DRV5012 超低消費電力、デジタル・ラッチ、ホール効果センサ

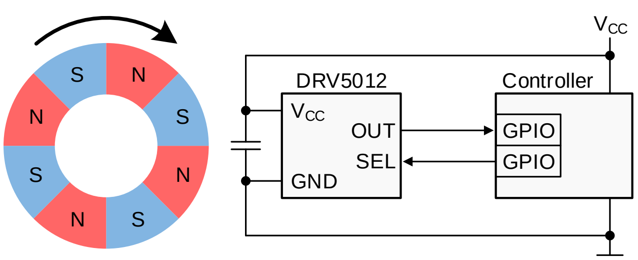
1 特長

- **業界最先端の低消費電力**
- **サンプリング・レートをピンで選択可能:**
  - SEL = Low: 20Hzで1.3µA使用(1.8V)
  - SEL = High: 2.5kHzで142µA使用(1.8V)
- **1.65V～5.5VのV_{CC}範囲で動作**
- **高い磁気感度: ±2mT (標準値)**
- **堅牢なヒステリシス: 4mT (標準値)**
- **プッシュプルCMOS出力**
- **小さく薄型のX2SONパッケージ**
- **–40℃～+85℃の動作温度範囲**

2 アプリケーション

- **ブラシレスDCモータ・センサ**
- **インクリメンタル・ロータリー・エンコーダ:**
  - モータ速度
  - 機械的移動
  - 流量測定
  - ノブの回転
  - 車輪の速度
- **ポータブル医療機器**
- **電子ロック、電動アシスト自転車、電動ブラインド**
- **流量計**
- **非接触式の起動**

標準的な回路図



3 概要

DRV5012デバイスは超低消費電力のデジタル・ラッチのホール効果センサで、サンプリング・レートをピンで選択可能です。

磁石のS極がパッケージの上端に近づき、B_{OP}スレッショルドを超えると、デバイスはLOW電圧を駆動します。磁石のN極が近づき、B_{RP}スレッショルドを交差するまでの間、出力はLOWに維持され、交差した時点でHIGH電圧に駆動されます。出力を切り替えるには、N極とS極が交互に近づく必要があり、内蔵のヒステリシスによってB_{OP}とB_{RP}が分離されることで、堅牢なスイッチングが行われます。

DRV5012デバイスは、内蔵の発振器を使用して磁界をサンプリングし、SELピンの設定に応じて20Hzまたは2.5kHzのレートで出力を更新します。このデュアル帯域幅の機能により、システムは最小の消費電力で移動の変化を監視できます。

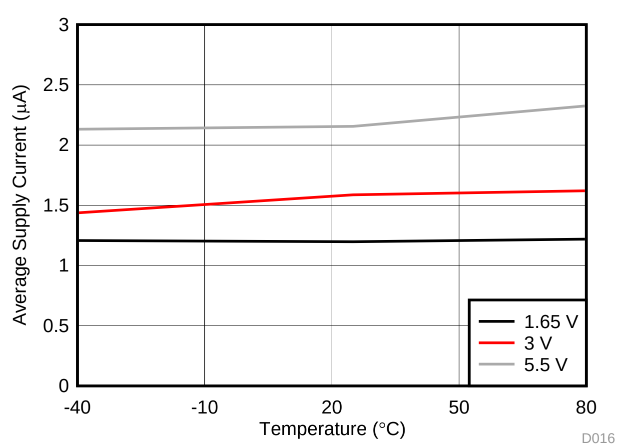
このデバイスは1.65V～5.5VのV_{CC}範囲で動作し、小型のX2SONパッケージに搭載されます。

製品情報(1)

型番	パッケージ	本体サイズ(公称)
DRV5012	X2SON (4)	1.10mm×1.40mm

(1) 利用可能なすべてのパッケージについては、このデータシートの末尾にある注文情報を参照してください。

20Hzモードでの消費電流



目次

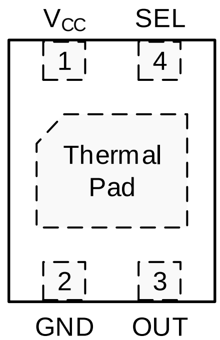
4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

日付	改訂内容	注
2017年8月	*	初版

5 Pin Configuration and Functions

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



Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
GND	2	—	Ground reference
OUT	3	O	Push-pull CMOS output. Drives a V_{CC} or ground level.
SEL	4	I	CMOS input that selects the sampling rate: a low voltage sets 20 Hz; a high voltage sets 2.5 kHz.
V_{CC}	1	—	1.65-V to 5.5-V power supply. TI recommends connecting this pin to a ceramic capacitor to ground with a value of at least 0.1 µF.
Thermal Pad	PAD	—	No-connect. This pin should be left floating or tied to ground. It should be 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
Power supply voltage	V_{CC}	–0.3	5.5	V
Power supply voltage slew rate	V_{CC}	Unlimited		V / µs
Output voltage	OUT	–0.3	V_{CC} + 0.3	V
Output current	OUT	–5	5	mA
Input voltage	SEL	–0.3	V_{CC} + 0.3	V
Magnetic flux density, B_{MAX}		Unlimited		T
Junction temperature, T_J			105	°C
Storage temperature, T_{stg}		–65	150	°C

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

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±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 (VCC)	1.65	5.5	V
V_O	Output voltage (OUT)	0	V_{CC}	V
I_O	Output current (OUT)	–5	5	mA
V_I	Input voltage (SEL)	0	V_{CC}	V
T_A	Operating ambient temperature	–40	85	°C

6.4 Thermal Information

THERMAL METRIC[1]		DRV5012 DMR (X2SON) 4 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	159	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	77	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	102	°C/W
ψ_{JT}	Junction-to-top characterization parameter	0.9	°C/W
ψ_{JB}	Junction-to-board characterization parameter	100	°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} = 1.65 V to 5.5 V, over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
OUT pin							
V_{OH}	High-level output voltage	I_{OUT} = –1 mA		V_{CC} – 0.35	V_{CC} – 0.1		V
V_{OL}	Low-level output voltage	I_{OUT} = 1 mA			0.1	0.3	V
SEL pin							
V_{IH}	High-level input voltage	V_{CC} = 1.65 to 2.5 V		0.8 × V_{CC}			V
		V_{CC} = 2.5 to 5.5 V		2			
V_{IL}	Low-level input voltage					0.15 × V_{CC}	V
I_{IH}	High-level input leakage current	SEL = V_{CC}			1		nA
I_{IL}	Low-level input leakage current	SEL = 0 V			1		nA
DYNAMIC CHARACTERISTICS							
f_S	Frequency of magnetic sampling	SEL = Low		13.3	20	37	Hz
		SEL = High		1665	2500	4700	
t_S	Period of magnetic sampling	SEL = Low		27	50	75	ms
		SEL = High		0.21	0.4	0.6	
$I_{CC(AVG)}$	Average current consumption	V_{CC} = 1.8 V	SEL = Low		1.3		µA
			SEL = High		142		
		V_{CC} = 3 V	SEL = Low		1.6	3.3	
			SEL = High		153	370	
		V_{CC} = 5 V	SEL = Low		2		
			SEL = High		160		
$I_{CC(PK)}$	Peak current consumption				2	2.7	mA
t_{ON}	Power-on time (see 図 11)				55	100	µs
t_{ACTIVE}	Active time period (see 図 11)				40		µs

6.6 Magnetic Characteristics

for V_{CC} = 1.65 V to 5.5 V, over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
B_{OP}	Magnetic threshold operate point (see 図 9)		0.6	2	3.3	mT
B_{RP}	Magnetic threshold release point (see 図 9)		–3.3	–2	–0.6	mT
B_{HYS}	Magnetic hysteresis: $\|B_{OP} – B_{RP}\|$		2	4		mT

6.7 Typical Characteristics

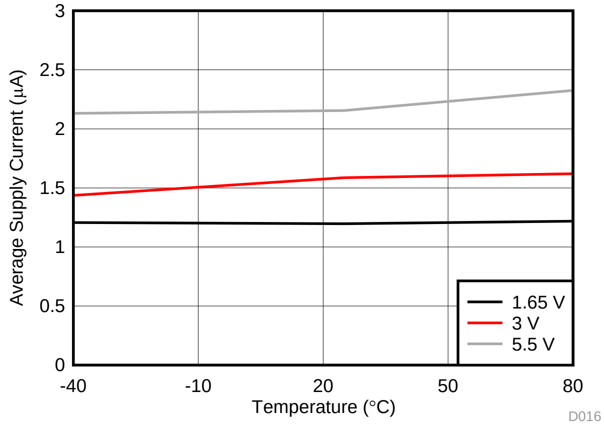


図 1. $I_{CC(AVG)}$ vs Temperature (20-Hz Mode)

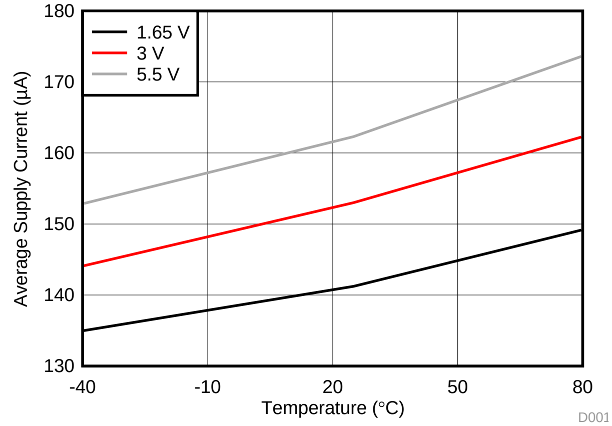


図 2. $I_{CC(AVG)}$ vs Temperature (2.5-kHz Mode)

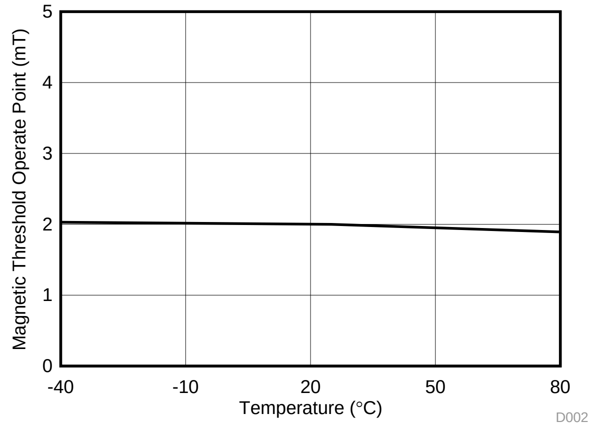


図 3. B_{OP} vs Temperature

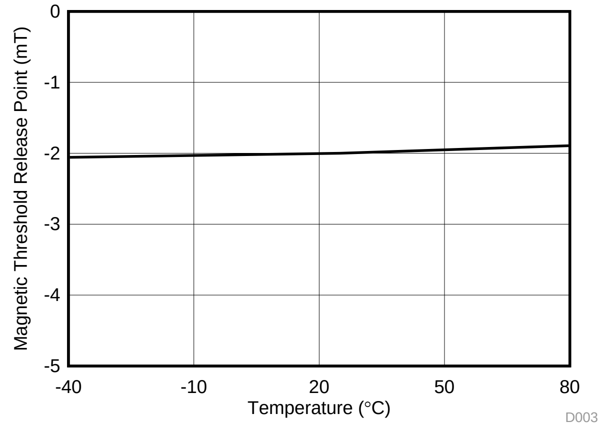


図 4. B_{RP} vs Temperature

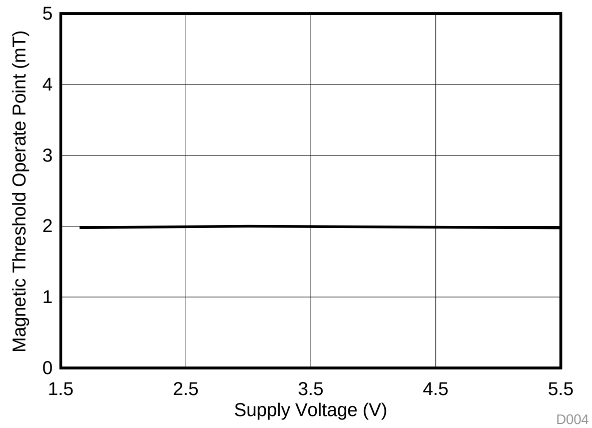


図 5. B_{OP} vs V_{CC}

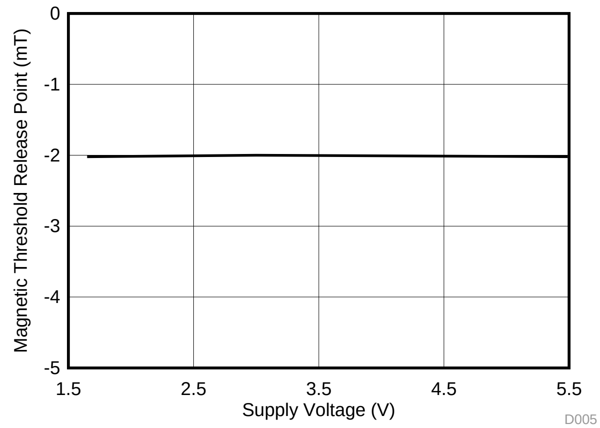


図 6. B_{RP} vs V_{CC}

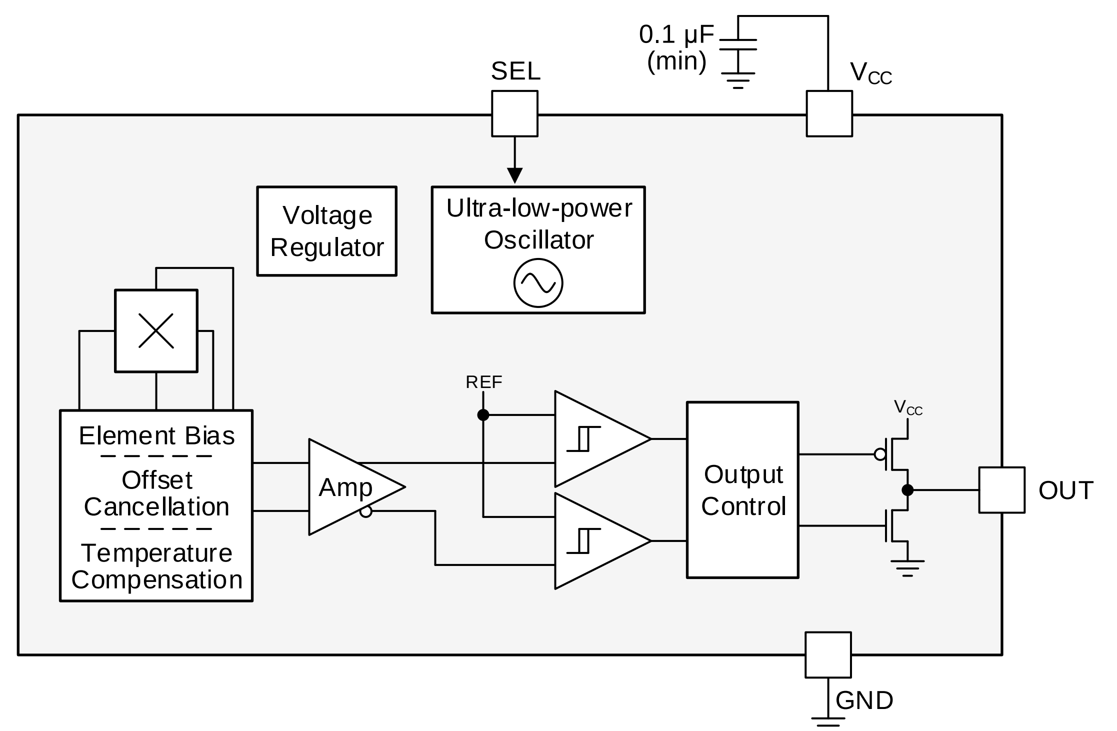
7 Detailed Description

7.1 Overview

The DRV5012 device 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, a north 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, and a low-frequency oscillator that enables ultra-low average power consumption. By operating from a 1.65-V to 5.5-V supply, the device periodically measures magnetic flux density, updates the output, and enters a low-power sleep state. A logic input pin, SEL, sets the sampling frequency to 20 Hz or 2.5 kHz with a tradeoff in power consumption.

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 Magnetic Flux Direction

The DRV5012 device is sensitive to the magnetic field component that is perpendicular to the top of the package (as shown in 図 7).

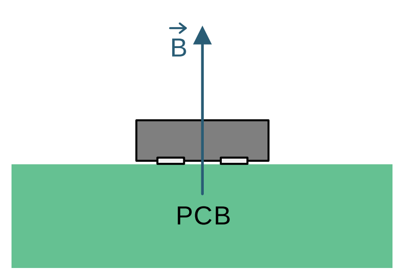


図 7. Direction of Sensitivity

Feature Description (continued)

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 results in negative millitesla values.

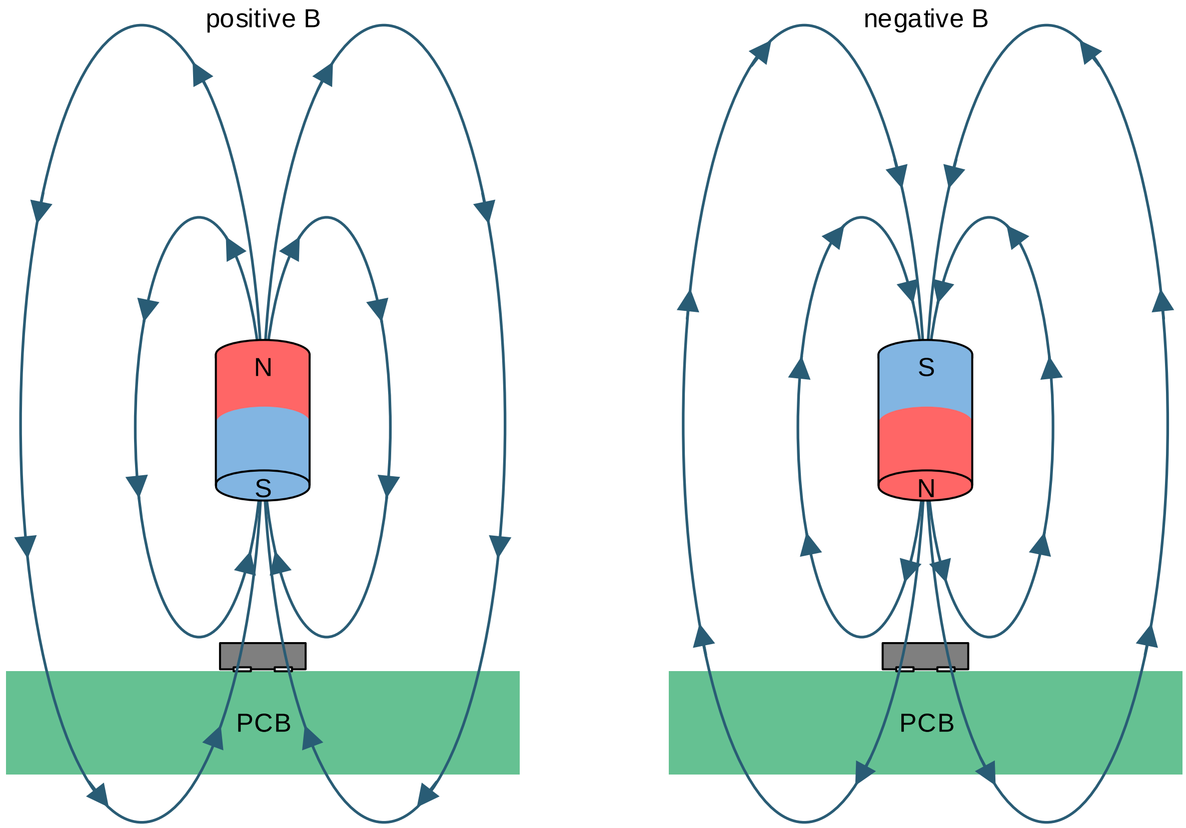


図 8. Flux Direction Polarity

7.3.2 Magnetic Response

図 9 shows the device functionality and hysteresis.

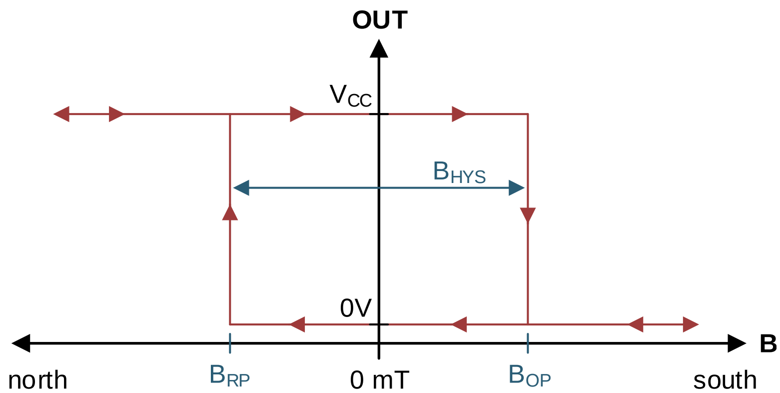


図 9. Device Functionality

Feature Description (continued)

7.3.3 Output Driver

The device features a push-pull CMOS output that can drive a V_{CC} or ground level.

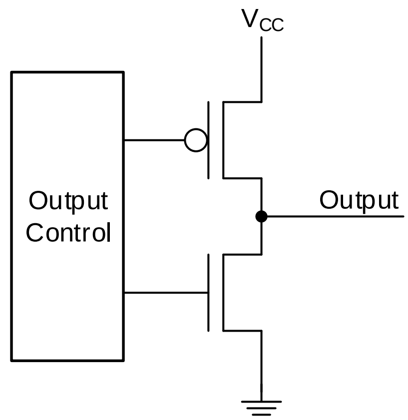


図 10. Push-Pull Output (Simplified)

7.3.4 Sampling Rate

When the DRV5012 device powers up, it 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 does not change between periods, the output also does not change.

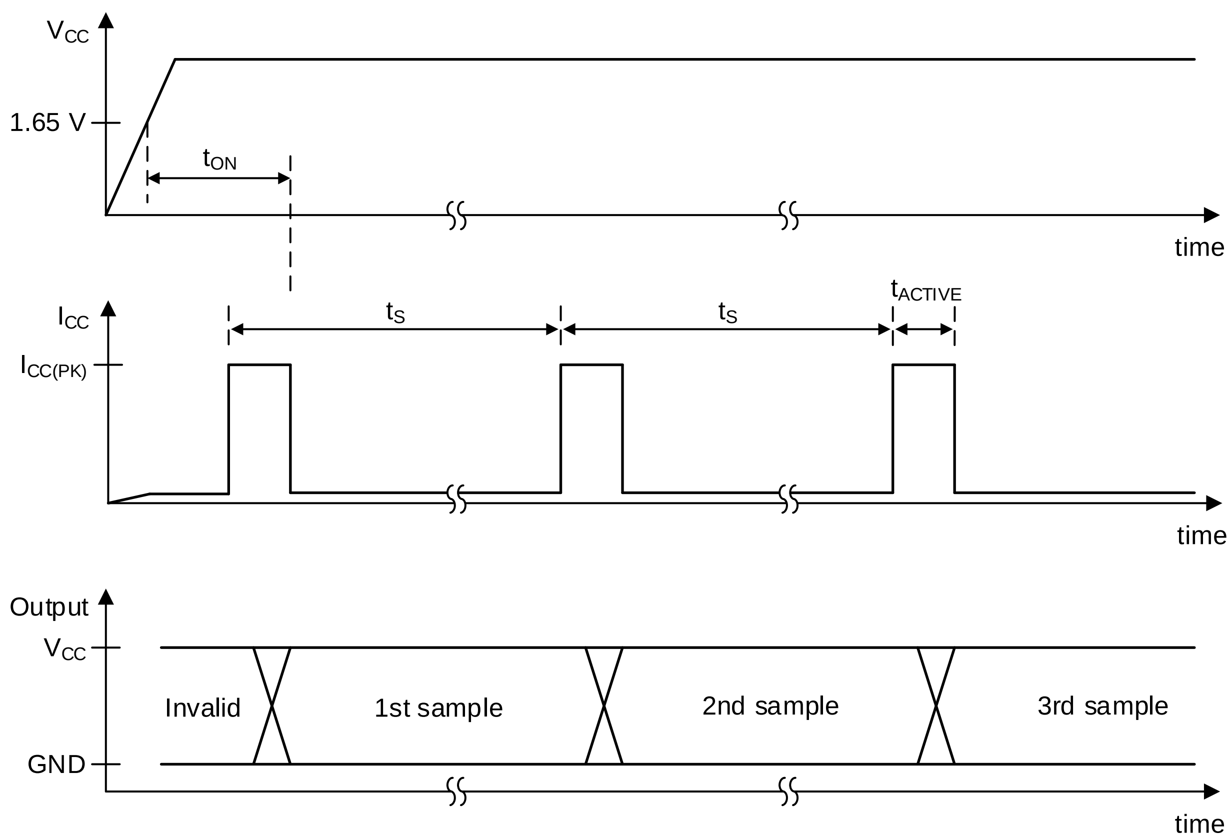


図 11. Timing Diagram

Feature Description (continued)

7.3.5 SEL Pin

The SEL pin is a CMOS input that selects between two sampling rates. When the pin is low, the device samples at 20 Hz and uses low power. When the pin is high, the device samples at 2500 Hz and uses more power. The SEL pin can be tied directly high or low, or it can be changed during device operation. If the SEL voltage changes, the device detects the new voltage during the next t_{ACTIVE} time.

7.3.6 Hall Element Location

The sensing element inside the device is in the center of the package when viewed from the top. 図 12 shows the tolerances and side-view dimensions.

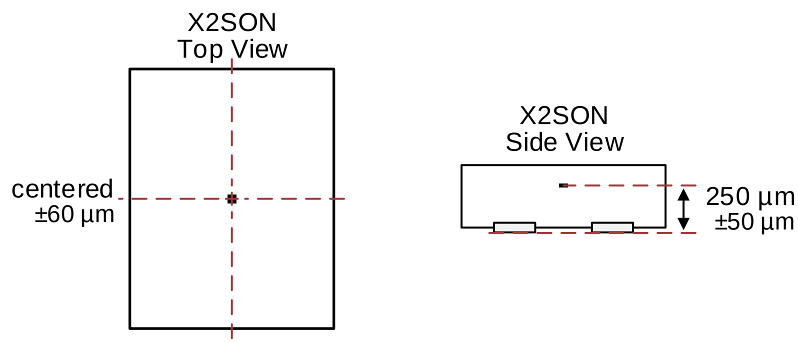


図 12. Hall Element Location

7.4 Device Functional Modes

The DRV5012 device has two operating modes, 20 Hz and 2.5 kHz, as set by the SEL pin. In both cases the *Recommended Operating Conditions* must be 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 DRV5012 device is typically used in rotary applications for brushless DC (BLDC) motor sensors or incremental rotary encoding.

To ensure reliable functionality, the magnet should apply a flux density at the sensor greater than the maximum B_{OP} and less than the minimum B_{RP} thresholds. It is good practice to add additional margin to account for mechanical tolerance, temperature effects, and magnet variation.

8.2 Typical Applications

8.2.1 BLDC Motor Sensors Application

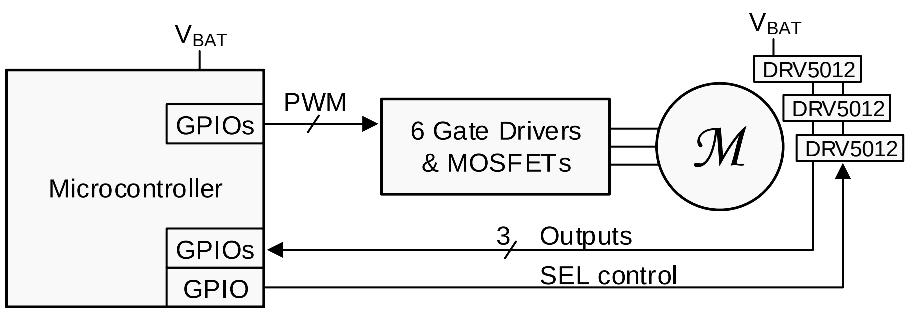


図 13. BLDC Motor System

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	3000
Number of magnet poles on the rotor	6
Magnetic material	Bonded Neodymium
Peak magnetic flux density at the Hall sensors	±15 mT
Battery voltage range (V_{BAT})	2 to 3.5 V

8.2.1.2 Detailed Design Procedure

Three-phase brushless DC motors often use 3 Hall effect latch devices to measure the electrical angle of the rotor and tell the controller how to drive the 3 wires. These wires connect to electromagnet windings, which generate magnetic fields that apply forces to the permanent magnets on the rotor.

The 3 Hall sensors should be spaced 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 1 north and 1 south magnetic pole. From the center of the motor axis, the number of degrees each sensor should be spaced equals **2 / [number of poles] × 120°**. In this design example, 1 sensor is placed at 0°, 1 sensor is placed 40° rotated, and 1 sensor is placed 80° rotated. Alternatively, a 3× degree offset can be added or subtracted to any sensor, meaning the third sensor could alternatively be placed at 80° – (3 × 40°) = –40°.

While an ideal BLDC motor would energize the phases at the exact correct times, the DRV5012 device introduces variable lag because of the sampling architecture that achieves low power. An acceptable amount of lag can be measured by the sampling time error as a percentage of the electrical period. This design example uses 3000 RPM, which is 50 revolutions per second. Each revolution has 6 poles (3 electrical cycles), so the electrical frequency is 150 Hz, a period of 6.7 ms. The DRV5012 device in 2.5 kHz mode has a sampling period of 0.4 ms, which is 6% of the electrical period. Generally, the maximum timing error should be kept under 10% to ensure the BLDC motor spins, and timing error can reduce motor efficiency.

When the motor in this example is not driven, the SEL pins of the DRV5012 devices are set to a low voltage, and the sensor outputs are monitored for changes. If a change occurs, the microcontroller wakes the system into a higher power state and takes other appropriate action.

8.2.1.3 Application Curve

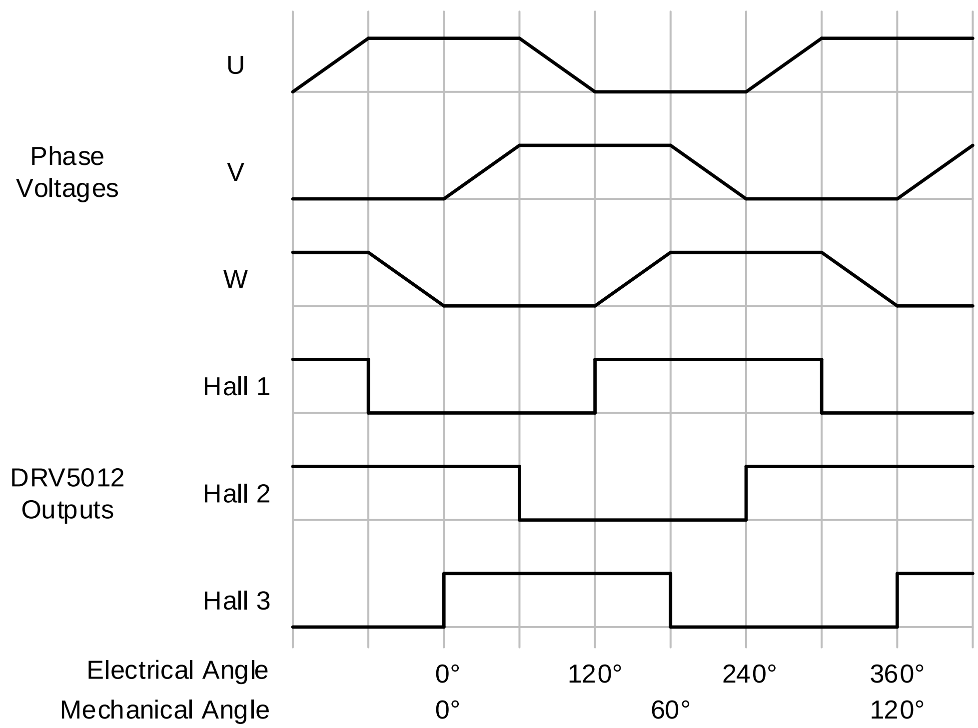


図 14. 3-Phase BLDC Motor Phase Voltages and Hall Signals

8.2.2 Incremental Rotary Encoding Application

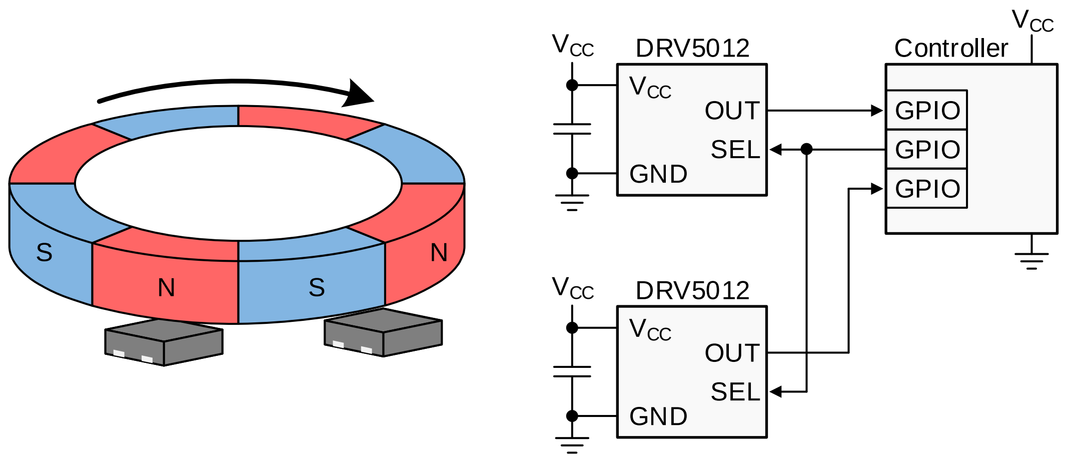


図 15. Incremental Rotary Encoding System

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 4000
Number of magnet poles	8
Magnetic material	Ferrite
Air gap above the Hall sensors	2.5 mm
Peak magnetic flux density at the sensors	±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 DRV5012 device nearby, the sensor generates voltage pulses as the magnet turns. If directional information is also needed (clockwise versus counterclockwise), a second DRV5012 device 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. 図 15 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, the TI Design TIDA-00480 uses a 66-pole magnet with changes every 2.7°.

Because the DRV5012 device periodically samples the magnetic field, there is a limit to the maximum rotational speed that can be measured. Generally, the device sampling rate should be faster than 2 times the number of poles per second. In this design example, the maximum speed is 4000 RPM, which involves 533 poles per second. The DRV5012 has a minimum sampling frequency of 1665 Hz (when the SEL pin is high), which is approximately 3 × 533 poles per second.

In systems where the sensor sampling rate is close to 2 times the number of poles per second, most of the samples will measure a magnetic field that is significantly lower than the peak value, since the peaks only occur when the sensor and pole are perfectly aligned. In this case, margin should be added by applying a stronger magnetic field that has peaks significantly higher than the maximum B_{OP} of the DRV5012 device.

8.2.2.3 Application Curve

Two signals in quadrature provide movement and direction information. Each 2-bit state has unique adjacent 2-bit states for clockwise and counterclockwise.

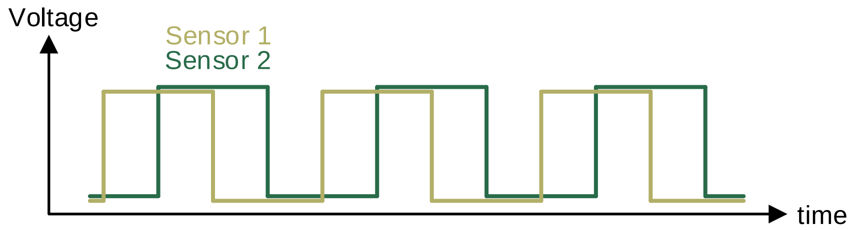


図 16. 2-bit Quadrature Output

8.3 Do's and Don'ts

Because the Hall element is sensitive to magnetic fields that are perpendicular to the top of the package, a correct magnet orientation must be used for the sensor to detect the field. 図 17 shows correct and incorrect orientations when using a ring magnet.

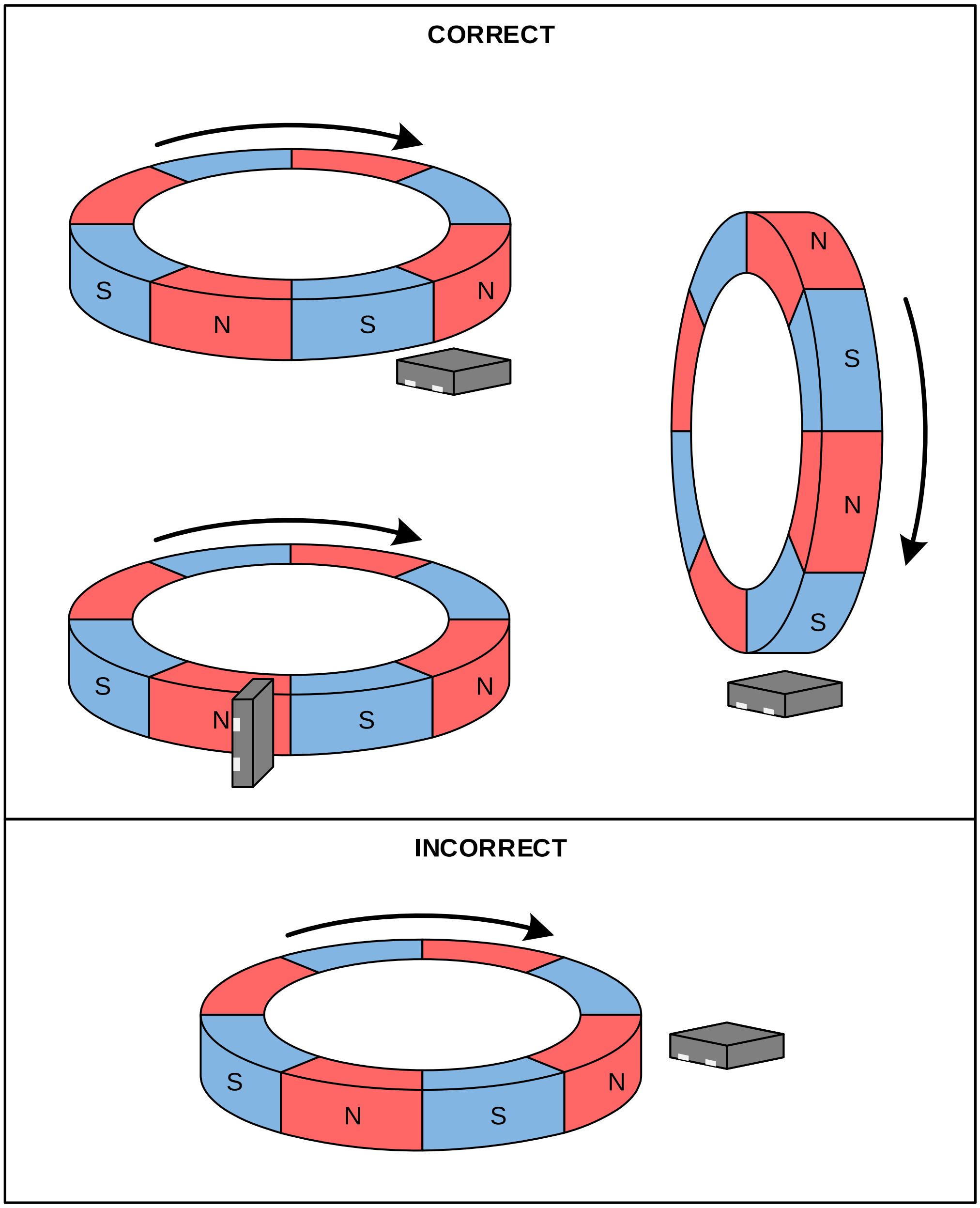


図 17. Correct and Incorrect Magnet Orientations

9 Power Supply Recommendations

The DRV5012 device is powered from 1.65-V to 5.5-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 0.1 µF.

10 Layout

10.1 Layout Guidelines

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

10.2 Layout Example

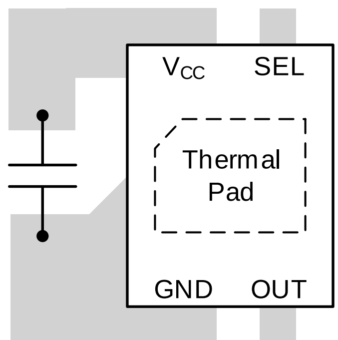


図 18. Layout Example

11 デバイスおよびドキュメントのサポート

11.1 デバイス・サポート

11.1.1 開発サポート

追加のデザイン・リファレンスについては、『*車載用ホール・センサの回転式エンコーダ*』TI Design (TIDA-00480)を参照してください。

11.2 ドキュメントの更新通知を受け取る方法

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11.3 コミュニティ・リソース

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11.5 静電気放電に関する注意事項

これらのデバイスは、限定的なESD（静電破壊）保護機能を内 蔵しています。保存時または取り扱い時は、MOSゲートに対す る静電破壊を防止するために、リード線同士をショートさせて おくか、デバイスを導電フォームに入れる必要があります。

11.6 Glossary

SLYZ022 — *TI Glossary*.

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

12 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

PACKAGING INFORMATION

Orderable 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)
DRV5012AEDMRR	Active	Production	X2SON (DMR) | 4	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	2AE
DRV5012AEDMRR.A	Active	Production	X2SON (DMR) | 4	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 85	2AE
DRV5012AEDMRT	Obsolete	Production	X2SON (DMR) | 4	-	-	Call TI	Call TI	-40 to 85	2AE

(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.

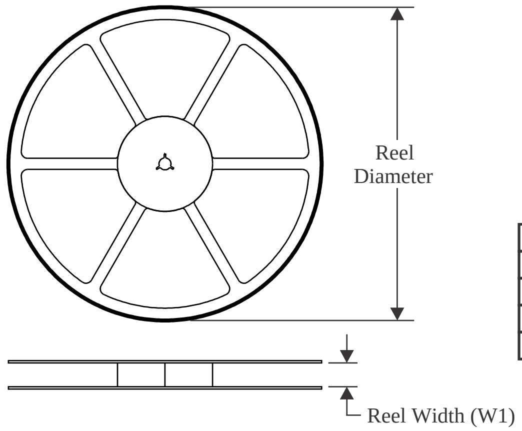
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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.

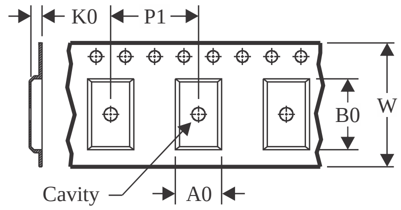
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

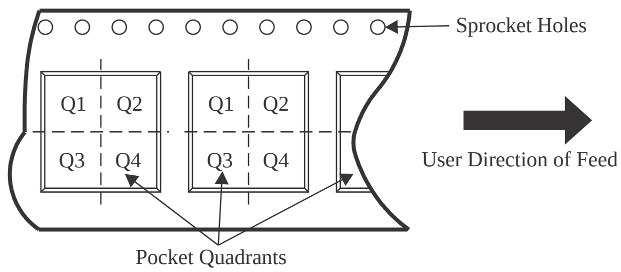


TAPE DIMENSIONS



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

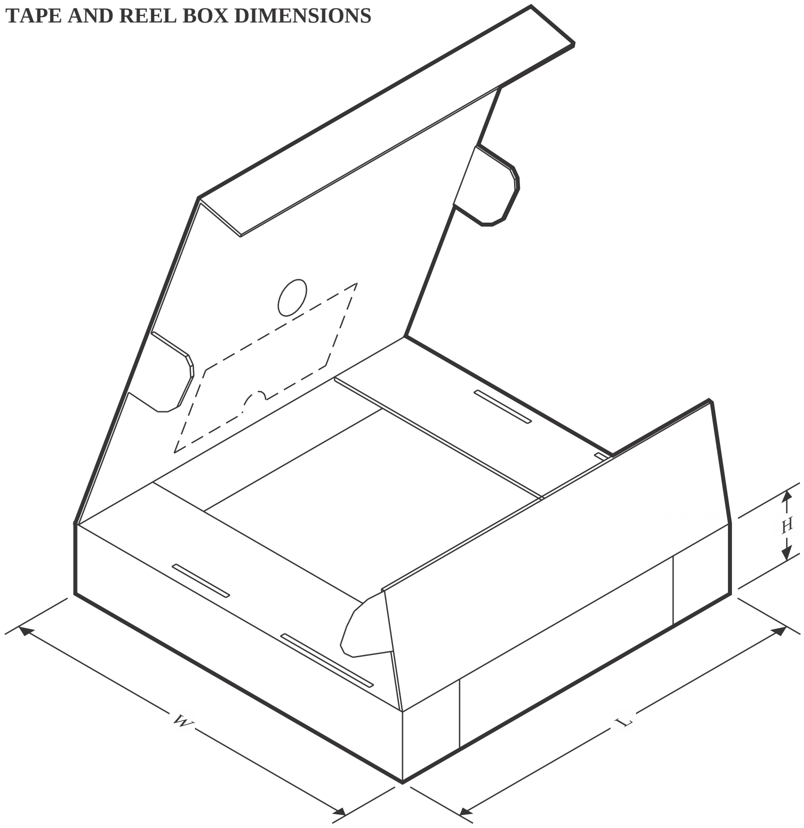
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
DRV5012AEDMRR	X2SON	DMR	4	3000	179.0	8.4	1.27	1.57	0.5	4.0	8.0	Q1

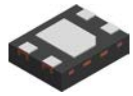
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DRV5012AEDMRR	X2SON	DMR	4	3000	200.0	183.0	25.0

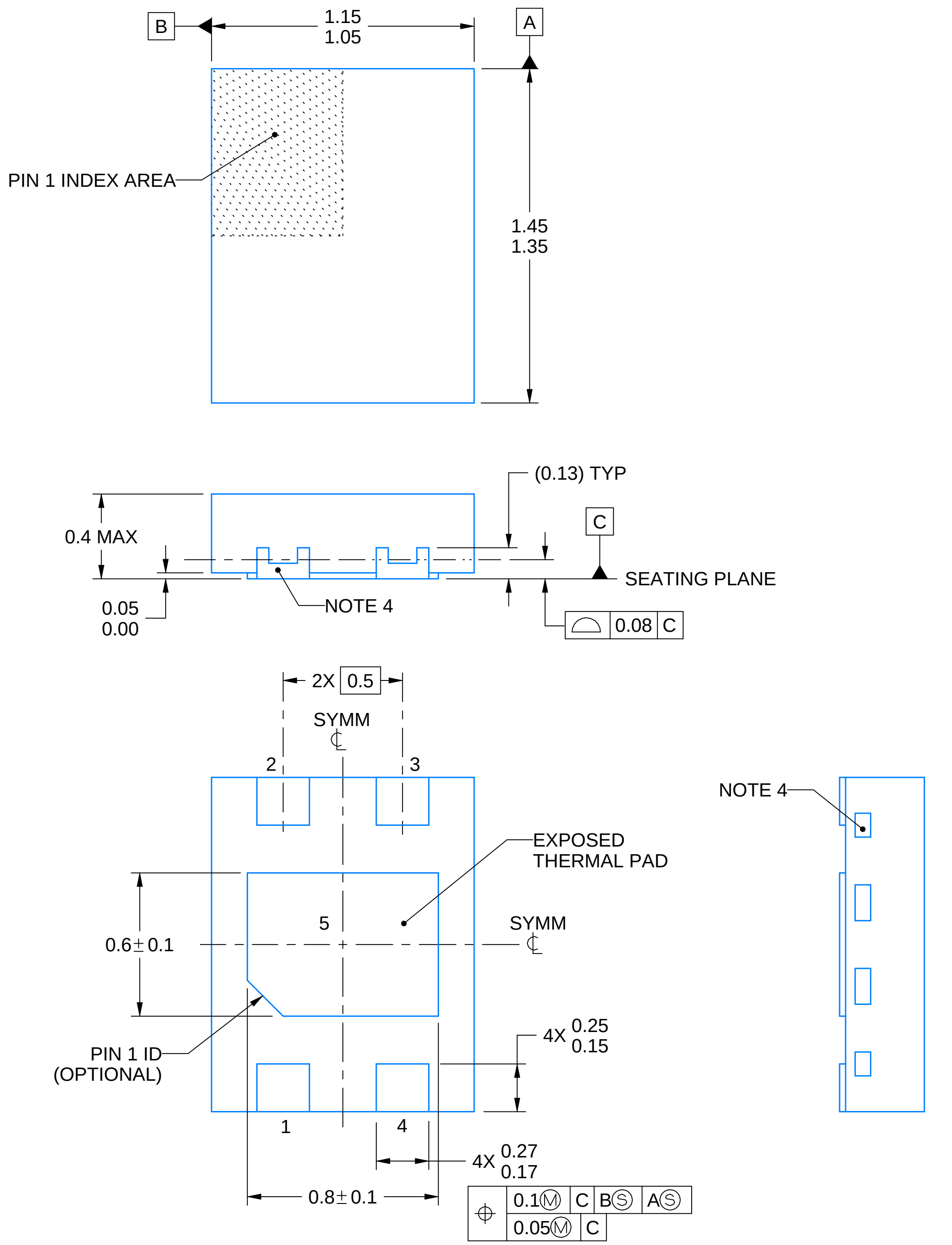
This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



PACKAGE OUTLINE

X2SON - 0.4 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



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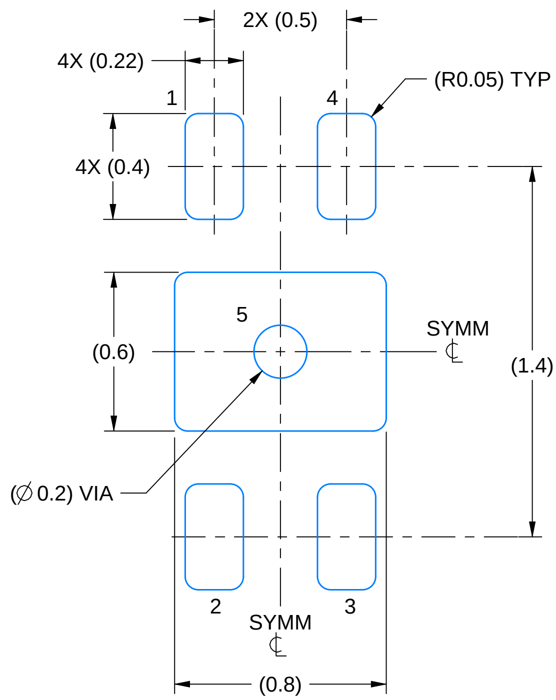
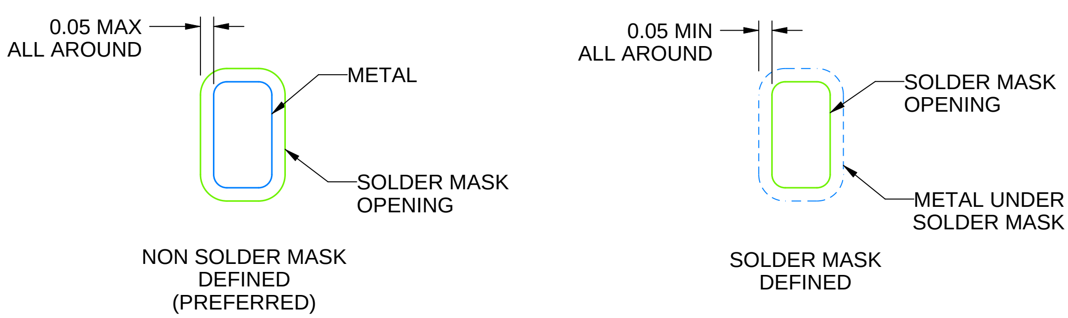
NOTES:

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. 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

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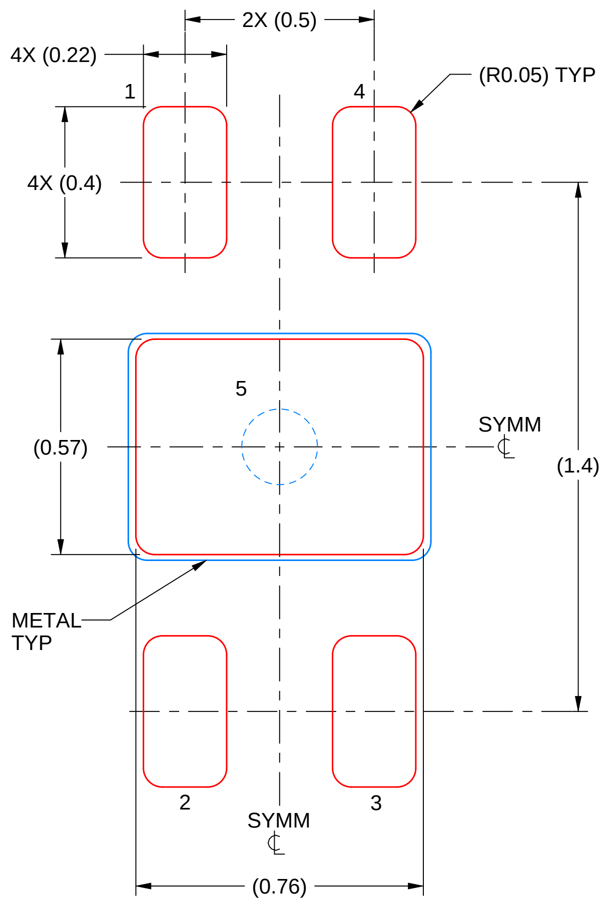
NOTES: (continued)

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

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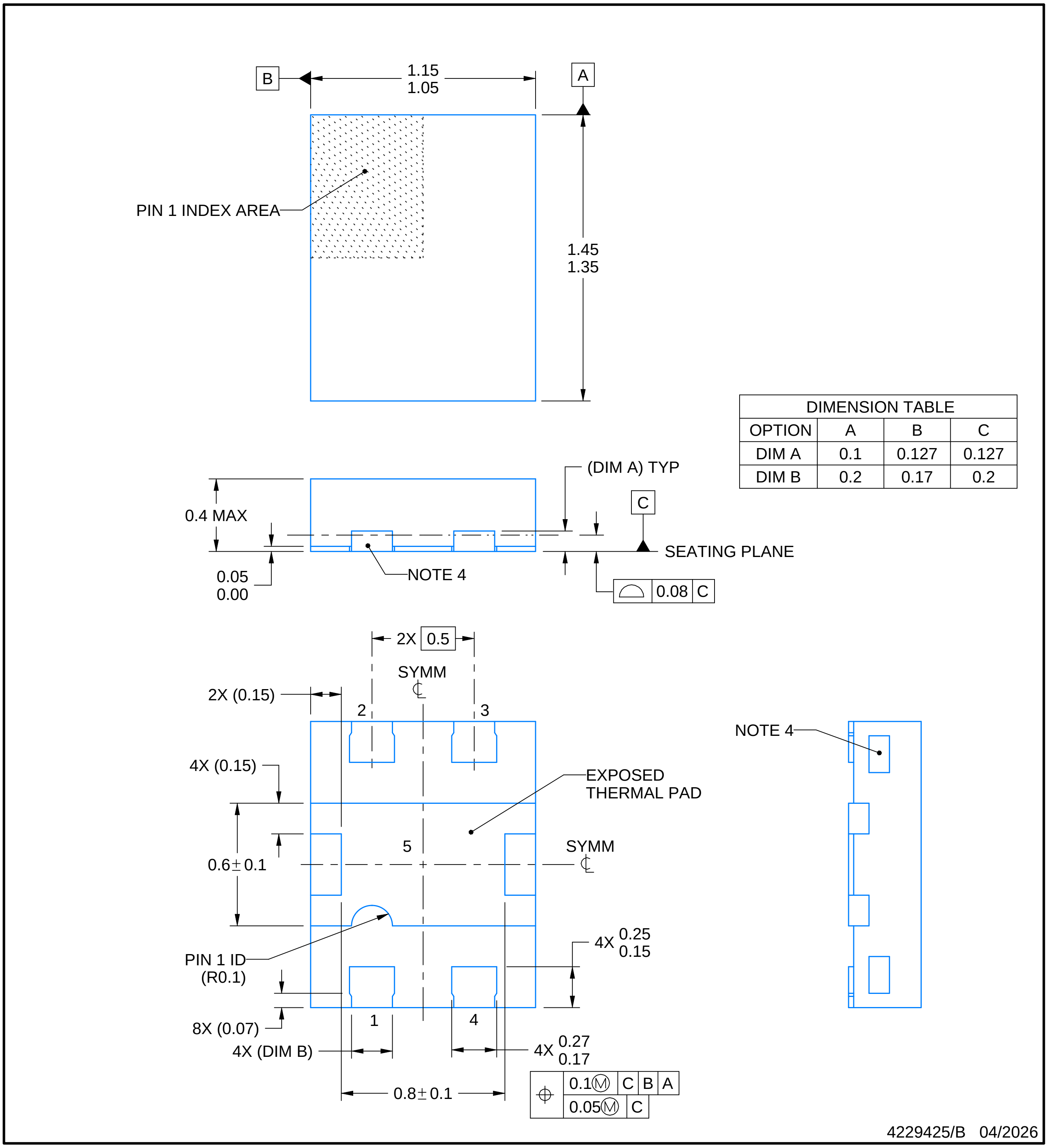
NOTES: (continued)

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

DMR0004B

X2SON - 0.4 mm max height

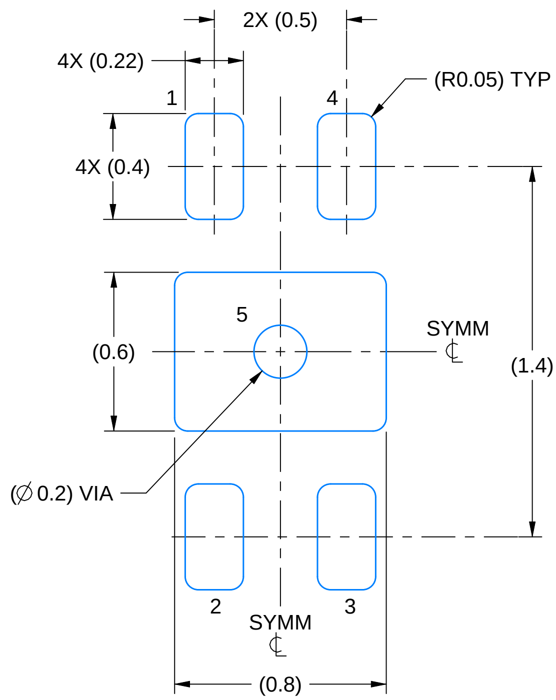
PLASTIC SMALL OUTLINE - NO LEAD



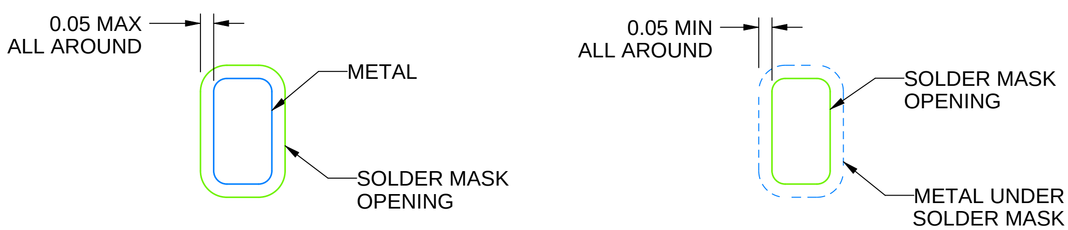
DIMENSION TABLE			
OPTION	A	B	C
DIM A	0.1	0.127	0.127
DIM B	0.2	0.17	0.2

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



NON SOLDER MASK
DEFINED
(PREFERRED)

SOLDER MASK
DEFINED

SOLDER MASK DETAILS

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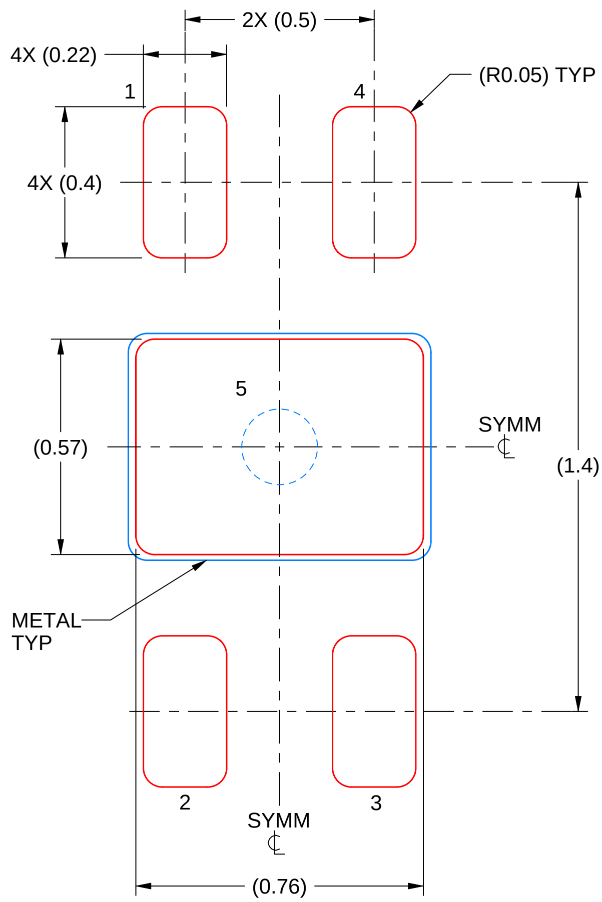
NOTES: (continued)

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.

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