DRV5011 低电压数字锁存器霍尔效应传感器

1 特性

- 超小型 X2SON、SOT-23、DSBGA 或 TO-92 封装
- 高磁性灵敏度：±2mT（典型值）
- 可靠磁滞：4mT（典型值）
- 快速感应带宽：30kHz
- V_{CC} 工作范围：2.5V 至 5.5V
- 推挽式 CMOS 输出
  – 支持 5mA 拉电流和 20mA 灌电流
- 工作温度：-40°C 至 +135°C

2 应用

- 无刷直流电机传感器
- 增量旋转编码：
  – 刷式直流电机反馈
  – 电机速度（转速计）
  – 机械行程
  – 流体测量
  – 旋钮转动
  – 轮速
- 电动自行车
- 流量计

3 说明

DRV5011 器件是一款数字锁存器霍尔效应传感器，专为电机和其他旋转系统而设计。

此器件具有工作电压范围为 2.5V 至 5.5V 的高效低电压架构，采用标准 SOT-23 封装以及薄型 X2SON、DSBGA 和 TO-92 封装。输出端采用推挽驱动器，无需使用上拉电阻器，使系统更加紧凑小巧。

当南磁极靠近封装顶部并且超出 B_{OP} 阈值时，该器件会驱动低电压。输出会保持低电平，直到应用北极并且超出 B_{RP} 阈值，这将使输出驱动高电压。必须交换北极和南极才能切换输出，且集成的磁滞会分开 B_{OP} 和 B_{RP} 以提供可靠切换。

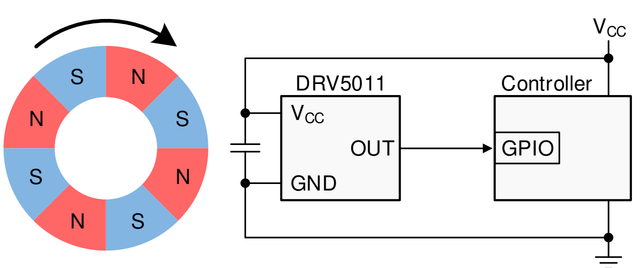
器件在 –40°C 至 +135°C 的宽环境温度范围内能够保持稳定一致的优异性能。

器件信息[1]

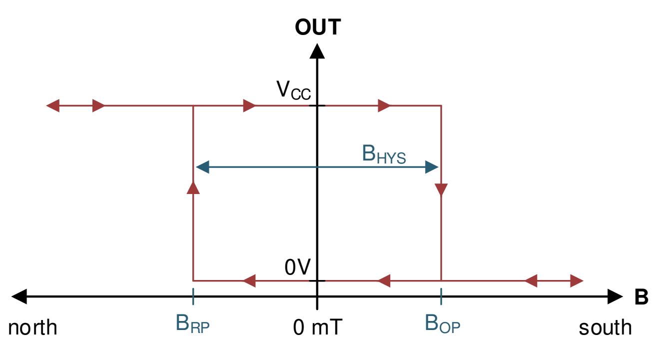
器件型号	封装	封装尺寸（标称值）
DRV5011	DSBGA (4)	0.80mm × 0.80mm
	SOT-23 (3)	2.92mm × 1.30mm
	X2SON (4)	1.10mm × 1.40mm
	TO-92 (3)	4.00mm × 3.15mm

(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。

典型原理图



磁响应



目录

4 修订历史记录

Changes from Revision A (April 2019) to Revision B — **Page**

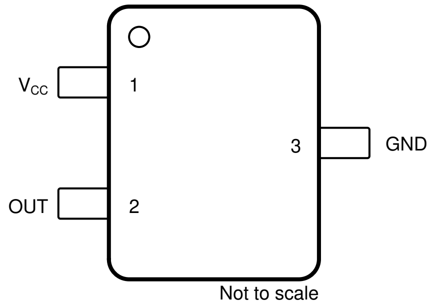
- 向数据表添加了 LPG (TO-92) 封装 1

Changes from Original (December 2017) to Revision A — **Page**

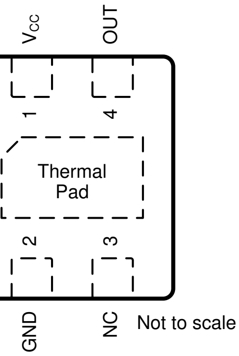
- 已添加 向数据表添加了 YBH (DSBGA) 封装 1
- 已添加 recommendation to limit power supply voltage variation to less than 50 mV_{PP} to *Power Supply Recommendations* section 15

5 Pin Configuration and Functions

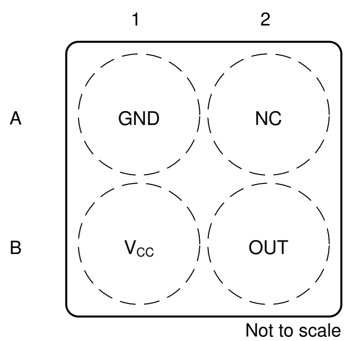
DBZ Package
3-Pin SOT-23
Top View



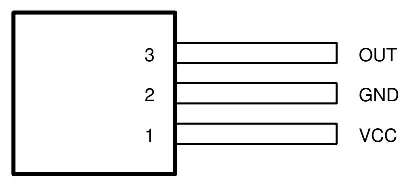
DMR Package
4-Pin X2SON With Exposed Thermal Pad
Top View



YBH Package
4-Pin DSBGA
Top View



LPG Package
3-Pin TO-92
Top View



Pin Functions

PIN					I/O	DESCRIPTION
NAME	DSBGA	SOT-23	X2SON	TO-92		
GND	A1	3	2	2	—	Ground reference
NC	A2	—	3	—	—	No-connect. This pin is not connected to the silicon. Leave this pin floating or tied to ground, and soldered to the board for mechanical support.
OUT	B2	2	4	3	O	Push-pull CMOS output. Drives a V_{CC} or ground level.
V_{CC}	B1	1	1	1	—	2.5-V to 5.5-V power supply. TI recommends connecting this pin to a ceramic capacitor to ground with a value of at least 0.01 µF.
Thermal Pad	—	—	Thermal Pad	—	—	Leave thermal pad floating or tied to ground, and soldered to the board for mechanical support.

6 Specifications

6.1 Absolute Maximum Ratings

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

			MIN	MAX	UNIT
V_{CC}	Power-supply voltage	V_{CC}	–0.3	5.5	V
	Power-supply voltage slew rate	V_{CC}	Unlimited		V/µs
V_O	Output voltage	OUT	–0.3	V_{CC} + 0.3	V
I_O	Output current	OUT	–5	30	mA
B	Magnetic flux density		Unlimited		T
T_J	Operating junction temperature			140	°C
T_A	Operating ambient temperature	For SOT-23 (DBZ), X2SON (DMR) and TO-92 (LPG)	–40	135	°C
		For DSBGA (YBH)	–40	125	
T_{stg}	Storage temperature		–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±6000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101(2)	±750	

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

6.3 Recommended Operating Conditions

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

			MIN	MAX	UNIT
V_{CC}	Power supply voltage	V_{CC}	2.5	5.5	V
V_O	Output voltage	OUT	0	V_{CC}	V
I_O	Output current(1)	OUT	–5	20	mA
T_J	Operating junction temperature			140	°C
T_A	Operating ambient temperature	For SOT-23 (DBZ), X2SON (DMR) and TO-92 (LPG)	–40	135	°C
		For DSBGA (YBH)	-40	125	

(1) Device-sourced current is negative. Device-sunk current is positive.

6.4 Thermal Information

THERMAL METRIC[1]		DRV5011 DBZ (SOT-23) 3 PINS	DRV5011 DMR (X2SON) 4 PINS	DRV5011 YBH (DSBGA) 4 PINS	DRV5011 LPG (TO-92) 3 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	356	159	194.1	183.1	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	128	77	1.6	74.2	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	94	102	68	158.8	°C/W
ψ_{JT}	Junction-to-top characterization parameter	11.4	0.9	0.8	15.2	°C/W
ψ_{JB}	Junction-to-board characterization parameter	92	100	67.9	158.8	°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} = 2.5 V to 5.5 V, over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{CC}	Operating supply current			2.3	3	mA
t_{ON}	Power-on time (see 图 10)			40	70	µs
t_d	Propagation delay time	From change in B to change in OUT		13	25	µs
V_{OH}	High-level output voltage	I_O = –1 mA	V_{CC} – 0.35	V_{CC} – 0.1		V
V_{OL}	Low-level output voltage	I_O = 20 mA		0.15	0.4	V

6.6 Magnetic Characteristics

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{BW}	Sensing bandwidth			30		kHz
B_{OP}	Magnetic threshold operate point (see 图 8)		0.6	2	3.8	mT
B_{RP}	Magnetic threshold release point (see 图 8)		–3.8	–2	–0.6	mT
B_{HYS}	Magnetic hysteresis: $\lvert B_{OP} – B_{RP}\rvert$		2	4	6	mT

6.7 Typical Characteristics

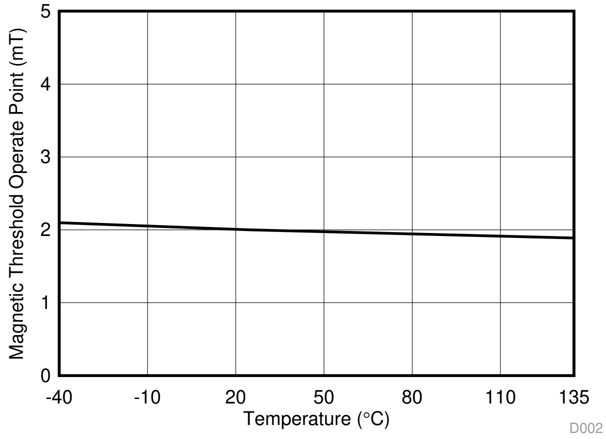


图 1. B_{OP} vs Temperature

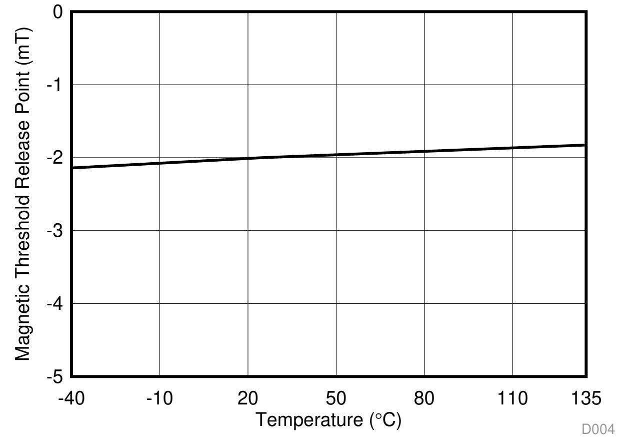


图 2. B_{RP} vs Temperature

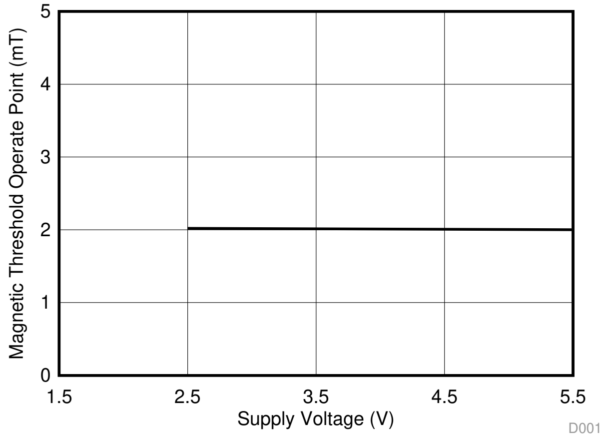


图 3. B_{OP} vs V_{CC}

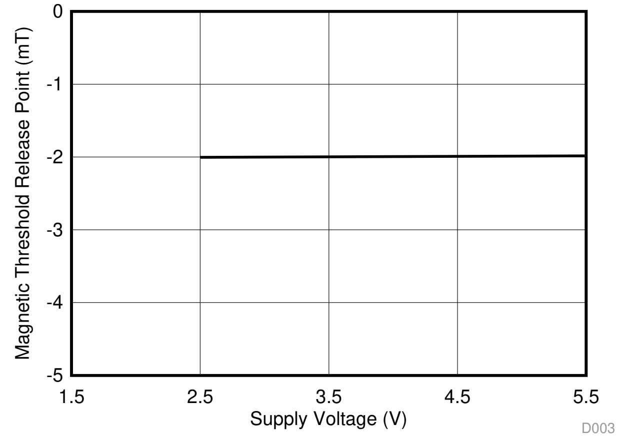


图 4. B_{RP} vs V_{CC}

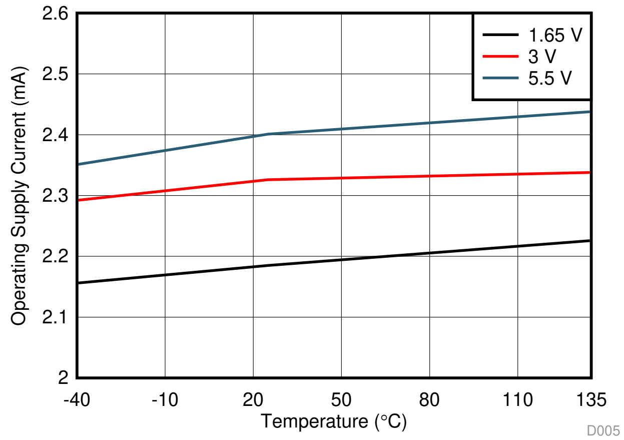


图 5. I_{CC} vs Temperature

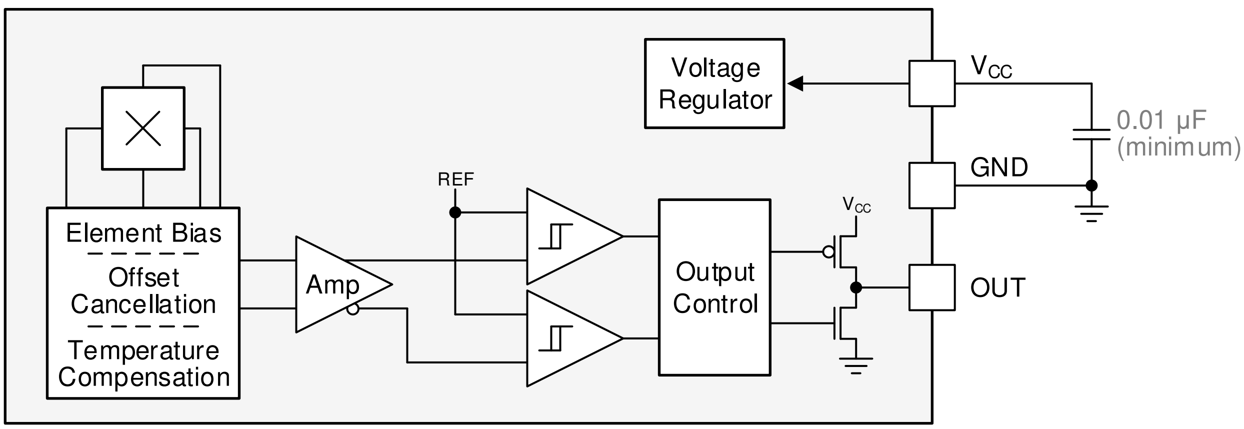
7 Detailed Description

7.1 Overview

The DRV5011 is a magnetic sensor with a digital output that latches the most recent pole measured. Applying a south magnetic pole near the top of the package causes the output to drive low, whereas a north magnetic pole causes the output to drive high, and the absence of a magnetic field causes the output to continue to drive the previous state, whether low or high.

The device integrates a Hall effect element, analog signal conditioning, offset cancellation circuits, amplifiers, and comparators. This provides stable performance across a wide temperature range and resistance to mechanical stress.

7.2 Functional Block Diagram



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7.3 Feature Description

7.3.1 Magnetic Flux Direction

The DRV5011 is sensitive to the magnetic field component that is perpendicular to the top of the package, as shown in 图 6.

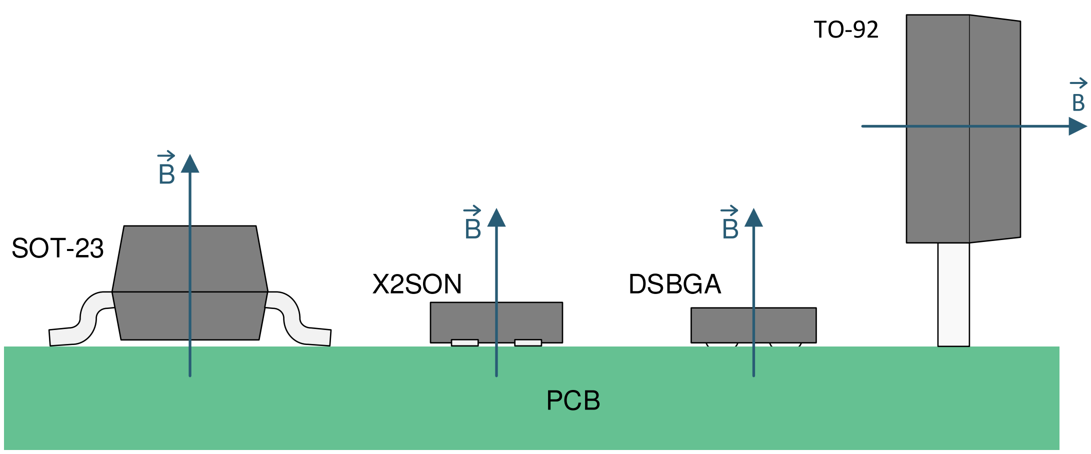


图 6. Direction of Sensitivity

Feature Description (接下页)

The 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. The magnetic flux that travels from the top to the bottom of the package results in negative millitesla values. 图 7 shows the flux direction polarity.

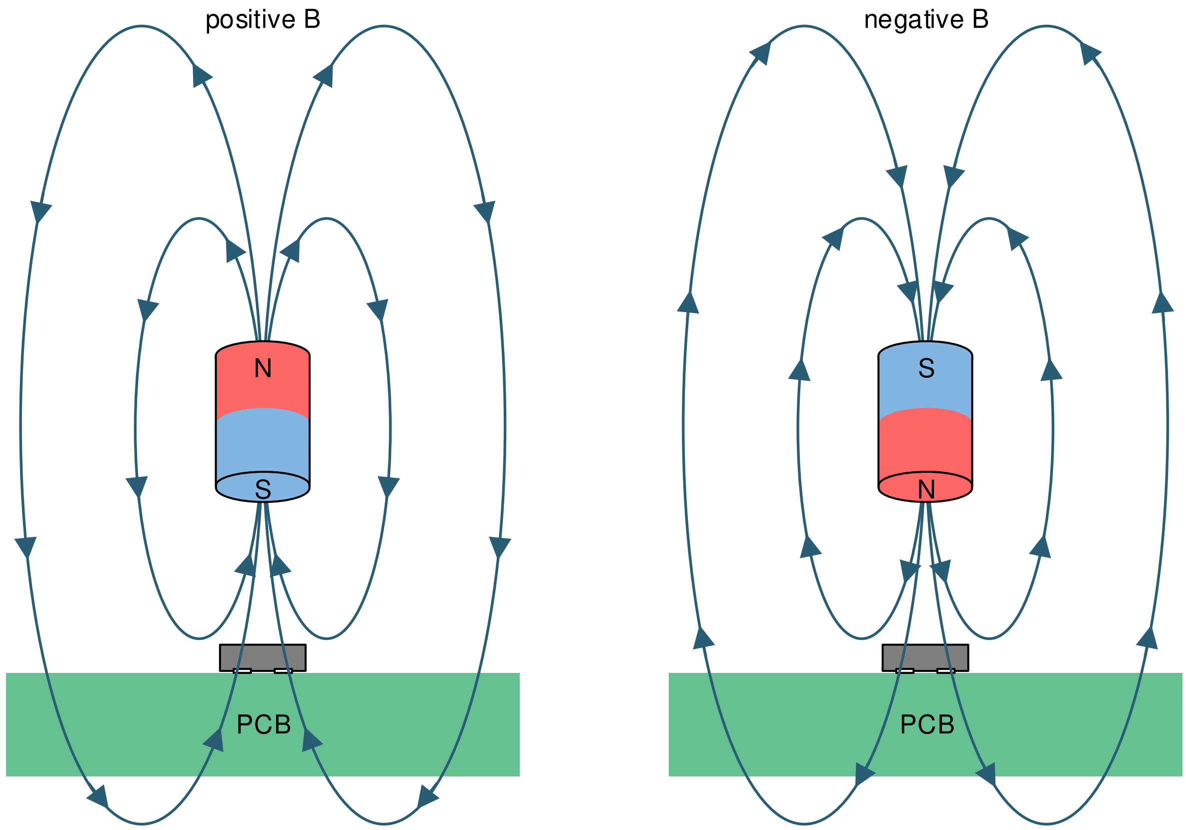


图 7. Flux Direction Polarity

7.3.2 Magnetic Response

图 8 shows the device functionality and hysteresis.

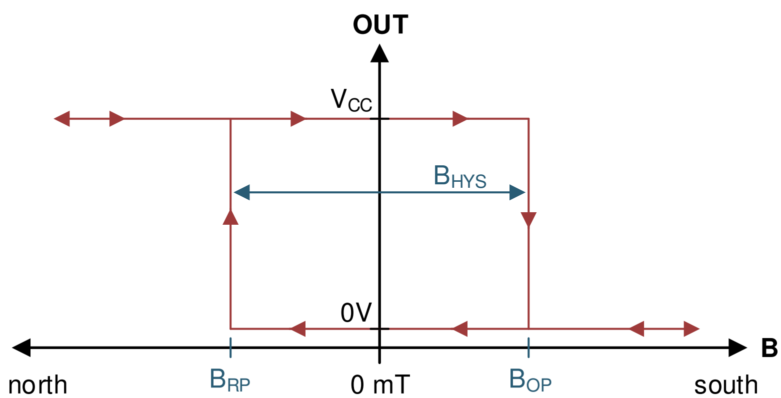


图 8. Device Functionality

Feature Description (接下页)

7.3.3 Output Driver

图 9 shows the device push-pull CMOS output that can drive a V_{CC} or ground level.

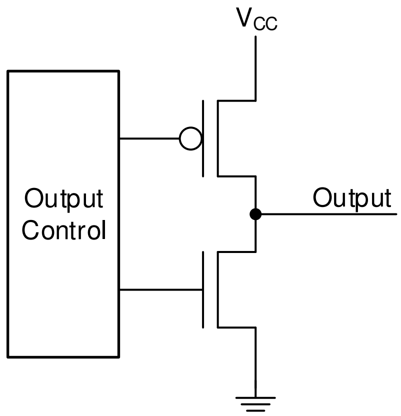


图 9. Push-Pull Output (Simplified)

7.3.4 Power-On Time

图 10 shows that after the V_{CC} voltage is applied, the DRV5011 measures the magnetic field and sets the output within the t_{ON} time.

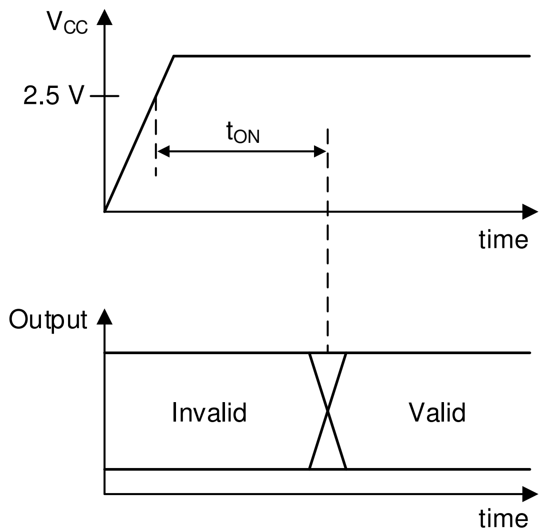


图 10. t_{ON} Definition

Feature Description (接下页)

7.3.5 Hall Element Location

The sensing element inside the device is in the center of both packages when viewed from the top. 图 11 shows the tolerances and side-view dimensions.

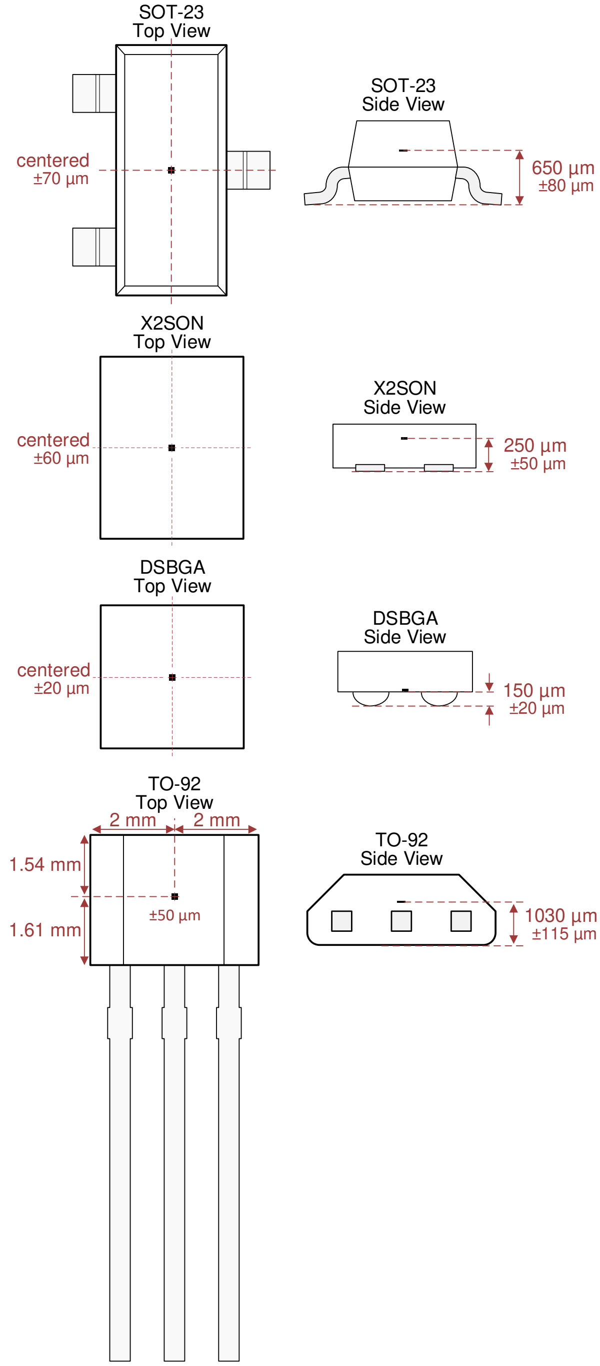


图 11. Hall Element Location

7.4 Device Functional Modes

The DRV5011 has one mode of operation that applies when the *Recommended Operating Conditions* are met.

8 Application and Implementation

注

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information

The DRV5011 is typically used in rotary applications for brushless DC (BLDC) motor sensors or incremental rotary encoding.

For reliable functionality, the magnet must apply a flux density at the sensor greater than the maximum B_{OP} and less than the minimum B_{RP} thresholds. Add additional margin to account for mechanical tolerance, temperature effects, and magnet variation. Magnets generally produce weaker fields as temperature increases.

8.2 Typical Applications

8.2.1 BLDC Motor Sensors Application

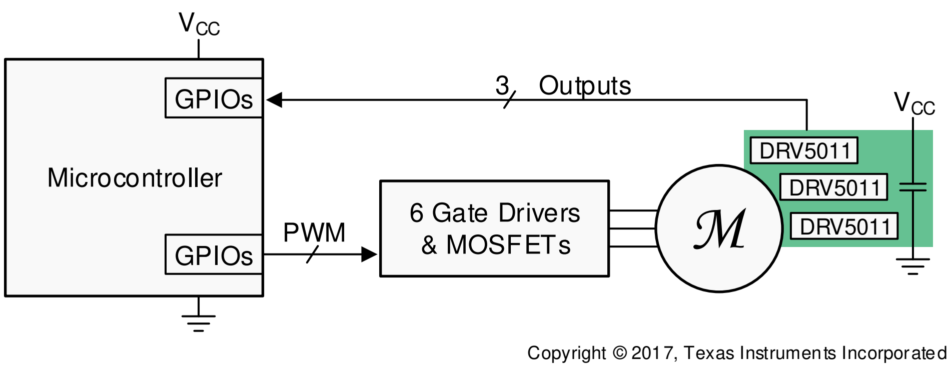


图 12. BLDC Motor System

8.2.1.1 Design Requirements

For this design example, use the parameters listed in 表 1.

表 1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Number of motor phases	3
Motor RPM	15 k
Number of magnet poles on the rotor	12
Magnetic material	Bonded Neodymium
Maximum temperature inside the motor	125°C
Magnetic flux density peaks at the Hall sensors at maximum temperature	±11 mT
Hall sensor V_{CC}	5 V ±10%

8.2.1.2 Detailed Design Procedure

Three-phase brushless DC motors often use three Hall effect latch devices to measure the electrical angle of the rotor and tell the controller how to drive the three wires. These wires connect to electromagnet windings, which generate magnetic fields that apply forces to the permanent magnets on the rotor.

Space the three Hall sensors across the printed-circuit board (PCB) so that they are 120 electrical degrees apart. This configuration creates six 3-bit states with equal time duration for each electrical cycle, which consists of one north and one south magnetic pole. From the center of the motor axis, the number of degrees to space each sensor equals *2 / [number of poles] × 120°*. In this design example, the first sensor is placed at 0°, the second sensor is placed 20° rotated, and the third sensor is placed 40° rotated. Alternatively, a 3× degree offset can be added or subtracted to any sensor, meaning the third sensor could alternatively be placed at 40° – (3 × 20°) = –20°.

8.2.1.3 Application Curve

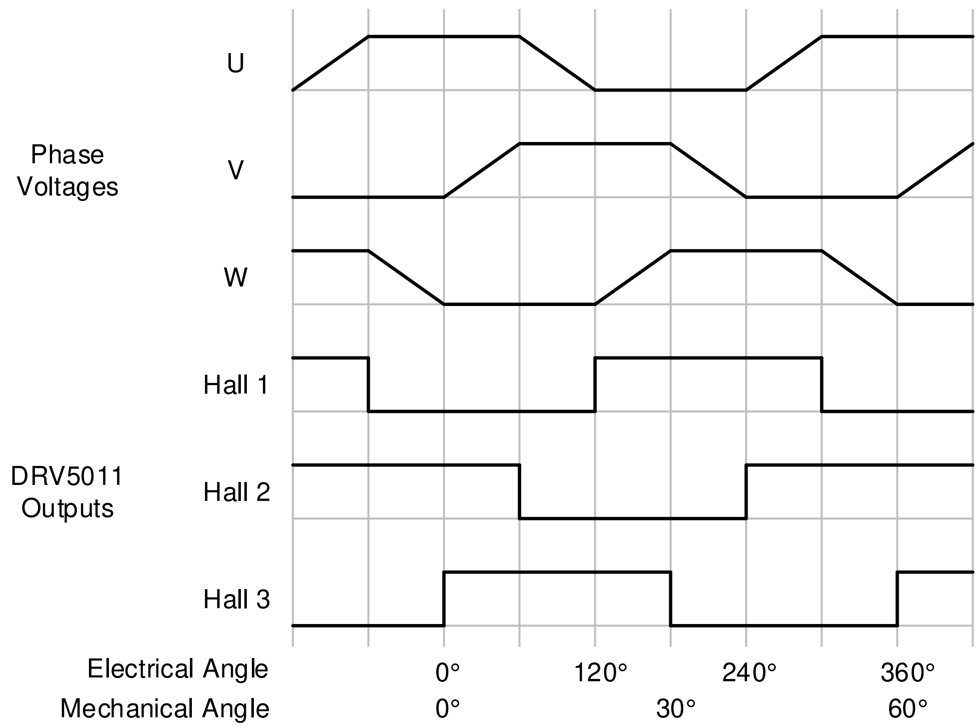


图 13. Phase Voltages and Hall Signals for 3-Phase BLDC Motor

8.2.2 Incremental Rotary Encoding Application

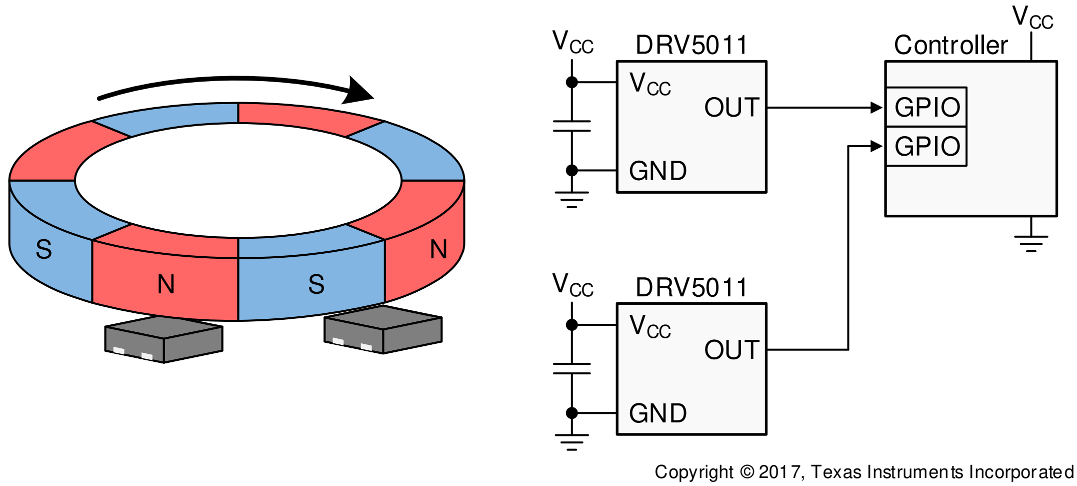


图 14. Incremental Rotary Encoding System

8.2.2.1 Design Requirements

For this design example, use the parameters listed in 表 2.

表 2. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
RPM range	0 to 45 k
Number of magnet poles	8
Magnetic material	Ferrite
Air gap above the Hall sensors	2.5 mm
Magnetic flux density peaks at the Hall sensors at maximum temperature	±7 mT

8.2.2.2 Detailed Design Procedure

Incremental encoders are used on knobs, wheels, motors, and flow meters to measure relative rotary movement. By attaching a ring magnet to the rotating component and placing a DRV5011 nearby, the sensor generates voltage pulses as the magnet turns. If directional information is also needed (clockwise versus counterclockwise), a second DRV5011 can be added with a phase offset, and then the order of transitions between the two signals describes the direction.

Creating this phase offset requires spacing the two sensors apart on the PCB, and an ideal 90° quadrature offset is attained when the sensors are separated by half the length of each magnet pole, plus any integer number of pole lengths. 图 14 shows this configuration, as the sensors are 1.5 pole lengths apart. One of the sensors changes its output every *360° / 8 poles / 2 sensors* = 22.5° of rotation. For reference, TI Design TIDA-00480, *Automotive Hall Sensor Rotary Encoder*, uses a 66-pole magnet with changes every 2.7°.

The maximum rotational speed that can be measured is limited by the sensor bandwidth. Generally, the bandwidth must be faster than two times the number of poles per second. In this design example, the maximum speed is 45000 RPM, which involves 6000 poles per second. The DRV5011 sensing bandwidth is 30 kHz, which is five times the pole frequency. In systems where the sensor sampling rate is close to two times the number of poles per second, most of the samples measure a magnetic field that is significantly lower than the peak value, because the peaks only occur when the sensor and pole are perfectly aligned. In this case, add margin by applying a stronger magnetic field that has peaks significantly higher than the maximum B_{OP}.

8.2.2.3 *Application Curve*

Two signals in quadrature provide movement and direction information. 图 15 shows how each 2-bit state has unique adjacent 2-bit states for clockwise and counterclockwise.

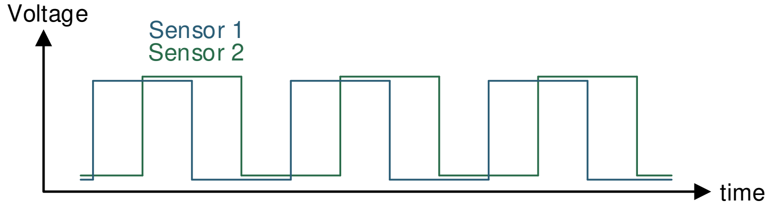


图 15. Quadrature Output (2-Bit)

8.3 Dos and Don'ts

The Hall element is sensitive to magnetic fields that are perpendicular to the top of the package; therefore, the correct magnet orientation must be used for the sensor to detect the field. 图 16 shows correct and incorrect orientations when using a ring magnet.

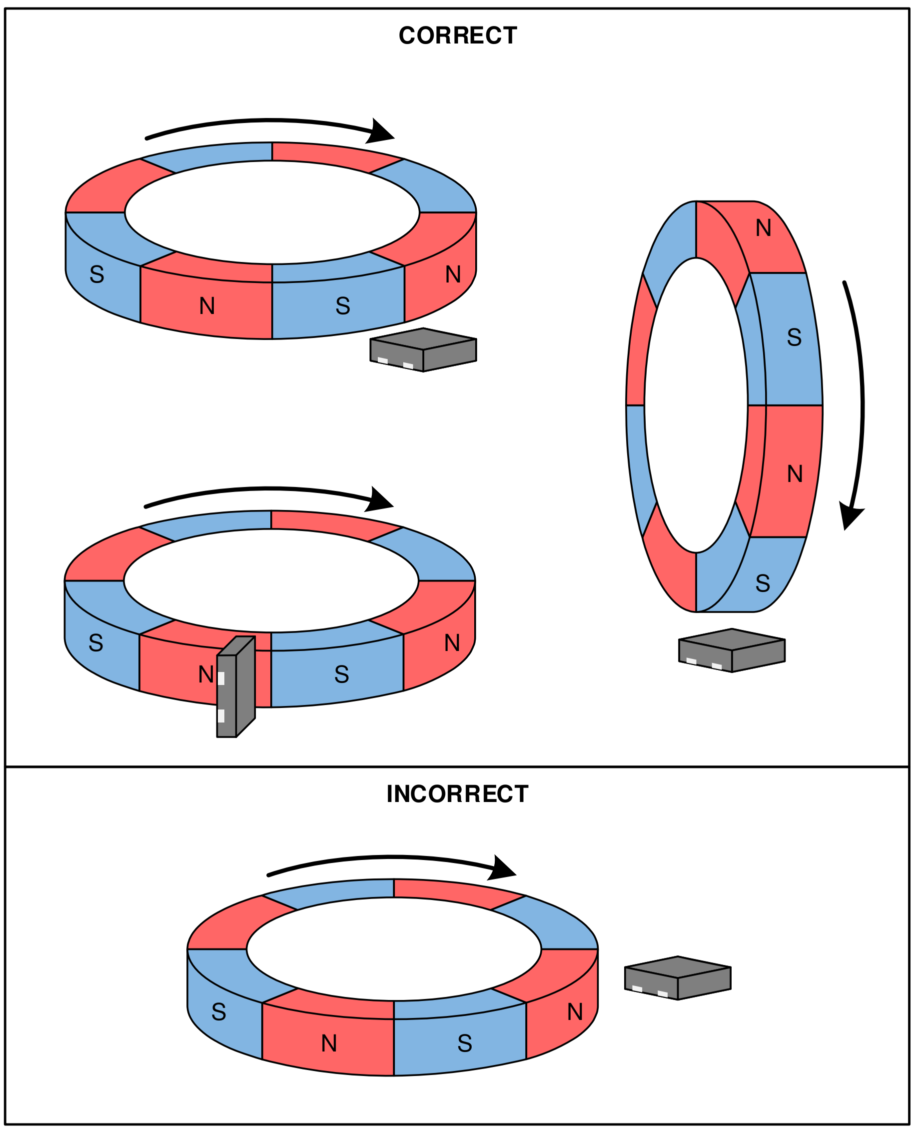


图 16. Correct and Incorrect Magnet Orientations

9 Power Supply Recommendations

The DRV5011 is powered from 2.5-V to 5.5-V dc power supplies. A 0.01-µF (minimum) ceramic capacitor rated for V_{CC} must be placed as close to the DRV5011 device as possible. Larger values of the bypass capacitor may be needed 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_{PP}.

10 Layout

10.1 Layout Guidelines

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

10.2 Layout Examples

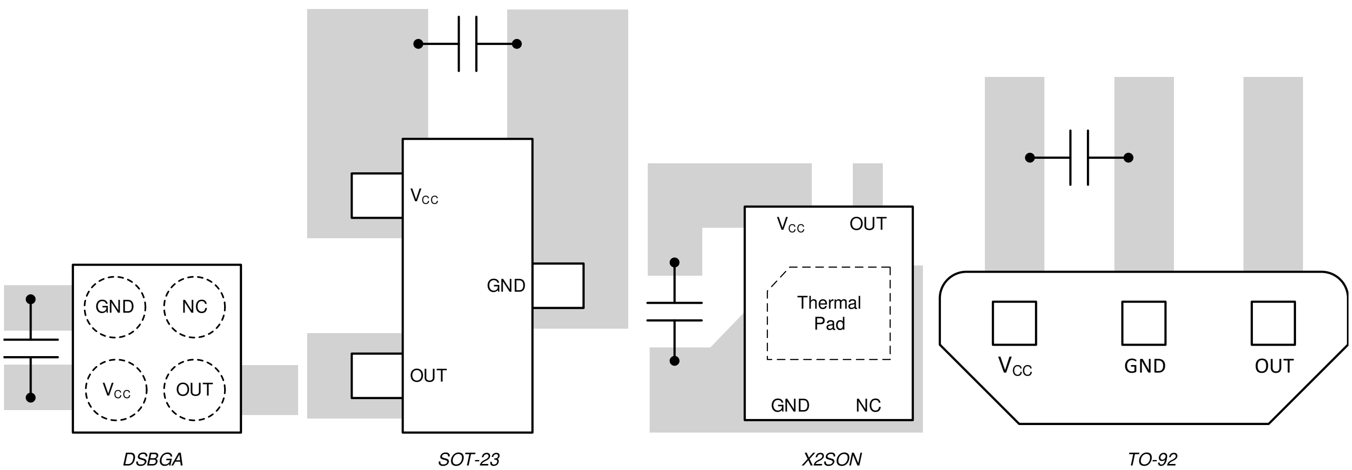


图 17. Layout Examples

11 器件和文档支持

11.1 器件支持

11.1.1 开发支持

有关其他设计参考，请参阅*汽车霍尔传感器旋转编码器* TI 设计 (TIDA-00480)。

TI 还为 DRV5011 提供了以下评估模块 (EVM)：

- 德州仪器 (TI)，*DRV5011 超低功耗、数字锁存器霍尔效应传感器评估模块*
- 德州仪器 (TI)，*用于评估 SOT-23 和 TO-92 霍尔传感器的分线适配器*

11.2 文档支持

11.2.1 相关文档

请参阅如下相关文档：

- *DRV5011-5012EVM* 用户指南
- *HALL-ADAPTER-EVM* 用户指南

11.3 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。单击右上角的*通知我*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。

11.4 社区资源

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

11.5 商标

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

11.6 静电放电警告

ESD 可能会损坏该集成电路。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措施和安装程序，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。

11.7 Glossary

SLYZ022 — *TI Glossary*.

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

12 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更，恕不另行通知，且不会对此文档进行修订。如需获取此数据表的浏览器版本，请查阅左侧的导航栏。

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
DRV5011ADDBZR	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 135	1AD
DRV5011ADDBZR.A	Active	Production	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 135	1AD
DRV5011ADDBZT	Obsolete	Production	SOT-23 (DBZ) | 3	-	-	Call TI	Call TI	-40 to 135	1AD
DRV5011ADDMRR	Active	Production	X2SON (DMR) | 4	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 135	1AD
DRV5011ADDMRR.A	Active	Production	X2SON (DMR) | 4	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 135	1AD
DRV5011ADDMRT	Obsolete	Production	X2SON (DMR) | 4	-	-	Call TI	Call TI	-40 to 135	1AD
DRV5011ADLPG	Active	Production	TO-92 (LPG) | 3	1000 | BULK	Yes	SN	N/A for Pkg Type	-40 to 135	11AD
DRV5011ADLPG.A	Active	Production	TO-92 (LPG) | 3	1000 | BULK	Yes	SN	N/A for Pkg Type	-40 to 135	11AD
DRV5011ADLPGM	Active	Production	TO-92 (LPG) | 3	3000 | AMMO	Yes	SN	N/A for Pkg Type	-40 to 135	11AD
DRV5011ADLPGM.A	Active	Production	TO-92 (LPG) | 3	3000 | AMMO	Yes	SN	N/A for Pkg Type	-40 to 135	11AD
DRV5011ADYBHR	Active	Production	DSBGA (YBH) | 4	3000 | LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 125	A
DRV5011ADYBHR.A	Active	Production	DSBGA (YBH) | 4	3000 | LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 125	A
DRV5011ADYBHT	Obsolete	Production	DSBGA (YBH) | 4	-	-	Call TI	Call TI	-40 to 125	A

(1) **Status:** For more details on status, see our product life cycle.

(2) **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.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **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.

(5) **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.

(6) **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.

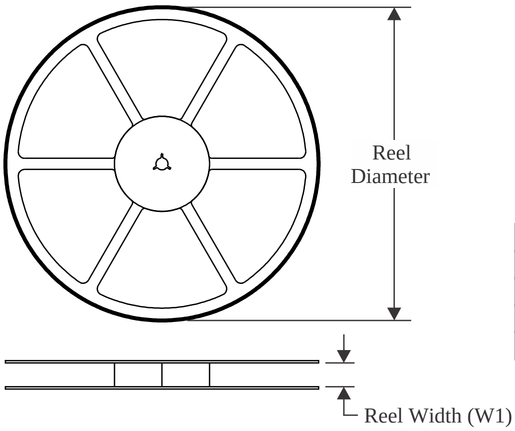
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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.

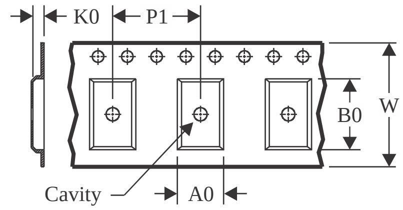
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

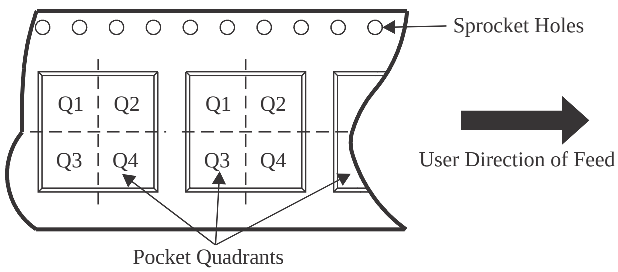


TAPE DIMENSIONS



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

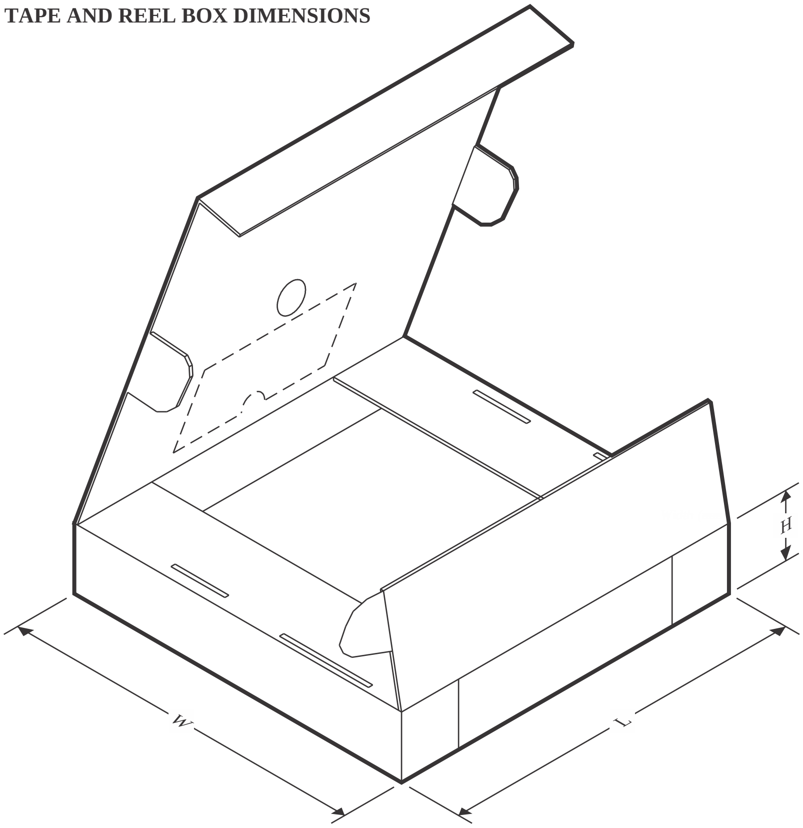
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
DRV5011ADDBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
DRV5011ADDMRR	X2SON	DMR	4	3000	180.0	8.4	1.27	1.57	0.5	4.0	8.0	Q1
DRV5011ADYBHR	DSBGA	YBH	4	3000	180.0	8.4	0.85	0.89	0.51	2.0	8.0	Q2

TAPE AND REEL BOX DIMENSIONS



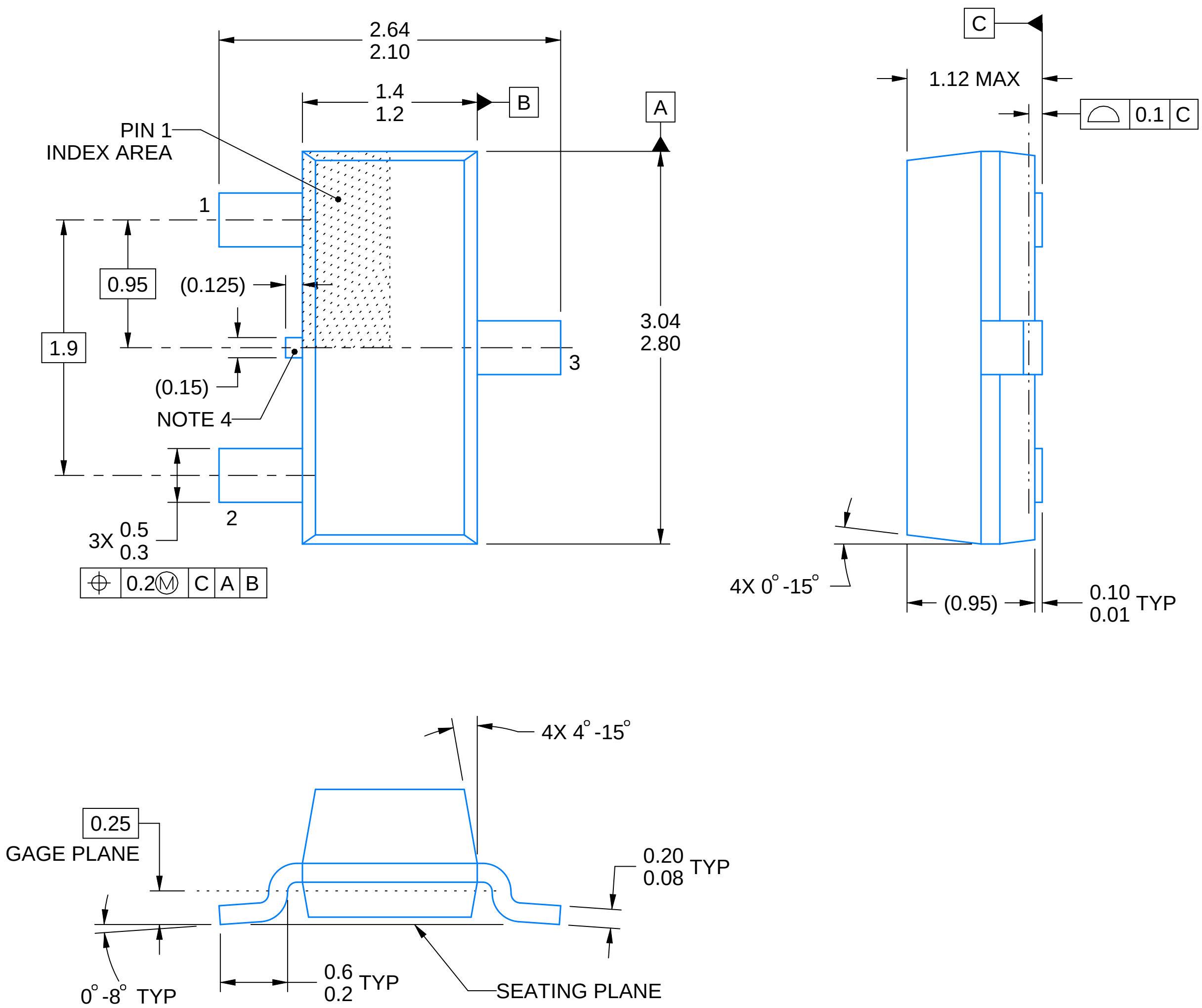
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DRV5011ADDBZR	SOT-23	DBZ	3	3000	183.0	183.0	20.0
DRV5011ADDMRR	X2SON	DMR	4	3000	200.0	183.0	25.0
DRV5011ADYBHR	DSBGA	YBH	4	3000	182.0	182.0	20.0

PACKAGE OUTLINE

SOT-23 - 1.12 mm max height

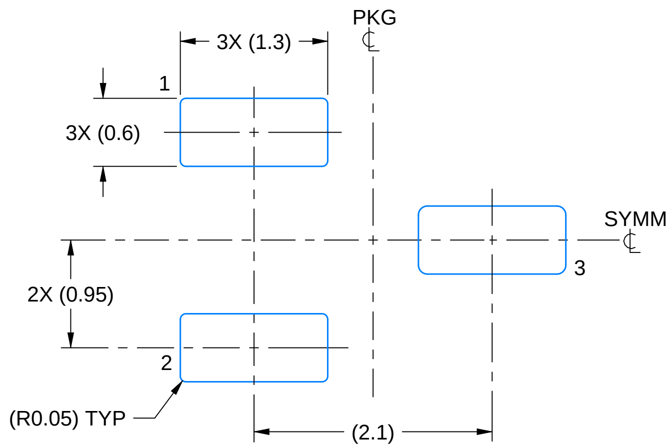
SMALL OUTLINE TRANSISTOR



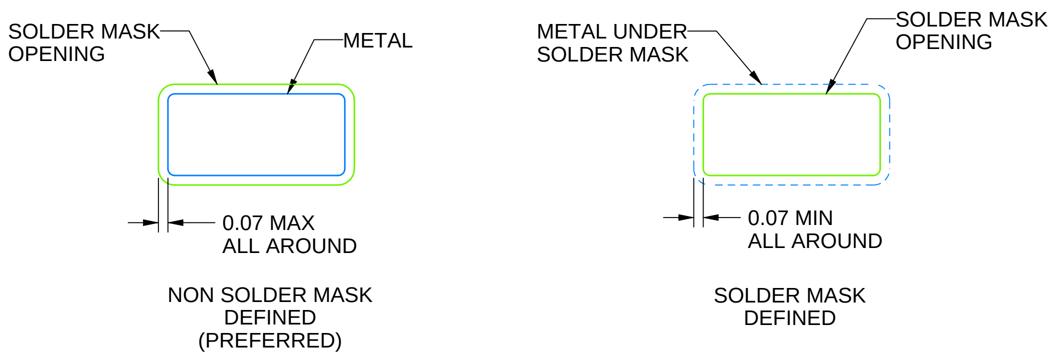
4214838/F 08/2024

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



LAND PATTERN EXAMPLE
SCALE:15X

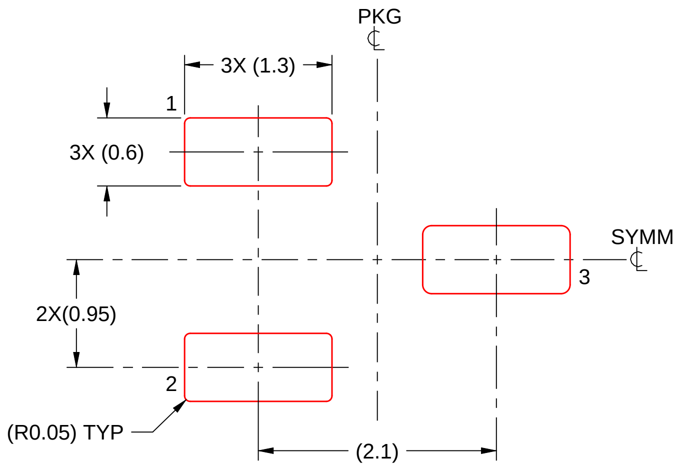


SOLDER MASK DETAILS

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.

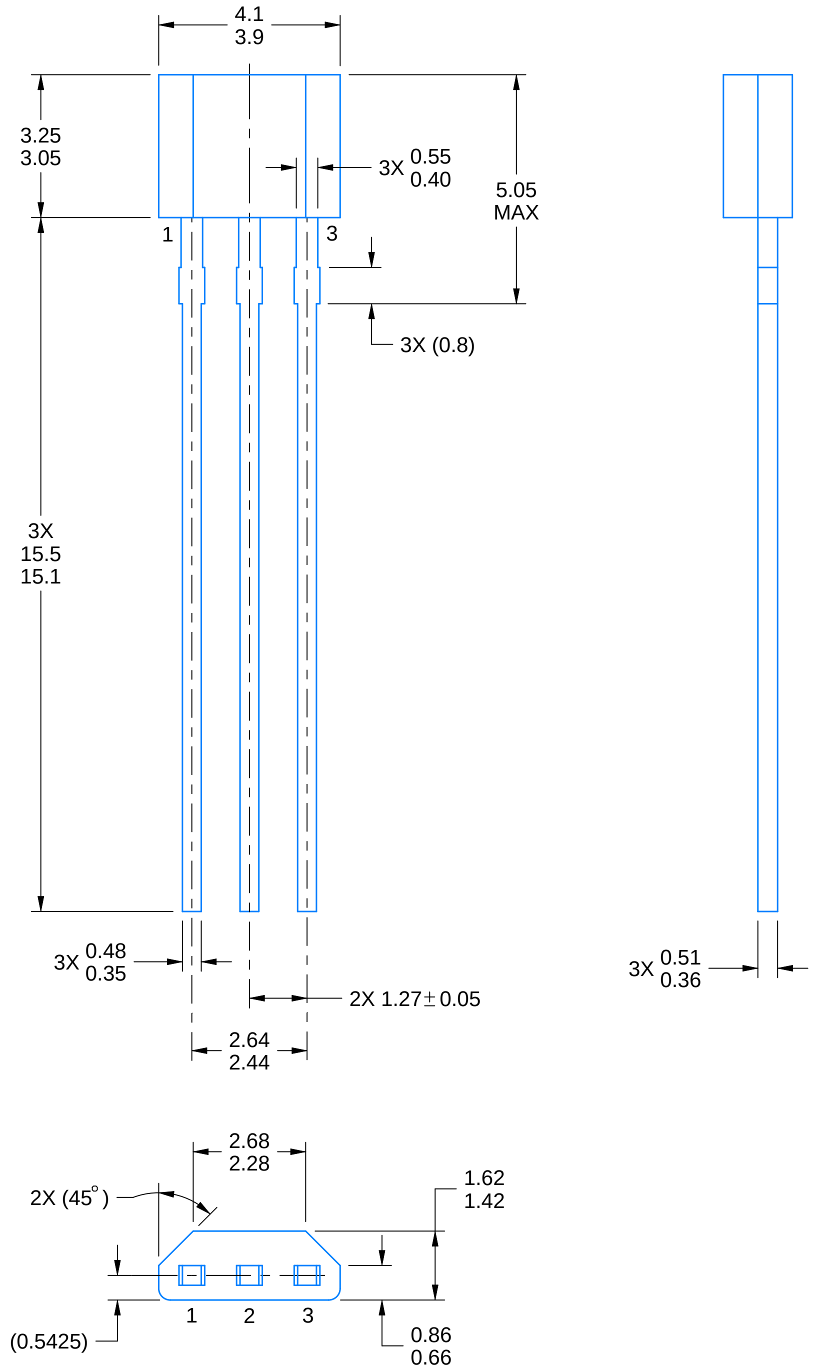


SOLDER PASTE EXAMPLE
BASED ON 0.125 THICK STENCIL
SCALE:15X

4214838/F 08/2024

NOTES: (continued)

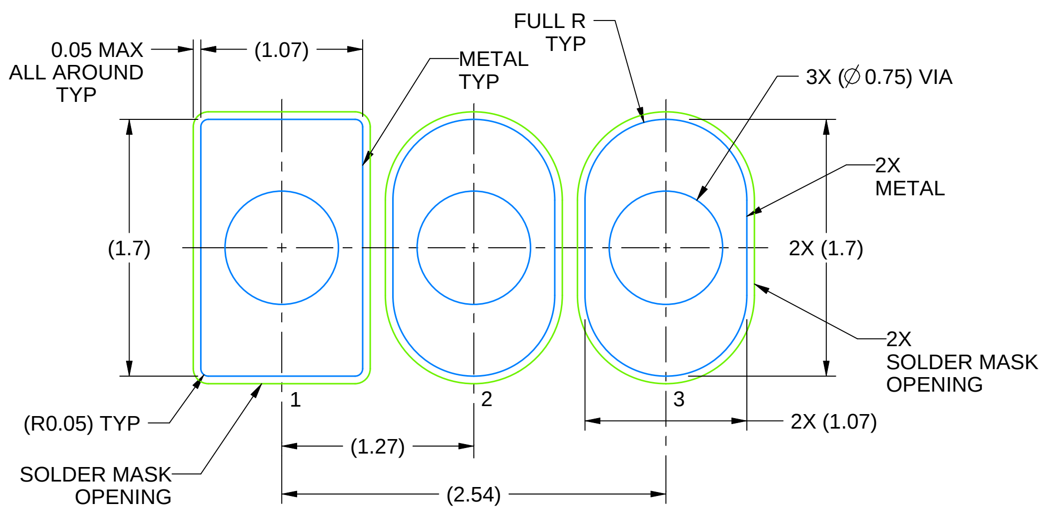
7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.



4221343/C 01/2018

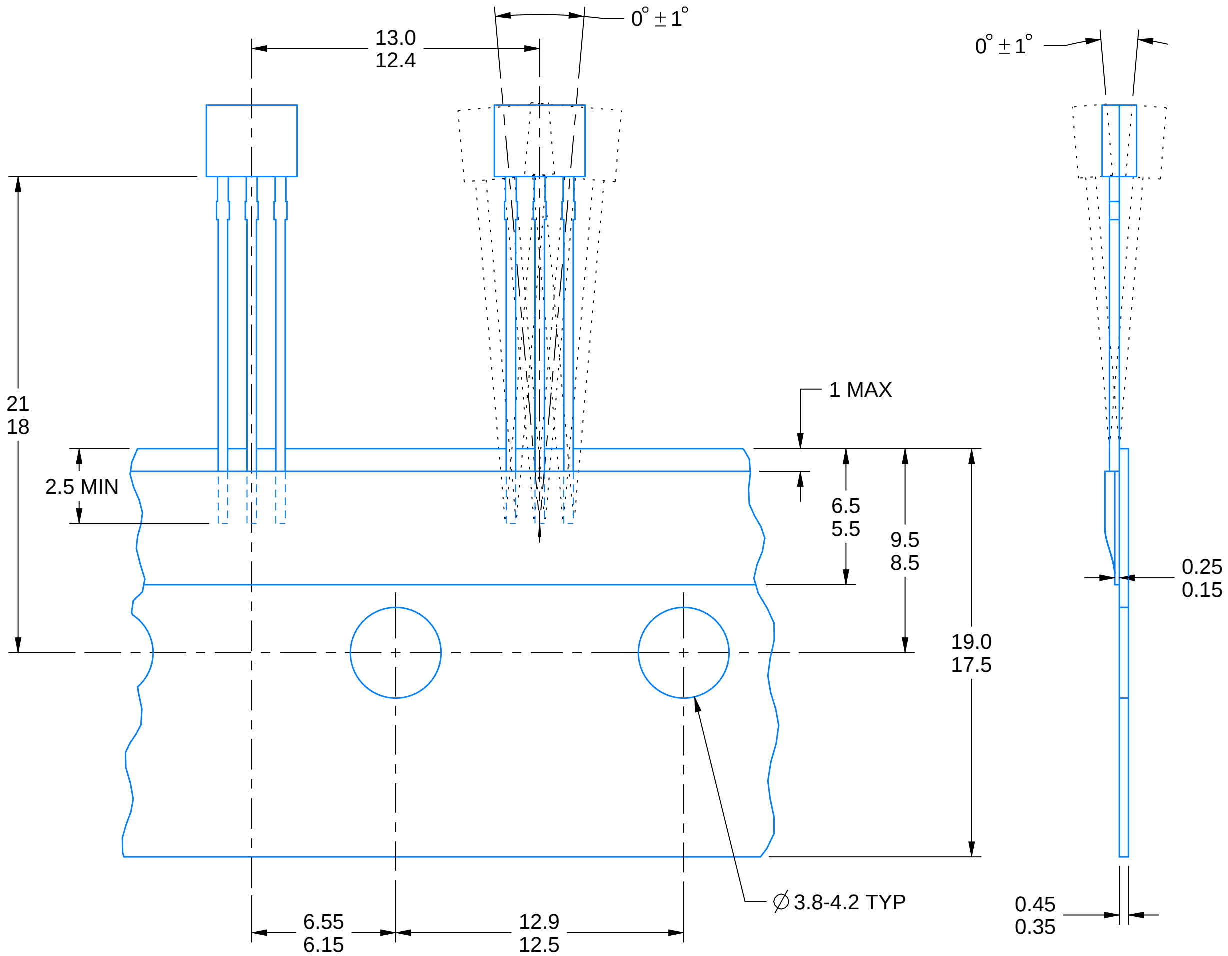
NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.



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

4221343/C 01/2018



4221343/C 01/2018

DMR 4

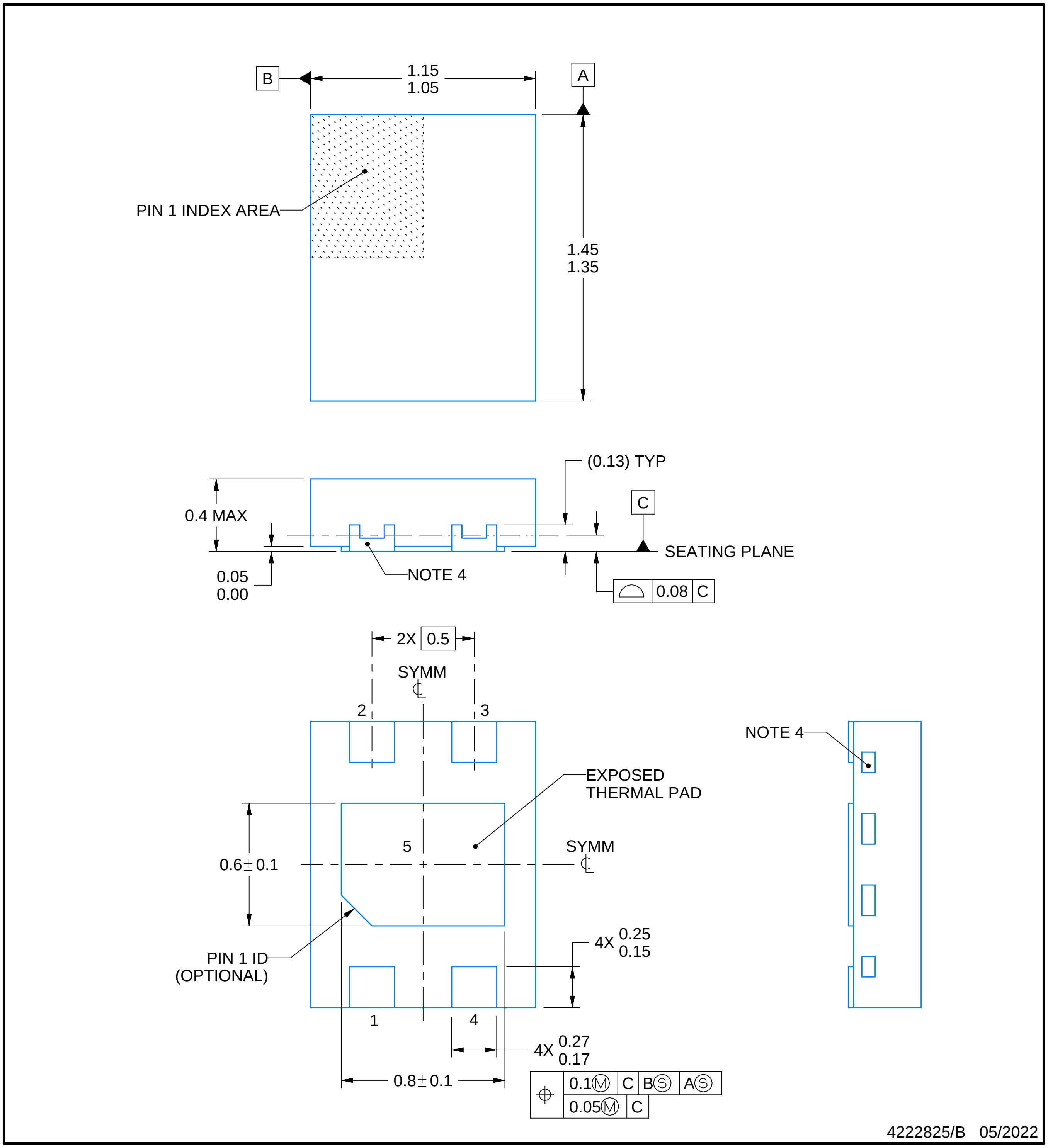
X2SON - 0.4 mm max height

1.1 x 1.4, 0.5 mm pitch

PLASTIC SMALL OUTLINE - NO LEAD

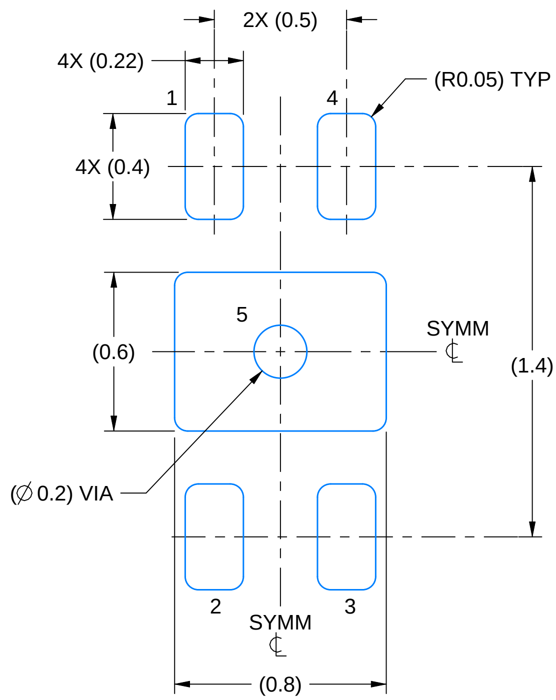
This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4229480/A

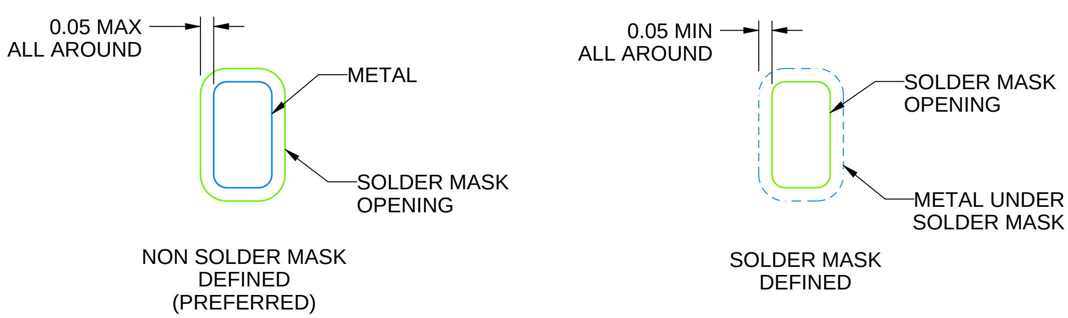


NOTES:

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. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.
4. Quantity and shape of side wall metal may vary.



LAND PATTERN EXAMPLE
SCALE:35X

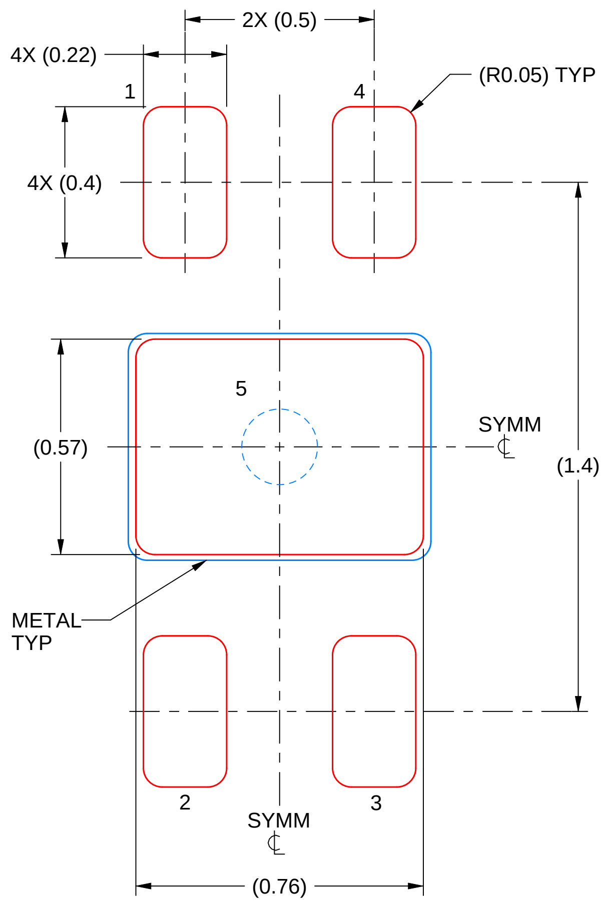


SOLDER MASK DETAILS

4222825/B 05/2022

NOTES: (continued)

5. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
6. Vias are optional depending on application, refer to device data sheet. If all or some are implemented, recommended via locations are shown. It is recommended that vias under paste be filled, plugged or tented.



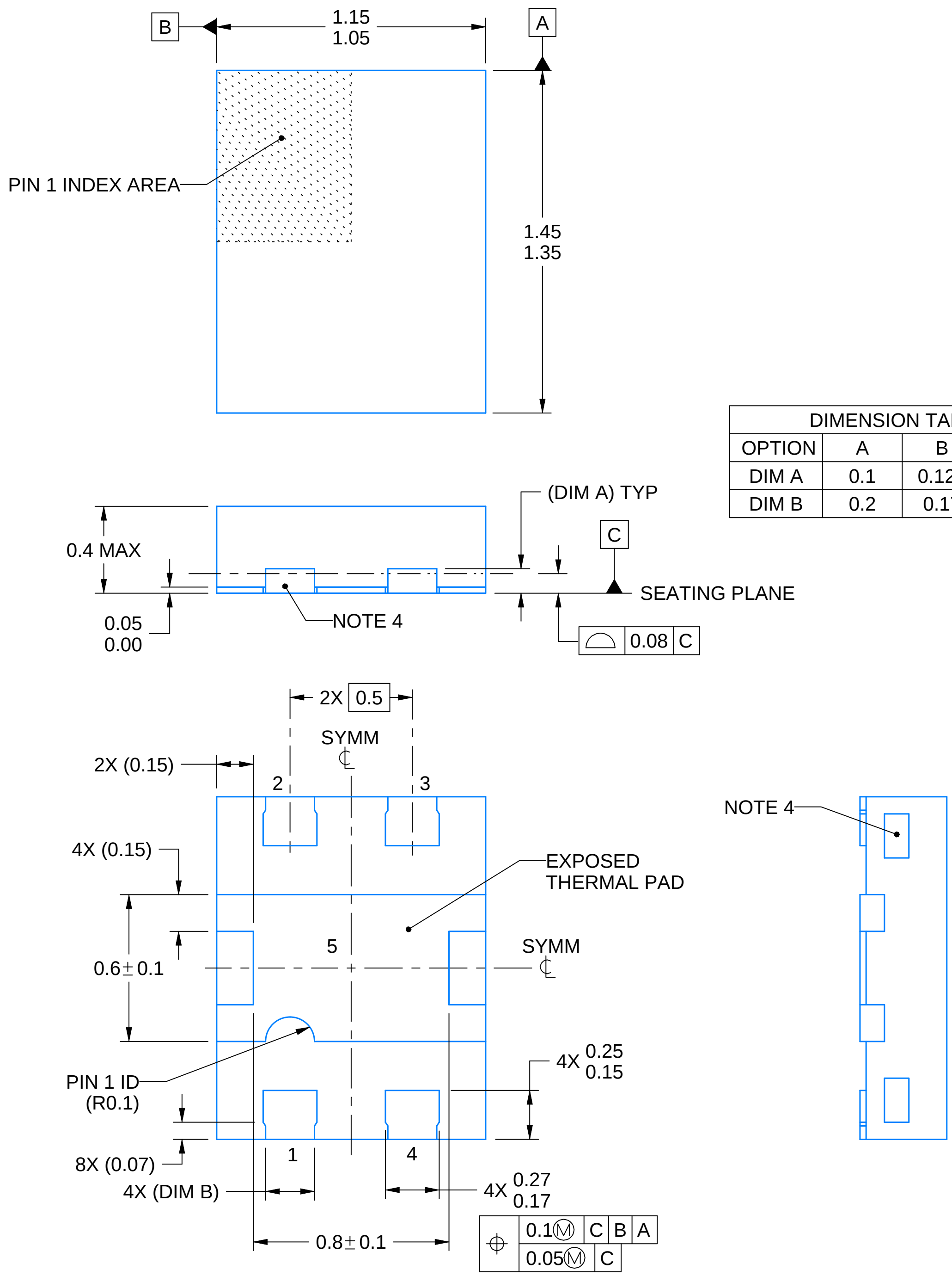
SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL

EXPOSED PAD 5:
90% PRINTED SOLDER COVERAGE BY AREA
SCALE:50X

4222825/B 05/2022

NOTES: (continued)

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

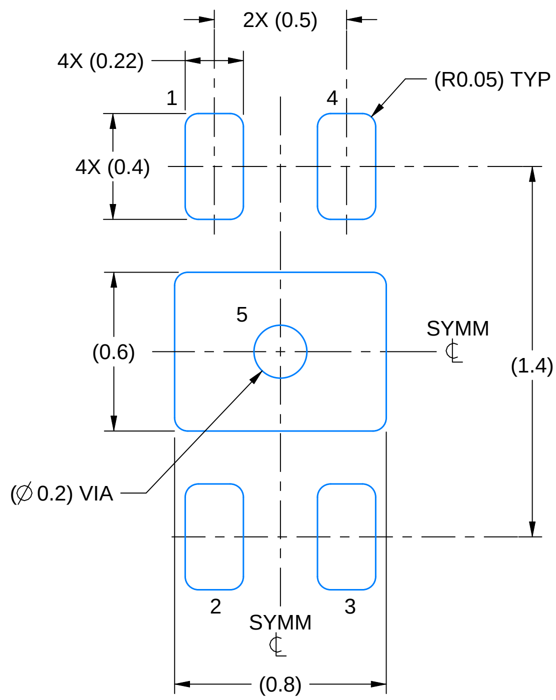


DIMENSION TABLE			
OPTION	A	B	C
DIM A	0.1	0.127	0.127
DIM B	0.2	0.17	0.2

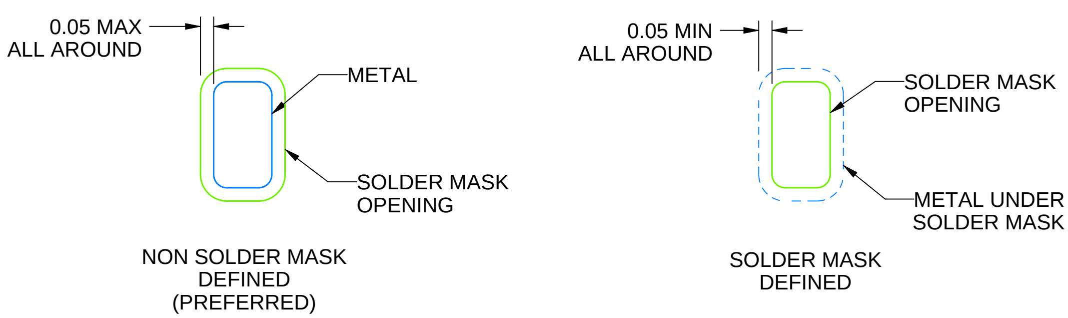
4229425/B 04/2026

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. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.
4. Quantity, shape and location of side wall metal may vary.



LAND PATTERN EXAMPLE
SCALE:35X

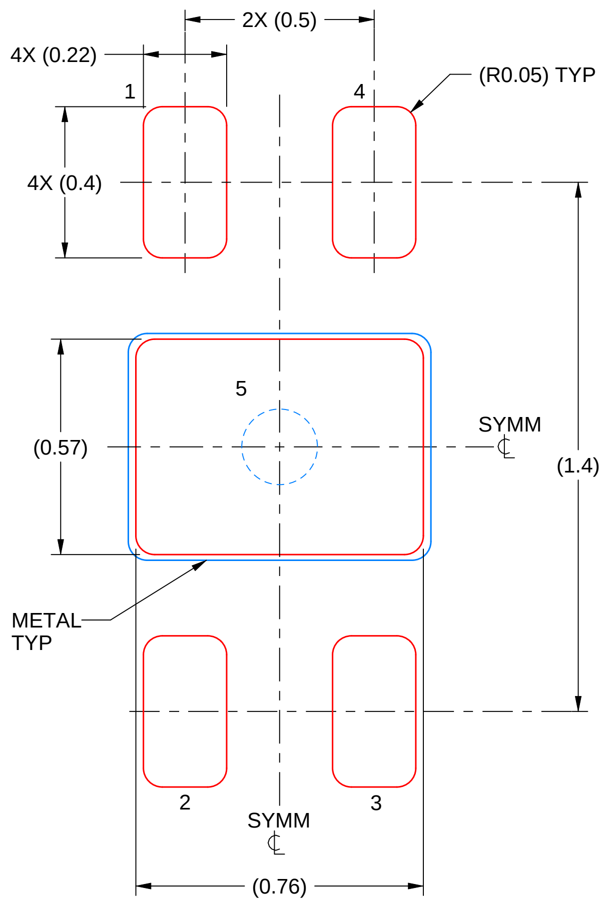


SOLDER MASK DETAILS

4229425/B 04/2026

NOTES: (continued)

5. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
6. Vias are optional depending on application, refer to device data sheet. If all or some are implemented, recommended via locations are shown. It is recommended that vias under paste be filled, plugged or tented.



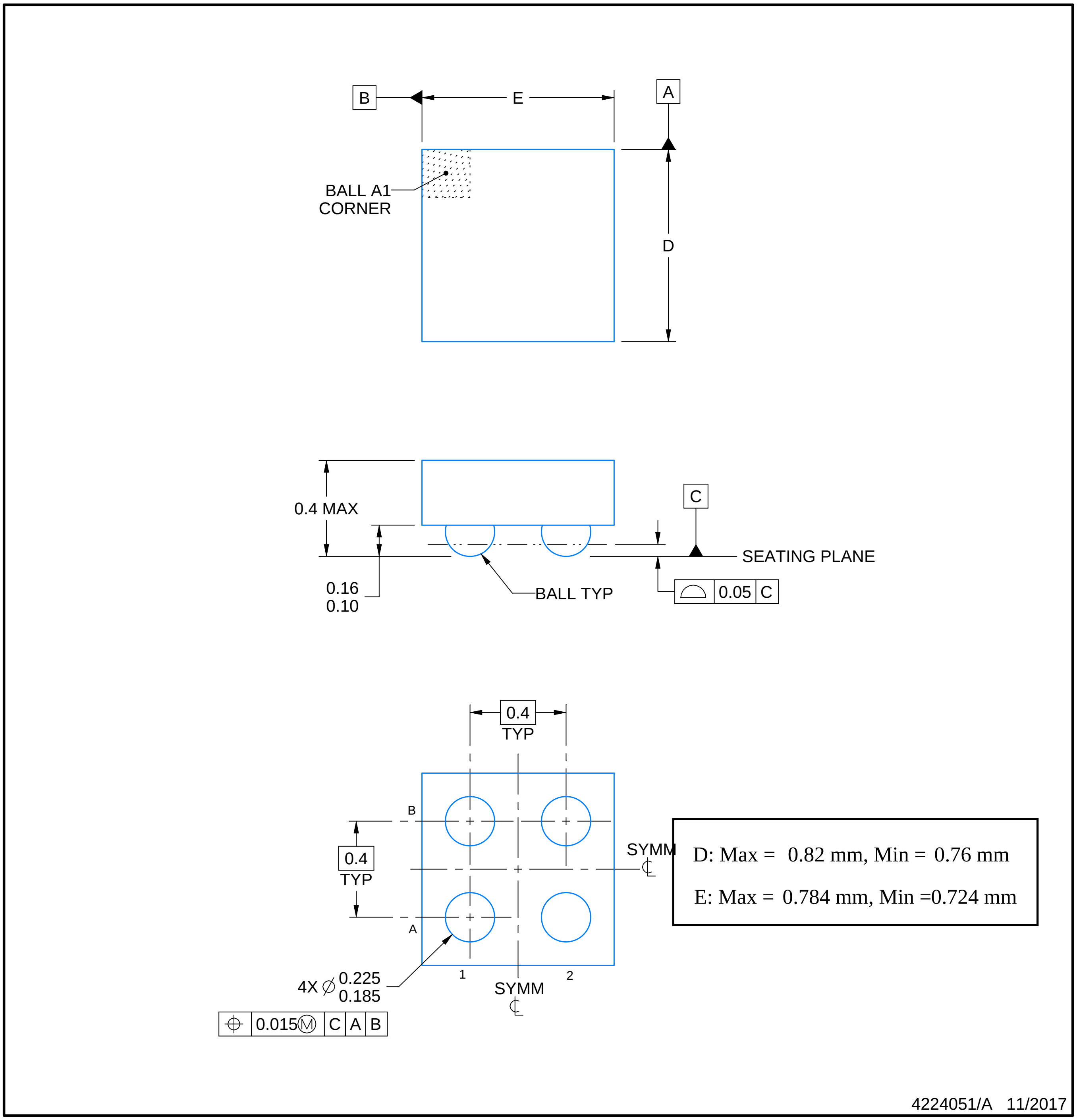
SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL

EXPOSED PAD 5:
90% PRINTED SOLDER COVERAGE BY AREA
SCALE:50X

4229425/B 04/2026

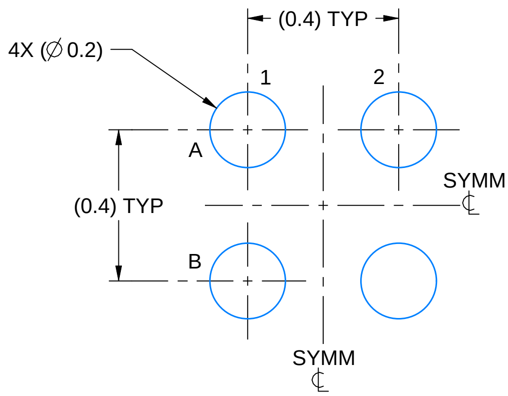
NOTES: (continued)

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

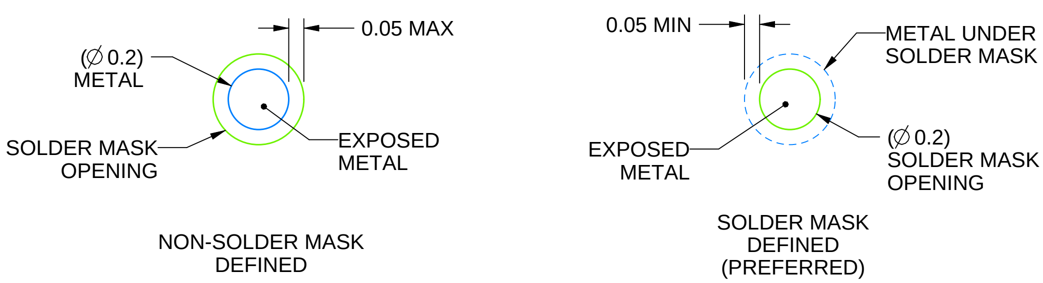


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 50X

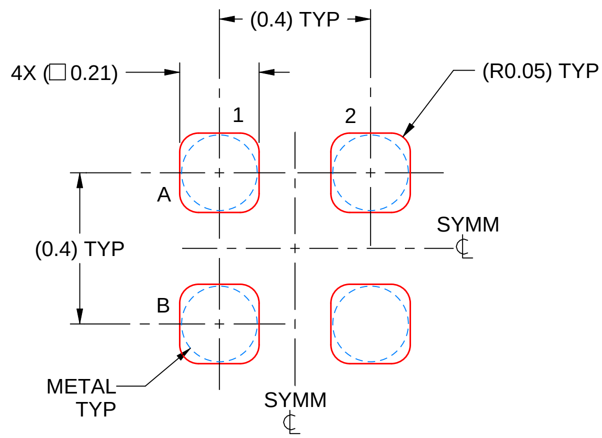


SOLDER MASK DETAILS
NOT TO SCALE

4224051/A 11/2017

NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. See Texas Instruments Literature No. SNVA009 (www.ti.com/lit/snva009).



SOLDER PASTE EXAMPLE
BASED ON 0.075 mm THICK STENCIL
SCALE: 50X

4224051/A 11/2017

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

重要通知和免责声明