

# TMAG5123 平面高精度高压霍尔效应开关

## 1 特性

- 平面全极霍尔效应开关
- 高磁性灵敏度：
  - TMAG5123B：4.1mT (典型值)
  - TMAG5123C：7.5mT (典型值)
  - TMAG5123D：10.9mT (典型值)
- 支持宽电压范围
  - 2.5V 至 38V 工作  $V_{CC}$  范围
  - 无需外部稳压器
- 宽工作温度范围
  - 环境工作温度范围：-40°C 至 +125°C
- 30kHz 连续转换
- 开漏输出
- SOT-23 封装选项
- 保护特性
  - 支持高达 40V 的负载突降
  - 20V 的反向电池保护
  - 输出短路保护
  - 输出电流限制

## 2 应用

- 大家电
- 小型家用电器
- 无线扫地机器人
- 流量计
- 家用断路器
- 开关检测

## 3 说明

TMAG5123 是一款斩波稳定型全极低电平有效平面霍尔效应开关传感器。TMAG5123 通过测量与表面贴装型 SOT-23 封装印刷电路板 (PCB) 表面平行的磁场，可简化传感器的机械放置。

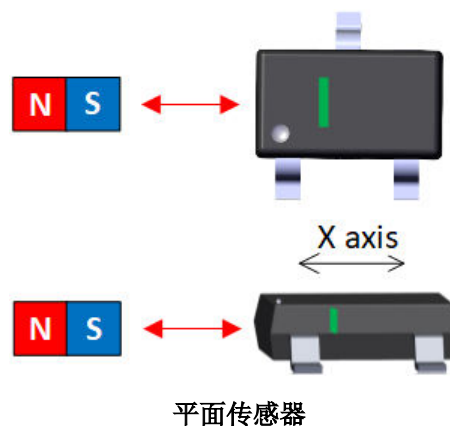
可以使用不同的灵敏度水平以满足应用的具体要求。当施加的磁通量密度值超过运行点 (BOP) 阈值时 (按绝对磁场值计算)，开漏输出将产生低电平电压。输出会保持低电平，直到施加磁场降至低于释放点 (BRP) 阈值 (也按绝对值计算)。

TMAG5123 具有 2.5V 至 38V 的宽工作电压范围，反极性保护高达 -20V，可以在工业应用中稳健运行。

器件信息

| 器件型号     | 封装 <sup>(1)</sup> | 封装尺寸 (标称值)      |
|----------|-------------------|-----------------|
| TMAG5123 | SOT-23 (3)        | 2.92mm × 1.30mm |

(1) 如需了解所有可用封装，请参阅数据表末尾的封装选项附录。



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## 4 Revision History

| DATE     | REVISION | NOTES           |
|----------|----------|-----------------|
| May 2021 | *        | Initial Release |

## 5 Device Comparison Table

| DEVICE   | DEVICE OPTION | Threshold level (BOP) |
|----------|---------------|-----------------------|
| TMAG5123 | B             | 4.1mT                 |
|          | C             | 7.5mT                 |
|          | D             | 10.9mT                |

## 6 Pin Configuration and Functions

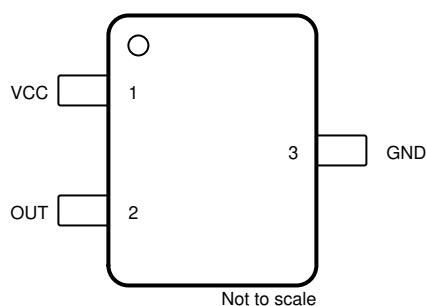


图 6-1. DBZ Package 3-Pin SOT-23 Top View

表 6-1. Pin Functions

| PIN |      | TYPE         | DESCRIPTION                                                                                                                     |
|-----|------|--------------|---------------------------------------------------------------------------------------------------------------------------------|
| NO. | NAME |              |                                                                                                                                 |
| 1   | VCC  | Power supply | 2.5-V to 38-V power supply. Connect a ceramic capacitor with a value of at least 0.01 $\mu$ F (minimum) between VCC and ground. |
| 2   | OUT  | Output       | Hall sensor open-drain output. The open drain requires a pull-up resistor                                                       |
| 3   | GND  | Ground       | Ground reference.                                                                                                               |

## 7 Specifications

### 7.1 Absolute Maximum Ratings

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

|                                         |          | MIN       | MAX | UNIT |
|-----------------------------------------|----------|-----------|-----|------|
| Power Supply Voltage                    | $V_{CC}$ | - 20      | 40  | V    |
| Magnetic Flux Density, B <sub>MAX</sub> |          | Unlimited |     | T    |
| Junction temperature, $T_J$             |          |           | 150 | °C   |
| Storage temperature, $T_{stg}$          |          | - 65      | 150 | °C   |

- (1) Stresses beyond those listed under *Absolute Maximum Rating* 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 Condition*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

### 7.2 ESD Ratings

|             |                         |                                                                                          | VALUE | UNIT |
|-------------|-------------------------|------------------------------------------------------------------------------------------|-------|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins <sup>(1)</sup>              | ±2000 | V    |
|             |                         | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <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.

### 7.3 Recommended Operating Conditions

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

|            |                         | MIN  | MAX | UNIT |
|------------|-------------------------|------|-----|------|
| $V_{CC}$   | Power supply voltage    | 2.5  | 38  | V    |
| $V_O$      | Output pin voltage      | 0    | 38  | V    |
| $I_{SINK}$ | Output pin current sink | 0    | 20  | mA   |
| $T_A$      | Ambient temperature     | - 40 | 125 | °C   |

### 7.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | TMAG5123     | UNIT |
|-------------------------------|----------------------------------------------|--------------|------|
|                               |                                              | DBZ (SOT-23) |      |
|                               |                                              | 3 PINS       |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 197.7        | °C/W |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance    | 87.1         | °C/W |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 27.4         | °C/W |
| $\Psi_{JT}$                   | Junction-to-top characterization parameter   | 3.7          | °C/W |
| $\Psi_{JB}$                   | Junction-to-board characterization parameter | 27.1         | °C/W |

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

## 7.5 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     | $V_{CC} = 2.5V \text{ to } 38V, T_A = 25^\circ C$                          |      | 3.5  |     | mA      |
| $I_{CC}$                  | Operating supply current     | $V_{CC} = 2.5V \text{ to } 38V, T_A = -40^\circ C \text{ to } 125^\circ C$ |      | 3.5  | 5.4 | mA      |
| $I_{RCC}$                 | Reverse-battery current      | $V_{CC} = -20V$                                                            | -100 |      |     | $\mu A$ |
| $t_{ON}$                  | Power-on-time                |                                                                            |      | 62.5 |     | $\mu s$ |
| $P_{OS}$                  | Power-on-state               | $V_{CC} > V_{CCmin}, t > t_{ON}$                                           |      | High |     |         |
| <b>OUTPUT</b>             |                              |                                                                            |      |      |     |         |
| $V_{OL}$                  | Low-level output voltage     | $I_{OL} = 5mA$                                                             | 0    |      | 0.5 | V       |
| $I_{OH}$                  | Output leakage current       | $V_{CC} = 5V$                                                              |      | 0.1  | 1   | $\mu A$ |
| $I_{SC}$                  | Output short-circuit current |                                                                            |      | 65   | 100 | mA      |
| $t_R$                     | Output rise time             | $R_L = 1k\Omega, C_L = 50pF, V_{CC} = 12V$                                 |      | 0.2  |     | $\mu s$ |
| $t_F$                     | Output fall time             | $R_L = 1k\Omega, C_L = 50pF, V_{CC} = 12V$                                 |      | 0.2  |     | $\mu s$ |
| $t_{PD}$                  | Propagation delay time       | Change in B field to change in output                                      |      | 50   |     | $\mu s$ |
| <b>FREQUENCY RESPONSE</b> |                              |                                                                            |      |      |     |         |
| $f_{CHOP}$                | Chopping frequency           |                                                                            |      | 320  |     | kHz     |
| $f_{BW}$                  | Signal bandwidth             |                                                                            |      | 10   |     | kHz     |

## 7.6 Magnetic Characteristics

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

| PARAMETER        |                                                       | TEST CONDITIONS                                     | MIN  | TYP   | MAX  | UNIT |
|------------------|-------------------------------------------------------|-----------------------------------------------------|------|-------|------|------|
| TMAG5123B        |                                                       |                                                     |      |       |      |      |
| B <sub>OP</sub>  | Magnetic field operating point                        | VCC = 2.5V to 38V, T <sub>A</sub> = - 40°C to 125°C | ±2.2 | ±4.1  | ±6   | mT   |
| B <sub>RP</sub>  | Magnetic field release point                          |                                                     | ±0.3 | ±2.2  | ±4   | mT   |
| B <sub>HYS</sub> | Magnetic hysteresis B <sub>OP</sub> - B <sub>RP</sub> |                                                     | ±0.5 | ±1.9  | ±3   | mT   |
| TMAG5123C        |                                                       |                                                     |      |       |      |      |
| B <sub>OP</sub>  | Magnetic field operating point                        | VCC = 2.5V to 38V, T <sub>A</sub> = - 40°C to 125°C | ±5.5 | ±7.5  | ±9.5 | mT   |
| B <sub>RP</sub>  | Magnetic field release point                          |                                                     | ±3.5 | ±5.5  | ±7.5 | mT   |
| B <sub>HYS</sub> | Magnetic hysteresis B <sub>OP</sub> - B <sub>RP</sub> |                                                     | ±0.5 | ±2    | ±3   | mT   |
| TMAG5123D        |                                                       |                                                     |      |       |      |      |
| B <sub>OP</sub>  | Magnetic field operating point                        | VCC = 2.5V to 38V, T <sub>A</sub> = - 40°C to 125°C | ±8.7 | ±10.9 | ±13  | mT   |
| B <sub>RP</sub>  | Magnetic field release point                          |                                                     | ±6.7 | ±8.9  | ±11  | mT   |
| B <sub>HYS</sub> | Magnetic hysteresis B <sub>OP</sub> - B <sub>RP</sub> |                                                     | ±0.5 | ±2    | ±3   | mT   |

## 7.7 Typical Characteristics

at  $T_A = 25^\circ\text{C}$  typical and  $V_{CC} = 6\text{V}$  (unless otherwise noted)

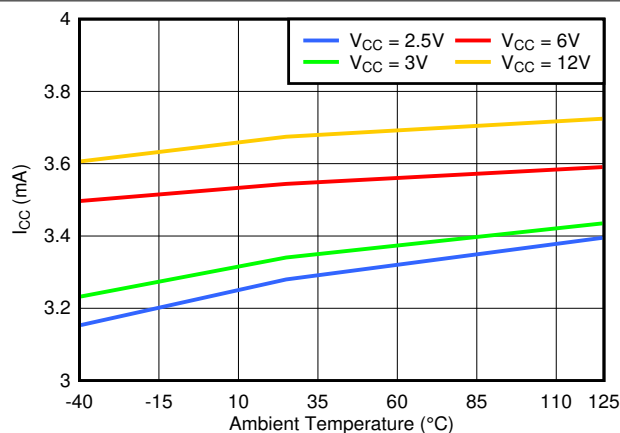


图 7-1. TMAG5123  $I_{CC}$  vs Temperature

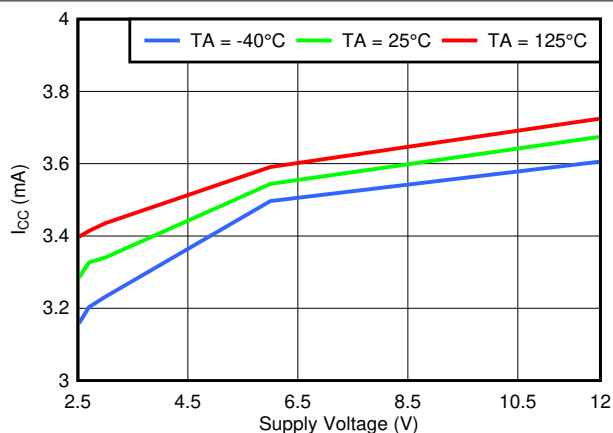


图 7-2. TMAG5123  $I_{CC}$  vs Voltage

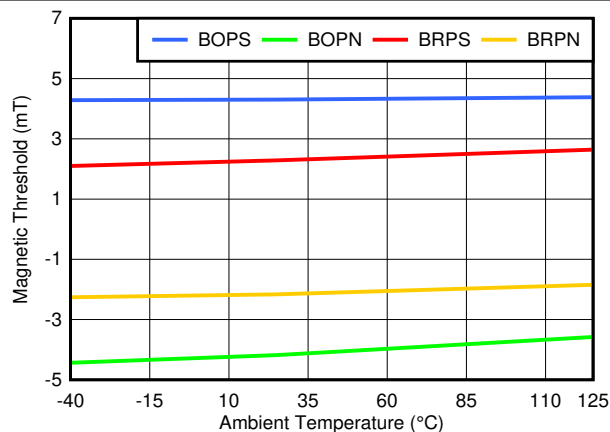


图 7-3. TMAG5123B Magnetic Thresholds vs Temperature

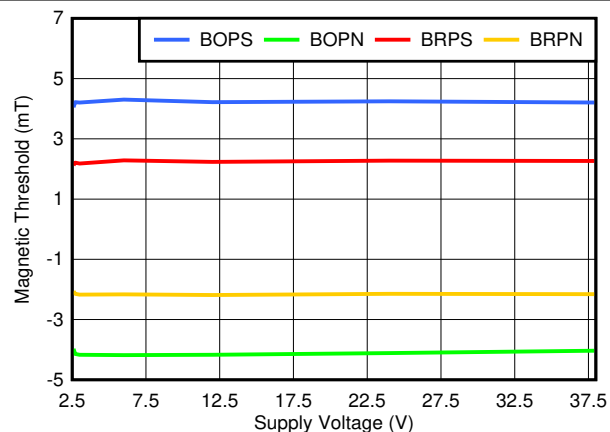


图 7-4. TMAG5123B Magnetic Thresholds vs Voltage

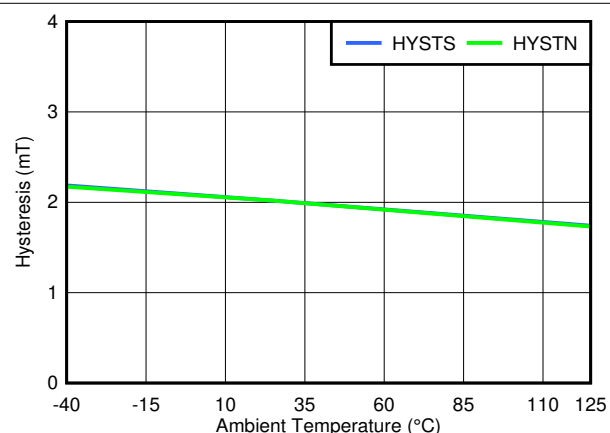


图 7-5. TMAG5123B Hysteresis vs Temperature

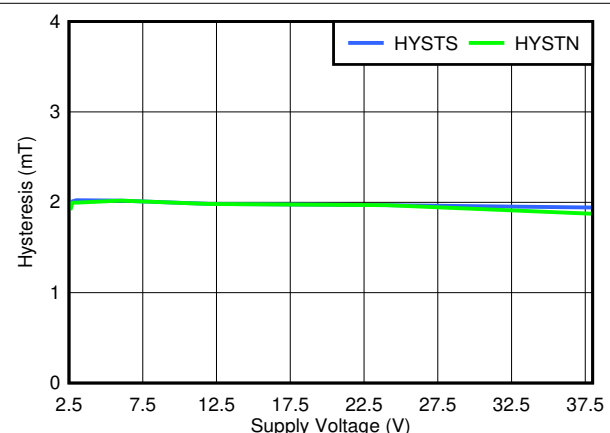


图 7-6. TMAG5123B Hysteresis vs Supply Voltage

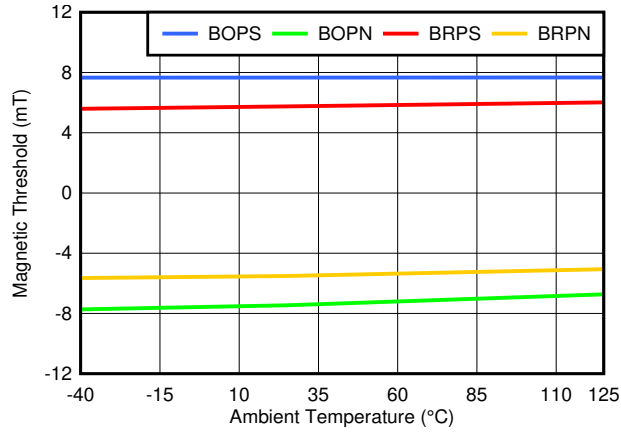


图 7-7. TMAG5123C Magnetic Thresholds vs Temperature

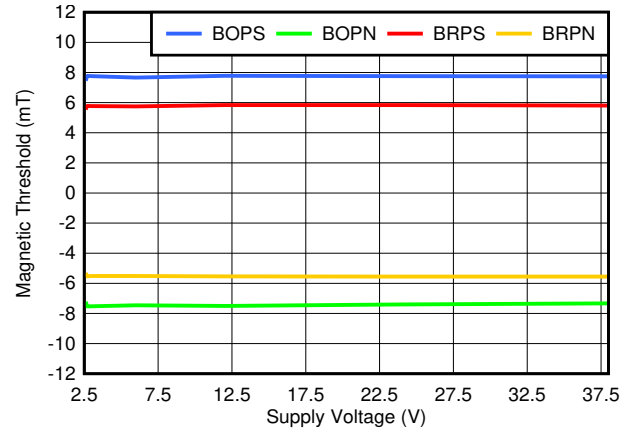


图 7-8. TMAG5123C Magnetic Thresholds vs Voltage

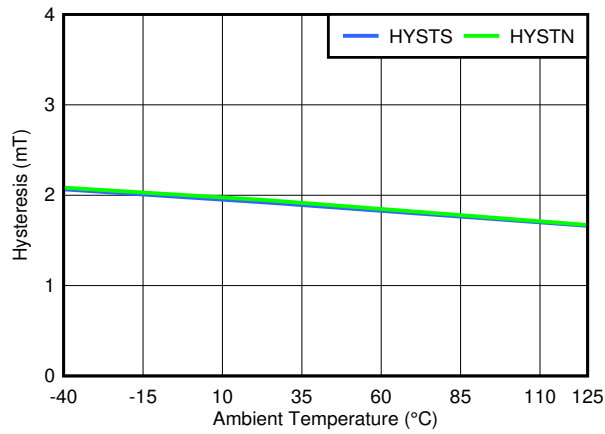


图 7-9. TMAG5123C Hysteresis vs Temperature

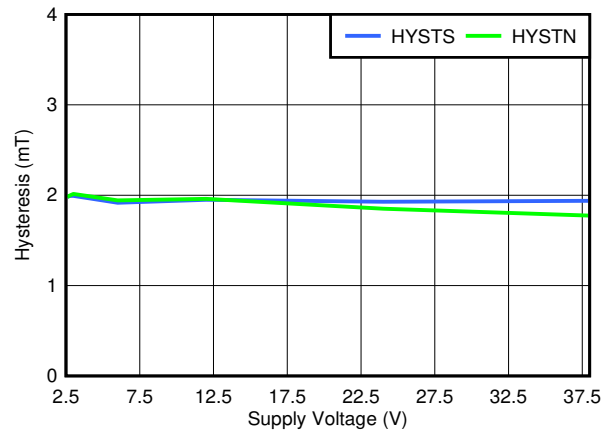


图 7-10. TMAG5123C Hysteresis vs Supply Voltage

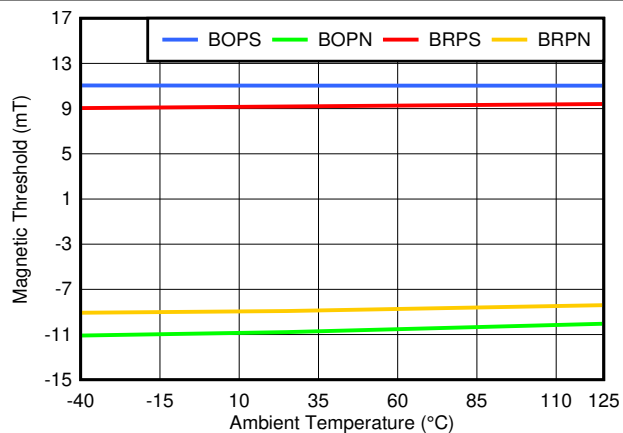


图 7-11. TMAG5123D Magnetic Thresholds vs Temperature

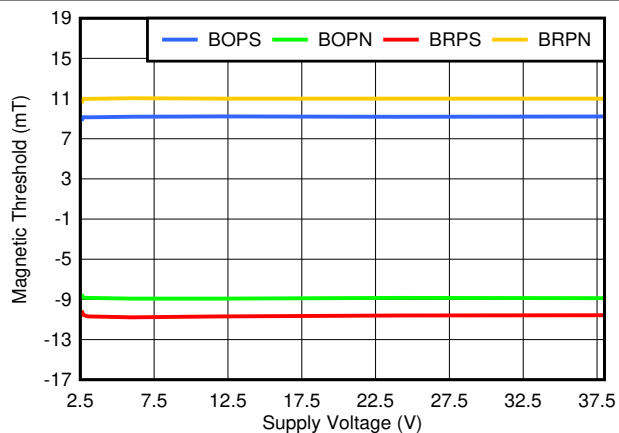


图 7-12. TMAG5123D Magnetic Thresholds vs Voltage

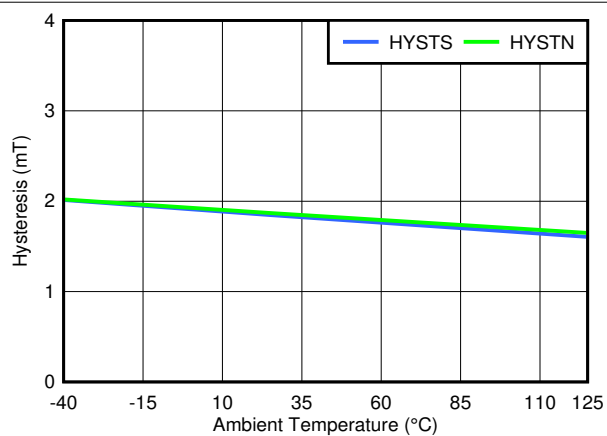


图 7-13. TMAG5123D Hysteresis vs Temperature

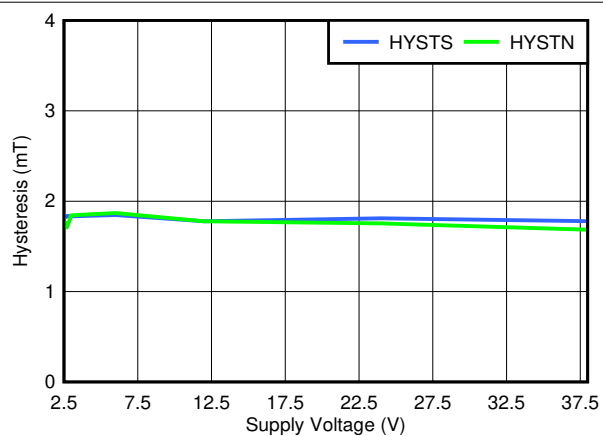


图 7-14. TMAG5123D Hysteresis vs Supply Voltage

## 8 Detailed Description

### 8.1 Overview

The TMAG5123 device is a chopper-stabilized Hall sensor with a digital omnipolar switch output for magnetic sensing applications. The TMAG5123 device can be powered with a supply voltage range between 2.5-V and 38 V, and can withstand  $-20$ -V reverse battery conditions continuously. Note that the TMAG5123 device will not operate when approximately  $-20$ -V to 2.5-V is applied to the VCC pin (with respect to GND). In addition, the device can withstand voltages up to 40 V for transient durations.

While most of the Hall-effect sensors switch their output in the presence of a vertical field, the TMAG5123 will switch the output in the presence of a horizontal field. The TMAG5123 is then an in-plane or vertical sensor, sensitive to a horizontal or parallel magnetic fields.

The omnipolar configuration allows the Hall sensor to respond to either a south or north pole. A strong magnetic field of either polarity will cause the output to pull low (operate point, BOP), and a weaker magnetic field will cause the output to release (release point, BRP). Hysteresis is included in between the operate and release points, so magnetic field noise will not trip the output accidentally.

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

### 8.2 Functional Block Diagram

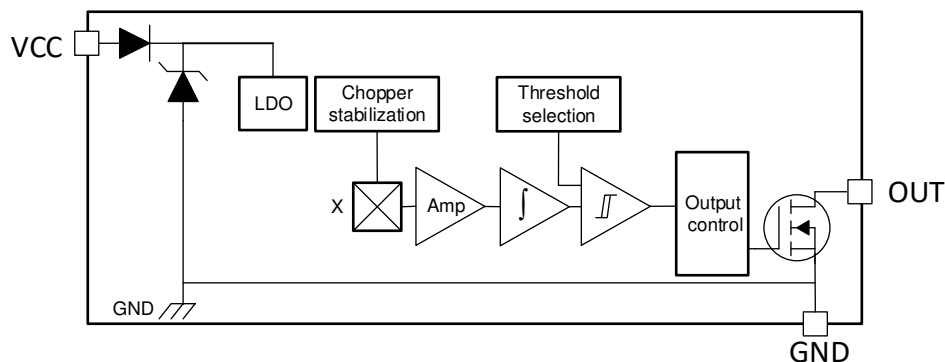


图 8-1. Block Diagram

### 8.3 Feature Description

#### 8.3.1 Field Direction Definition

The TMAG5123 is sensitive to both south and north poles in the same plane as the die as shown 图 8-2.

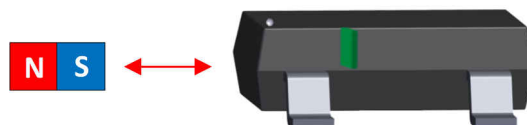


图 8-2. Field Direction Definition

### 8.3.2 Device Output

The TMAG5123 is featured with an open drain output. In order to generate a two state output, a pull-up resistor needs to be added.

Once the device is powered and with no magnetic field applied to it, the output stays at  $V_{out}(H)$ . As an omnipolar sensor the output will go down to  $V_{out}(L)$  when the field increase beyond the BOP threshold either with a north or a south magnetic field. When the field decrease below the BRP threshold, either with a north or a south magnetic field, the output will go up to  $V_{out}(H)$ .

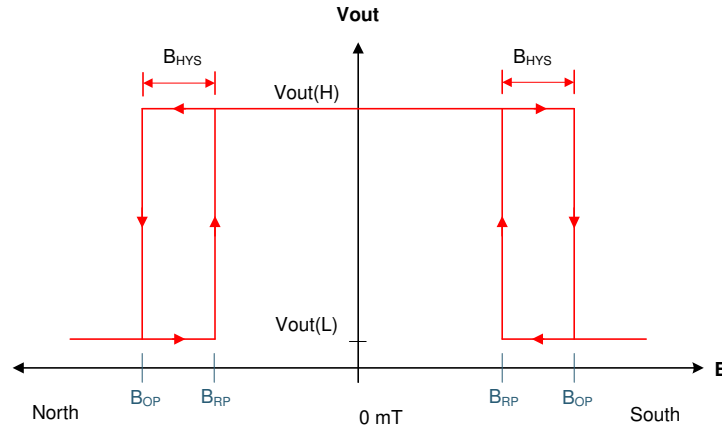


图 8-3. Omnipolar Functionality

### 8.3.3 Protection Circuits

The TMAG5123 device is protected against load dump and reverse-supply conditions

#### 8.3.3.1 Load Dump Protection

The TMAG5123 device operates at DC VCC conditions up to 38-V nominally, and can additionally withstand VCC = 40-V. No current-limiting series resistor is required for this protection.

#### 8.3.3.2 Reverse Supply Protection

The TMAG5123 device is protected in the event that the VCC pin and the GND pin are reversed (up to -20-V).

### 8.3.4 Hall Element Location

The sensing element inside the device is in the center of both packages when viewed from the top. 图 8-4 shows the tolerances and side-view dimensions.

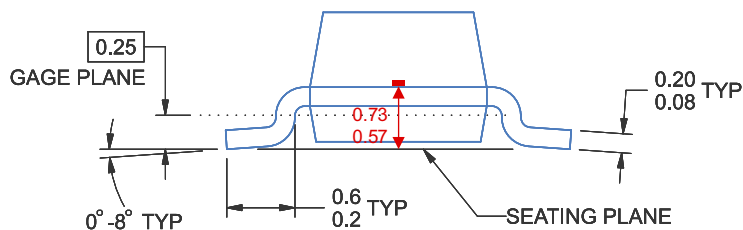
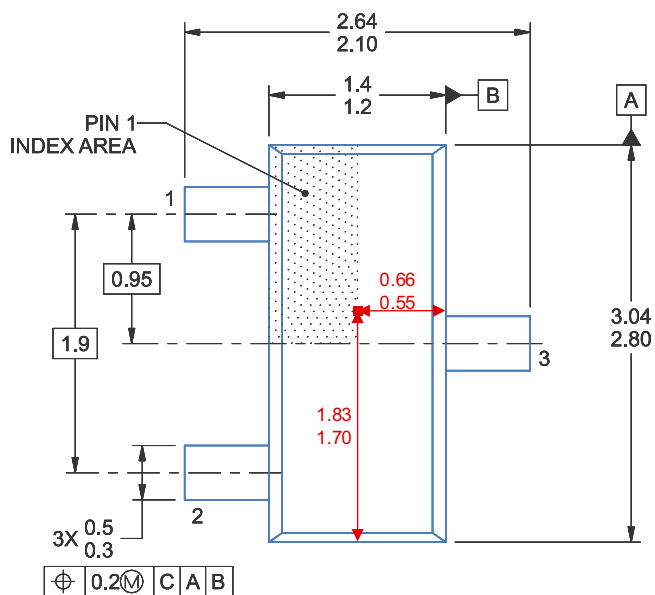


图 8-4. Hall Element Location

### 8.3.5 Power-On Time

图 8-5 shows the behavior of the device after the  $V_{CC}$  voltage is applied and when the field is below the  $B_{OP}$  threshold. Once the minimum value for  $V_{CC}$  is reached, the TMAG5123 will take time  $t_{ON}$  to power up and then time  $t_{PD}$  to update the output to a level High.

图 8-6 shows the behavior of the device after the  $V_{CC}$  voltage is applied and when the field is above the  $B_{OP}$  threshold. Once the minimum value for  $V_{CC}$  is reached, the TMAG5123 will take time  $t_{ON}$  to power up and then time  $t_{PD}$  to update the output to a level Low.

The output value during  $t_{ON}$  is unknown in both cases. The output value at the end of  $t_{ON}$  will be set at High.

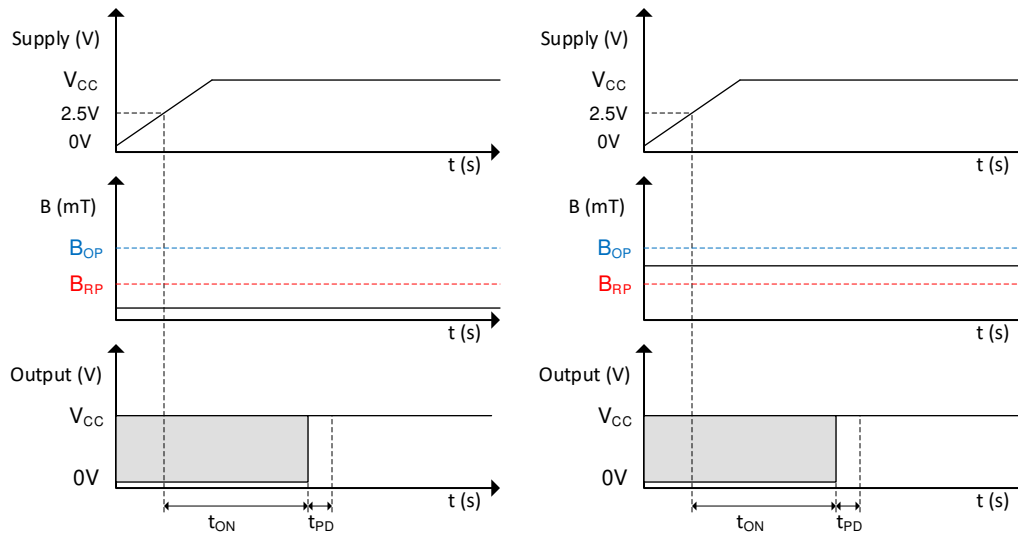


图 8-5. Power-On Time When  $B < B_{OP}$

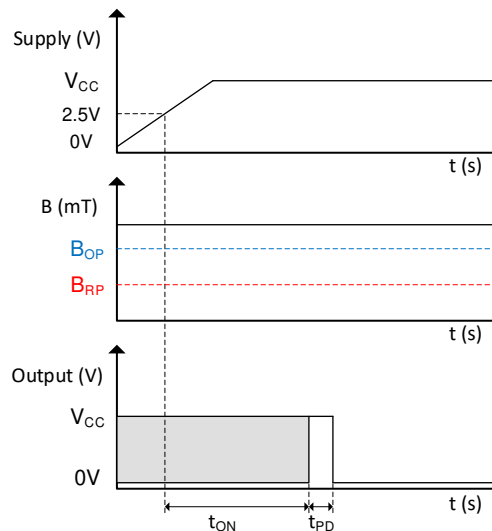


图 8-6. Power-On Time When  $B > B_{OP}$

### 8.3.6 Propagation Delay

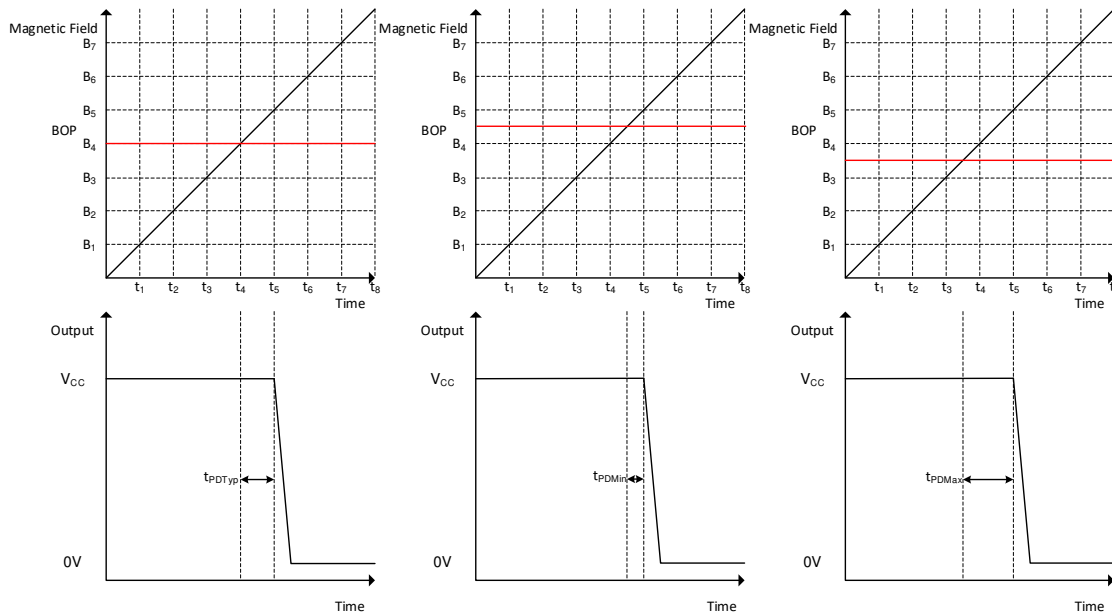
The TMAG5123 samples the Hall element at a nominal sampling interval of  $t_{PD}$  to detect the presence of a magnetic south or north pole. Between each sampling interval, the device calculates the average magnetic field applied to the device. If this average value crosses the  $B_{OP}$  or  $B_{RP}$  threshold, the device changes the corresponding level as defined in 图 8-3. The Hall sensor + magnet system is by nature asynchronous, therefore

the propagation delay ( $t_{PD}$ ) will vary depending on when the magnetic field goes above the  $B_{OP}$  value. As shown in 图 8-7, the output delay also depends on when the magnetic field goes above the  $B_{OP}$  value.

The first graph in 图 8-7 shows the typical case. The magnetic field goes above the  $B_{OP}$  value at the moment the output is updated. The part will only require one sampling period of  $t_{PD}$  to update the output.

The second graph in 图 8-7 shows a magnetic field going above the  $B_{OP}$  value just before half of the sampling period. This is the best-case scenario where the output is updated in just half of the sampling period.

Finally, the third graph in 图 8-7 shows the worst-case scenario where the magnetic field goes above the  $B_{OP}$  value just after half of the sampling period. At the next output update, the device will still see the magnetic field under the  $B_{OP}$  threshold and will require a whole new sampling period to update the output.



**图 8-7. Field Sampling Timing**

图 8-8 shows TMAG5123 propagation delay analysis when a magnetic south or north pole is applied. The Hall element of the TMAG5123 experiences an increasing magnetic field as a magnetic south or north pole approaches the device, as well as a decreasing magnetic field as a magnetic south or north pole moves away. At time  $t_1$ , the magnetic field goes above the  $B_{OP}$  threshold. The output will then start to move after the propagation delay ( $t_{PD}$ ). This time will vary depending on when the sampling period is, as shown in 图 8-7. At  $t_2$ , the output start pulling the output voltage Low. At  $t_3$ , the output is completely pulled down. The same process happens on the other way when the magnetic value is going under the  $B_{RP}$  threshold.

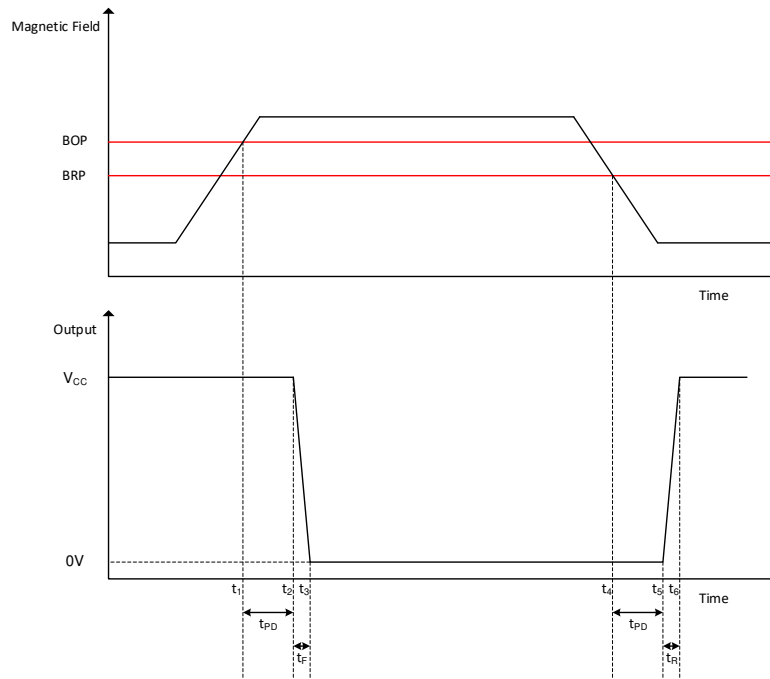


图 8-8. Propagation Delay

### 8.3.7 Chopper Stabilization

The Basic Hall-effect sensor consists of four terminals where a current is injected through two opposite terminals and a voltage is measured through the other opposite terminals. The voltage measured is proportional to the current injected and the magnetic field measured. By knowing the current injected, the device can then know the magnetic field strength. The problem is that the voltage generated is small in amplitude while the offset voltage generated is more significant. To create a precise sensor, the offset voltage must be minimized.

Chopper stabilization is one way to significantly minimize this offset. It is achieved by "spinning" the sensor and sequentially applying the bias current and measuring the voltage for each pair of terminals. This means that a measurement is completed once the spinning cycle is completed. The full cycle is completed after sixteen measurements. The output of the sensor is connected to an amplifier and an integrator that will accumulate and filter out a voltage proportional to the magnetic field present. Finally, a comparator will switch the output if the voltage reaches either the BOP or BRP threshold (depending on which state the output voltage was previously in).

The frequency of each individual measurement is referred as the Chopping frequency, or  $f_{\text{CHOP}}$ . The total conversion time is referred as the Propagation delay time,  $t_{\text{PD}}$ , and is basically equal to  $16/f_{\text{CHOP}}$ . Finally, the Signal bandwidth,  $f_{\text{BW}}$ , represents the maximum value of the magnetic field frequency, and is equal to  $(f_{\text{CHOP}}/16)/2$  as defined by the sampling theorem.

## 8.4 Device Functional Modes

The device operates in only one mode when operated within the [Recommended Operating Conditions](#).

## 9 Application and Implementation

### Note

以下应用部分中的信息不属于 TI 器件规格的范围，TI 不担保其准确性和完整性。TI 的客户应负责确定器件是否适用于其应用。客户应验证并测试其设计，以确保系统功能。

### 9.1 Application Information

The TMAG5123 is typically used in magnetic-field sensing applications to detect the proximity of a magnet that is in the "in-plane" axis from the sensor. The magnet is often attached to a movable component in the system.

The TMAG5123 is a Hall sensor that implements a Hall sensing element that senses parallel to the package of the part rather than through the z-axis of the device. This eases constraints in system design where a parallel magnetic field is needed to be detected, but normal industry packages, such as TO-92 are undesirable due to space constraints.

### 9.2 Typical Applications

#### 9.2.1 In-Plane Typical Application Diagrams

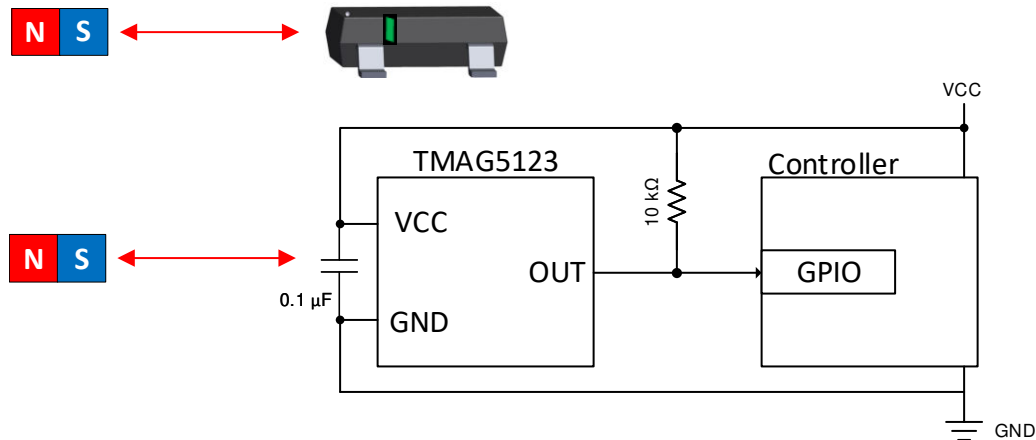


图 9-1. Typical In-Plane Sensing Diagram

### 9.2.1.1 Design Requirements

For this design example, use the parameters listed in one of the 3 tables below depending on which version of the device is used.

**表 9-1. Design Parameters for TMAG5123B**

| DESIGN PARAMETER                   | EXAMPLE VALUE                       |
|------------------------------------|-------------------------------------|
| V <sub>CC</sub>                    | 12V                                 |
| TMAG5123 Device                    | TMAG5123B                           |
| Magnet                             | 1-cm Cube NdFeB (N45)               |
| Minimum Magnet Distance to Operate | 2.8 cm ( $\pm 6$ mT) with BOP Max   |
| Maximum Magnet Distance to Release | 8.4 cm ( $\pm 0.3$ mT) with BRP Min |

**表 9-2. Design Parameters for TMAG5123C**

| DESIGN PARAMETER                   | EXAMPLE VALUE                        |
|------------------------------------|--------------------------------------|
| V <sub>CC</sub>                    | 12V                                  |
| TMAG5123 Device                    | TMAG5123C                            |
| Magnet                             | 1-cm Cube NdFeB (N45)                |
| Minimum Magnet Distance to Operate | 2.33 cm ( $\pm 9.5$ mT) with BOP Max |
| Maximum Magnet Distance to Release | 3.44 cm ( $\pm 3.5$ mT) with BRP Min |

**表 9-3. Design Parameters for TMAG5123D**

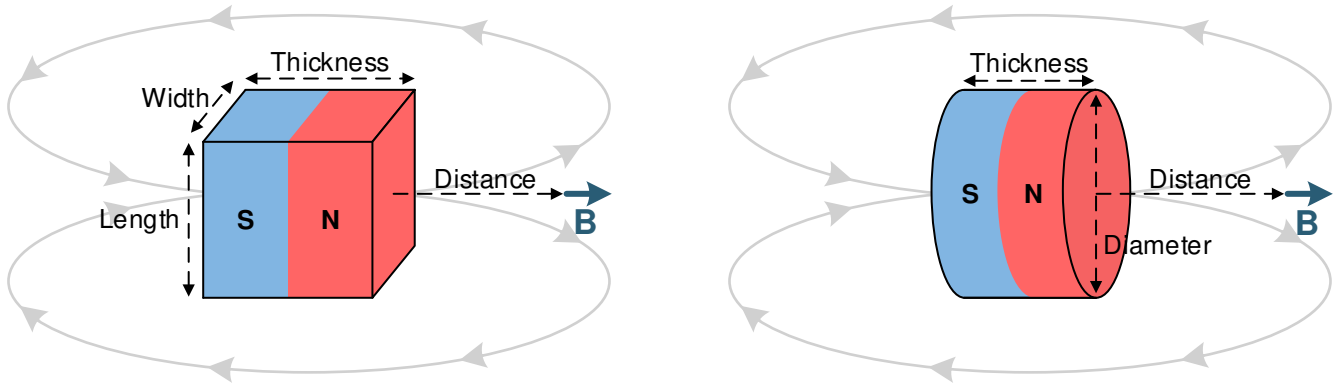
| DESIGN PARAMETER                   | EXAMPLE VALUE                        |
|------------------------------------|--------------------------------------|
| V <sub>CC</sub>                    | 12V                                  |
| TMAG5123 Device                    | TMAG5123D                            |
| Magnet                             | 1-cm Cube NdFeB (N45)                |
| Minimum Magnet Distance to Operate | 2.04 cm ( $\pm 13$ mT) with BOP Max  |
| Maximum Magnet Distance to Release | 2.68 cm ( $\pm 6.7$ mT) with BRP Min |

### 9.2.1.2 Detailed Design Procedure

When designing a digital-switch magnetic sensing system, three variables should always be considered: the magnet, sensing distance, and threshold of the sensor.

The TMAG5123 device has a detection threshold specified by parameter B<sub>OP</sub>, which is the amount of magnetic flux required to pass through the Hall sensor mounted inside the TMAG5123. To reliably activate the sensor, the magnet must apply a flux greater than the maximum specified B<sub>OP</sub>. In such a system, the sensor typically detects the magnet before it has moved to the closest position, but designing to the maximum parameter ensures robust turn-on for all possible values of B<sub>OP</sub>. When the magnet moves away from the sensor, it must apply less than the minimum specified B<sub>RP</sub> to reliably release the sensor.

Magnets are made from various ferromagnetic materials that have tradeoffs in cost, drift with temperature, absolute maximum temperature ratings, remanence or residual induction (B<sub>r</sub>), and coercivity (H<sub>c</sub>). The B<sub>r</sub> and the dimensions of a magnet determine the magnetic flux density (B) it produces 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.



**图 9-2. Rectangular Block and Cylinder Magnets**

Use 方程式 1 for the rectangular block shown in 图 9-2:

$$\vec{B} = \frac{B_r}{\pi} \left( \arctan \left( \frac{WL}{2D\sqrt{4D^2 + W^2 + L^2}} \right) - \arctan \left( \frac{WL}{2(D+T)\sqrt{4(D+T)^2 + W^2 + L^2}} \right) \right) \quad (1)$$

Use 方程式 2 for the cylinder shown in 图 9-2:

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

where

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

An online tool, the *Hall Effect Switch Magnetic Field Calculator*, that uses these formulas is located at <http://www.ti.com/product/tmag5123>.

All magnetic materials generally have a lower  $B_r$  at higher temperatures. Systems should have margin to account for this, as well as for mechanical tolerances.

For the TMAG5123B, the maximum BOP is 4.5 mT. Choosing a 1-cm cube NdFeB N45 magnet, Equation 1 shows that this point occurs at 3.05 cm. This means that, provided the design places the magnet within 3.05 cm from the sensor during a "turn-on" event, the magnet will activate the sensor. The removal of the magnet away from the device will ensure a crossing of the minimum BRP point and will return the device to its initial state.

### 9.2.1.3 Application Curve

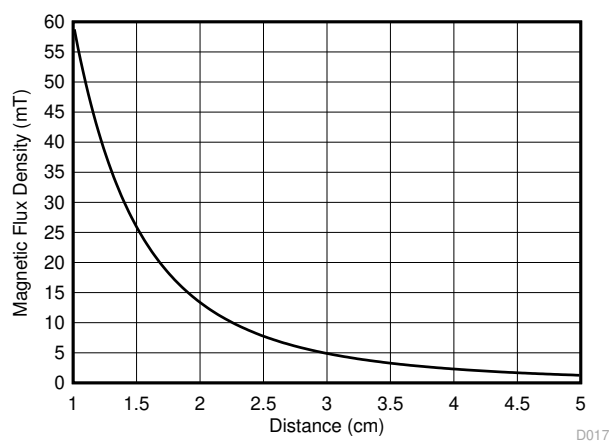


图 9-3. Magnetic Profile of a 1-cm Cube NdFeB Magnet

## 10 Power Supply Recommendations

The TMAG5123 is powered from 2.5-V to 38-V DC power supplies. 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  $\mu\text{F}$ .

## 11 Layout

### 11.1 Layout Guidelines

The bypass capacitor should be placed near the TMAG5123 to reduce noise.

Generally, using PCB copper planes underneath the TMAG5123 device has no effect on magnetic flux, and does not interfere with device performance. This is because copper is not a ferromagnetic material. However, If nearby system components contain iron or nickel, they may redirect magnetic flux in unpredictable ways.

### 11.2 Layout Example

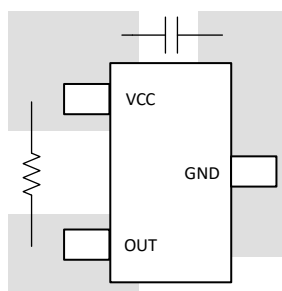


图 11-1. TMAG5123 Layout Example

## 12 Device and Documentation Support

### 12.1 接收文档更新通知

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### 12.2 支持资源

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### 12.5 术语表

[TI 术语表](#) 本术语表列出并解释了术语、首字母缩略词和定义。

## 13 Mechanical, Packaging, and Orderable Information

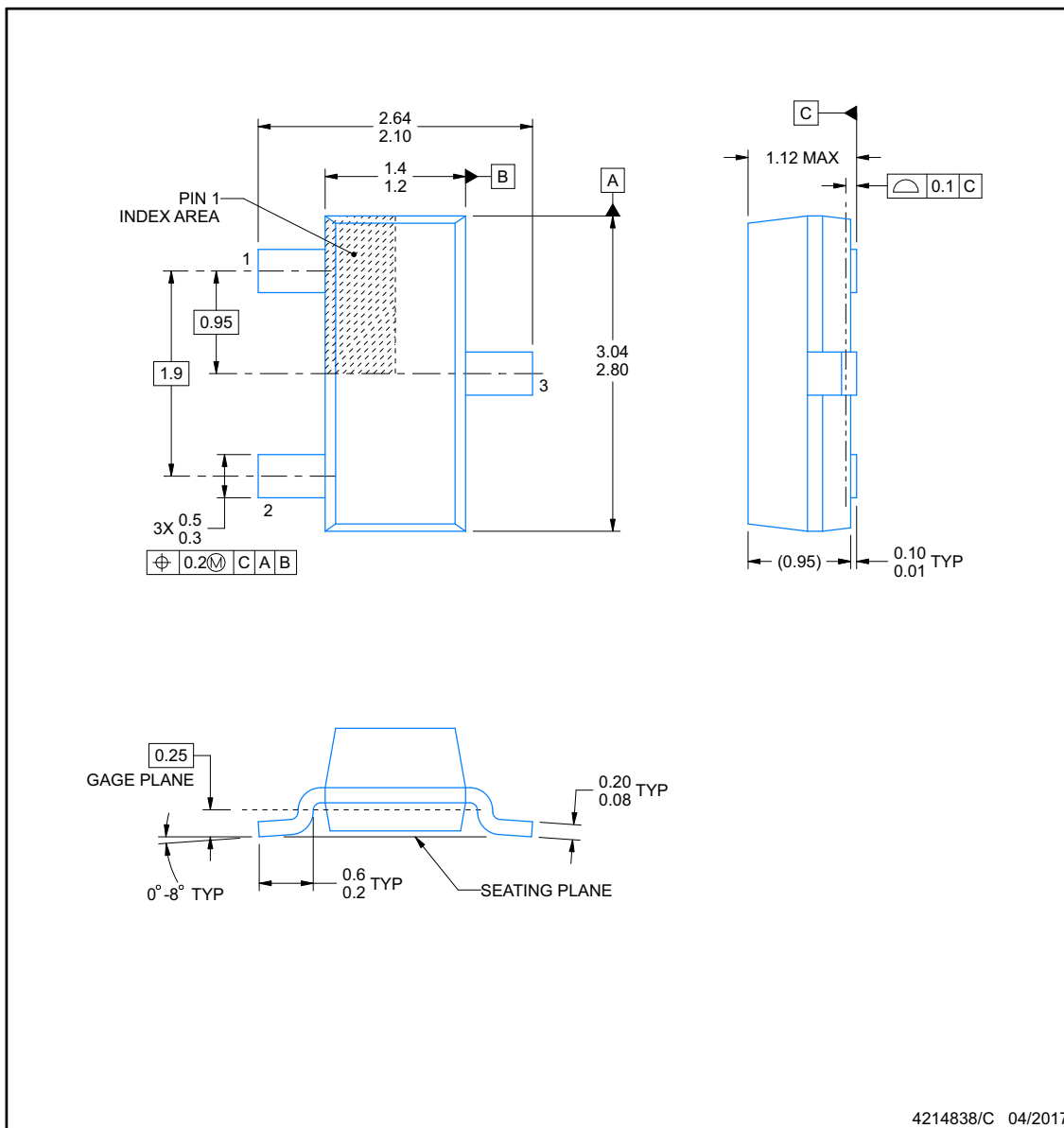
The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand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



**DBZ0003A**

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

SMALL OUTLINE TRANSISTOR

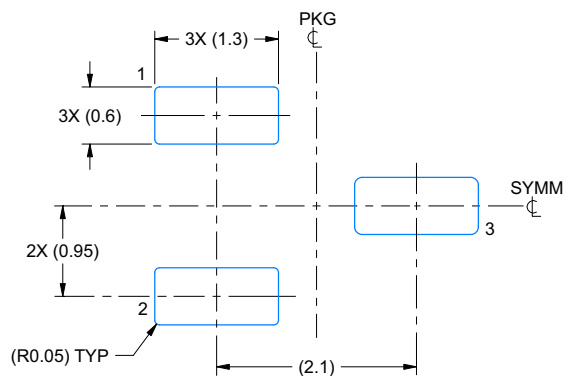


**NOTES:**

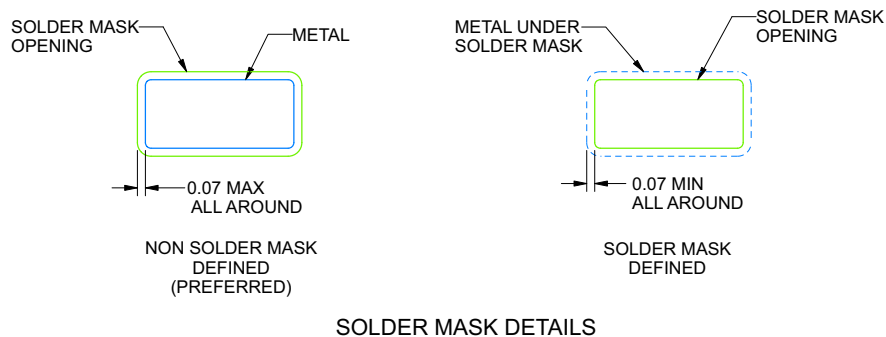
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-236, except minimum foot length.

**EXAMPLE BOARD LAYOUT****DBZ0003A****SOT-23 - 1.12 mm max height**

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
SCALE:15X



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NOTES: (continued)

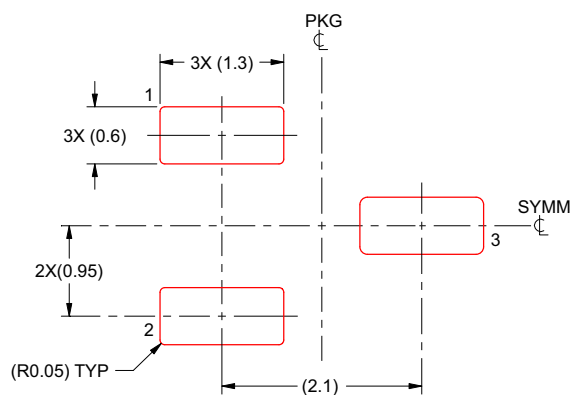
4. Publication IPC-7351 may have alternate designs.
5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

**DBZ0003A**

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

SMALL OUTLINE TRANSISTOR



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

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NOTES: (continued)

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

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| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| TMAG5123B1CQDBZR | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | SN                                   | Level-3-260C-168 HR  | -40 to 125   | 23B1                    | <a href="#">Samples</a> |
| TMAG5123C1CQDBZR | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | SN                                   | Level-3-260C-168 HR  | -40 to 125   | 23C1                    | <a href="#">Samples</a> |
| TMAG5123D1CQDBZR | ACTIVE        | SOT-23       | DBZ                | 3    | 3000           | RoHS & Green    | SN                                   | Level-3-260C-168 HR  | -40 to 125   | 23D1                    | <a href="#">Samples</a> |

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(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.

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- Automotive : [TMAG5123-Q1](#)

NOTE: Qualified Version Definitions:

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

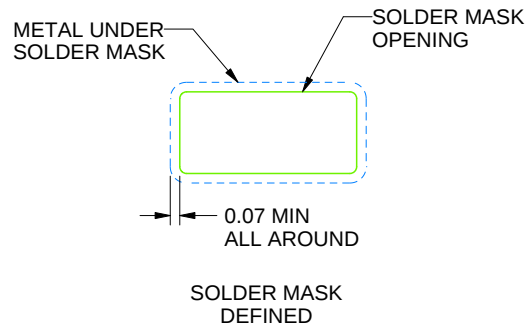
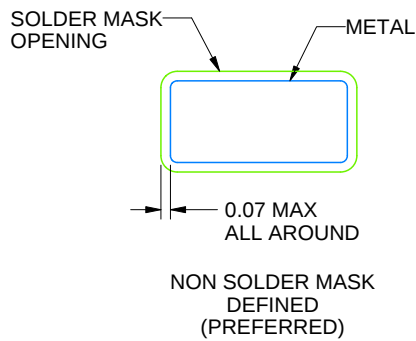
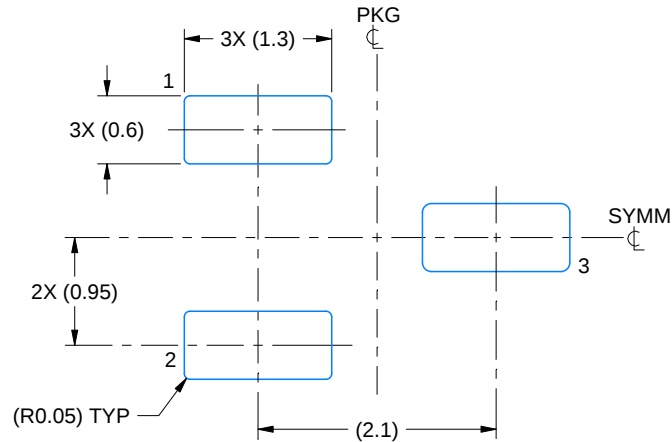


# EXAMPLE BOARD LAYOUT

DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER MASK DETAILS

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NOTES: (continued)

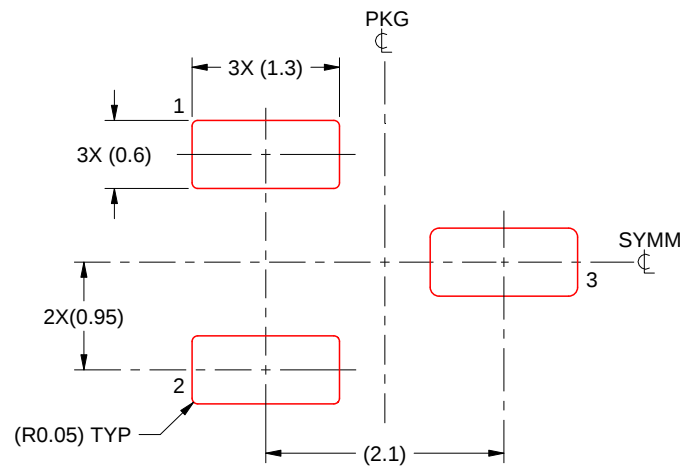
4. Publication IPC-7351 may have alternate designs.
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# EXAMPLE STENCIL DESIGN

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)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
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