

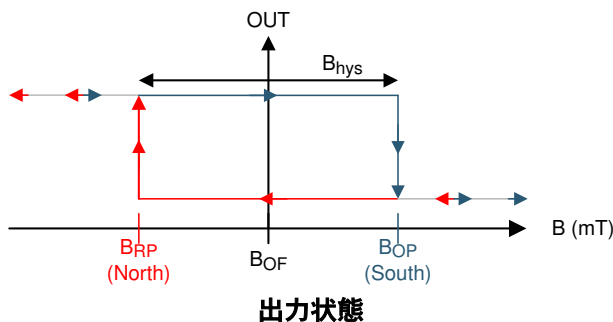
# TMAG5115 高速、低ジッタ、ホール効果ラッチ

## 1 特長

- 高速デジタル双極性ラッチ ホール センサ
  - 小さい伝搬遅延:  $5\mu\text{s}$
  - 低ジッタ:  $5\mu\text{s}$
  - 帯域幅 (BW):  $60\text{kHz}$
- 広い電圧範囲をサポート:
  - $2.5\text{V} \sim 26\text{V}$
  - 外部レギュレータ不要
- 短いパワーオン時間:  $62.5\mu\text{s}$
- 高精度スレッショルド:
  - $\pm 3\text{mT}$  (ばらつき  $\pm 1\text{mT}$  以下)
  - $\pm 1\text{mT}$  (ばらつき  $\pm 0.7\text{mT}$  以下)
- 保護機能:
  - 出力短絡保護
  - 出力電流制限
  - 過熱保護
- オープンドレイン出力 ( $15\text{mA}$  シンク)
- 広い動作温度範囲:
  - $-40^\circ\text{C} \sim 125^\circ\text{C}$
- 小さなパッケージと占有面積:
  - 表面実装の 3 ピン SOT-23
    - $2.92\text{mm} \times 2.37\text{mm}$

## 2 アプリケーション

- コードレス電動工具
- ロボット掃除機
- コンピュータ ファン
- バルブとソレノイドの状態
- 産業用ブラシレス DC モーター



## 3 概要

TMAG5115 デバイスは、高速伝搬遅延と低ジッタを実現する高性能ホール効果ラッチ センサです。このデバイスは温度範囲全体にわたって高い感度安定性を持ち、高い RPM を必要とするアプリケーション向けに設計された統合型保護機能も備えています。低ジッタと低伝搬遅延の組み合わせは、電力効率の向上やシステム レベルの寄生ノイズの低減に役立ちます。

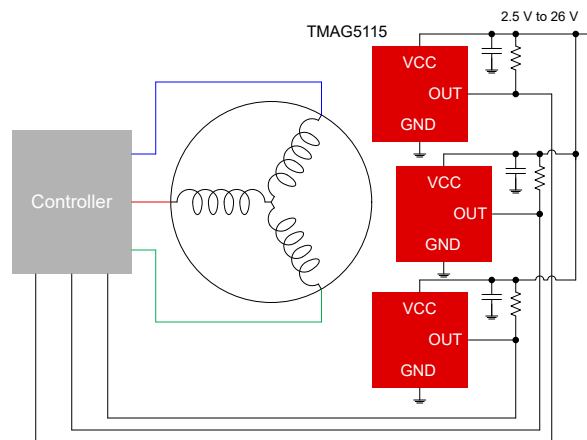
$15\text{mA}$  の電流シンク能力を持つオープンドレイン出力段を備えています。TMAG5115 は  $2.5\text{V} \sim 26\text{V}$  の広い動作電圧範囲に対応し、産業用および商業用の幅広いアプリケーション向けに設計されています。出力短絡、過電流、過熱状態に対する内部保護機能が搭載されています。

TMAG5115 は業界標準の SOT-23 パッケージで供給されます。

### パッケージ情報 (1)

| 部品番号     | パッケージ           | パッケージ サイズ(2)                         |
|----------|-----------------|--------------------------------------|
| TMAG5115 | DBZ (SOT-23, 3) | $2.92\text{mm} \times 2.37\text{mm}$ |

- 供給されているすべてのパッケージについては、[セクション 11](#) を参照してください。
- パッケージ サイズ (長さ × 幅) は公称値であり、該当する場合はピンも含まれます。



アプリケーション概略図



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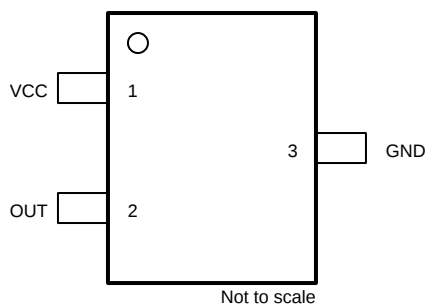
## 4 Device Comparison

**表 4-1. Device Comparison**

| VERSION     | TYPICAL THRESHOLD | TYPICAL HYSTERESIS | MAGNETIC RESPONSE | OUTPUT TYPE | SENSOR ORIENTATION | BANDWIDTH | PACKAGES AVAILABLE |
|-------------|-------------------|--------------------|-------------------|-------------|--------------------|-----------|--------------------|
| TMAG5115A1C | 1 mT              | 2 mT               | Active Low        | Open-drain  | Z                  | 60 kHz    | SOT-23             |
| TMAG5115B1C | 3 mT              | 6 mT               | Active Low        | Open-drain  | Z                  | 60 kHz    | SOT-23             |

## 5 Pin Configuration and Functions

For additional configuration information, see the [Mechanical, Packaging, and Orderable Information](#) section.



**図 5-1. DBZ Package 3-Pin SOT-23 Top View**

**表 5-1. Pin Functions**

| PIN             |     | TYPE | DESCRIPTION                                                                  |
|-----------------|-----|------|------------------------------------------------------------------------------|
| NAME            | NO. |      |                                                                              |
| GND             | 3   | GND  | Ground pin                                                                   |
| OUT             | 2   | O    | Hall sensor open-drain output. Requires a resistor pullup, typically 10 kΩ.  |
| V <sub>CC</sub> | 1   | P    | Supply pin. 2.5 V to 26 V. TI recommends to use a minimum 0.01-μF capacitor. |

## 6 Specifications

### 6.1 Absolute Maximum Ratings

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

|                                         |                      | MIN       | MAX       | UNIT |
|-----------------------------------------|----------------------|-----------|-----------|------|
| V <sub>CC</sub>                         | Power supply voltage | –0.3      | 30        | V    |
| I <sub>SINK</sub>                       | Output sink current  |           | 30        | mA   |
| Magnetic flux density, B <sub>MAX</sub> |                      | Unlimited | Unlimited | T    |
| Junction temperature, T <sub>J</sub>    |                      | –65       | 150       | °C   |
| Storage temperature, T <sub>stg</sub>   |                      | –65       | 150       | °C   |

- (1) Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If used outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

### 6.2 ESD Ratings

|                    |                         |                                                                   | VALUE | UNIT |
|--------------------|-------------------------|-------------------------------------------------------------------|-------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup> | ±2000 | V    |
|                    |                         | Charged device model (CDM), ANSI/ESDA/JEDEC JS-002 <sup>(2)</sup> | ±500  |      |

- (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 <sub>CC</sub>   | Power supply voltage <sup>(1)</sup> | 2.5 | 26  | V    |
| V <sub>O</sub>    | Output pin voltage                  | 0   | 26  | V    |
| I <sub>SINK</sub> | Output pin current sink             | 0   | 15  | mA   |
| T <sub>A</sub>    | Ambient temperature                 | –40 | 125 | °C   |

- (1) Operating outside the [TMAG5115 Recommended Supply and Temperature Curve](#) can cause the device to enter a thermal shutdown state.

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | TMAG5115     | UNIT |
|-------------------------------|----------------------------------------------|--------------|------|
|                               |                                              | DBZ (SOT-23) |      |
|                               |                                              | 3 PINS       |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 208.2        | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 102.3        | °C/W |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | 40.6         | °C/W |
| Ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 9.7          | °C/W |
| Ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 40.2         | °C/W |
| R <sub>θJC(bot)</sub>         | Junction-to-case (bottom) thermal resistance | –            | °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

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

| PARAMETER                 |                                         | TEST CONDITIONS                                                                          | MIN | TYP  | MAX | UNIT             |
|---------------------------|-----------------------------------------|------------------------------------------------------------------------------------------|-----|------|-----|------------------|
| <b>POWER SUPPLY</b>       |                                         |                                                                                          |     |      |     |                  |
| $I_{CC}$                  | Operating supply current                | $V_{CC} = 2.5\text{ V to }26\text{ V}$<br>$T_A = -40^\circ\text{C to }125^\circ\text{C}$ |     | 6    | 8   | mA               |
| $t_{ON}$                  | Power-on time                           |                                                                                          |     | 62.5 |     | $\mu\text{s}$    |
| $P_{OS}$                  | Power-on state                          | $V_{CC} > V_{CCmin}$<br>$t < t_{ON}$                                                     |     | High |     |                  |
| <b>OUTPUT</b>             |                                         |                                                                                          |     |      |     |                  |
| $V_{OL}$                  | Low-level output voltage                | $I_{OL} = 5\text{ mA}$                                                                   | 0   |      | 0.7 | V                |
| $I_{OH}$                  | Output leakage current                  | $V_{CC} = 2.5\text{ V to }26\text{ V}$                                                   |     | 0.1  | 1   | $\mu\text{A}$    |
| $I_{SC}$                  | Output short-circuit current protection |                                                                                          | 15  | 25   | 80  | mA               |
| $t_R$                     | Output rise time                        | $R_L = 10\text{ k}\Omega$<br>$C_L = 50\text{ pF}$<br>$V_{CC} = 12\text{ V}$              |     | 2    |     | $\mu\text{s}$    |
| $t_F$                     | Output fall time                        | $R_L = 10\text{ k}\Omega$<br>$C_L = 50\text{ pF}$<br>$V_{CC} = 12\text{ V}$              |     | 2    |     | $\mu\text{s}$    |
| $t_{PD}$                  | Propagation delay time                  |                                                                                          |     | 5    | 6   | $\mu\text{s}$    |
| Jitter                    | Output jitter window                    | 1-kHz triangle magnetic wave with peak value at $\pm 8\text{ mT}$                        |     | 5    |     | $\mu\text{s}$    |
| Jitter                    | Output jitter window                    | 1-kHz square magnetic wave with peak value at $\pm 8\text{ mT}$                          |     | 0.2  |     | $\mu\text{s}$    |
| Noise <sub>pp</sub>       | Internal Noise                          |                                                                                          |     | 125  | 200 | $\mu\text{T}$    |
| $T_{SHUT}$                | Junction temperature shutdown threshold |                                                                                          | 156 | 168  | 180 | $^\circ\text{C}$ |
| $T_{REC}$                 | Junction temperature recovery threshold |                                                                                          | 131 | 143  | 155 | $^\circ\text{C}$ |
| <b>FREQUENCY RESPONSE</b> |                                         |                                                                                          |     |      |     |                  |
| $f_{CHOP}$                | Chopping frequency                      | TMAG5115xx                                                                               |     | 1000 |     | kHz              |
| $f_{BW}$                  | Signal bandwidth                        | TMAG5115xx                                                                               |     | 60   |     | kHz              |

## 6.6 Magnetic Characteristics

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

| PARAMETER        |                                                       | TEST CONDITIONS                 | MIN  | TYP | MAX  | UNIT |
|------------------|-------------------------------------------------------|---------------------------------|------|-----|------|------|
| TMAG5115A        |                                                       |                                 |      |     |      |      |
| B <sub>OP</sub>  | Magnetic field operating point                        | V <sub>CC</sub> = 2.5 V to 26 V | 0.2  | 1   | 1.7  | mT   |
| B <sub>RP</sub>  | Magnetic field release point                          |                                 | −1.7 | −1  | −0.2 | mT   |
| B <sub>HYS</sub> | Magnetic hysteresis B <sub>OP</sub> - B <sub>RP</sub> |                                 | 0.4  | 2   | 3.4  | mT   |
| TMAG5115B        |                                                       |                                 |      |     |      |      |
| B <sub>OP</sub>  | Magnetic field operating point                        | V <sub>CC</sub> = 2.5 V to 26 V | 2    | 3   | 4    | mT   |
| B <sub>RP</sub>  | Magnetic field release point                          |                                 | −4   | −3  | −2   | mT   |
| B <sub>HYS</sub> | Magnetic hysteresis B <sub>OP</sub> - B <sub>RP</sub> |                                 | 4    | 6   | 8    | mT   |

## 6.7 Typical Characteristics

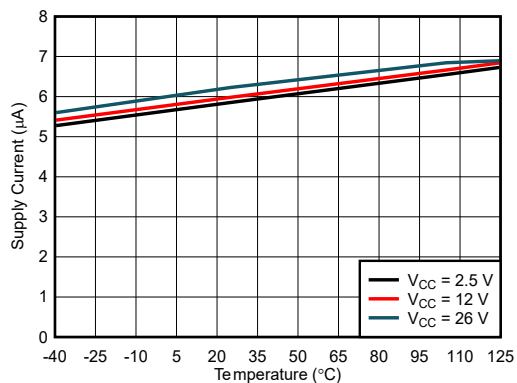
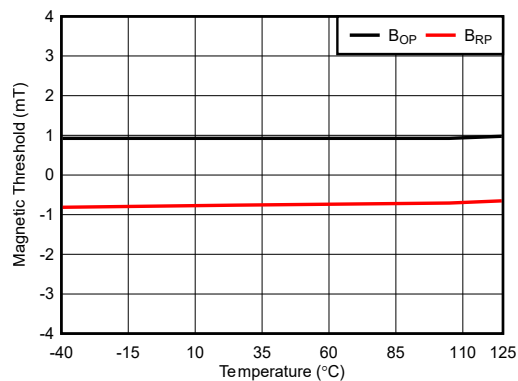
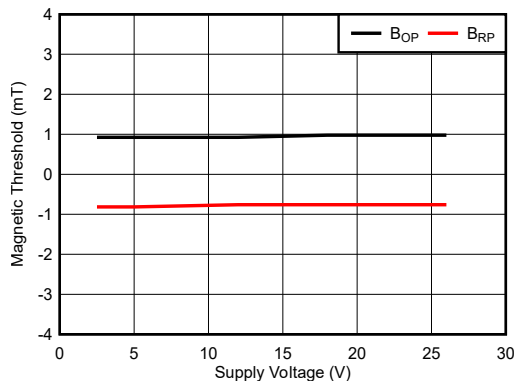


図 6-1.  $I_{CC}$  vs  $T_A$



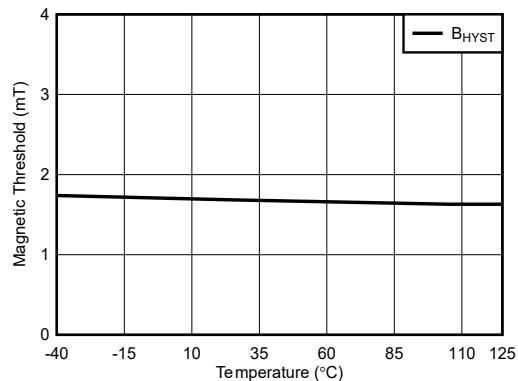
$V_{CC} = 12 V$

図 6-2. TMAG5115A  $B_{OP}$  and  $B_{RP}$  vs  $T_A$



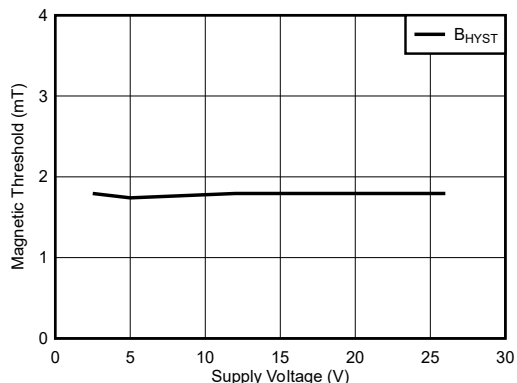
$T_A = 25^{\circ}C$

図 6-3. TMAG5115A  $B_{OP}$  and  $B_{RP}$  vs  $V_{CC}$



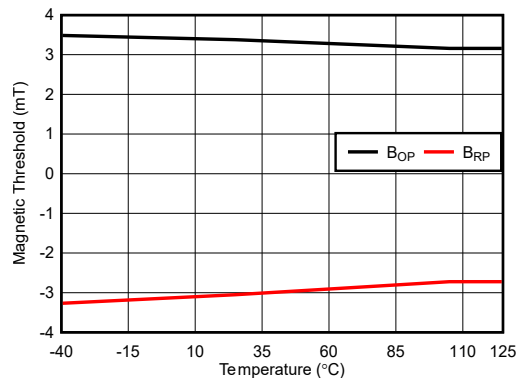
$V_{CC} = 12 V$

図 6-4. TMAG5115A  $B_{HYST}$  vs  $T_A$



$T_A = 25^{\circ}C$

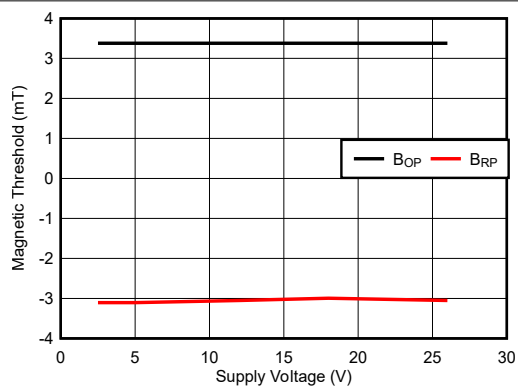
図 6-5. TMAG5115A  $B_{HYST}$  vs  $V_{CC}$



$V_{CC} = 12 V$

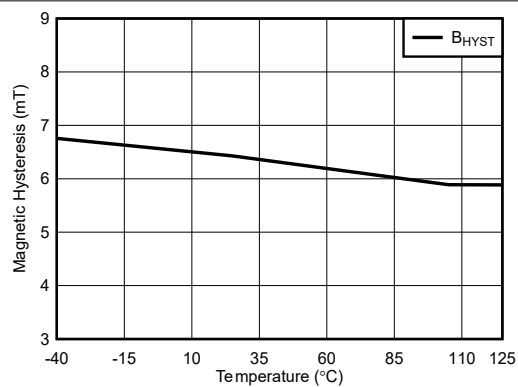
図 6-6. TMAG5115B  $B_{OP}$  and  $B_{RP}$  vs  $T_A$

## 6.7 Typical Characteristics (continued)



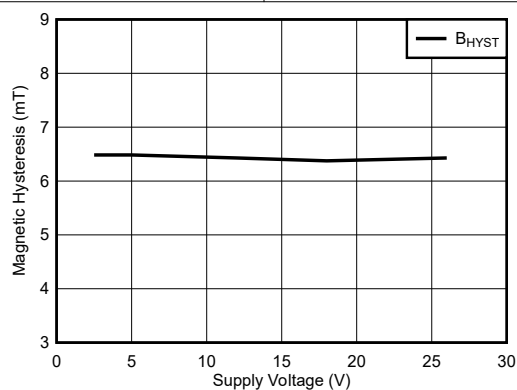
$T_A = 25^\circ\text{C}$

図 6-7. TMAG5115B  $B_{OP}$  and  $B_{RP}$  vs  $V_{CC}$



$V_{CC} = 12\text{ V}$

図 6-8. TMAG5115B  $B_{HYST}$  vs  $T_A$



$T_A = 25^\circ\text{C}$

図 6-9. TMAG5115B  $B_{HYST}$  vs  $V_{CC}$

## 7 Detailed Description

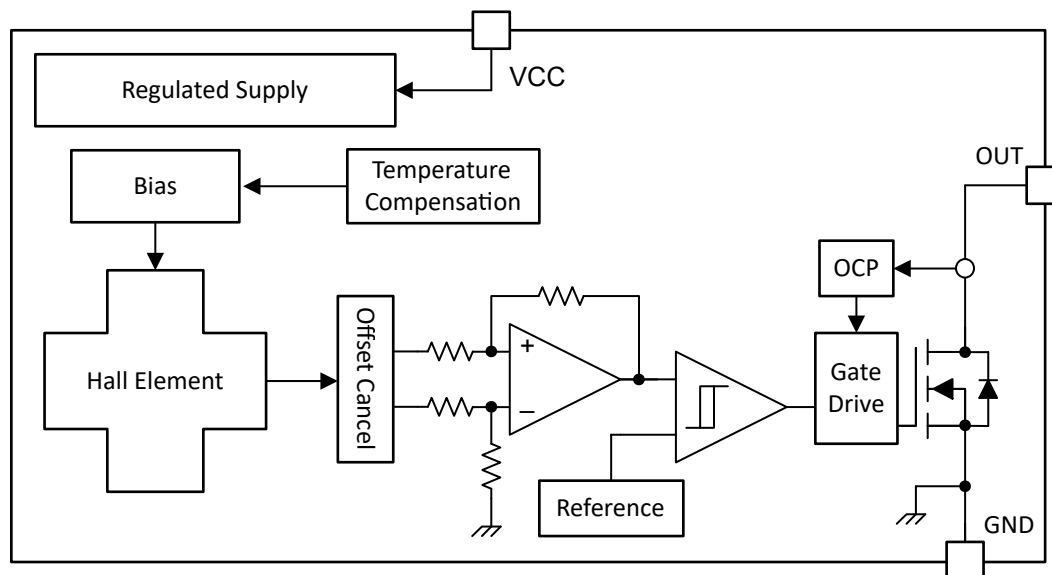
### 7.1 Overview

The TMAG5115 is a chopper-stabilized Hall sensor with a digital latched output for magnetic sensing applications. The TMAG5115 device can be powered with a supply voltage between 2.5 V and 26 V. The field polarity is defined as follows: a south pole near the marked side of the package is a positive magnetic field, and a north pole near the marked side of the package is a negative magnetic field.

The output state is dependent on the magnetic field perpendicular to the package. A south pole near the marked side of the package causes the output to pull low (operate point,  $B_{OP}$ ), and a north pole near the marked side of the package causes the output to release (release point,  $B_{RP}$ ). Hysteresis is included in between the operate point and the release point therefore magnetic-field noise does not accidentally trip the output.

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 to allow for easier interfacing with controller circuits.

### 7.2 Functional Block Diagram



## 7.3 Feature Description

### 7.3.1 Field Direction Definition

Figure 7-1 shows the positive magnetic field defined as a south pole near the marked side of the package and the negative magnetic field defined as a north pole near the marked side of the package.

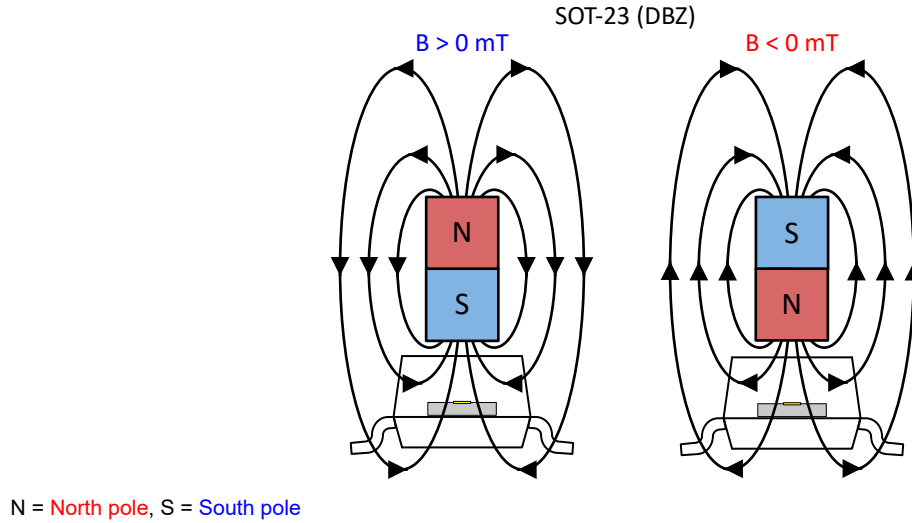


Figure 7-1. Field Direction Definition

### 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 and can either be Hi-Z or low. 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.

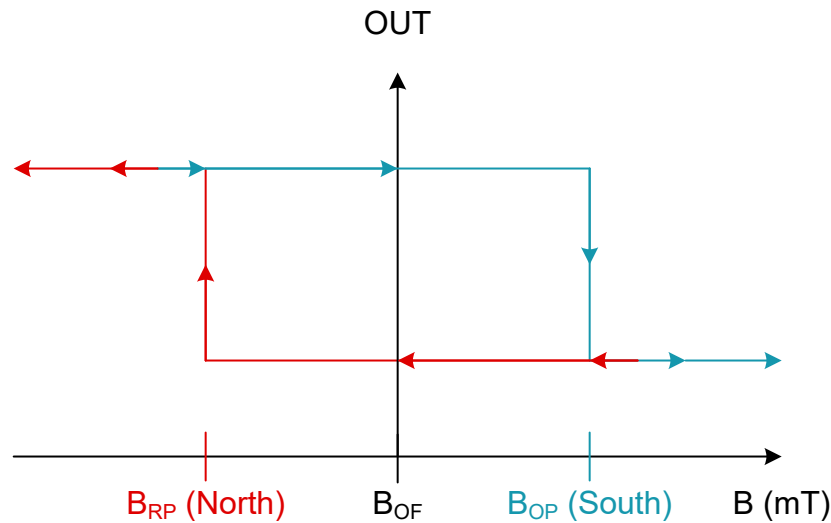


Figure 7-2. TMAG5115  $B_{OP} > 0$

### 7.3.3 Power-On Time

After applying  $V_{CC}$  to the TMAG5115,  $t_{on}$  must elapse before the OUT pin is valid. During the power-up sequence, the output is Hi-Z. A pulse as shown in [Figure 7-3](#) and [Figure 7-4](#) occurs at the end of  $t_{on}$ . This pulse can allow the host processor to determine when the TMAG5115 output is valid after start-up. In Case 1 ([Figure 7-3](#)) and Case 2 ([Figure 7-4](#)), the output is defined assuming a constant magnetic field  $B > B_{OP}$  and  $B < B_{RP}$ .

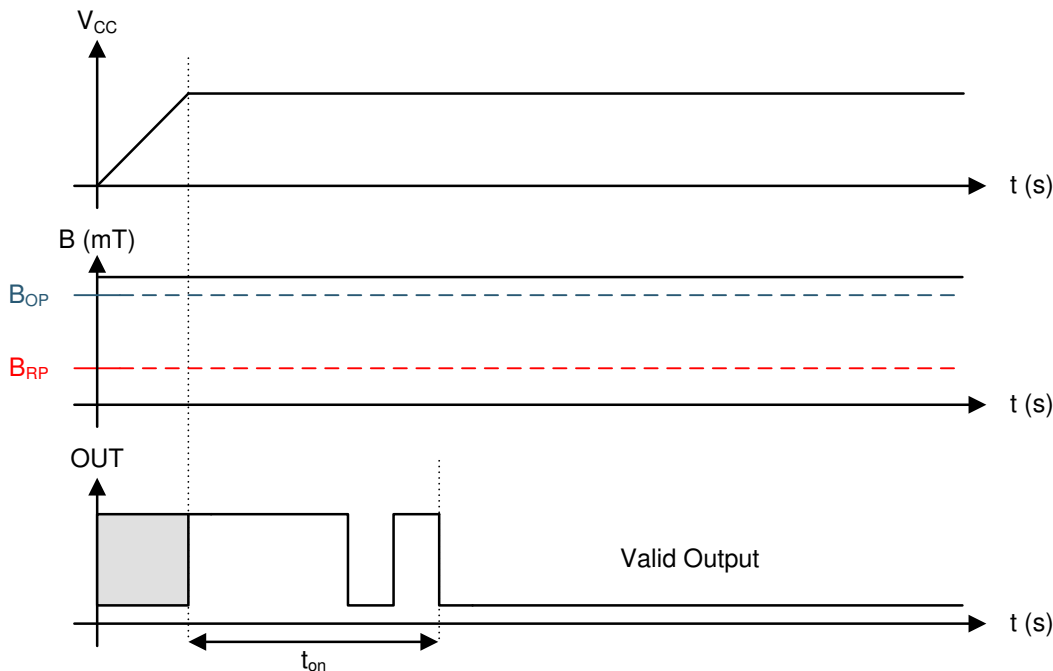


Figure 7-3. Case 1: Power On When  $B > B_{OP}$

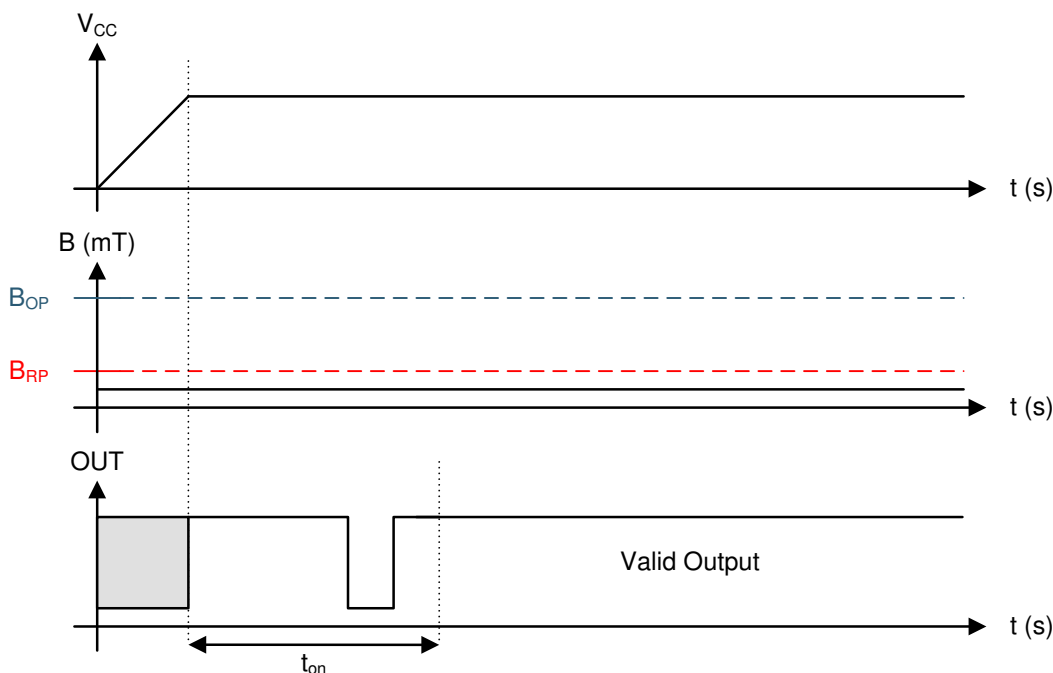
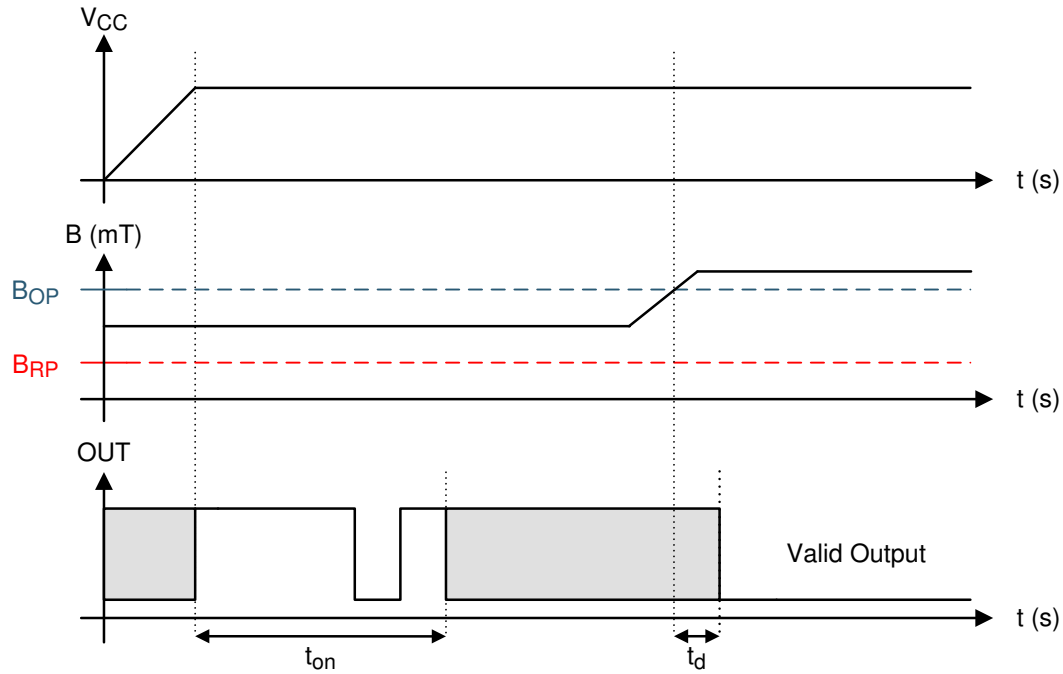
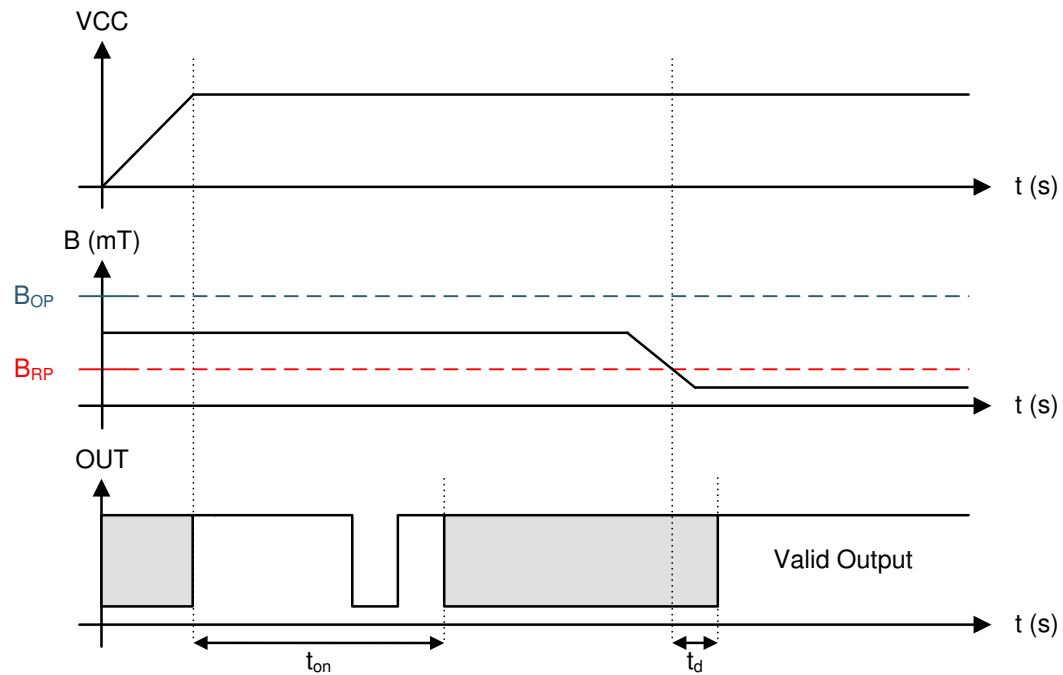


Figure 7-4. Case 2: Power On When  $B < B_{RP}$

If the device is powered on with the magnetic field strength  $B_{RP} < B < B_{OP}$ , then the device output is indeterminate and can either be Hi-Z or pulled low. During the power-up sequence, the output is held Hi-Z until  $t_{on}$  has elapsed. At the end of  $t_{on}$ , a pulse is given on the OUT pin to indicate that  $t_{on}$  has elapsed. After  $t_{on}$ , if the magnetic field changes such that  $B_{OP} < B$ , the output is released. Case 3 (Figure 7-5) and Case 4 (Figure 7-6) show examples of this behavior.



**Figure 7-5. Case 3: Power On When  $B_{RP} < B < B_{OP}$ , Followed by  $B > B_{OP}$**



**Figure 7-6. Case 4: Power On When  $B_{RP} < B < B_{OP}$ , Followed by  $B < B_{RP}$**

### 7.3.4 Output Stage

図 7-7 shows the TMAG5115 open-drain NMOS output structure, rated to sink up to 15 mA of current.

注

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

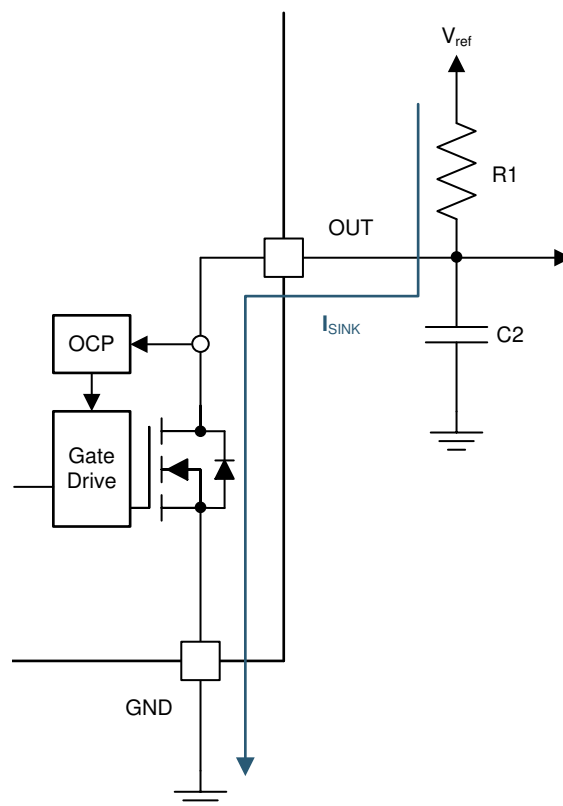


図 7-7. NMOS Open-Drain Output

Select a value for C2 based on the system bandwidth specifications as shown in 式 1.

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

Most applications do not require this C2 filtering capacitor.

### 7.3.5 Protection Circuits

The TMAG5115 device is fully protected against overcurrent and overtemperature conditions. 表 7-1 lists a summary of the protection circuits.

**表 7-1. Protection Circuit Summary**

| FAULT           | CONDITION                            | DEVICE    | DESCRIPTION                                             | RECOVERY                          |
|-----------------|--------------------------------------|-----------|---------------------------------------------------------|-----------------------------------|
| FET overload    | $I_{\text{SINK}} \geq I_{\text{SC}}$ | Operating | Output current is clamped to $I_{\text{SC}}$            | $I_{\text{SINK}} < I_{\text{SC}}$ |
| Overtemperature | $T_J \geq 156^\circ\text{C}$         | Operating | Device shuts down until recovery temperature is reached | $T_J \leq 156^\circ\text{C}$      |

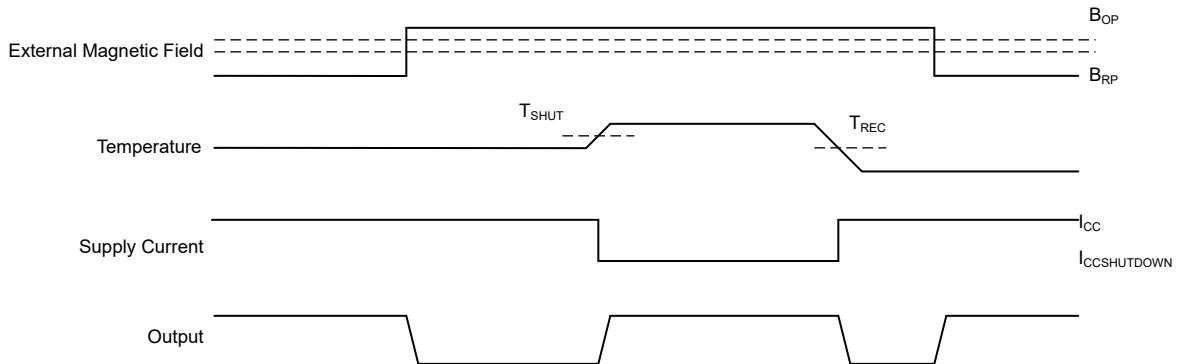
#### 7.3.5.1 Short-Circuit Protection

An analog current-limit circuit limits the current through the FET. The driver current is clamped to  $I_{\text{SC}}$ . During this clamping, the  $r_{\text{DS(on)}}$  of the output FET is increased from the nominal value.

#### 7.3.5.2 Overtemperature Protection

The TMAG5115 features overtemperature protection to prevent damage to the device and system in the case of runaway thermal heating. If the output is short-circuited, there will be greater power dissipation through the device causing the junction temperature to rise. If the temperature rises to above the limits specified in the [Electrical Characteristics](#) table, the device will enter a thermal shutdown and the OUT pin will turn to Hi-Z regardless of the current magnetic field detected.

The TMAG5115 thermal shutdown can be differentiated from normal operation by viewing the supply current into the device. While in thermal shutdown, the supply current is lower than normal operation.



**図 7-8. TMAG5115 Overtemperature Protection Diagram**

The TMAG5115 can support a supply voltage of 2.5 V to 26 V. Higher temperature and supply conditions can increase the junction temperature of the device, however, which can exceed the thermal shutdown limit. This can cause a device shutdown. TI recommends to not exceed a temperature and supply combination shown in 図 7-9.

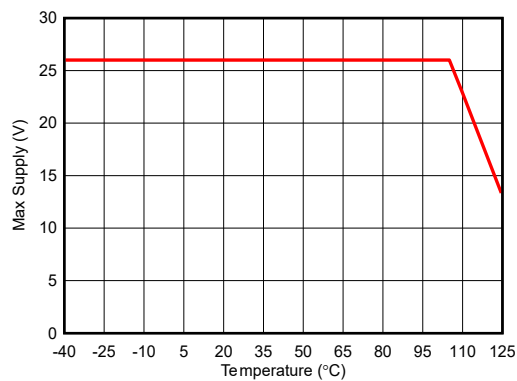


図 7-9. TMAG5115 Recommended Supply and Temperature Curve

## 7.4 Device Functional Modes

The TMAG5115 is active only when  $V_{CC}$  is between 2.5 V and 26 V and  $T_J$  is less than 156°C.

## 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, as well as validating and testing their design implementation to confirm system functionality.

### 8.1 Application Information

The TMAG5115 is used in magnetic position sensing applications. The device features a high-speed architecture to facilitate precise field measurement. With latching magnetic characteristics, the output is turned low or high respectively with a sufficiently strong south or north pole facing the package top side. When removing the magnetic field, the device keeps its previous state.

For reliable functionality, the magnet must apply a flux density at the sensor greater than the corresponding maximum  $B_{OP}$  or  $B_{RP}$  numbers specified in the [Magnetic Characteristics](#) table. Add additional margin to account for mechanical tolerance, temperature effects, and magnet variation.

### 8.2 Typical Applications

#### 8.2.1 Standard Circuit

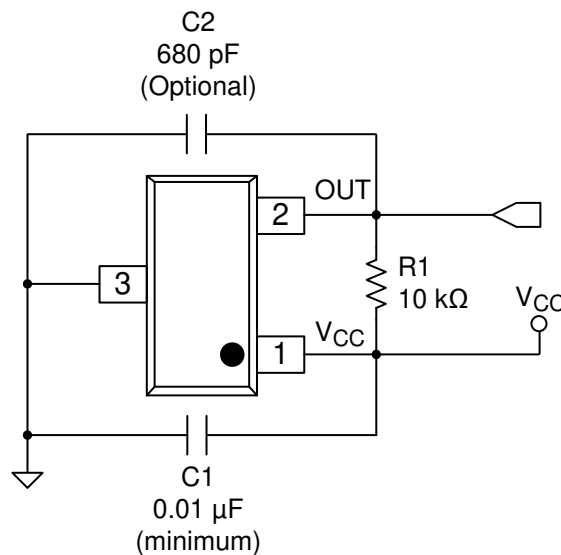


図 8-1. Typical Application Circuit

##### 8.2.1.1 Design Requirements

For this design example, use the parameters listed in [表 8-1](#) as the input parameters.

表 8-1. Design Parameters

| DESIGN PARAMETER | REFERENCE | EXAMPLE VALUE  |
|------------------|-----------|----------------|
| Supply voltage   | $V_{CC}$  | 3.0 V to 3.6 V |
| System bandwidth | $f_{BW}$  | 10 kHz         |

### 8.2.1.2 Detailed Design Procedure

表 8-2. External Components

| COMPONENT | PIN 1           | PIN 2              | RECOMMENDED                                                     |
|-----------|-----------------|--------------------|-----------------------------------------------------------------|
| C1        | V <sub>CC</sub> | GND                | A 0.01-μF (minimum) ceramic capacitor rated for V <sub>CC</sub> |
| C2        | OUT             | GND                | <b>Optional:</b> Place a ceramic capacitor to GND               |
| R1        | OUT             | REF <sup>(1)</sup> | Requires a resistor pullup                                      |

(1) REF is not a pin on the TMAG5115 device, but a REF supply-voltage pullup is required for the OUT pin. The OUT pin may be pulled up to V<sub>CC</sub>.

#### 8.2.1.2.1 Configuration Example

In a 3.3-V system,  $3.0\text{V} \leq V_{\text{ref}} \leq 3.6\text{V}$ . Use 式 2 to calculate the allowable range for R1.

$$\frac{V_{\text{ref max}}}{30\text{ mA}} \leq R1 \leq \frac{V_{\text{ref min}}}{100\text{ }\mu\text{A}} \quad (2)$$

For this design example, use 式 3 to calculate the allowable range of R1.

$$\frac{3.4\text{ V}}{30\text{ mA}} \leq R1 \leq \frac{3.2\text{ V}}{100\text{ }\mu\text{A}} \quad (3)$$

Therefore:

$$120\text{ }\Omega \leq R1 \leq 30\text{ k}\Omega \quad (4)$$

After finding the allowable range of R1 (式 4), select a value between 500  $\Omega$  and 32 k $\Omega$  for R1.

Assuming a system bandwidth of 10 kHz, use 式 5 to calculate the value of C2.

$$2 \times f_{\text{BW}} (\text{Hz}) < \frac{1}{2\pi \times R1 \times C2} \quad (5)$$

For this design example, use 式 6 to calculate the value of C2.

$$2 \times 10\text{ kHz} < \frac{1}{2\pi \times R1 \times C2} \quad (6)$$

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

A selection of R1 = 10 k $\Omega$  and C2 = 680 pF can cause a low-pass filter with a corner frequency of 23.4 kHz.

### 8.2.1.3 Application Curves

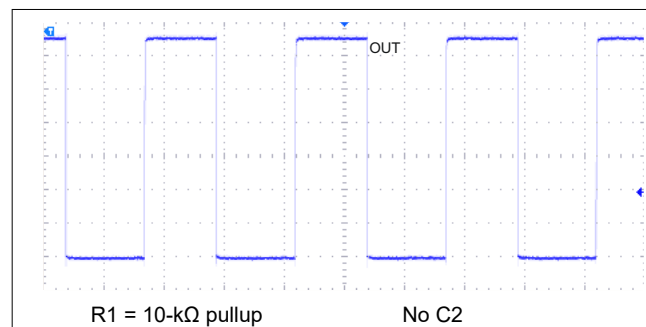


図 8-2. 10-kHz Switching Magnetic Field

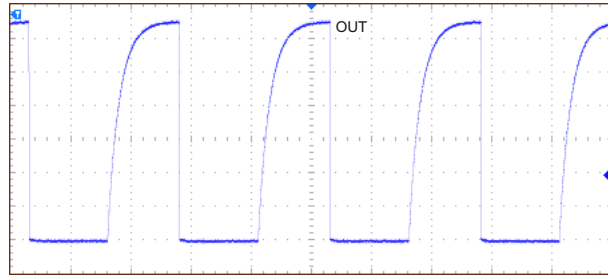


図 8-3. 10-kHz Switching Magnetic Field

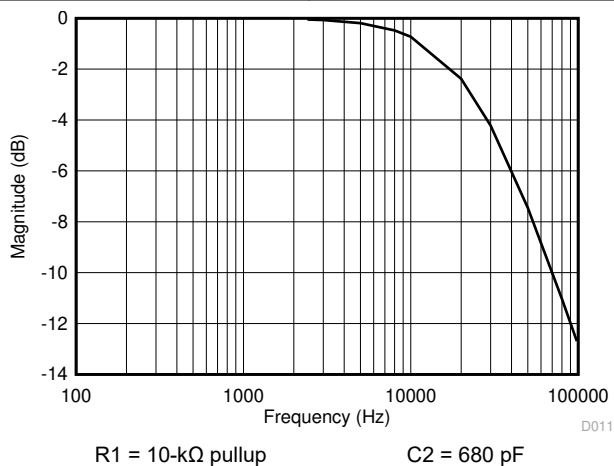


図 8-4. Low-Pass Filtering

### 8.3 Power Supply Recommendations

The TMAG5115 device is designed to operate from an input voltage supply range between 2.5 V and 26 V. A recommended 0.1- $\mu$ F ceramic capacitor rated for  $V_{CC}$  must be placed as close to the TMAG5115 as possible. Bypass capacitor values larger than 0.1  $\mu$ F may be required to attenuate any significant high-frequency ripple and noise components generated by the power source. TI recommends limiting the supply voltage variation to less than 50 mV<sub>PP</sub>.

### 8.4 Layout

#### 8.4.1 Layout Guidelines

TI recommends placing the bypass capacitor near the TMAG5115 device for efficient power delivery with minimal inductance. TI recommends placing 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, using PCB copper planes underneath the TMAG5115 device has no effect on magnetic flux and does not interfere with device performance. This is because copper is not a ferromagnetic material. However, nearby system components that contain iron or nickel can redirect magnetic flux in unpredictable ways.

#### 8.4.2 Layout Example

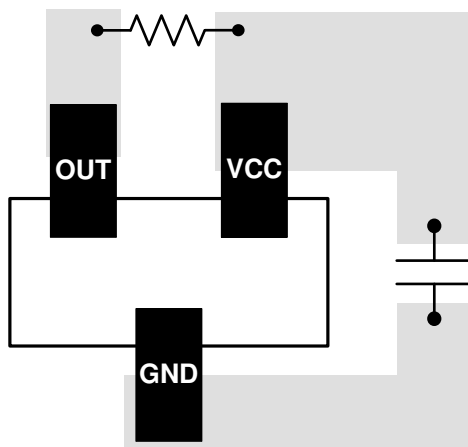


图 8-5. TMAG5115 Layout Example

## 9 Device and Documentation Support

### 9.1 Device Support

#### 9.1.1 Hall Sensor Location

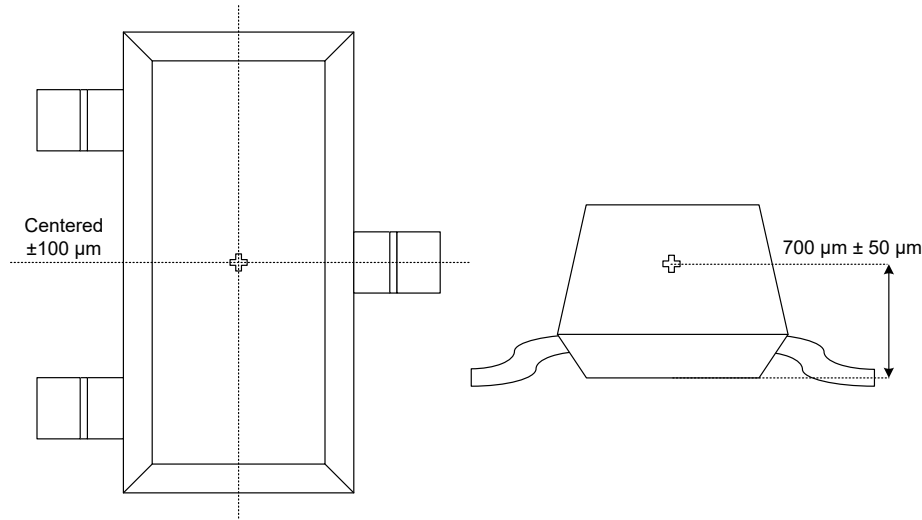


図 9-1. Hall Sensor Location (Not to Scale)

### 9.2 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、[www.tij.co.jp](http://www.tij.co.jp) のデバイス製品フォルダを開いてください。[通知] 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ることができます。変更の詳細については、改訂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。

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### 9.6 用語集

[テキサス・インスツルメンツ用語集](#)

この用語集には、用語や略語の一覧および定義が記載されています。

## 10 Revision History

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。

| Changes from Revision A (February 2023) to Revision B (August 2024)                                                                                                                       | Page              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| • 測定値の単位と値の間のスペースを削除.....                                                                                                                                                                 | <a href="#">1</a> |
| • 「製品情報」表を「パッケージ情報」に変更 .....                                                                                                                                                              | <a href="#">1</a> |
| • Changed the typical threshold and typical hysteresis values in the <i>Device Comparison</i> table to correctly match the values found in the <i>Magnetic Characteristics</i> table..... | <a href="#">3</a> |

| Changes from Revision * (December 2022) to Revision A (February 2023) | Page              |
|-----------------------------------------------------------------------|-------------------|
| • Added <i>Device Comparison</i> table.....                           | <a href="#">3</a> |
| • Added TMAG5115A magnetic specifications.....                        | <a href="#">5</a> |
| • Added typical characteristic curves for TMAG5115A.....              | <a href="#">6</a> |

## 11 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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## PACKAGING INFORMATION

| Orderable part number            | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|----------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TMAG5115A1CQDBZR</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | 15A1                |
| TMAG5115A1CQDBZR.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | 15A1                |
| <a href="#">TMAG5115B1CQDBZR</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | 15B1                |
| TMAG5115B1CQDBZR.A               | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | 15B1                |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts 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.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

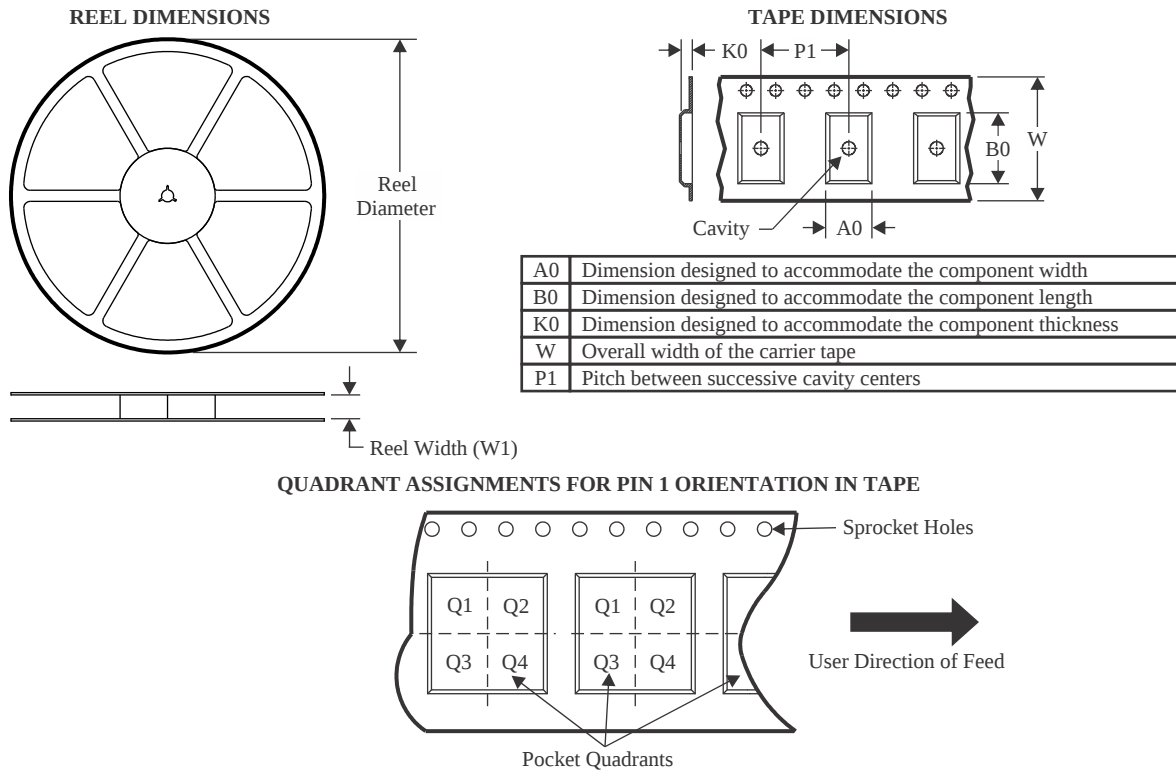
<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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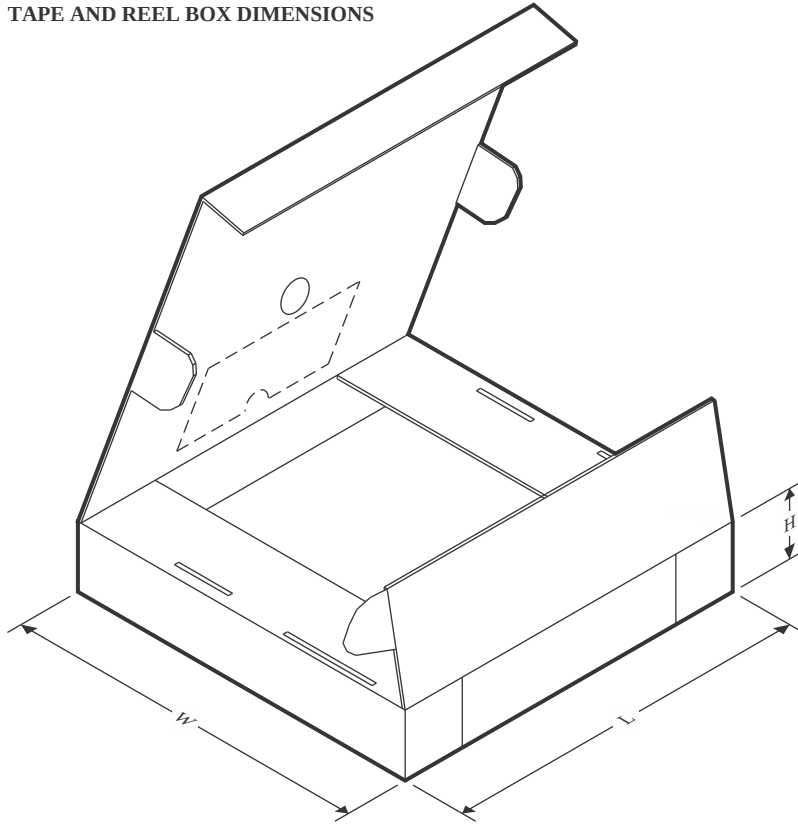
## TAPE AND REEL INFORMATION



\*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 |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TMAG5115A1CQDBZR | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |
| TMAG5115B1CQDBZR | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 9.0                | 3.15    | 2.77    | 1.22    | 4.0     | 8.0    | Q3            |

## TAPE AND REEL BOX DIMENSIONS

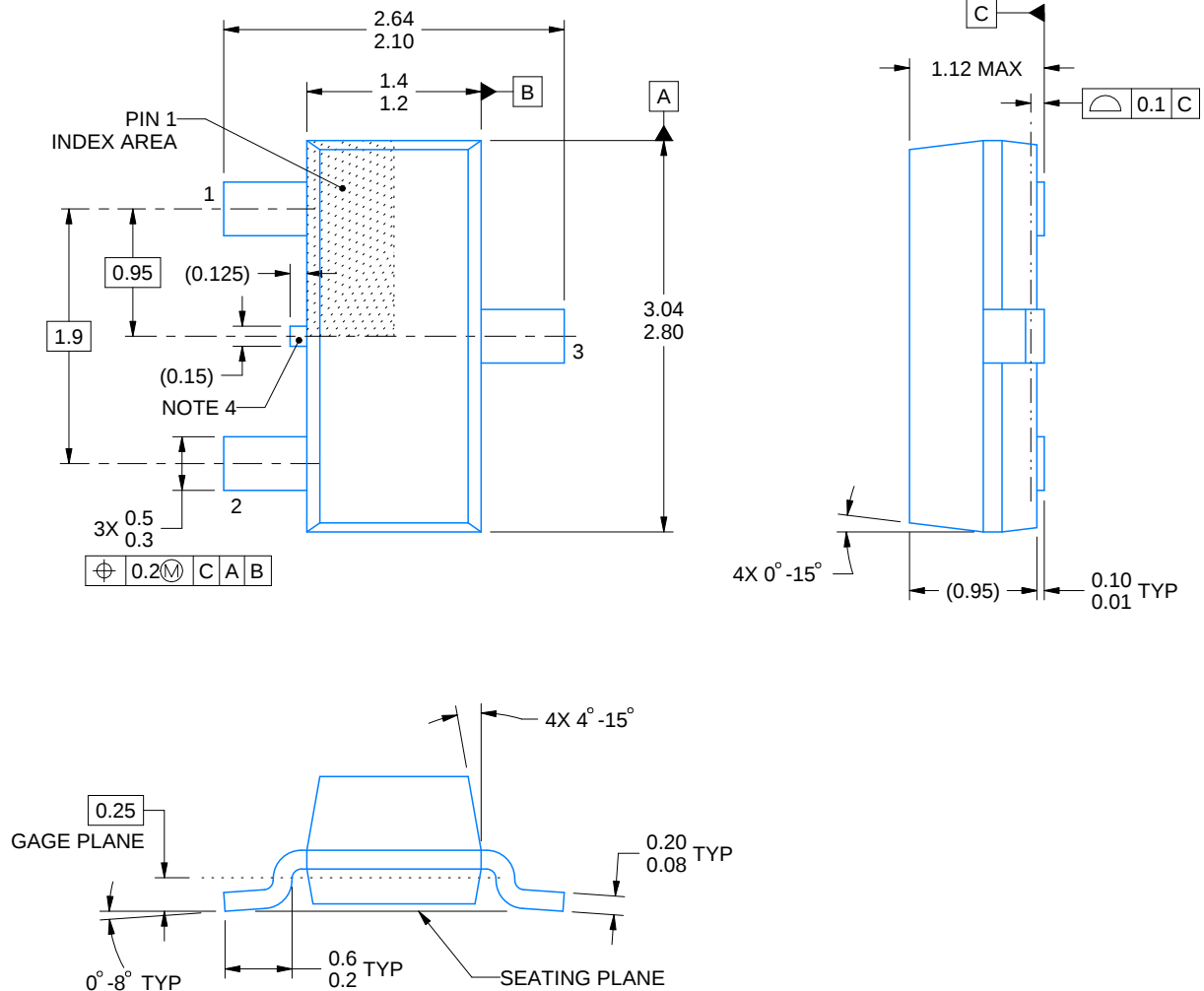


\*All dimensions are nominal

| Device           | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TMAG5115A1CQDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TMAG5115B1CQDBZR | SOT-23       | DBZ             | 3    | 3000 | 180.0       | 180.0      | 18.0        |

**DBZ0003A****PACKAGE OUTLINE****SOT-23 - 1.12 mm max height**

SMALL OUTLINE TRANSISTOR



4214838/F 08/2024

**NOTES:**

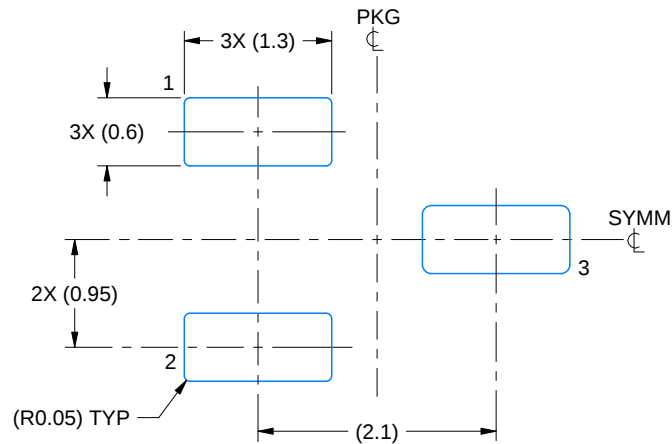
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-236, except minimum foot length.
4. Support pin may differ or may not 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

# EXAMPLE BOARD LAYOUT

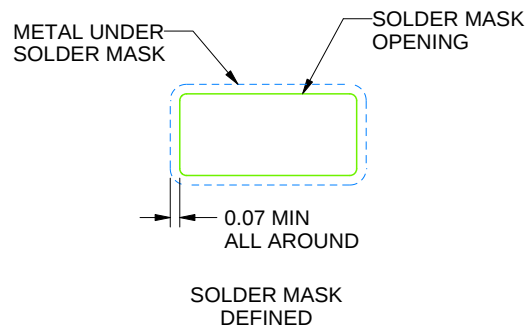
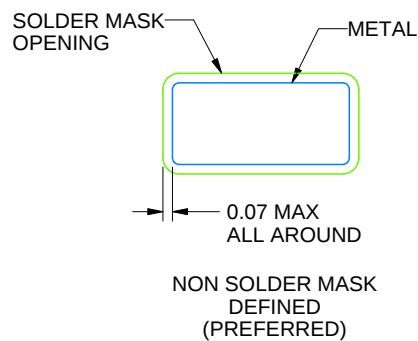
DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
SCALE:15X



SOLDER MASK DETAILS

4214838/F 08/2024

NOTES: (continued)

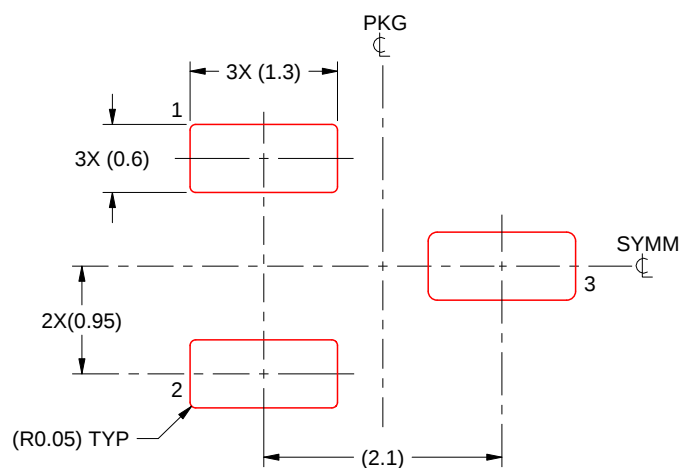
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# 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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