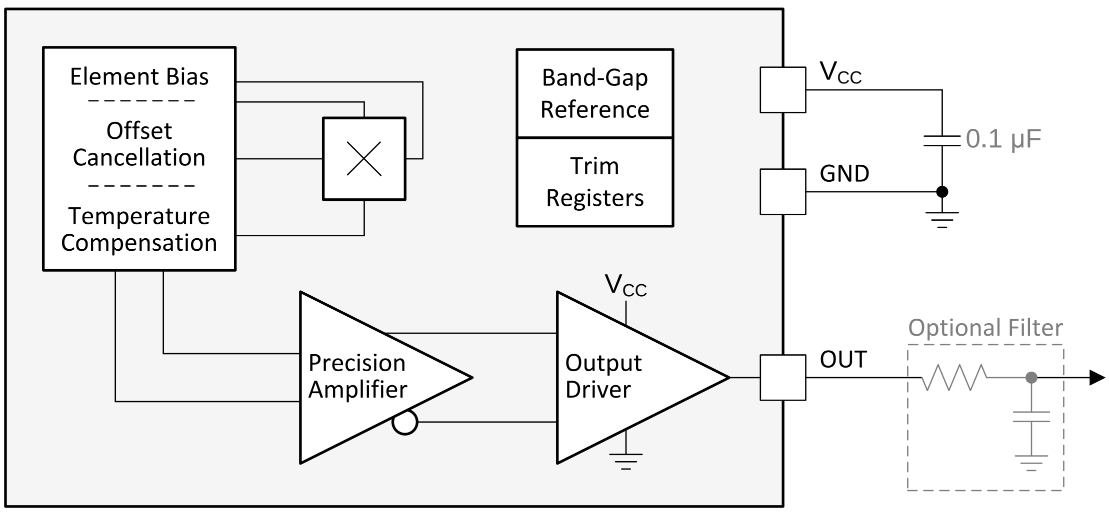
**図 15. Sensitivity vs Temperature**

# 7 Detailed Description

## 7.1 Overview

The DRV5056 is a 3-pin linear Hall effect sensor with fully integrated signal conditioning, temperature compensation circuits, mechanical stress cancellation, and amplifiers. The device operates from 3.3-V and 5-V (±10%) power supplies, measures magnetic flux density, and outputs a proportional analog voltage that is referenced to $V_{CC}$.

## 7.2 Functional Block Diagram




## 7.3 Feature Description

### 7.3.1 Magnetic Flux Direction

As shown in 図 16, the DRV5056 is sensitive to the magnetic field component that is perpendicular to the die inside the package.

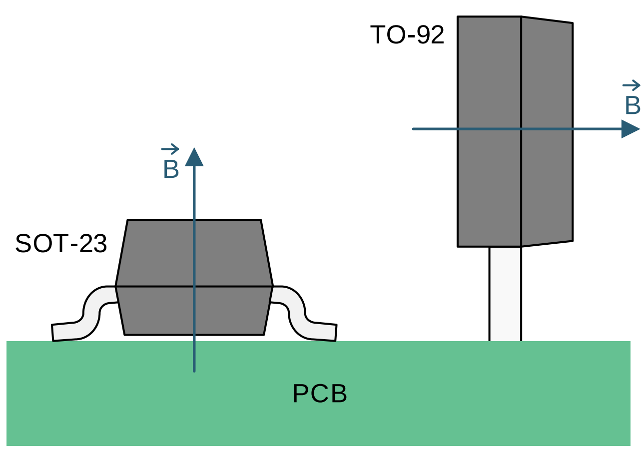



**図 16. Direction of Sensitivity**

## Feature Description (continued)

Magnetic flux that travels from the bottom to the top of the package is considered positive. This condition exists when a south magnetic pole is near the top (marked-side) of the package. Magnetic flux that travels from the top to the bottom of the package results in negative millitesla values.

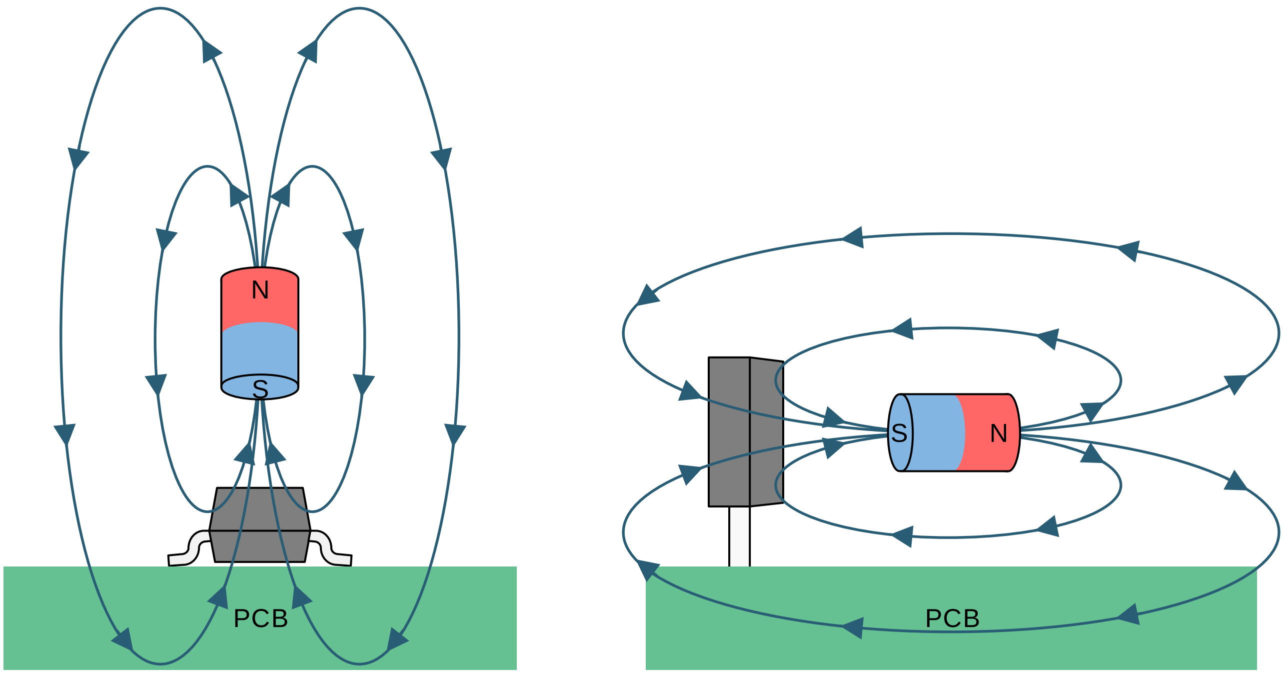



**図 17. The Flux Direction for Positive B**

### 7.3.2 Magnetic Response

The DRV5056 outputs an analog voltage according to 式 1 when in the presence of a magnetic field:

$$V_{OUT} = V_Q + B \times \left(Sensitivity_{(25°C)} \times (1 + S_{TC} \times (T_A - 25°C))\right)$$

where
- $V_Q$ is typically 600 mV
- B is the applied magnetic flux density
- $Sensitivity_{(25°C)}$ depends on the device option and $V_{CC}$
- $S_{TC}$ is typically 0.12%/°C
- $T_A$ is the ambient temperature
- $V_{OUT}$ is within the $V_L$ range (1)

As an example, consider the DRV5056A3 with $V_{CC}$ = 3.3 V, a temperature of 50°C, and 67 mT applied. Excluding tolerances, $V_{OUT}$ = 600 mV + 67 mT × (30 mV/mT × [1 + 0.0012/°C × (50°C – 25°C)]) = 2.67 V.

The DRV5056 only responds to the flux density of a magnetic south pole.

## Feature Description (continued)

### 7.3.3 Sensitivity Linearity

The device produces a linear response when the output voltage is within the specified $V_L$ range. Outside this range, sensitivity is reduced and nonlinear. 図 18 graphs the magnetic response.

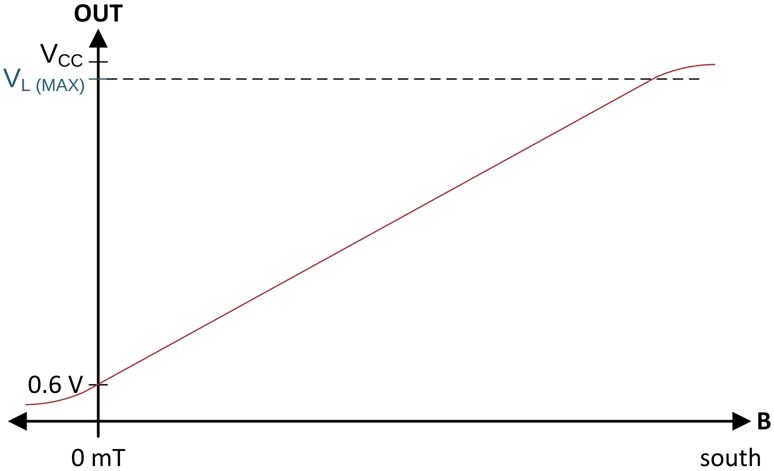



**図 18. Magnetic Response**

式 2 calculates parameter $B_L$, the minimum linear sensing range at 25°C taking into account the maximum quiescent voltage and sensitivity tolerances.

$$B_{L(MIN)} = \frac{V_{L(MAX)} - V_{Q(MAX)}}{S_{(MAX)}} \quad (2)$$

The parameter $S_{LE}$ defines linearity error as the difference in sensitivity between any two positive B values when the output is within the $V_L$ range.

### 7.3.4 Ratiometric Architecture

The DRV5056 has a ratiometric analog architecture that scales the sensitivity linearly with the power-supply voltage. For example, the sensitivity is 5% higher when $V_{CC}$ = 5.25 V compared to $V_{CC}$ = 5 V. This behavior enables external ADCs to digitize a more consistent value regardless of the power-supply voltage tolerance, when the ADC uses $V_{CC}$ as its reference.

式 3 calculates sensitivity ratiometry error:

$$S_{RE} = 1 - \frac{S_{(VCC)} / S_{(5V)}}{V_{CC} / 5V} \text{ for } V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}, \qquad S_{RE} = 1 - \frac{S_{(VCC)} / S_{(3.3V)}}{V_{CC} / 3.3V} \text{ for } V_{CC} = 3 \text{ V to } 3.6 \text{ V}$$

where

- $S_{(VCC)}$ is the sensitivity at the current $V_{CC}$ voltage
- $S_{(5V)}$ or $S_{(3.3V)}$ is the sensitivity when $V_{CC}$ = 5 V or 3.3 V
- $V_{CC}$ is the current $V_{CC}$ voltage (3)

## Feature Description (continued)

### 7.3.5 Operating $V_{CC}$ Ranges

The DRV5056 has two recommended operating $V_{CC}$ ranges: 3 V to 3.6 V and 4.5 V to 5.5 V. When $V_{CC}$ is in the middle region between 3.6 V to 4.5 V, the device continues to function, but sensitivity is less known because there is a crossover threshold near 4 V that adjusts device characteristics.

### 7.3.6 Sensitivity Temperature Compensation For Magnets

Magnets generally produce weaker fields as temperature increases. The DRV5056 compensates by increasing sensitivity with temperature, as defined by the parameter $S_{TC}$. The sensitivity at $T_A$ = 125°C is typically 12% higher than at $T_A$ = 25°C.

### 7.3.7 Power-On Time

After the $V_{CC}$ voltage is applied, the DRV5056 requires a short initialization time before the output is set. The parameter $t_{ON}$ describes the time from when $V_{CC}$ crosses 3 V until OUT is within 5% of $V_Q$, with 0 mT applied and no load attached to OUT. 図 19 shows this timing diagram.

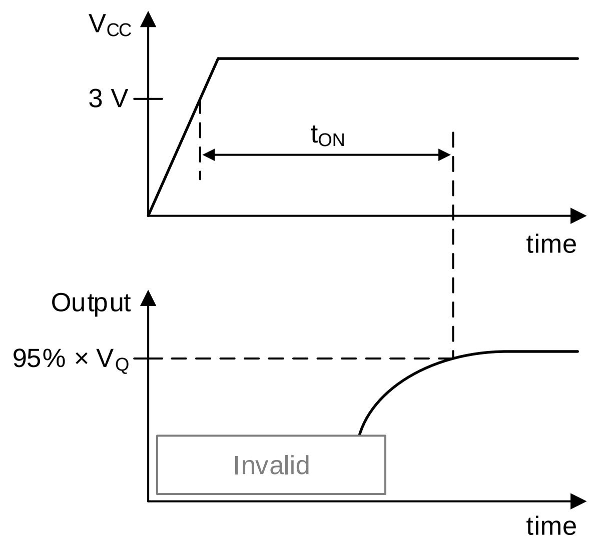



**図 19. $t_{ON}$ Definition**

## Feature Description (continued)

### 7.3.8 Hall Element Location

図 20 shows the location of the sensing element inside each package option.

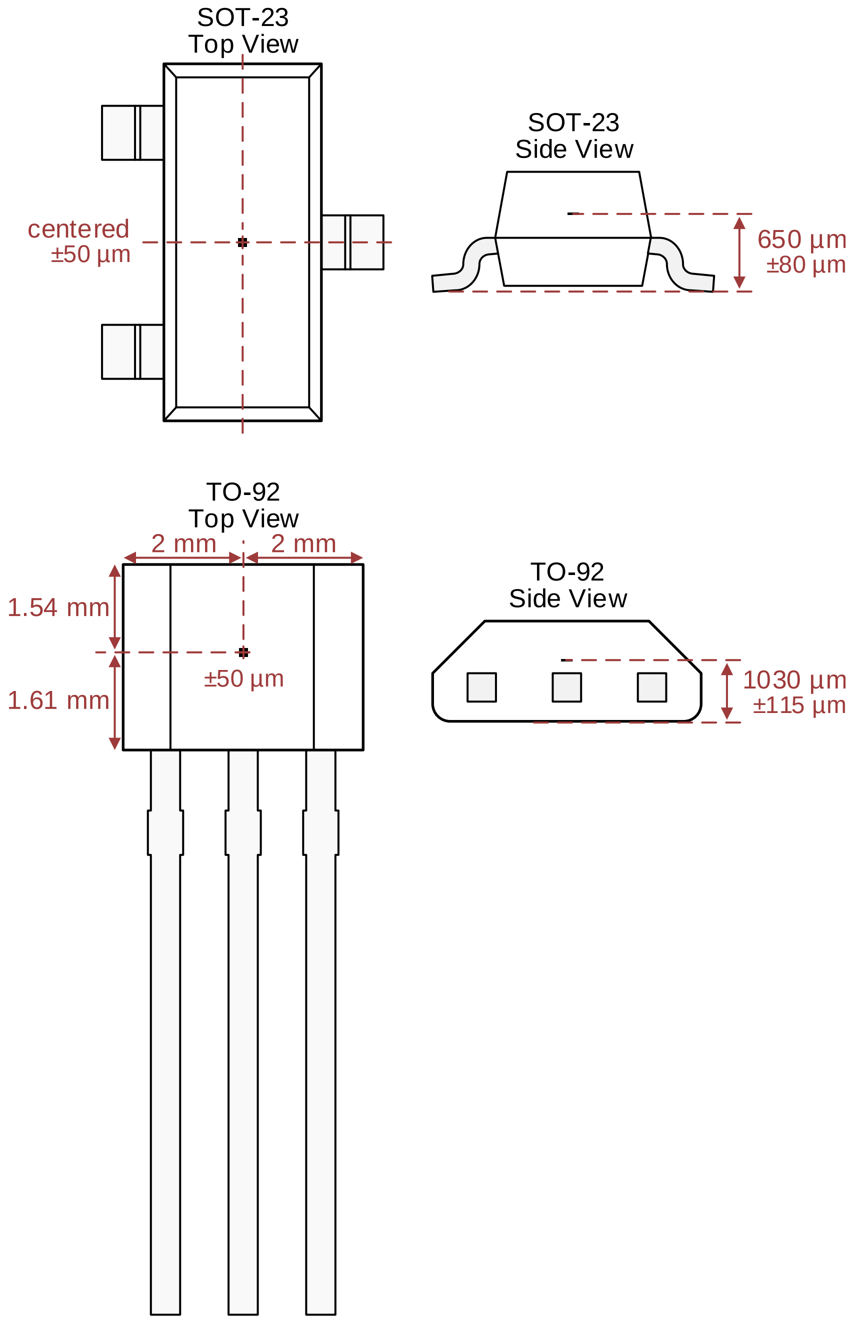



**図 20. Hall Element Location**

## 7.4 Device Functional Modes

The DRV5056 has one mode of operation that applies when the *Recommended Operating Conditions* are met.

# 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

### 8.1.1 Selecting the Sensitivity Option

Select the highest DRV5056 sensitivity option that can measure the required range of magnetic flux density, so that the output voltage swing is maximized.

Larger magnets and greater sensing distances can generally enable better positional accuracy than very small magnets at close distances, because magnetic flux density increases exponentially with the proximity to a magnet.

### 8.1.2 Temperature Compensation for Magnets

The DRV5056 temperature compensation is designed to directly compensate the average drift of neodymium (NdFeB) magnets and partially compensate ferrite magnets. The residual flux density ($B_r$) of a magnet typically reduces by 0.12%/°C for NdFeB, and 0.20%/°C for ferrite. When the operating temperature range of a system is reduced, temperature drift errors are also reduced.

### 8.1.3 Adding a Low-Pass Filter

As illustrated in the *Functional Block Diagram*, an RC low-pass filter can be added to the device output for the purpose of minimizing voltage noise when the full 20-kHz bandwidth is not needed. This filter can improve the signal-to-noise ratio (SNR) and overall accuracy. Do not connect a capacitor directly to the device output without a resistor in between because doing so can make the output unstable.

### 8.1.4 Designing for Wire Break Detection

Some systems must detect if interconnect wires become open or shorted. The DRV5056 can support this function.

First, select a sensitivity option that causes the output voltage to stay within the $V_L$ range during normal operation. Second, add a pullup resistor between OUT and $V_{CC}$. TI recommends a value between 20 kΩ to 100 kΩ, and the current through OUT must not exceed the $I_O$ specification, including current going into an external ADC. Then, if the output voltage is ever measured to be within 150 mV of $V_{CC}$ or GND, a fault condition exists. 図 21 shows the circuit, and 表 1 describes fault scenarios.

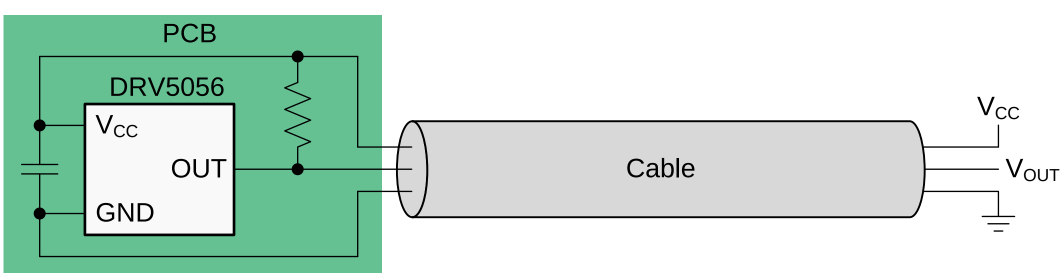



**図 21. Wire Fault Detection Circuit**

表 1. Fault Scenarios and the Resulting $V_{OUT}$

| FAULT SCENARIO | $V_{OUT}$ |
|---|---|
| $V_{CC}$ disconnects | Close to GND |
| GND disconnects | Close to $V_{CC}$ |
| $V_{CC}$ shorts to OUT | Close to $V_{CC}$ |
| GND shorts to OUT | Close to GND |

## 8.2 Typical Application

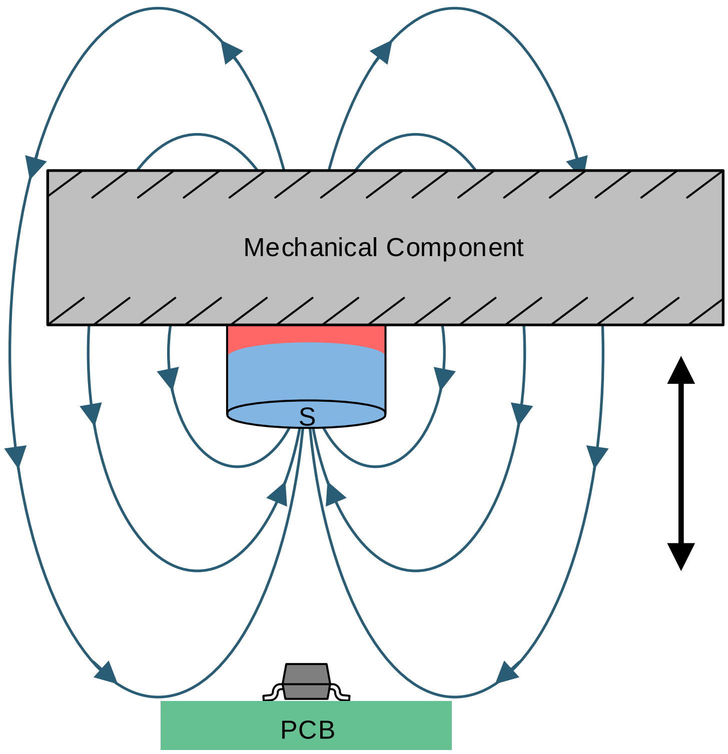



図 22. Unipolar Sensing Application

### 8.2.1 Design Requirements

Use the parameters listed in 表 2 for this design example.

表 2. Design Parameters

| DESIGN PARAMETER | EXAMPLE VALUE |
|---|---|
| $V_{CC}$ | 3.3 V |
| Magnet | 10-mm diameter × 6-mm long cylinder, ferrite |
| Distance from magnet to sensor | From 20 mm to 3 mm |
| Maximum B at the sensor at 25°C | 72 mT at 3 mm |
| Device option | DRV5056A3-Q1 |

### 8.2.2 Detailed Design Procedure

This design example consists of a mechanical component that moves back and forth, an embedded magnet with the south pole facing the printed-circuit board, and a DRV5056. The DRV5056 outputs an analog voltage that describes the precise position of the component. The component must not contain ferromagnetic materials such as iron, nickel, and cobalt because these materials change the magnetic flux density at the sensor.

When designing a linear magnetic sensing system, always consider these three variables: the magnet, sensing distance, and range of the sensor. Select the DRV5056 with the highest sensitivity that has a $B_L$ (linear magnetic sensing range) that is larger than the maximum magnetic flux density in the application.

Magnets are made from various ferromagnetic materials that have tradeoffs in cost, drift with temperature, absolute maximum temperature ratings, remanence or residual induction ($B_r$), and coercivity ($H_c$). The $B_r$ and the dimensions of a magnet determine the magnetic flux density (B) produced in 3-dimensional space. For simple magnet shapes, such as rectangular blocks and cylinders, there are simple equations that solve B at a given distance centered with the magnet. 図 23 shows diagrams for 式 4 and 式 5.

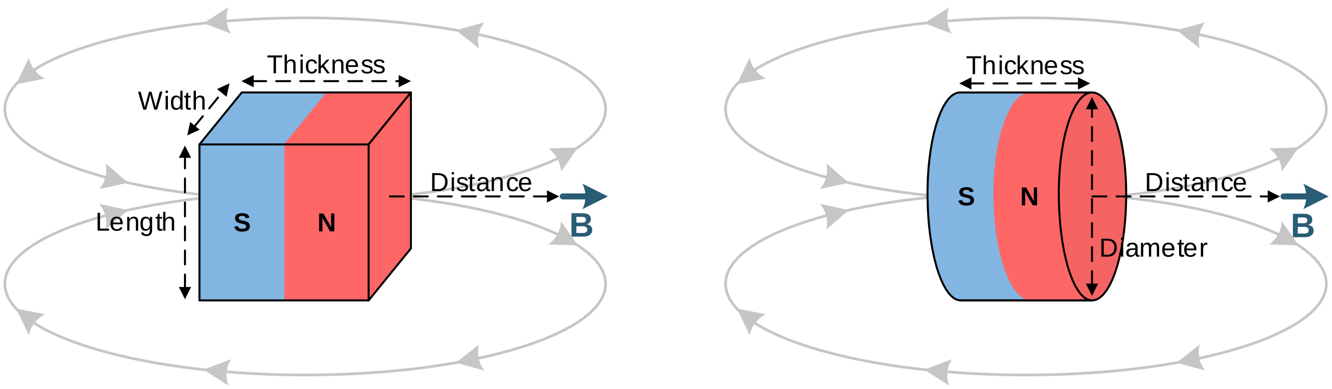



**図 23. Rectangular Block and Cylinder Magnets**

Use 式 4 for the rectangular block shown in 図 23:

$$\vec{B} = \frac{B_r}{\pi}\left(\arctan\left(\frac{WL}{2D\sqrt{4D^2 + W^2 + L^2}}\right) - \arctan\left(\frac{WL}{2(D + T)\sqrt{4(D + T)^2 + W^2 + L^2}}\right)\right) \tag{4}$$

Use 式 5 for the cylinder shown in 図 23:

$$\vec{B} = \frac{B_r}{2}\left(\frac{D + T}{\sqrt{(0.5C)^2 + (D + T)^2}} - \frac{D}{\sqrt{(0.5C)^2 + D^2}}\right)$$

where

- W is width
- L is length
- T is thickness (the direction of magnetization)
- D is distance
- C is diameter (5)

### 8.2.3 Application Curve

図 24 shows the magnetic flux density versus distance for a 10-mm × 6-mm cylinder ferrite magnet.

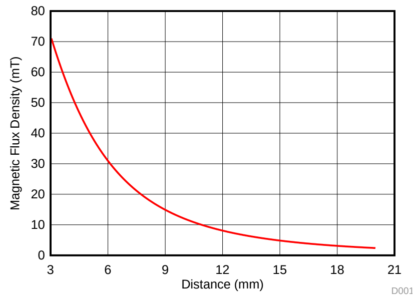



**図 24. Magnetic Profile of a 10-mm × 6-mm Cylindrical Ferrite Magnet**

## 8.3 What to Do and What Not to Do

Because the Hall element is sensitive to magnetic fields that are perpendicular to the top of the package, a correct magnet approach must be used for the sensor to detect the field. 図 25 illustrates correct and incorrect approaches.

## What to Do and What Not to Do (continued)

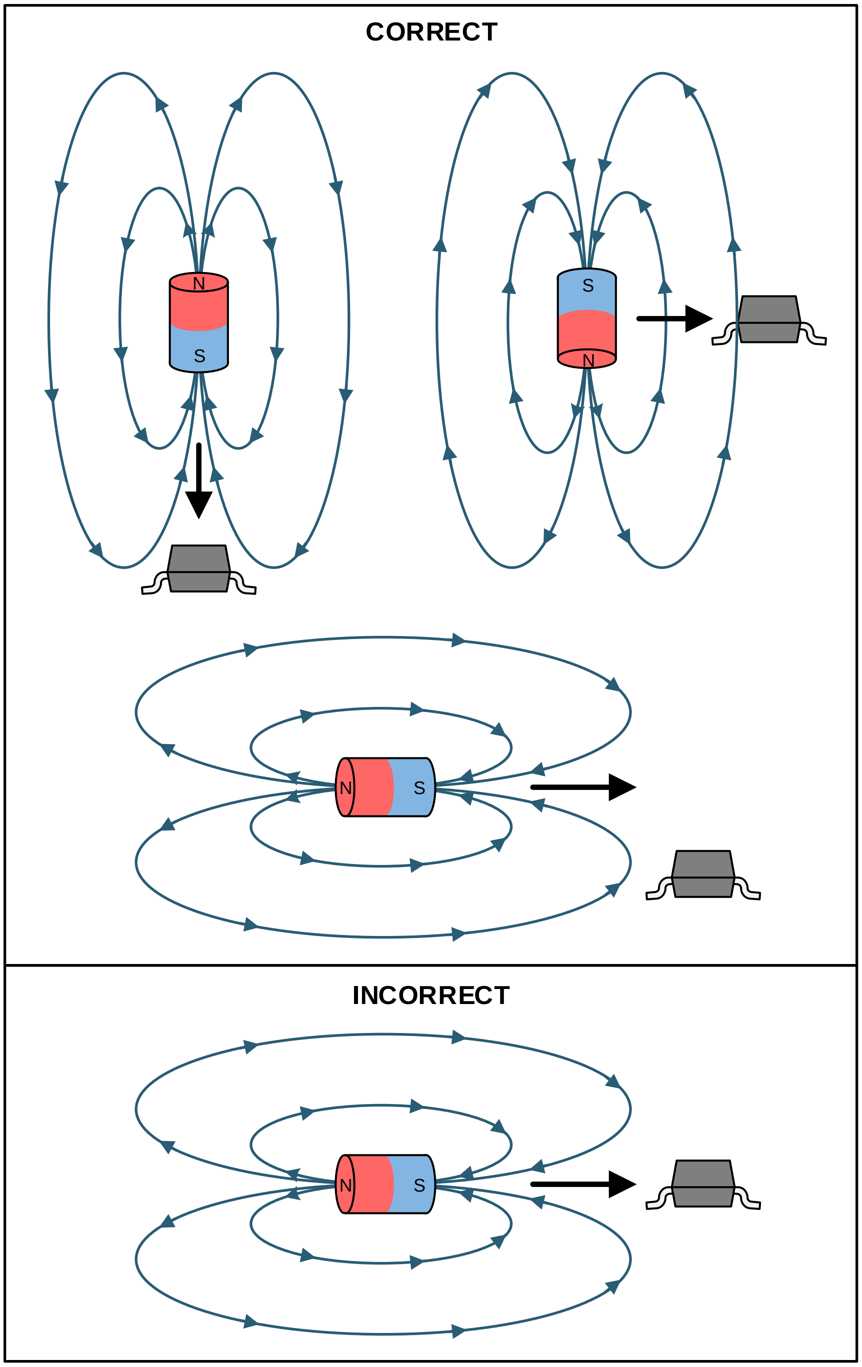



図 25. Correct and Incorrect Magnet Approaches

# 9 Power Supply Recommendations

A decoupling capacitor close to the device must be used to provide local energy with minimal inductance. TI recommends using a ceramic capacitor with a value of at least 0.01 µF.

# 10 Layout

## 10.1 Layout Guidelines

Magnetic fields pass through most nonferromagnetic materials with no significant disturbance. Embedding Hall effect sensors within plastic or aluminum enclosures and sensing magnets on the outside is common practice. Magnetic fields also easily pass through most printed-circuit boards, which makes placing the magnet on the opposite side possible.

## 10.2 Layout Examples

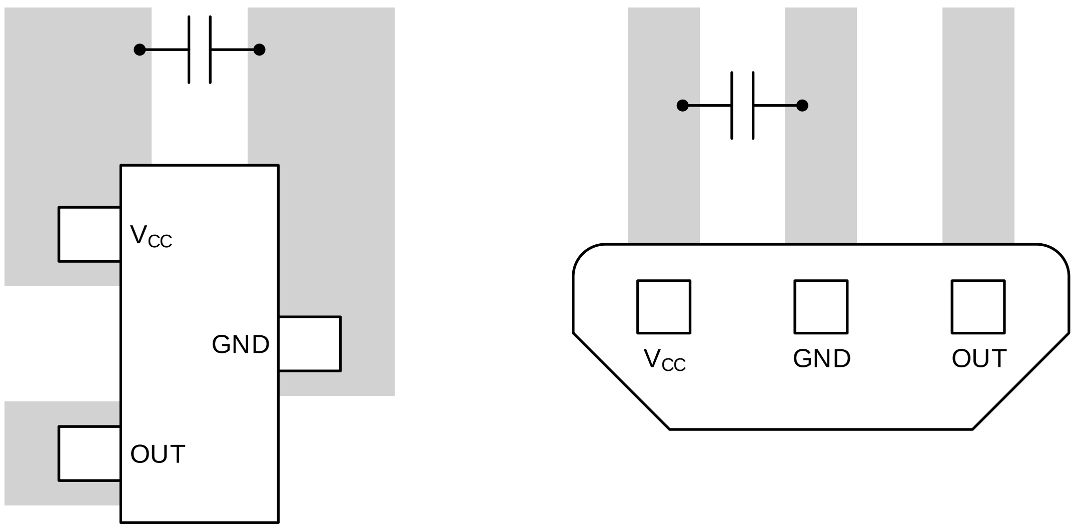



**図 26. Layout Examples**

# 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、*『増分式ロータリー・エンコーダ設計の考慮事項』アプリケーション・ノート*
- テキサス・インスツルメンツ、*『リニア・ホール効果センサによる角度の測定』アプリケーション・ノート*
- テキサス・インスツルメンツ、*『リニア・ホール効果センサによる角度の測定』*

## 11.2 ドキュメントの更新通知を受け取る方法

ドキュメントの更新についての通知を受け取るには、ti.comのデバイス製品フォルダを開いてください。右上の「アラートを受け取る」をクリックして登録すると、変更されたすべての製品情報に関するダイジェストを毎週受け取れます。変更の詳細については、修正されたドキュメントに含まれている改訂履歴をご覧ください。

## 11.3 コミュニティ・リソース

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

**TI E2E™ Online Community** ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At 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 商標

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## 11.5 静電気放電に関する注意事項

すべての集積回路は、適切なESD保護方法を用いて、取扱いと保存を行うようにして下さい。

静電気放電はわずかな性能の低下から完全なデバイスの故障に至るまで、様々な損傷を与えます。高精度の集積回路は、損傷に対して敏感であり、極めてわずかなパラメータの変化により、デバイスに規定された仕様に適合しなくなる場合があります。

## 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DRV5056A1QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | SN | Level-2-260C-1 YEAR | -40 to 125 | 56A1 | Samples |
| DRV5056A1QDBZT | OBSOLETE | SOT-23 | DBZ | 3 | | TBD | Call TI | Call TI | -40 to 125 | 56A1 | |
| DRV5056A1QLPG | ACTIVE | TO-92 | LPG | 3 | 1000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 125 | 56A1 | Samples |
| DRV5056A1QLPGM | ACTIVE | TO-92 | LPG | 3 | 3000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 125 | 56A1 | Samples |
| DRV5056A2QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | SN | Level-2-260C-1 YEAR | -40 to 125 | 56A2 | Samples |
| DRV5056A2QDBZT | OBSOLETE | SOT-23 | DBZ | 3 | | TBD | Call TI | Call TI | -40 to 125 | 56A2 | |
| DRV5056A2QLPG | ACTIVE | TO-92 | LPG | 3 | 1000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 125 | 56A2 | Samples |
| DRV5056A2QLPGM | ACTIVE | TO-92 | LPG | 3 | 3000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 125 | 56A2 | Samples |
| DRV5056A3QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | SN | Level-2-260C-1 YEAR | -40 to 125 | 56A3 | Samples |
| DRV5056A3QDBZT | OBSOLETE | SOT-23 | DBZ | 3 | | TBD | Call TI | Call TI | -40 to 125 | 56A3 | |
| DRV5056A3QLPG | ACTIVE | TO-92 | LPG | 3 | 1000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 125 | 56A3 | Samples |
| DRV5056A3QLPGM | ACTIVE | TO-92 | LPG | 3 | 3000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 125 | 56A3 | Samples |
| DRV5056A4QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | SN | Level-2-260C-1 YEAR | -40 to 125 | 56A4 | Samples |
| DRV5056A4QDBZT | OBSOLETE | SOT-23 | DBZ | 3 | | TBD | Call TI | Call TI | -40 to 125 | 56A4 | |
| DRV5056A4QLPG | ACTIVE | TO-92 | LPG | 3 | 1000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 125 | 56A4 | Samples |
| DRV5056A4QLPGM | ACTIVE | TO-92 | LPG | 3 | 3000 | RoHS & Green | SN | N / A for Pkg Type | -40 to 125 | 56A4 | Samples |
| DRV5056A6QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | SN | Level-2-260C-1 YEAR | -40 to 125 | 56A6 | Samples |
| DRV5056A6QDBZT | OBSOLETE | SOT-23 | DBZ | 3 | | TBD | Call TI | Call TI | -40 to 125 | 56A6 | |
| DRV5056Z1QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | SN | Level-2-260C-1 YEAR | -40 to 125 | 56Z1 | Samples |
| DRV5056Z1QDBZT | OBSOLETE | SOT-23 | DBZ | 3 | | TBD | Call TI | Call TI | -40 to 125 | 56Z1 | |
| DRV5056Z2QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | SN | Level-2-260C-1 YEAR | -40 to 125 | 56Z2 | Samples |
| DRV5056Z2QDBZT | OBSOLETE | SOT-23 | DBZ | 3 | | TBD | Call TI | Call TI | -40 to 125 | 56Z2 | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DRV5056Z3QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | SN | Level-2-260C-1 YEAR | -40 to 125 | 56Z3 | Samples |
| DRV5056Z3QDBZT | OBSOLETE | SOT-23 | DBZ | 3 | | TBD | Call TI | Call TI | -40 to 125 | 56Z3 | |
| DRV5056Z4QDBZR | ACTIVE | SOT-23 | DBZ | 3 | 3000 | RoHS & Green | SN | Level-2-260C-1 YEAR | -40 to 125 | 56Z4 | Samples |
| DRV5056Z4QDBZT | OBSOLETE | SOT-23 | DBZ | 3 | | TBD | Call TI | Call TI | -40 to 125 | 56Z4 | |

(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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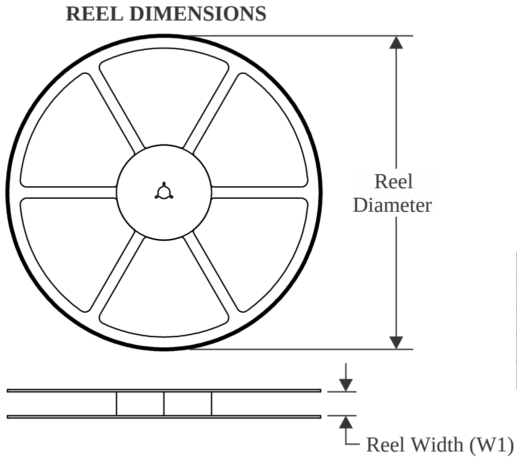
**OTHER QUALIFIED VERSIONS OF DRV5056 :**

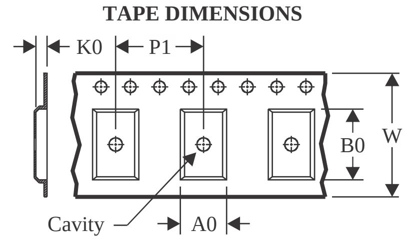
- Automotive : DRV5056-Q1

NOTE: Qualified Version Definitions:

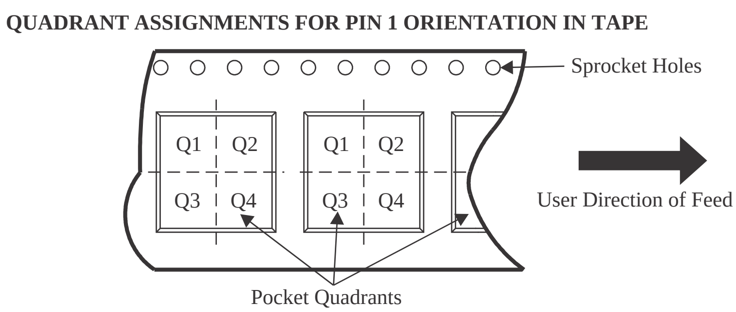
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

## TAPE AND REEL INFORMATION



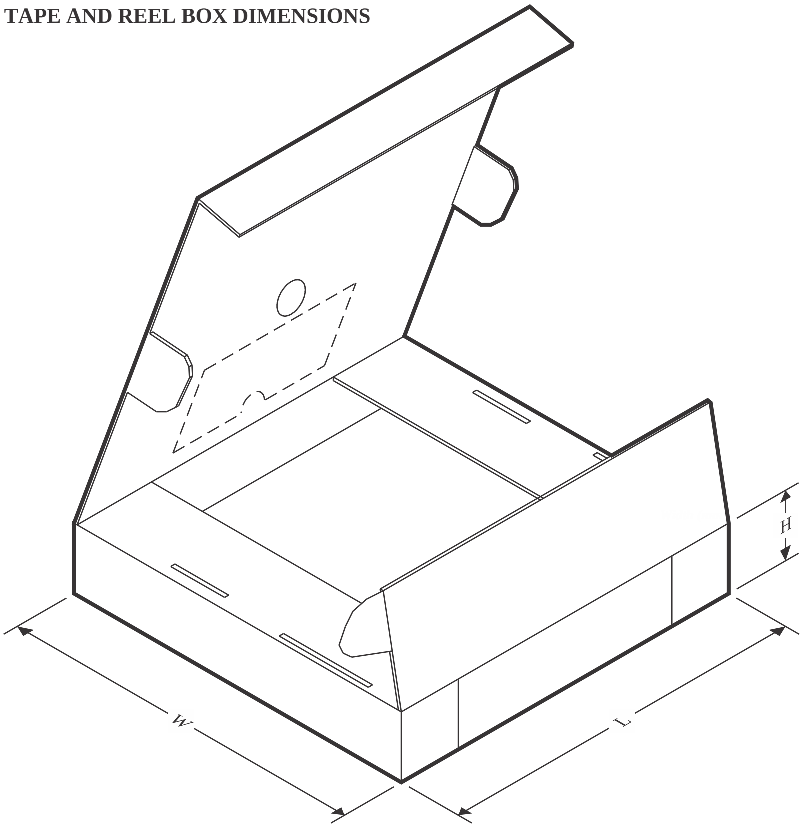

| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |




*All dimensions are nominal

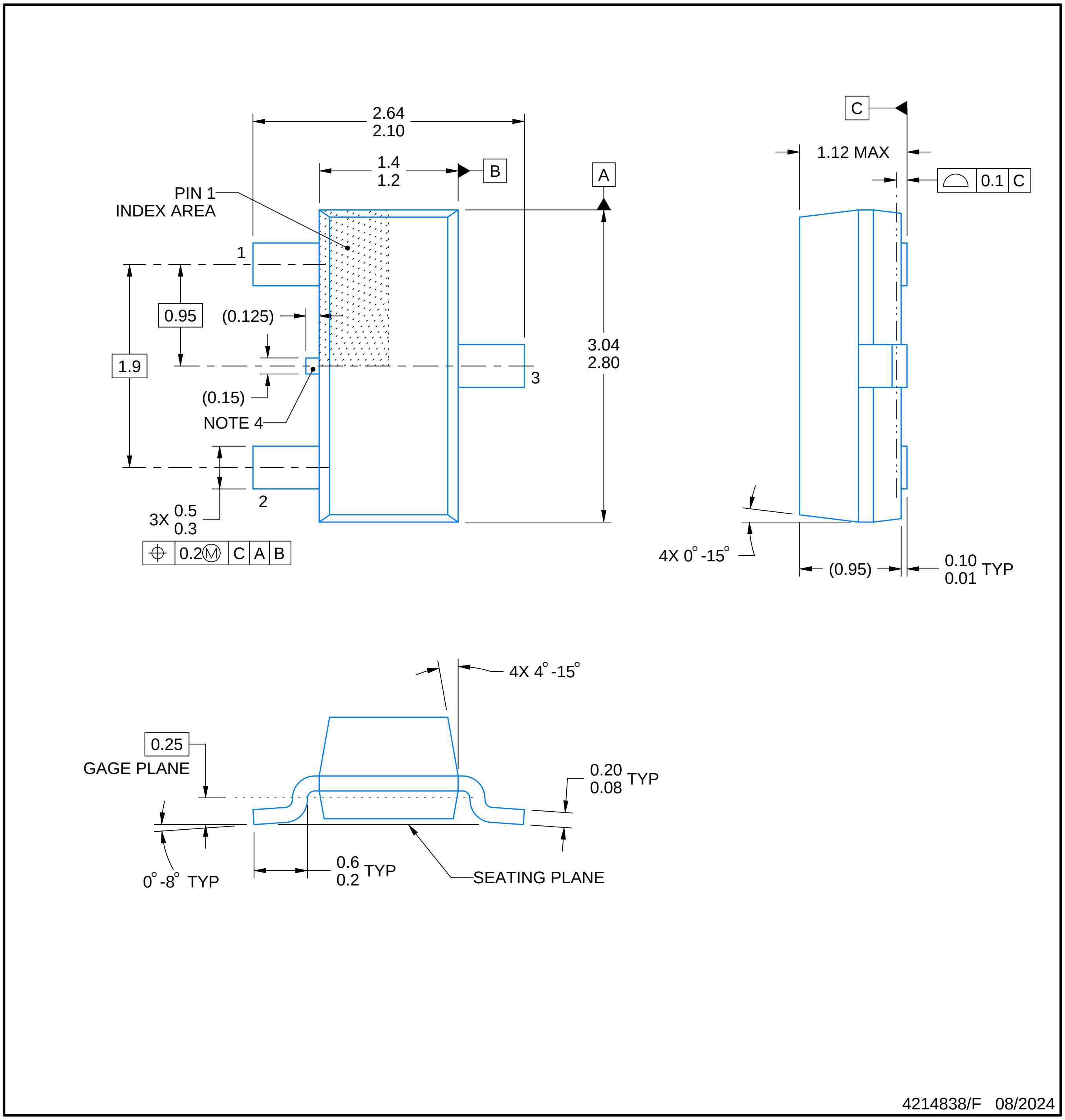
| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRV5056A1QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056A2QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056A2QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056A3QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056A3QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056A4QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056A4QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056A6QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056Z1QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056Z1QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056Z2QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056Z3QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056Z4QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |
| DRV5056Z4QDBZR | SOT-23 | DBZ | 3 | 3000 | 180.0 | 8.4 | 3.2 | 2.85 | 1.3 | 4.0 | 8.0 | Q3 |

**TAPE AND REEL BOX DIMENSIONS**



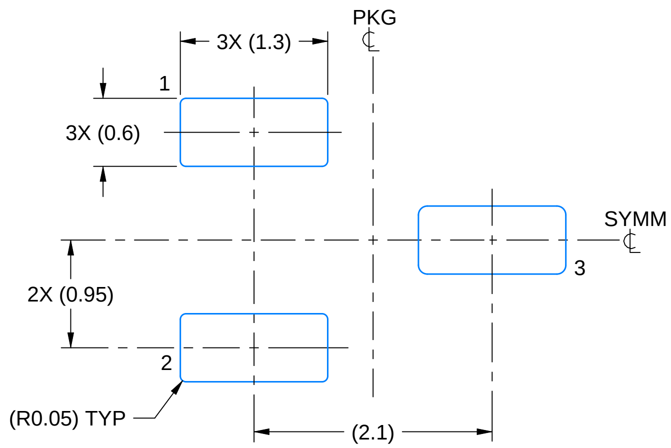

*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| DRV5056A1QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056A2QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056A2QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056A3QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056A3QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056A4QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056A4QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056A6QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056Z1QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056Z1QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056Z2QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056Z3QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056Z4QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV5056Z4QDBZR | SOT-23 | DBZ | 3 | 3000 | 210.0 | 185.0 | 35.0 |

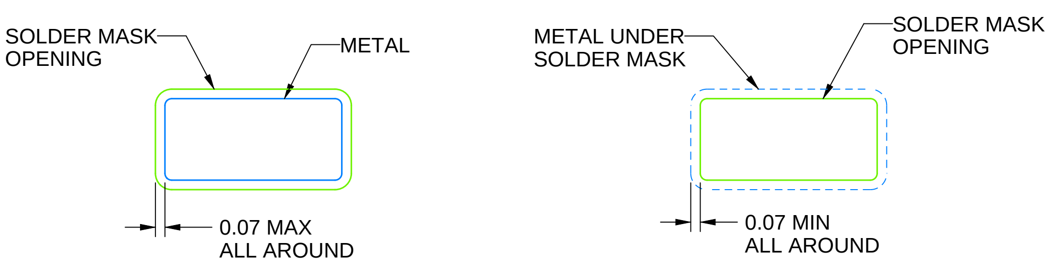



NOTES:

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.
4. Support pin may differ or may not be present.
5. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side




LAND PATTERN EXAMPLE
SCALE:15X




NON SOLDER MASK
DEFINED
(PREFERRED)

SOLDER MASK
DEFINED

SOLDER MASK DETAILS

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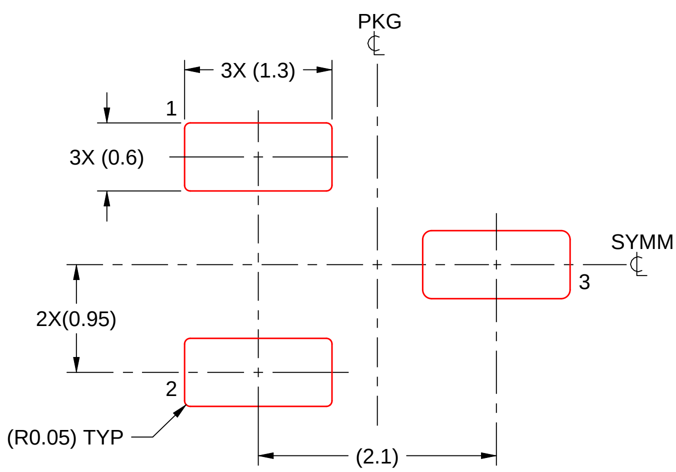
NOTES: (continued)

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




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

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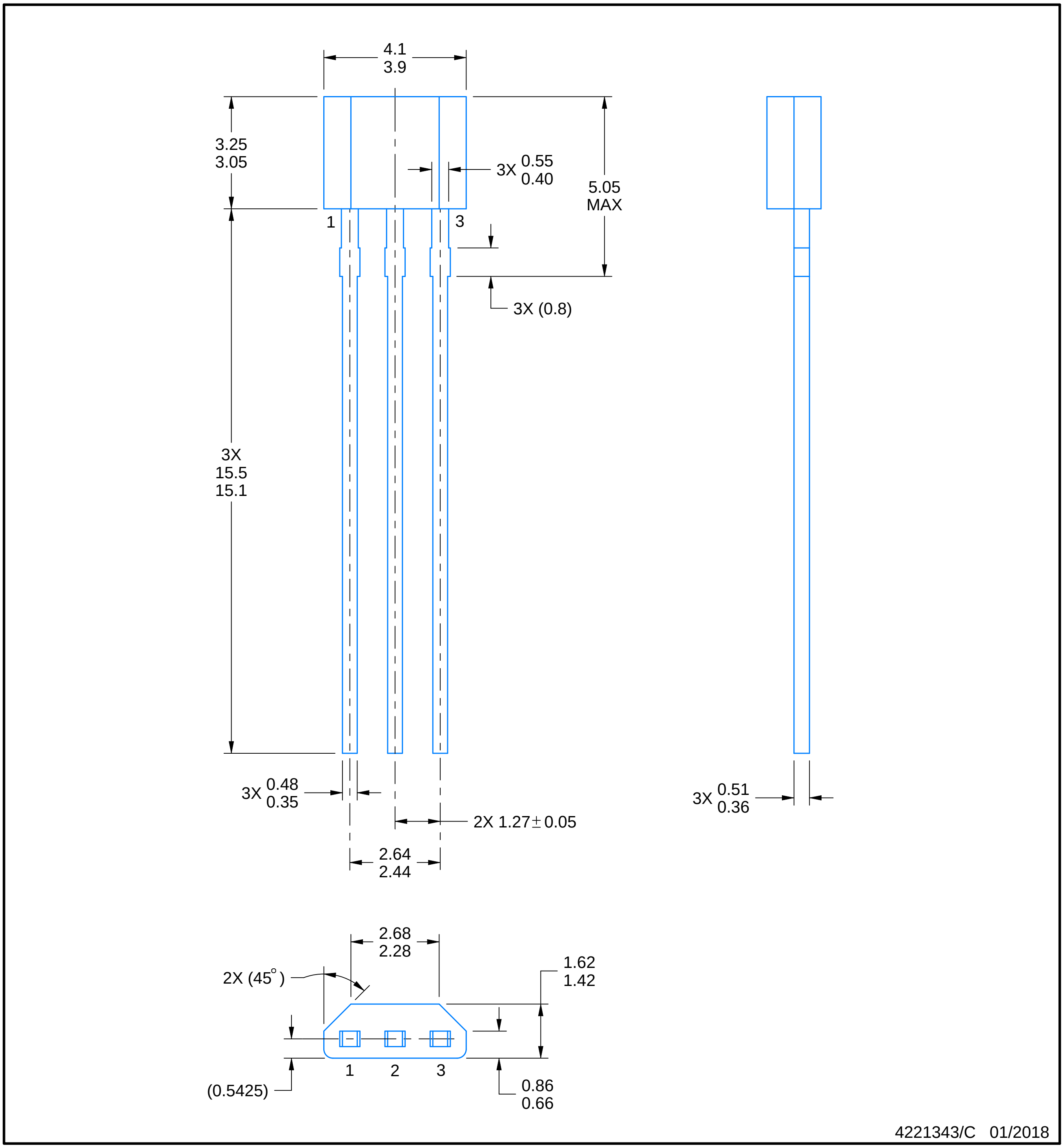
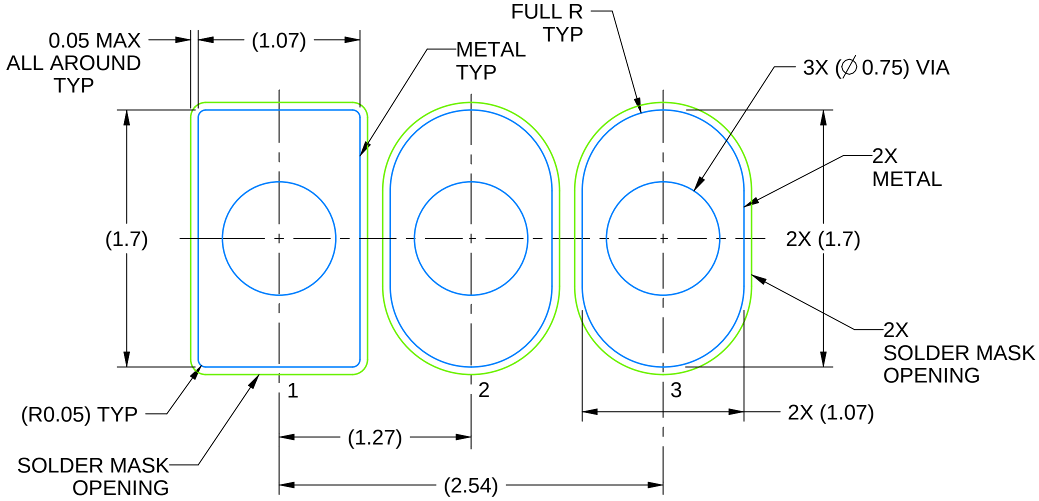
NOTES: (continued)

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.




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.




LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE:20X

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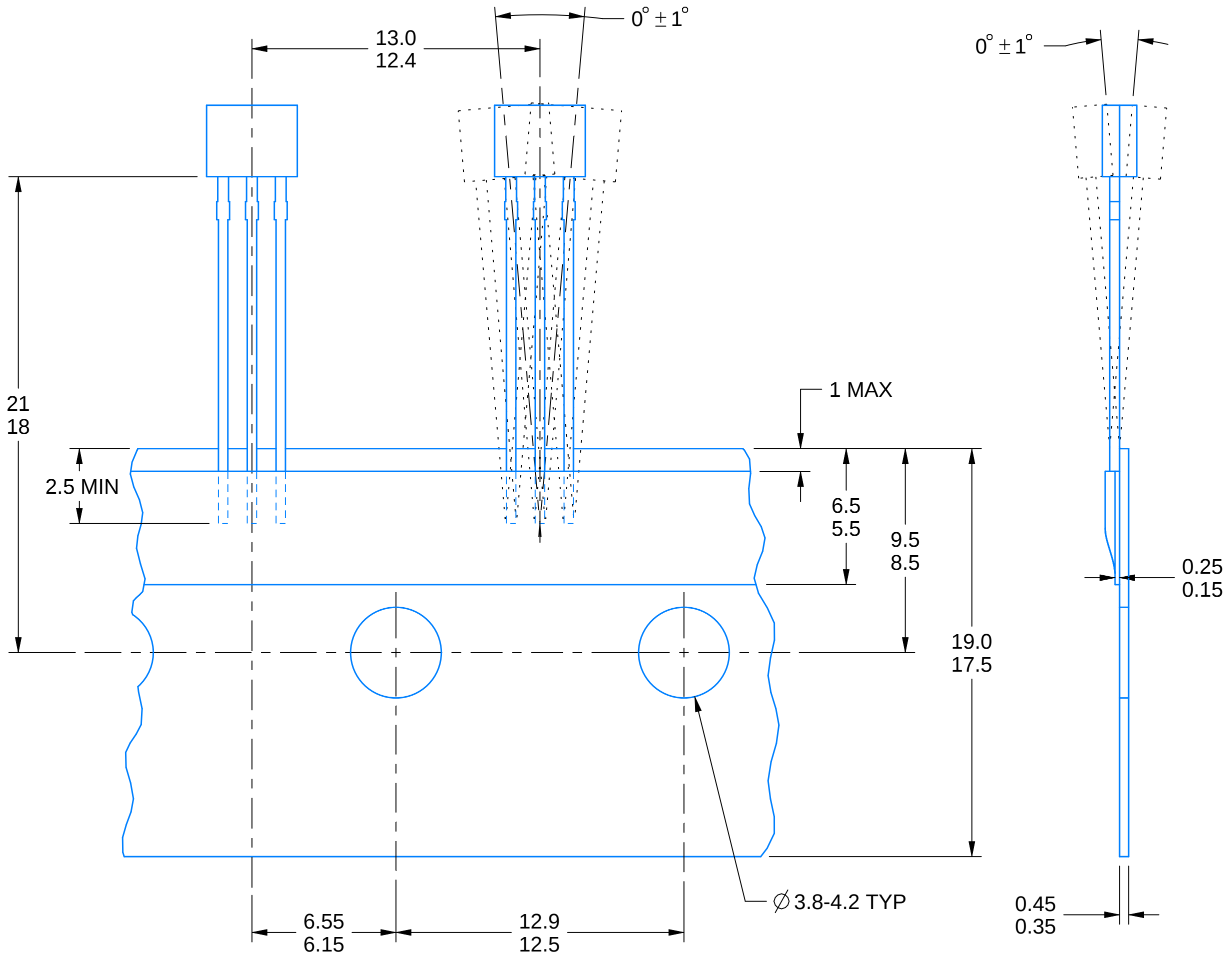
# LPG0003A

## TO-92 - 5.05 mm max height

TRANSISTOR OUTLINE

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# 重要なお知らせと免責事項



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