Texas Instruments

TMAG5131-Q1
ZHCSQO5B – APRIL 2023 – REVISED FEBRUARY 2024

TMAG5131-Q1 汽车类、低功耗、高精度、霍尔效应开关

1 特性

- 符合面向汽车应用的 AEC-Q100 标准：
  - 温度等级 1：–40°C 至 +125°C，T_A
- Z 轴霍尔效应开关
- 超低功耗（典型 $I_{CC(AVG)}$）：
  - 10Hz 版本：在 3V 时为 1.25µA
  - 20Hz 版本：在 3V 时为 1.37µA
- 工作 V_{CC} 范围：1.65V 至 5.5V
- 高精度磁性阈值（典型 B_{OP}）：
  - 具有 0.6mT 迟滞的 1.8mT
  - 具有 1.2mT 或 1.5mT 迟滞的 3mT
- 全极和单极磁响应
- 推挽或开漏输出选项
- 低电平有效或高电平有效输出选项
- 业界通用 SOT-23 (DBZ) 封装

2 应用

- 车门把手和电子门锁
- 转向柱换挡杆
- 遮阳板、化妆镜或手套箱亮起
- 后备箱的开合传感器
- 雨刮器电机位置传感器
- 制动踏板或后灯执行器
- 天窗和尾门
- 电动座椅和摇臂开关
- 汽车车身电机位置反馈

3 说明

TMAG5131-Q1 是一款超低功耗、低电压、高精度霍尔效应传感器，专为紧凑型和电池关键型汽车应用而设计。该器件提供多种磁性阈值、采样率和输出类型，适用于各种应用。

当施加的磁通量密度超过工作点 (B_{OP}) 阈值时，器件会输出低电压（对于低电平有效版本）。输出会保持低电平，直到磁通密度降至低于释放点 (B_{RP})，随后器件输出高电压。对于高电平有效版本，输出（低电平/高电平）行为被反转。全极磁响应使器件输出能够通过封装的 Z 轴对正负磁通量敏感，而单极版本仅响应正磁通量。

TMAG5131-Q1 在内部进行下电上电，从而以超低的电流消耗运行。在 3V 电压下，10Hz 版本的平均电流消耗为 1.25μA，20Hz 版本消耗 1.37μA。

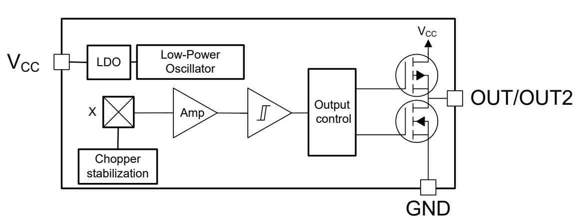
TMAG5131-Q1 采用业界通用的 SOT-23 封装和引脚排列。

该器件可在 1.65V 至 5.5V 的 V_{CC} 范围以及 –40°C 至 125°C 的更大工作温度范围内运行。

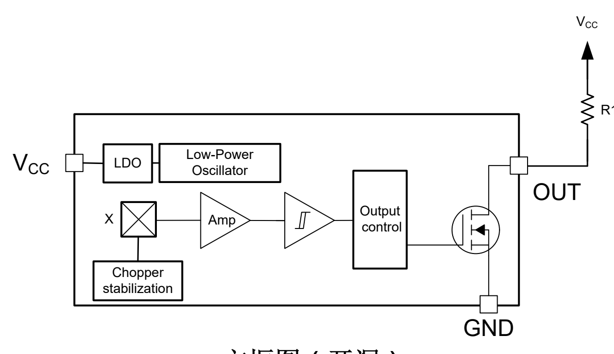
封装信息

器件型号	封装(1) (2)	封装尺寸(3)
TMAG5131-Q1	DBZ（SOT-23，3）	2.92mm x 2.37mm

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。
(2) 请参阅*器件比较*表。
(3) 封装尺寸（长 × 宽）为标称值，并包括引脚（如适用）。



方框图（推挽）



方框图（开漏）

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4 Device Comparison

表 4-1. Device Comparison

VERSION	TYPICAL THRESHOLD	TYPICAL HYSTERESIS	MAGNETIC RESPONSE	OUTPUT TYPE	SENSOR ORIENTATION	SAMPLING RATE	PACKAGES AVAILABLE
TMAG5131A1C	1.8mT	0.6mT	Omnipolar Active Low	Push-pull	Z	10Hz	SOT-23
TMAG5131C1D	3mT	1.5mT	Omnipolar Active Low	Push-pull	Z	20Hz	SOT-23
TMAG5131C5D	3mT	1.2mT	Unipolar Active High	Push-pull	Z	20Hz	SOT-23
TMAG5131C7D	3mT	1.5mT	Omnipolar Active Low	Open-drain	Z	20Hz	SOT-23

5 Pin Configuration and Functions

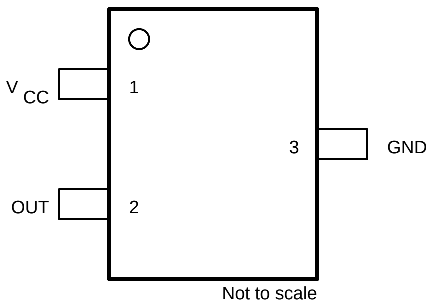


图 5-1. DBZ Package 3-Pin SOT-23 (Top View): A1C, C1D, C7D Versions

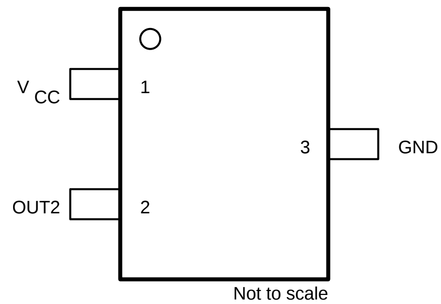


图 5-2. DBZ Package 3-Pin SOT-23 (Top View): C5D Version

表 5-1. Pin Functions

PIN			TYPE(1)	DESCRIPTION
NAME	SOT-23 (A1C, C1D, C7D)	SOT-23 (C5D)		
V_{CC}	1	1	—	1.65V to 5.5V power supply. TI recommends connecting this pin to a ceramic capacitor to ground with a value of at least 0.1μF.
OUT	2		O	Omnipolar output that responds to north and south magnetic poles near the top of the package
OUT2		2	O	Unipolar output that responds to south magnetic poles near the top of the package
GND	3	3	—	Ground reference

(1) O = output

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	5.5	V
Output pin voltage	OUT, OUT2	GND – 0.3	V_{CC} + 0.3	V
Output pin current	OUT, OUT2	–5	5	mA
Magnetic flux density, BMAX		Unlimited		T
Junction temperature, T_J			150	°C
Storage temperature, T_{stg}		–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
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins[1]	±2000	V
		Charged device model (CDM), per ANSI/ESDA/JEDEC JS-002, all pins[2]	± 500	

(1) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250V 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	1.65	5.5	V
V_O	Output voltage	0	5.5	V
I_O	Output current	–5	5	mA
T_A	Ambient temperature	–40	125	°C

6.4 Thermal Information

THERMAL METRIC[1]		TMAG5131-Q1 SOT-23 (DBZ) 3 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	227.4	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	122.7	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	61.2	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	21.3	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	60.8	°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} = 1.65V to 5.5V, over operating free-air temperature range (unless otherwise noted)

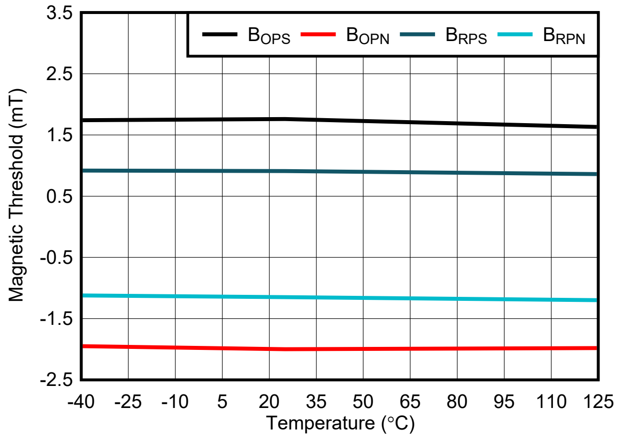
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
OPEN-DRAIN OUTPUT						
I_{OZ}	High impedance output leakage current	V_{CC} = 5.5V, OUT = 5.5V		5	100	nA
V_{OL}	Low-level output voltage	I_{OUT} = 1mA		0.1	0.3	V
PUSH-PULL OUTPUT DRIVER						
V_{OH}	High-level output voltage	I_{OUT} = -0.5mA	Vcc-0.35	Vcc-0.1		V
V_{OL}	Low-level output voltage	I_{OUT} = 0.5mA		0.1	0.3	V
A1C VERSION						
f_s	Frequency of magnetic sampling		7	10	14.5	Hz
t_s	Period of magnetic sampling		68	100	143	ms
$I_{CC(AVG)}$	Average current consumption	V_{CC} = 3V Temperature = 25°C		1.25	1.6	µA
		V_{CC} = 3V Temperature = -40°C to 125°C		1.25	2.2	µA
C1D, C5D, C7D VERSIONS						
f_s	Frequency of magnetic sampling		13	20	29	Hz
t_s	Period of magnetic sampling		35	50	77	ms
$I_{CC(AVG)}$	Average current consumption	V_{CC} = 3V Temperature = 25°C		1.37	2.1	µA
		V_{CC} = 3V Temperature = -40°C to 125°C		1.37	2.7	µA
ALL VERSIONS						
$I_{CC(PK)}$	Peak current consumption		0.8	1.25	2	mA
$I_{CC(SLP)}$	Sleep current consumption			0.8	1.4	µA
t_{ON}	Power-on time			55	100	µs
t_{ACTIVE}	Active time period		20	30	40	µs

6.6 Magnetic Characteristics

for VCC = 1.65V to 5.5V, over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
A1C VERSION						
B_{OP}	Magnetic operate point	Temperature = 25°C	±1.2	±1.8	±2.5	mT
		Temperature = –40°C to 125°C	±0.9	±1.8	±2.7	mT
B_{RP}	Magnetic release point	Temperature = 25°C	±0.5	±1.2	±1.5	mT
		Temperature = –40°C to 125°C	±0.3	±1.2	±2	mT
B_{HYS}	Magnetic hysteresis	Temperature = 25°C	±0.3	±0.6	±1.4	mT
		Temperature = –40°C to 125°C	±0.2	±0.6	±1.4	mT
C1D, C7D VERSIONS						
B_{OP}	Magnetic operate point	Temperature = 25°C	±2.4	±3	±3.8	mT
		Temperature = –40°C to 125°C	±2	±3	±4	mT
B_{RP}	Magnetic release point	Temperature = 25°C	±0.8	±1.5	±1.9	mT
		Temperature = –40°C to 125°C	±0.5	±1.5	±2.4	mT
B_{HYS}	Magnetic hysteresis	Temperature = 25°C	±1.2	±1.5	±2.4	mT
		Temperature = –40°C to 125°C	±1	±1.5	±2.5	mT
C5D VERSION						
B_{OP}	Magnetic operate point	Temperature = 25°C	2.4	3	3.6	mT
		Temperature = –40°C to 125°C	2	3	3.8	mT
B_{RP}	Magnetic release point	Temperature = 25°C	1.2	1.8	2.3	mT
		Temperature = –40°C to 125°C	1	1.8	2.6	mT
B_{HYS}	Magnetic hysteresis	Temperature = 25°C	0.7	1.2	1.7	mT
		Temperature = –40°C to 125°C	0.6	1.2	2	mT

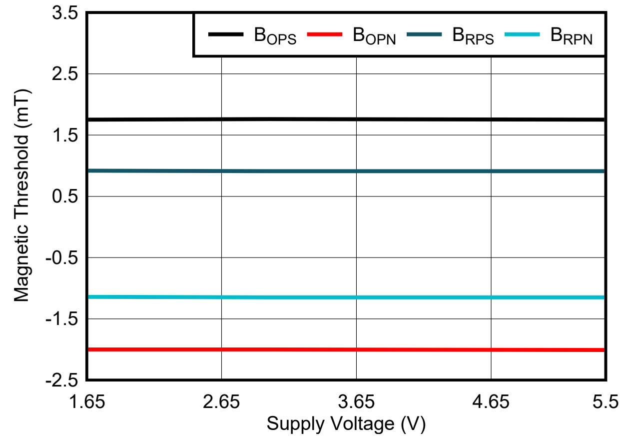
6.7 Typical Characteristics



V_{CC} = 3V

Version: A1C

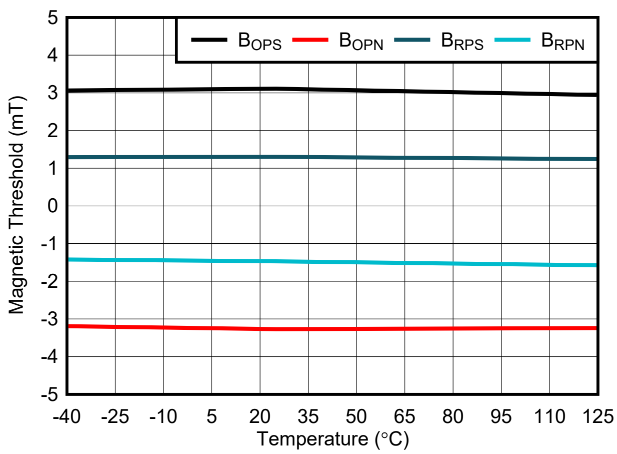
图 6-1. 1.8mT B_{OP}: Thresholds vs Temperature



T_A = 25°C

Version: A1C

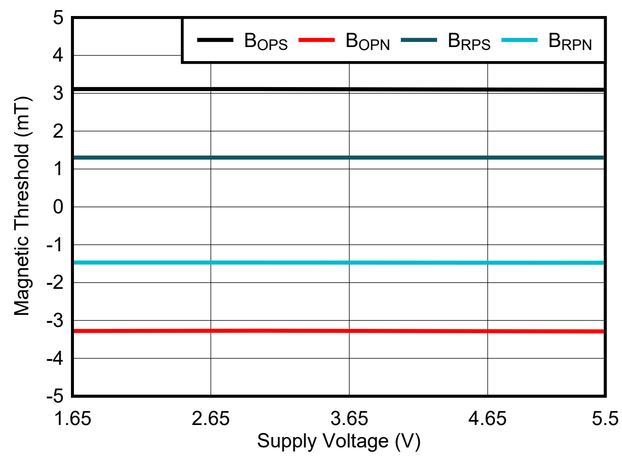
图 6-2. 1.8mT B_{OP}: Thresholds vs Supply Voltage



V_{CC} = 3V

Versions: C1D, C7D

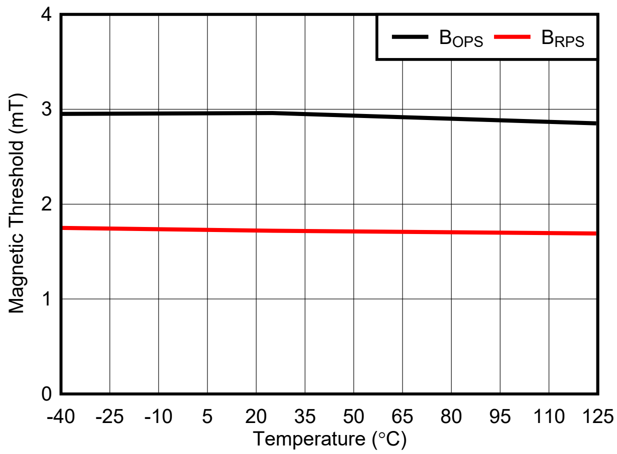
图 6-3. 3mT B_{OP}, 1.5mT B_{HYS}: Thresholds vs Temperature



T_A = 25°C

Versions: C1D, C7D

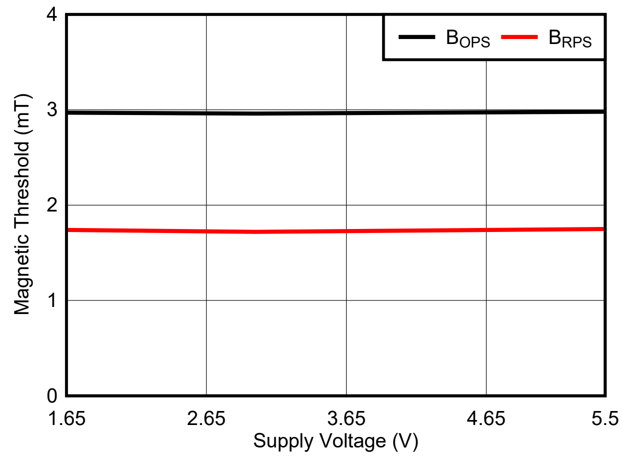
图 6-4. 3mT B_{OP}, 1.5mT B_{HYS}: Thresholds vs Supply Voltage



V_{CC} = 3V

Version: C5D

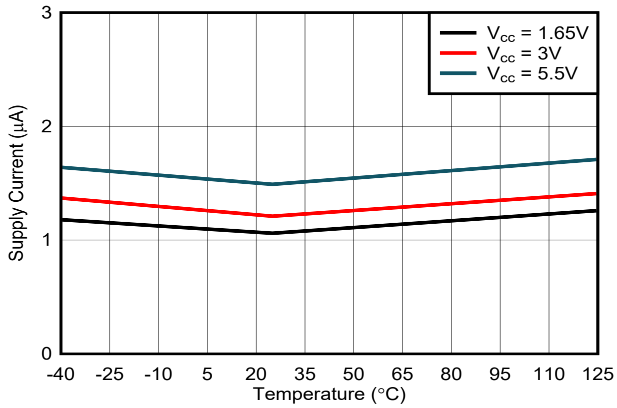
图 6-5. 3mT B_{OP}, 1.2mT B_{HYS}: Thresholds vs Temperature



T_A = 25°C

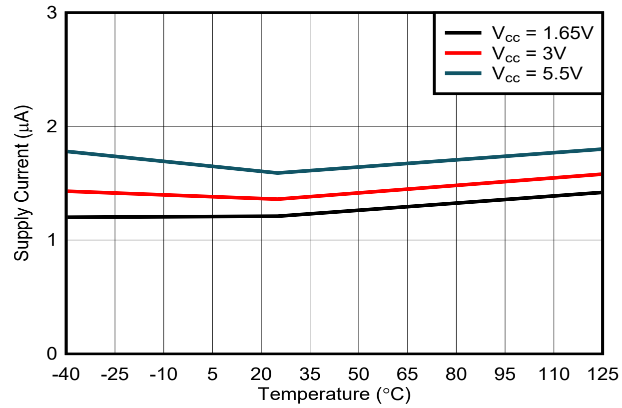
Version: C5D

图 6-6. 3mT B_{OP}, 1.2mT B_{HYS}: Thresholds vs Supply Voltage



Version: A1C

图 6-7. 10Hz: Average I_{CC} vs Temperature



Versions: C1D, C5D, C7D

图 6-8. 20Hz: Average I_{CC} vs Temperature

7 Detailed Description

7.1 Overview

The TMAG5131-Q1 device is a Z-axis Hall-effect sensor with a digital output that indicates when the magnetic flux density threshold has been crossed. The output type is available in a push-pull or open-drain configuration, and can be either active-low (outputs low when B_{OP} has been crossed) or active-high (outputs high when B_{OP} has been crossed). The magnetic output response of the device is available as an omnipolar or unipolar switch. The device integrates a Hall-effect element, analog signal conditioning, and a low-frequency oscillator that enables ultra-low power consumption. To achieve this low power consumption, the device periodically measures the magnetic flux density, updates its output, and then enters into a low-power sleep state in between measurements. With a temperature range of –40°C to 125°C and a supply range of 1.65V to 5.5V, the TMAG5131-Q1 is designed for a wide range of applications, including those that require low power operation.

7.2 Functional Block Diagrams

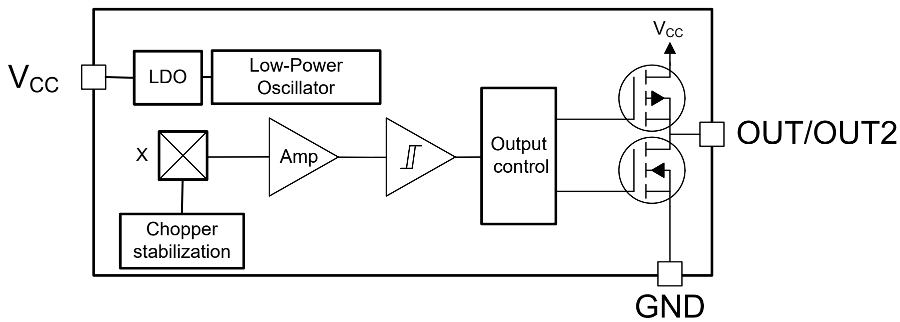


图 7-1. Block Diagram (Push-Pull)

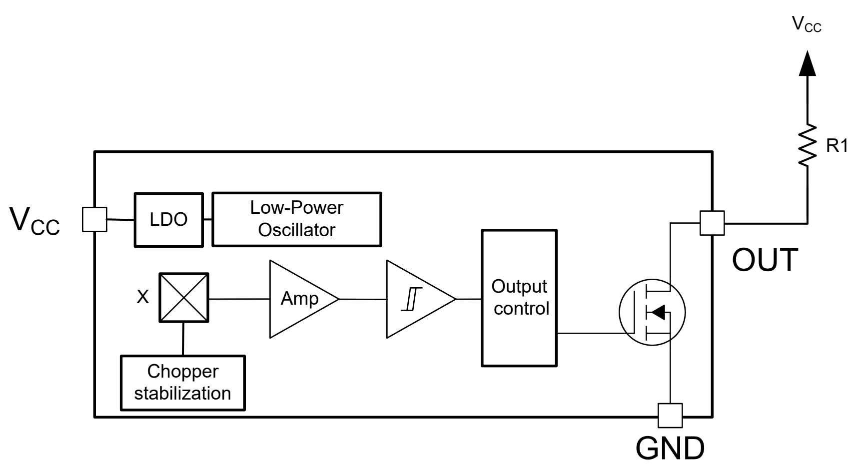


图 7-2. Block Diagram (Open-Drain)

7.3 Feature Description

7.3.1 Magnetic Flux Direction

图 7-3 shows that the TMAG5131-Q1 device is sensitive to the magnetic field component that is perpendicular to the top of the package.

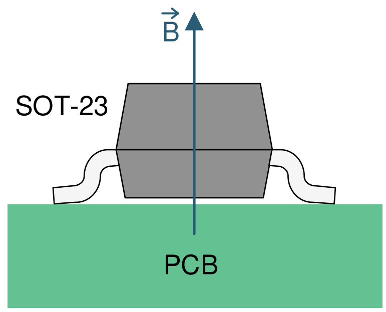


图 7-3. Direction of Sensitivity

Magnetic flux that travels from the bottom to the top of the package is considered positive in this data sheet. This condition exists when a south magnetic pole is near the top of the package. Magnetic flux that travels from the top to the bottom of the package is considered negative in this data sheet. This condition exists when a north magnetic pole is near the top of the package.

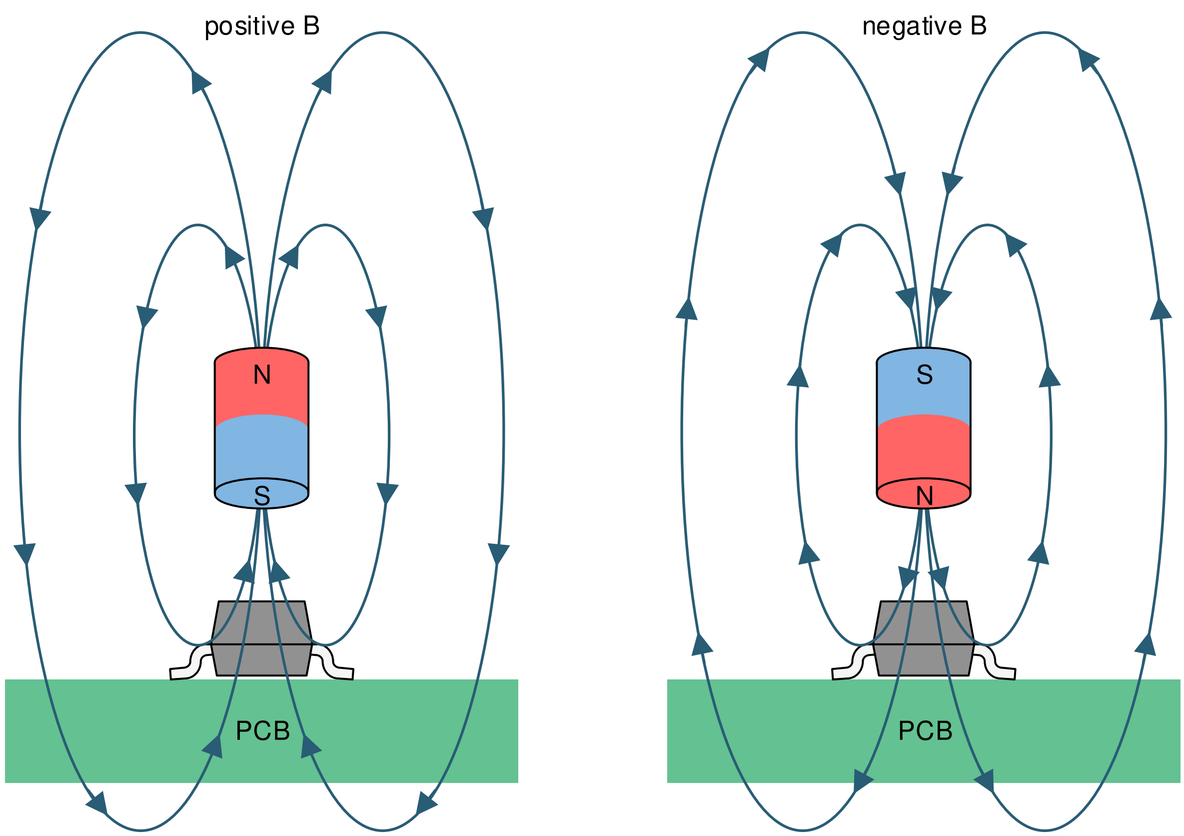


图 7-4. Flux Direction Polarity

7.3.2 Magnetic Response

The TMAG5131-Q1 A1C, C1D, and C7D versions have an omnipolar magnetic response and an active low output. 图 7-5 shows that the onmipolar output responds to both positive and negative magnetic flux, and goes low when B_{OP} is crossed.

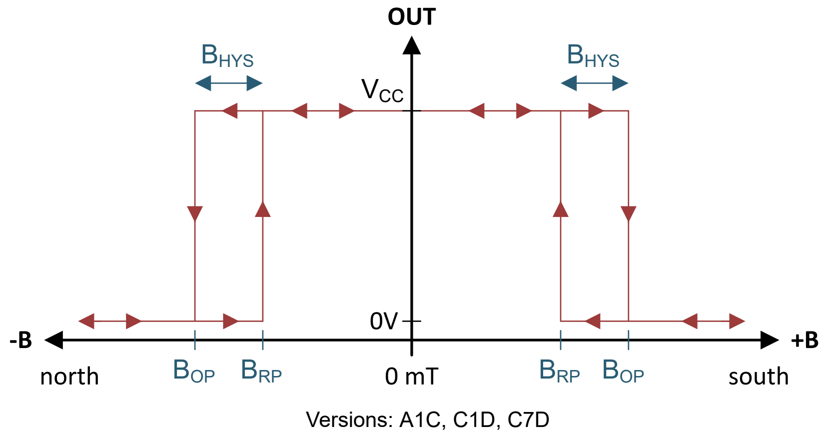


图 7-5. Omnipolar Active Low Functionality

The TMAG5131-Q1 C5D version has a unipolar magnetic response and an active high output. 图 7-6 shows that the unipolar output responds to a positive magnetic flux, and goes high when B_{OP} is crossed.

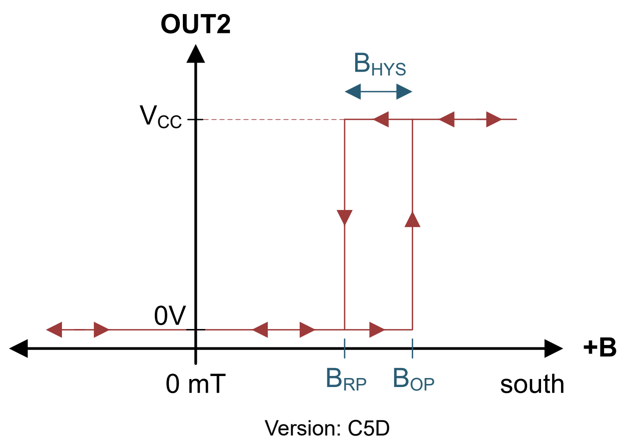


图 7-6. Unipolar Active High Functionality

7.3.3 Output Type

The TMAG5131-Q1 A1C, C1D, and C5D versions have a push-pull CMOS output which can drive a V_{CC} or ground voltage level.

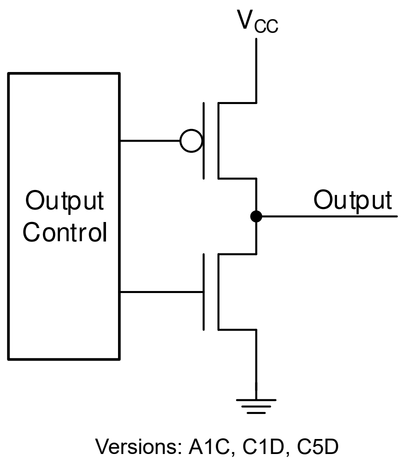


图 7-7. Push-Pull Output (Simplified)

The C7D version has an open-drain output. For this open-drain output version, an external pullup resistor must be used. Use 方程式 1 to calculate the minimum resistance value required for this pullup resistor. Use 1mA as the I_{OL} maximum for this device to achieve the V_{OL} maximum specification listed in the data sheet. Generally, TI recommends to use a resistor with a 10kΩ nominal value.

$$R_1 > \frac{V_{ref}}{I_{OL\ max}} \quad (1)$$

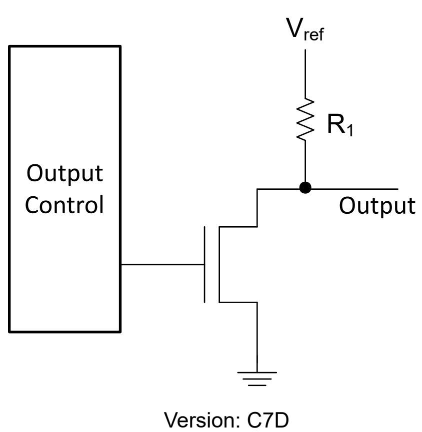


图 7-8. Open-Drain Output (Simplified)

7.3.4 Sampling Rate

When the TMAG5131-Q1 powers up, the device measures the first magnetic sample and sets the output within the t_{ON} time. The output is latched, and the device enters an ultra low power sleep state. After each t_S time has passed, the device measures a new sample and updates the output if necessary. If the magnetic field has not changed between periods, the output also does not change.

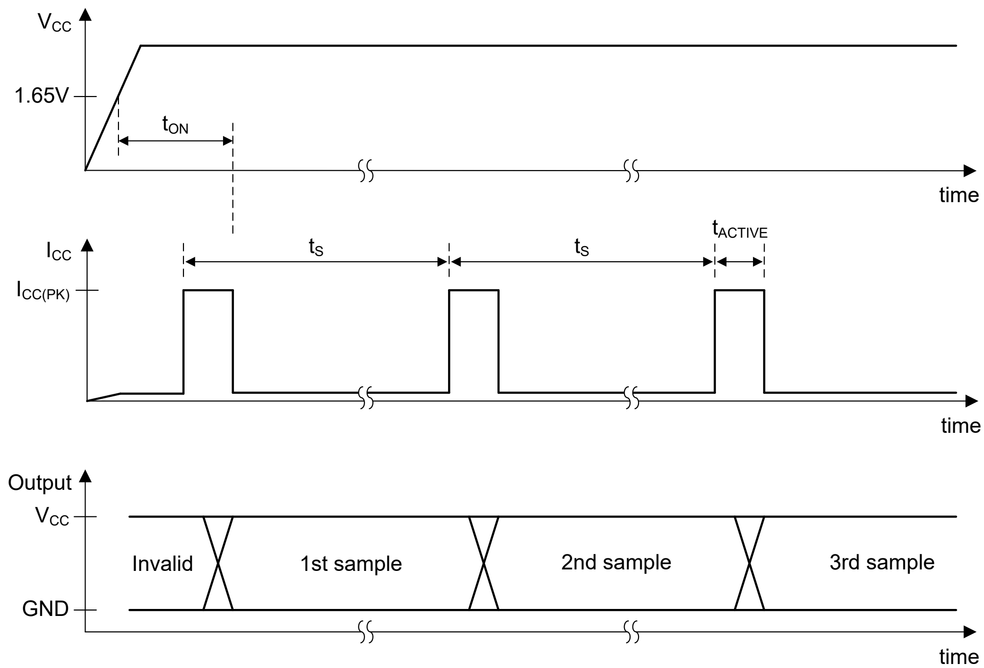


图 7-9. Timing Diagram

7.3.5 Hall Element Location

The sensing element inside the device is in the center of the SOT-23 package when viewed from the top. 图 7-10 shows the tolerances and side-view dimensions.

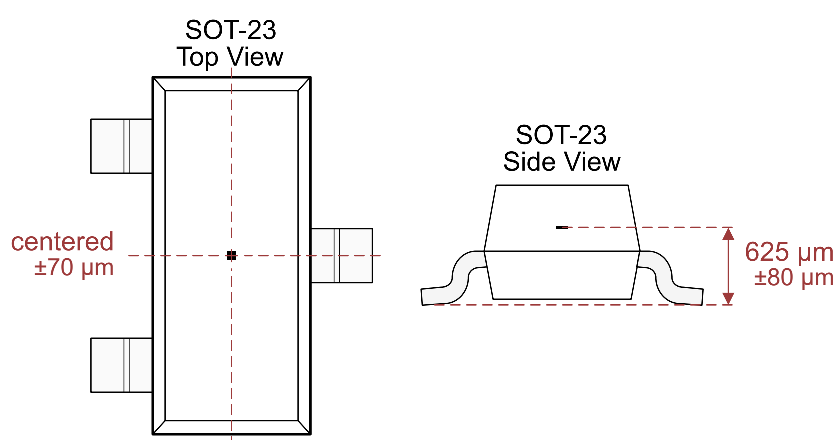


图 7-10. Hall Element Location

7.4 Device Functional Modes

The TMAG5131-Q1 device has one mode of operation that applies when operated within the *Recommended Operating Conditions*.

8 Application and Implementation

备注

以下应用部分中的信息不属于 TI 元件规格，TI 不担保其准确性和完整性。TI 的客户负责确定元件是否适合其用途，以及验证和测试其设计实现以确认系统功能。

8.1 Application Information

The TMAG5131-Q1 device is typically used to detect the proximity of a magnet. The magnet is often attached to a movable component in the system.

8.1.1 Defining the Design Implementation

The first step of the design is identifying the general design implementation. Define whether the magnet that needs to be detected is sliding past the sensor, moving head-on toward the sensor, or swinging toward the sensor on a hinge. 图 8-1 shows examples for each of the aforementioned design implementations.

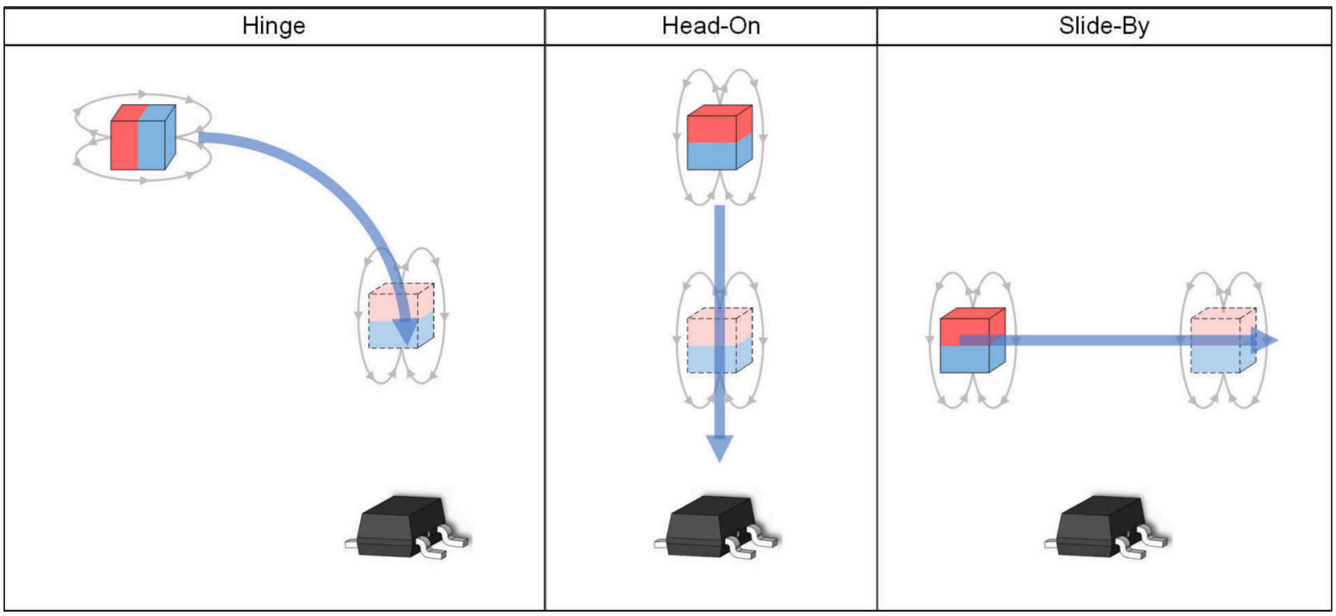


图 8-1. Design Implementations

With each implementation, the objective is to design the system such that the spatial coordinates of the transition region fall within the spatial coordinates associated with the B_{OP} maximum and B_{RP} minimum specifications. 图 8-2 shows a head-on example that shows how the location corresponding to the device B_{OPMAX} and B_{RPMIN} fall within the desired transition region. To facilitate rapid design iteration, TI's *Magnetic Sense Simulator (TIMSS)* webtool is leveraged in the following design examples.

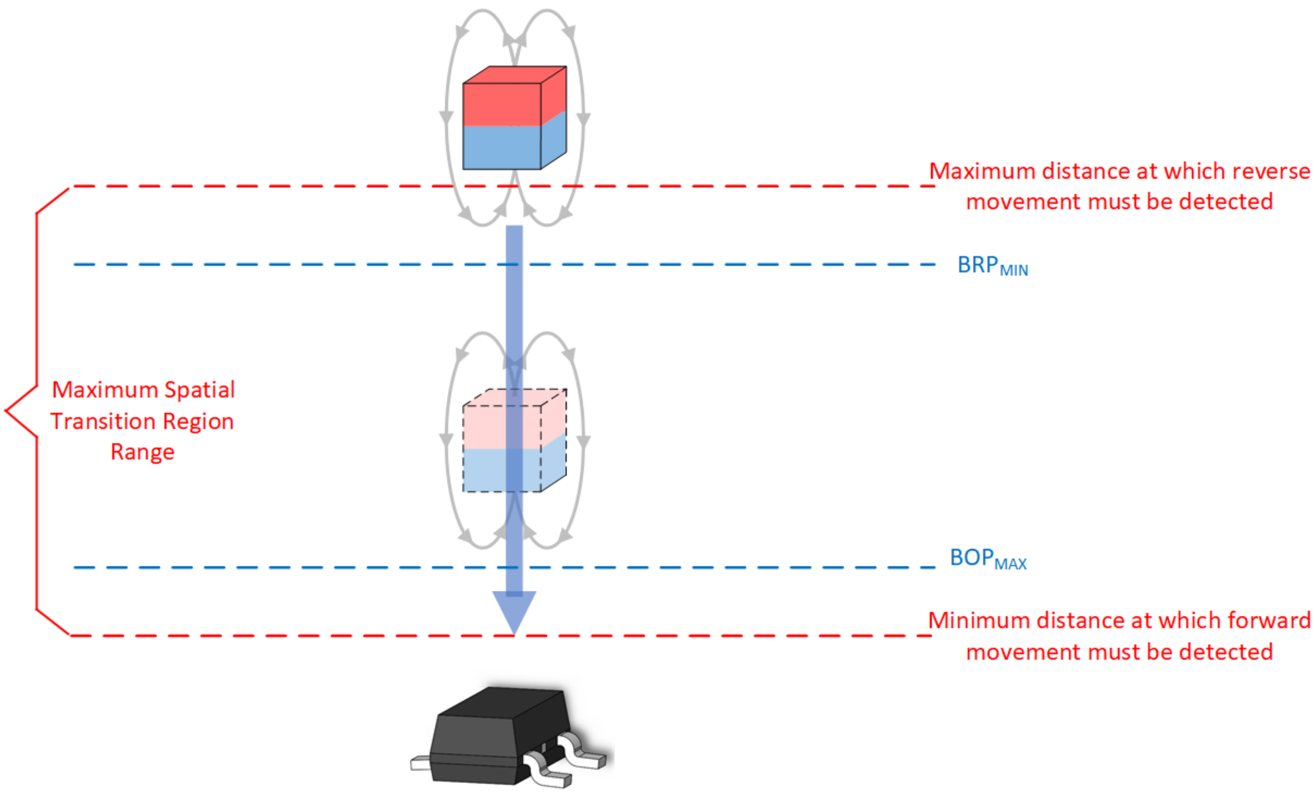


图 8-2. Head-On Example

8.2 Typical Applications

8.2.1 Hinge

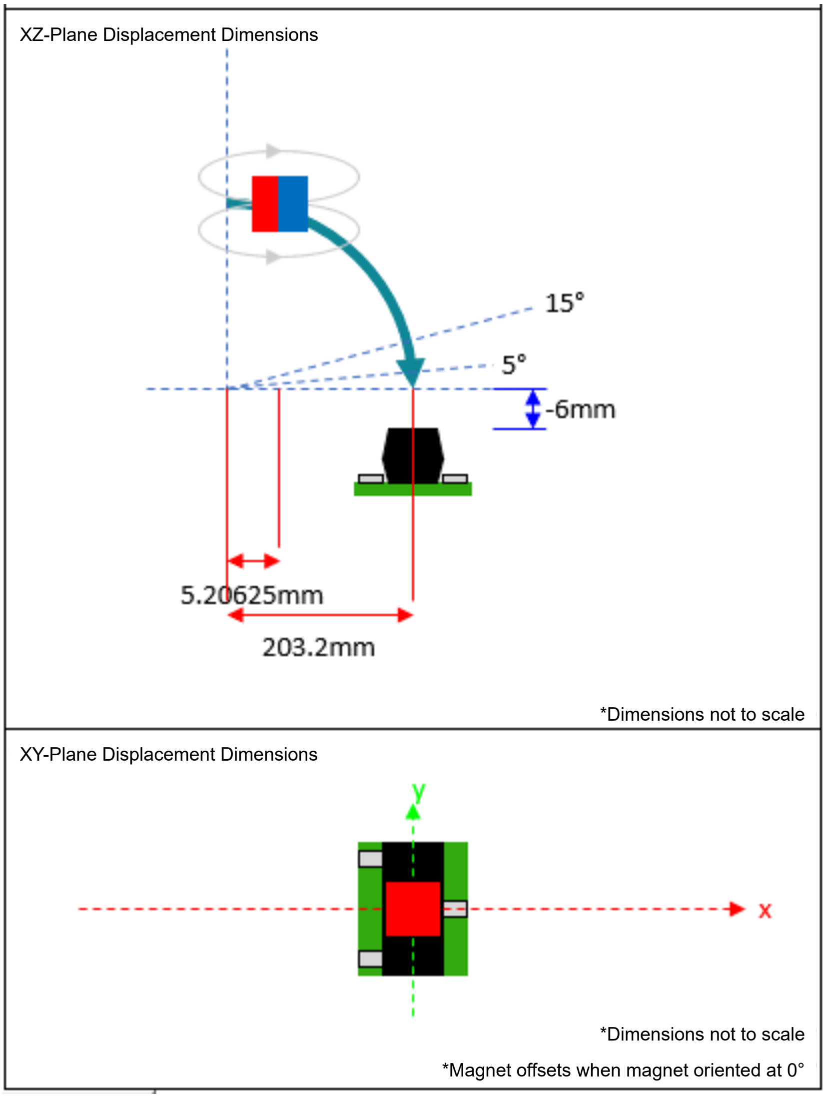


图 8-3. Typical Application Diagram

8.2.1.1 Design Requirements

表 8-1 lists the design parameters for this example.

表 8-1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
V_{CC}	3.3V
Switch Region	5° to 15°
Max Magnet Height	9.525mm (⅜ inch)
Max Magnet Width or Length	25.4mm (1 inches)
Fixture Width	304.8mm (12 inches)
Fixture Length	228.6mm (9 inches)
Sensor Distance from Hinge Origin	6mm (0.23622 inch)

表 8-1. Design Parameters （续）

DESIGN PARAMETER	EXAMPLE VALUE
Center of Magnet Offset from Hinge Origin	⩾ (6mm – Magnet Height/2)

8.2.1.2 Detailed Design Procedure

Due to the complex non-linear behavior magnets and the number of variables that can influence it, some experimentation is required to solve for a design that will work. This application uses a simple axial, dipole, block magnet. Users can consider other shapes for different field strengths or prices. A neodymium type of magnet (N52) is used. At the time of this writing, N52 can be commonly found with heights of 1/16", 1/8", 3/16", and 1/4". As price often increases with size, the first design attempt will be with a 1/16" thick magnet, which has a width and length equal to 0.25". Based on the sensor distance from hinge origin and fixture dimension constraints, there is a lot of flexibility on where the sensor can be placed. Due to other hardware within the fixture, the TMAG5131C1DQDBZRQ1 sensor is placed 203.2mm (8") from the origin. From there, the user can assess a design with the following displacement dimensions.

图 8-4 shows that the b-field magnitude for the TMAG5131C1DQDBZRQ1 is not adequate for the spatial constraints of 5° and 15°, as the B_Z magnitude only surpasses the B_{RP} minimum. There are a few options on how to proceed. As the $B_{OP(Max)}$ does not fall within our range, the user must increase field strength. This can be accomplished with a thicker magnet or by adjusting sensor and magnet z-offsets. The magnet cannot get any closer due to enclosure constraints, therefore the only option allowed is to increase the magnet thickness. After a few more iterations with the tool, a 0.25" × 0.25" × 0.375" magnet can work (see 图 8-5 and 图 8-6).

8.2.1.3 Application Curves

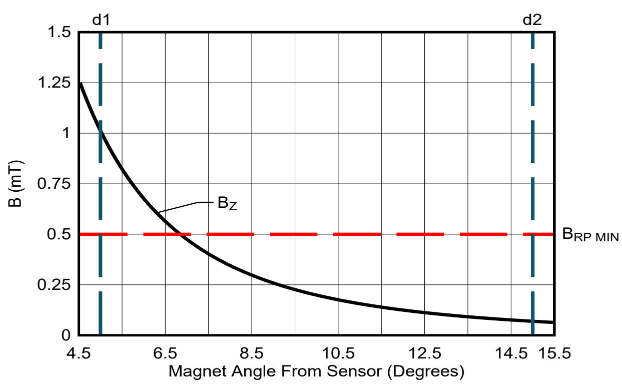


图 8-4. B-Field Hypothesis One

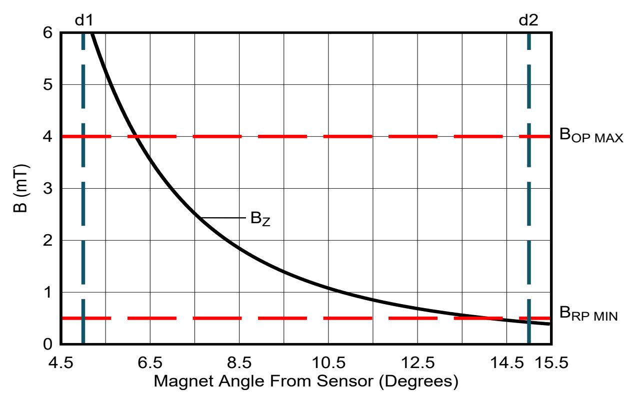


图 8-5. B-Field Hypothesis Two

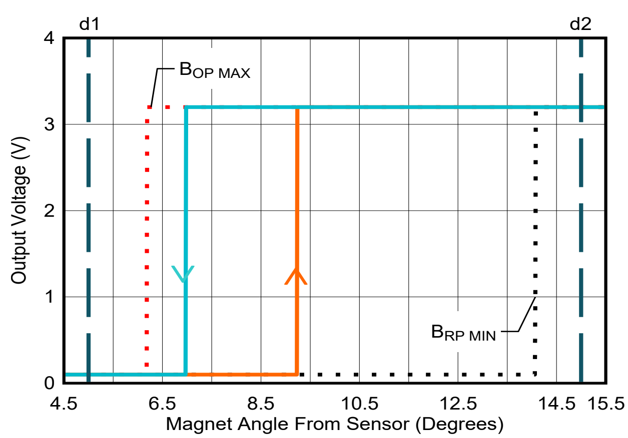


图 8-6. Thresholds From Hypothesis Two

8.2.2 Head-On

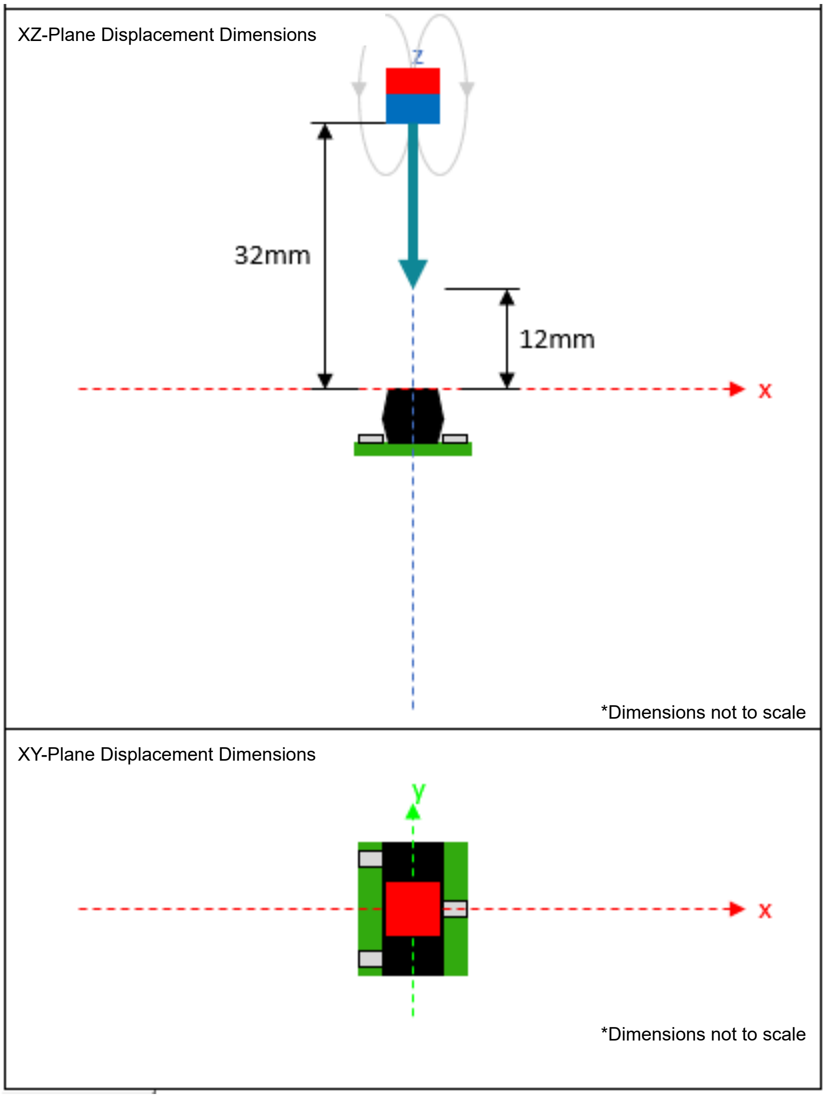


图 8-7. Typical Application Diagram

8.2.2.1 Design Requirements

表 8-2 lists the design parameters for this example.

表 8-2. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
V_{CC}	3.3V
Switch Region	Between 10mm and 30mm from sensor fixture surface
Sensor Distance from Equipment Outer Surface	2mm (0.0787 inch)
Magnet Length	25.4mm (< 1 inch)
Magnet Width	25.4mm (< 1 inch)
Magnet Height	6.35mm (< 1/4 inch)
Magnet Type	N42

8.2.2.2 Detailed Design Procedure

In this particular case, there are several N42 magnets available from prior projects. As the desired transition region is where the magnet surface is at least 12mm (10mm + 2mm) away from the sensor, we try an initial design with one of our larger magnets (3/8" × 3/16" × 3/16"). 图 8-8 shows the respective curve for this magnet along the movement along with the magnetic thresholds of the TMAG5131C1DQDBZRQ1.

While the B_z magnitude adequately exceeds the B_{OPMAX}, the B_z does not quite reach the B_{RPMIN}. Therefore, the user must make some adjustments so that B_z falls below B_{RPMIN} within the desired operating range. To reduce B_z, there are a few options. The user can offset the magnet or choose a smaller magnet. After iterating through increasing x-offsets and y-offsets as well as decreasing magnet thicknesses, the user can eventually find a solution that works. In this case, a 3/8" × 3/16" × 1/16" N42 magnet with no x or y offset from the sensor center is used. 图 8-9 and 图 8-10 shows the curves corresponding to the final magnet parameters.

8.2.2.3 Application Curve

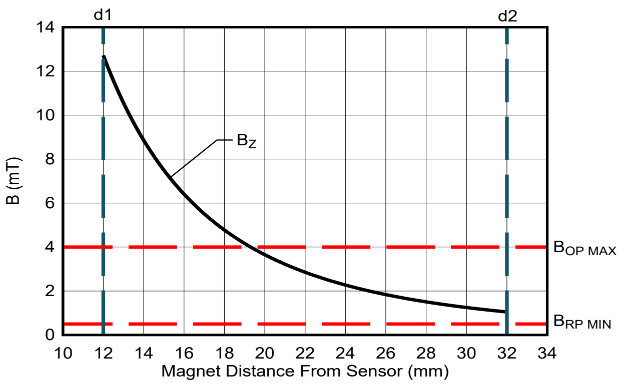


图 8-8. B-Field Hypothesis One

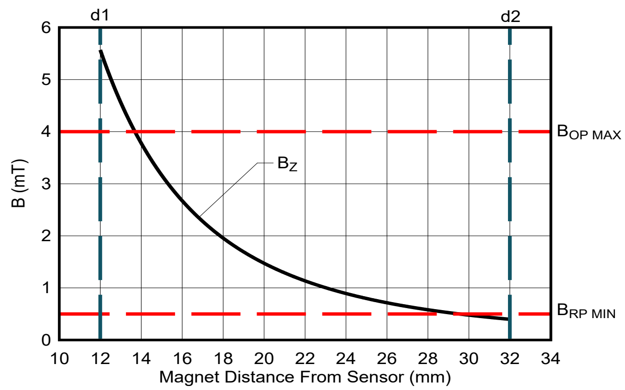


图 8-9. B-Field Hypothesis Two

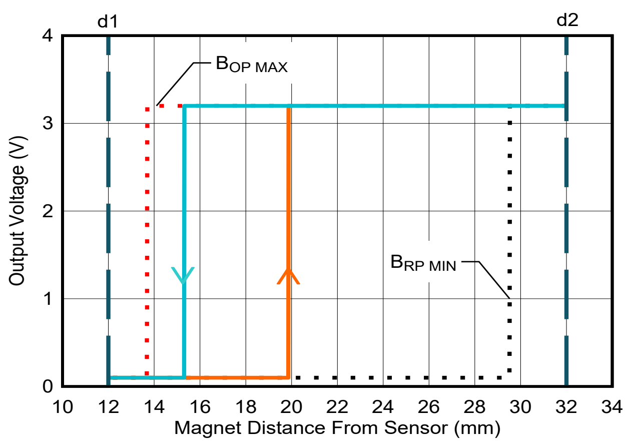


图 8-10. Thresholds From Hypothesis Two

8.2.3 Slide-By

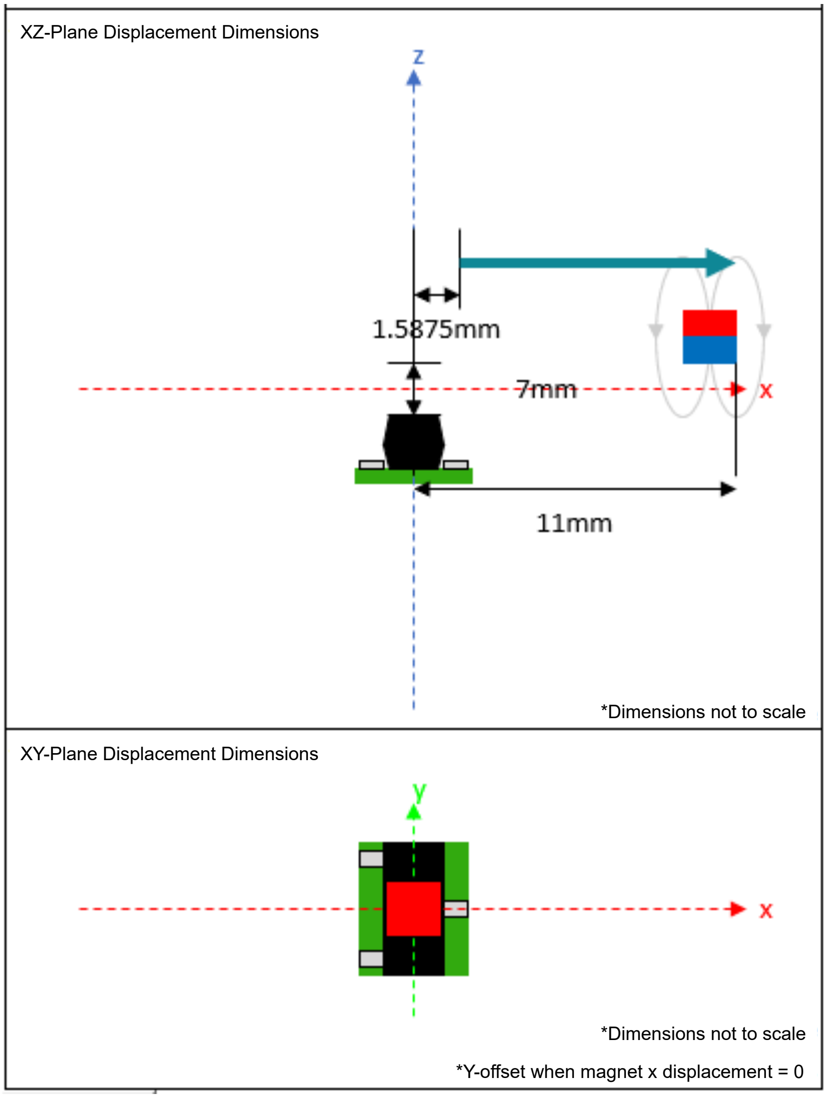


图 8-11. Typical Application Diagram

8.2.3.1 Design Requirements

表 8-3 lists the sign parameters for this example.

表 8-3. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
V_{CC}	3.3V
Magnet Range of Motion	11mm (< 0.433 inch)
Sensor Distance from Equipment Outer Surface	6mm (> 0.236 inch)
Magnet Length	12.7mm (< 1/2 inch)
Magnet Width	12.7mm (< 1/2 inch)
Magnet Height	3.175mm (< 1/8 inch)
Magnet Type	N42

8.2.3.2 Detailed Design Procedure

For this particular case involving the TMAG5131C1DQDBZRQ1, the user can arbitrarily start with a 1/8" × 1/8" × 1/16" magnet, a z-offset of 7mm (>6mm), and an initial displacement of one half of the magnet length (1/8"/2 = 1/16") and serendipitously get something that works (see 图 8-12 and 图 8-13). The right edge of the magnet cannot exceed 11mm, meaning the center of the magnet cannot exceed 9.4125mm (11 - 1.5875). Had the B-field not exceeded B_{OPMAX}, the user can try moving the magnet closer on the z-axis, made the magnet larger, or changed the magnet to one with higher permeability. Alternatively, if the b-field was too large, the magnet can be moved further away in each axis or a smaller magnet can be used.

8.2.3.3 Application Curve

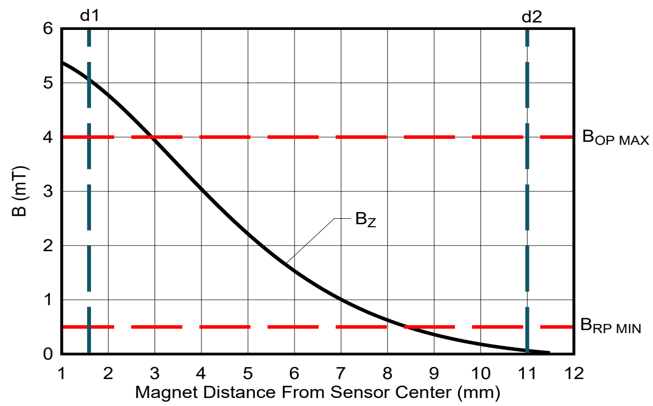


图 8-12. B-Field Hypothesis One

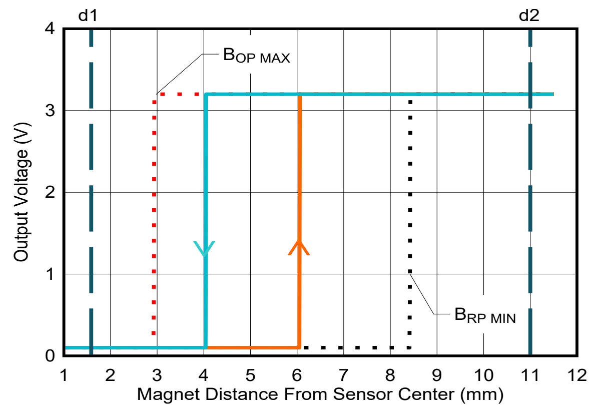


图 8-13. Thresholds From Hypothesis One

8.3 Power Supply Recommendations

The TMAG5131-Q1 device is powered from 1.65V to 5.5V 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 0.1µF.

8.4 Layout

8.4.1 Layout Guidelines

Magnetic fields pass through most non-ferromagnetic 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 (PCBs), which makes the placement of the magnet on the opposite side possible.

8.4.2 Layout Example

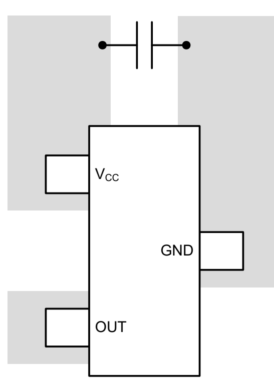


图 8-14. SOT-23 Layout Example

9 Device and Documentation Support

9.1 接收文档更新通知

要接收文档更新通知，请导航至 ti.com 上的器件产品文件夹。点击*通知* 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

9.2 支持资源

TI E2E™ 中文支持论坛是工程师的重要参考资料，可直接从专家处获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题，获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的使用条款。

9.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.
所有商标均为其各自所有者的财产。

9.4 静电放电警告

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

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

9.5 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。

10 Revision History

Changes from Revision A (February 2024) to Revision B (February 2024)	Page
• Changed 图 7-10	13

Changes from Revision * (April 2023) to Revision A (February 2024)	Page
• 将数据表状态从“预告信息”更改为：量产数据	1
• 向数据表中添加了 A1C 和 C5D 器件版本	1

11 Mechanical and Packaging 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.

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
TMAG5131A1CQDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 125	33EH	Samples
TMAG5131C1DQDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 125	32ZH	Samples
TMAG5131C5DQDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 125	33BH	Samples
TMAG5131C7DQDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 125	33AH	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

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

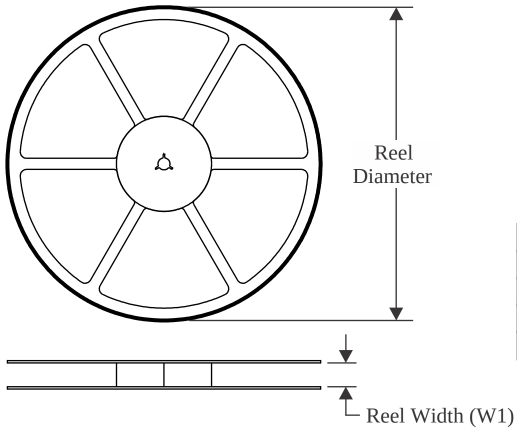
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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

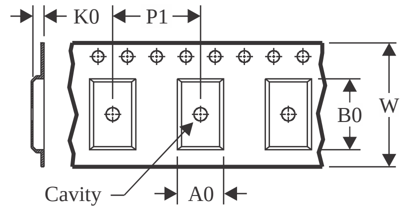
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

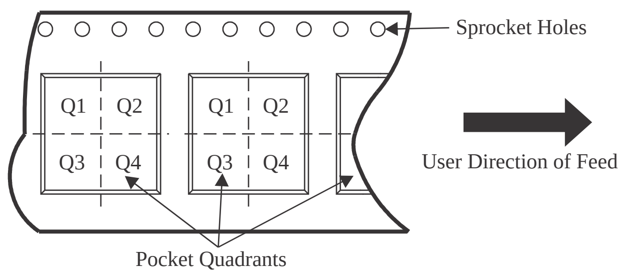


TAPE DIMENSIONS



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

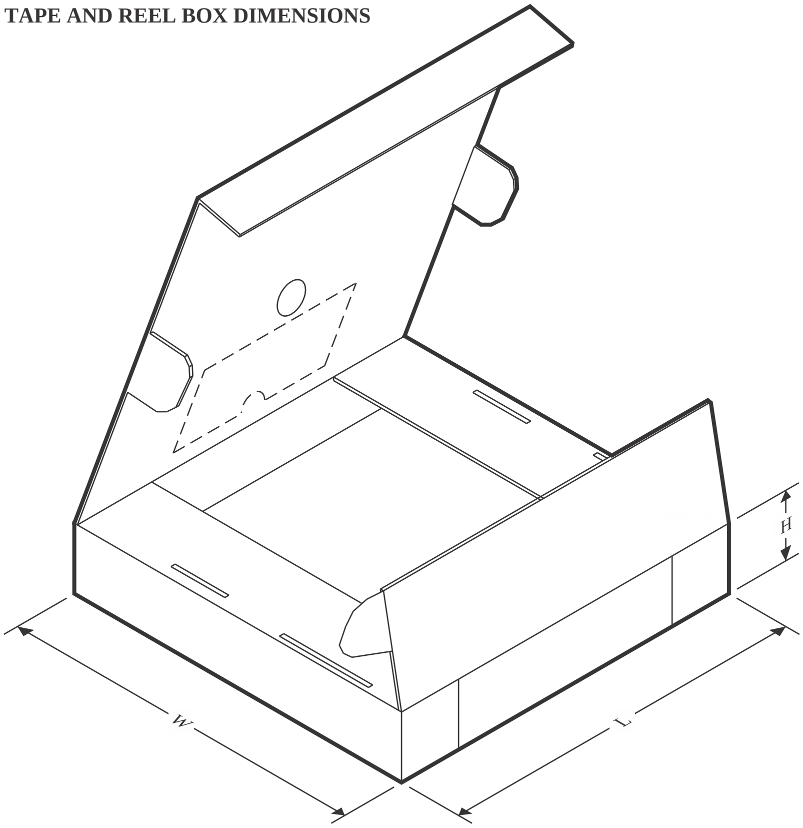
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

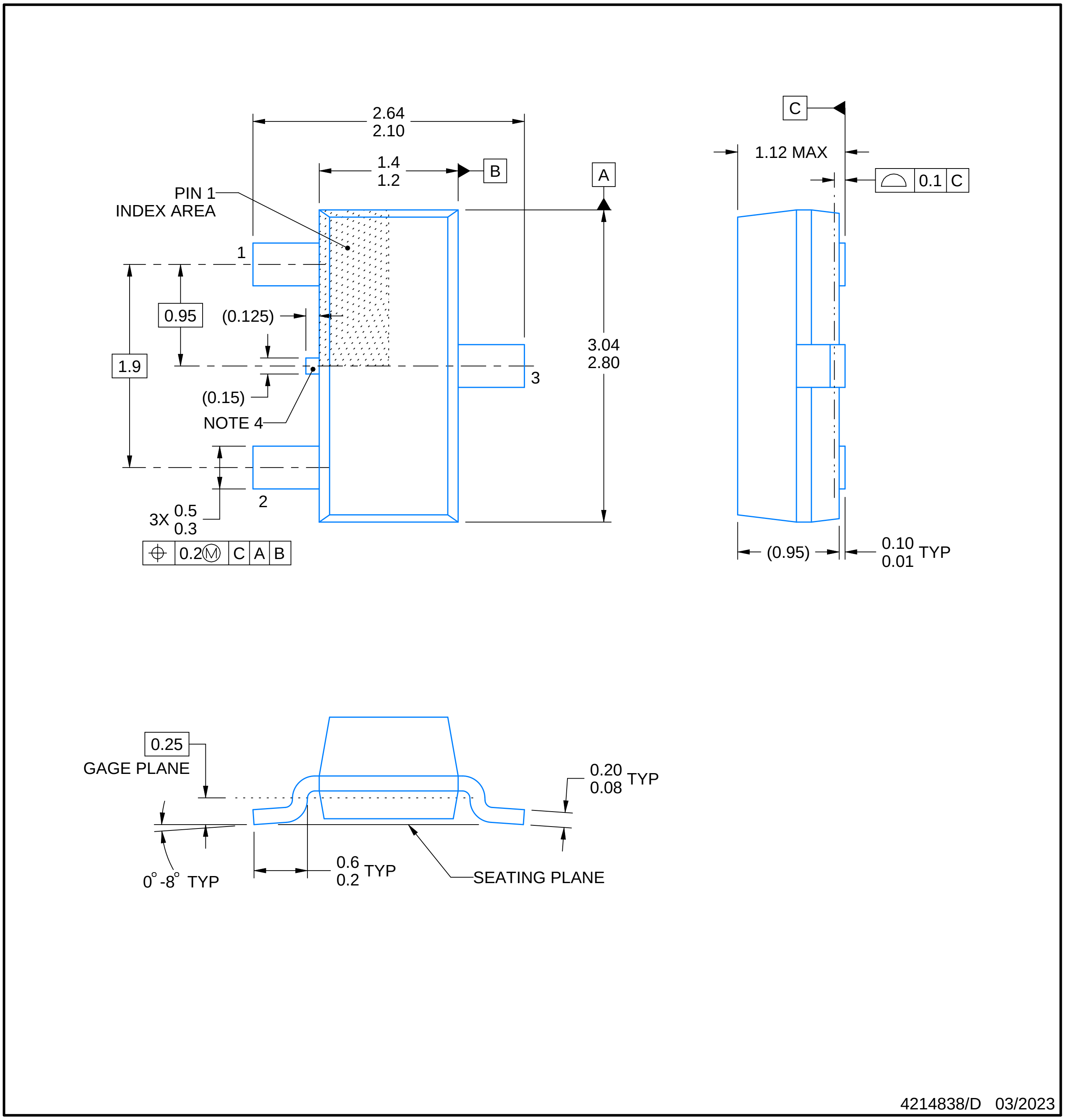
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TMAG5131A1CQDBZRQ1	SOT-23	DBZ	3	3000	180.0	8.4	3.2	2.85	1.3	4.0	8.0	Q3
TMAG5131C1DQDBZRQ1	SOT-23	DBZ	3	3000	180.0	8.4	3.2	2.85	1.3	4.0	8.0	Q3
TMAG5131C5DQDBZRQ1	SOT-23	DBZ	3	3000	180.0	8.4	3.2	2.85	1.3	4.0	8.0	Q3
TMAG5131C7DQDBZRQ1	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)
TMAG5131A1CQDBZRQ1	SOT-23	DBZ	3	3000	210.0	185.0	35.0
TMAG5131C1DQDBZRQ1	SOT-23	DBZ	3	3000	210.0	185.0	35.0
TMAG5131C5DQDBZRQ1	SOT-23	DBZ	3	3000	210.0	185.0	35.0
TMAG5131C7DQDBZRQ1	SOT-23	DBZ	3	3000	210.0	185.0	35.0



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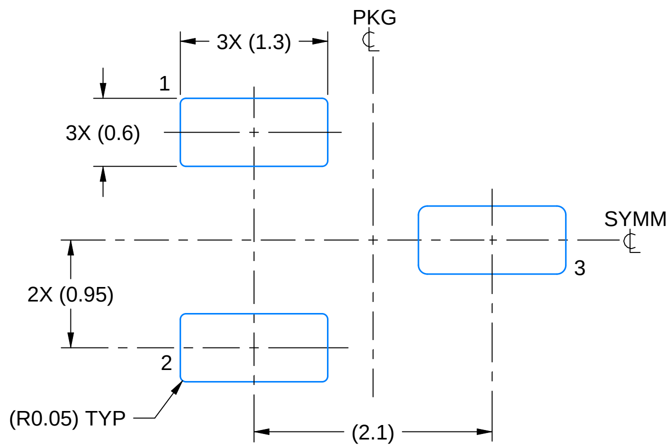
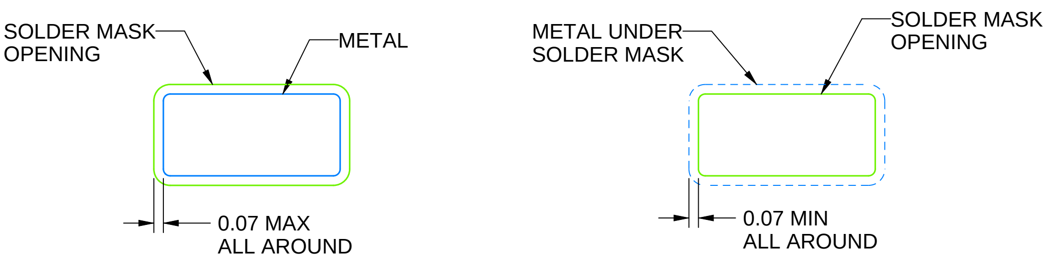
NOTES:

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.



LAND PATTERN EXAMPLE
SCALE:15X



NON SOLDER MASK
DEFINED
(PREFERRED)

SOLDER MASK
DEFINED

SOLDER MASK DETAILS

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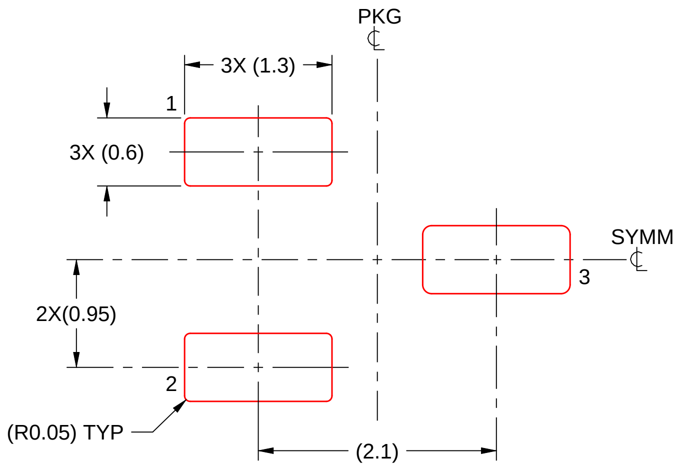
NOTES: (continued)

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



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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