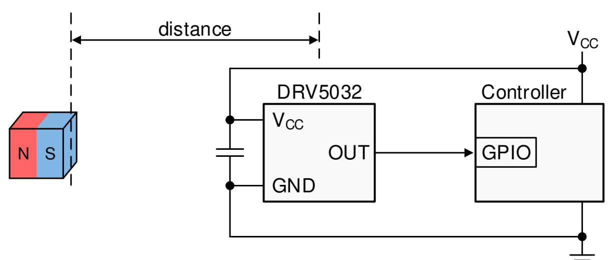
DRV5032 Ultra-Low-Power Digital-Switch Hall Effect Sensor

1 Features

- Industry-leading ultra-low power consumption
  - 5Hz version: 0.54μA
  - 20Hz versions: 1.3μA
  - 80Hz version: 5.2μA
- Operating V_{CC} range: 1.65V to 5.5V
- Operating temperature range: –40°C to +85°C
- Magnetic threshold options (maximum B_{OP}):
  - DG Version: 3.4mT
  - DU Version: 3.9mT
  - FA, FB, FC, FD Versions: 4.8mT
  - AJ Version: 9.5mT
  - ZE Version: 63mT
- Omnipolar and unipolar options
- Open-drain and push-pull output options
- SOT-23, X2SON and TO-92 package options

2 Applications

- Battery-critical position sensing
- Electricity meter tamper detection
- Cell Phone, laptop, or tablet case sensing
- E-locks, smoke detectors, appliances
- Medical devices, IoT systems
- Valve or solenoid position detection
- Contactless diagnostics or activation



Typical Schematic

3 Description

The DRV5032 device is an ultra-low-power digital-switch Hall effect sensor, designed for the most compact and battery-sensitive systems. The device is offered in multiple magnetic thresholds, sampling rates, output drivers, and packages to accommodate various applications.

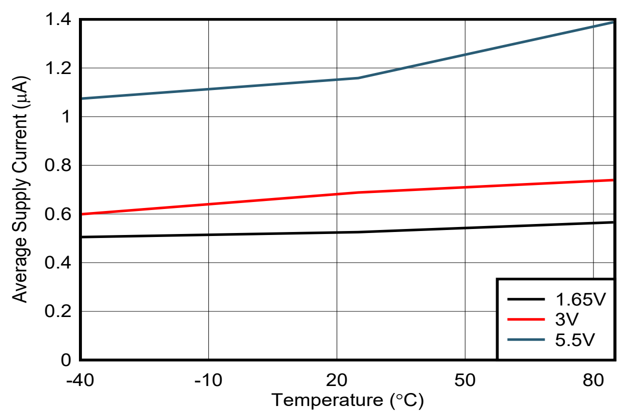
When the applied magnetic flux density exceeds the B_{OP} threshold, the device outputs a low voltage. The output stays low until the flux density decreases to less than B_{RP}, and then the output either drives a high voltage or becomes high impedance, depending on the device version. By incorporating an internal oscillator, the device samples the magnetic field and updates the output at a rate of 80Hz, 20Hz or 5Hz for the lowest current consumption. Omnipolar and unipolar magnetic responses are available.

The device operates from a V_{CC} range of 1.65V to 5.5V, and is packaged in a standard SOT-23, TO-92 and small X2SON.

Package Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE(2)
DRV5032	DBZ (SOT-23, 3)	2.92mm × 2.37mm
	DMR (X2SON, 4)	1.4mm × 1.1mm
	LPG (TO-92, 3)	4mm × 1.52mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.
(2) The package size (length × width) is a nominal value and includes pins, where applicable.



Current Consumption of 5Hz Version

Table of Contents

4 Device Comparison

Table 4-1. Device Comparison

VERSION	MAXIMUM THRESHOLD	MAGNETIC RESPONSE	OUTPUT TYPE	SAMPLING RATE	PACKAGES AVAILABLE
DRV5032DG	3.4 mT	Unipolar	Push-pull	80 Hz	X2SON
DRV5032DU	3.9 mT	Unipolar	Push-pull	20 Hz	SOT-23, X2SON, TO-92
DRV5032FA	4.8 mT	Omnipolar	Push-pull	20 Hz	SOT-23, X2SON, TO-92
DRV5032FB		Omnipolar	Push-pull	5 Hz	SOT-23, X2SON(1), TO-92
DRV5032FC		Omnipolar	Open-drain	20 Hz	SOT-23, TO-92
DRV5032FD		Unipolar	Push-pull	20 Hz	X2SON, TO-92
DRV5032AJ	9.5 mT	Omnipolar	Open-drain	20 Hz	SOT-23, X2SON, TO-92
DRV5032ZE	63 mT	Omnipolar	Open-drain	20 Hz	SOT-23, TO-92

(1) Preview information (not Production Data).

5 Pin Configuration and Functions

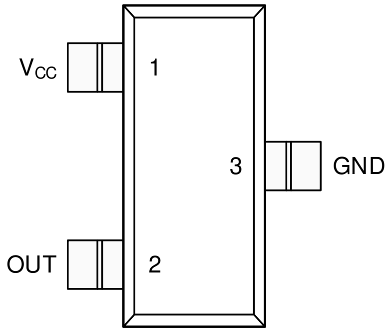


Figure 5-1. FA, FB, FC, AJ, ZE Versions DBZ Package 3-Pin SOT-23 Top View

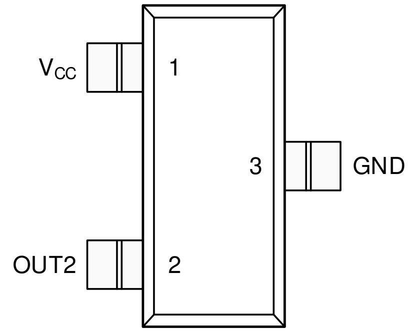


Figure 5-2. DU Version DBZ Package 3-Pin SOT-23 Top View

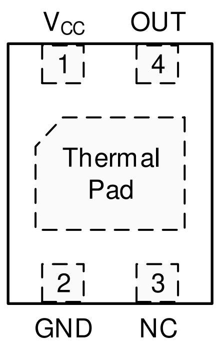


Figure 5-3. FA, AJ Versions DMR Package 4-Pin X2SON Top View

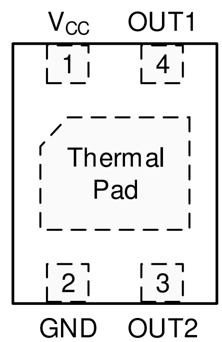


Figure 5-4. DU, DG, FD Versions DMR Package 4-Pin X2SON Top View

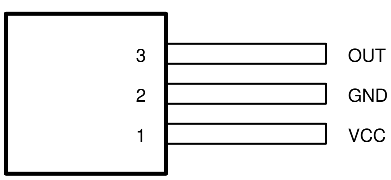


Figure 5-5. FA, FB, FC, AJ, ZE Versions LPG Package 3-Pin TO-92 Top View

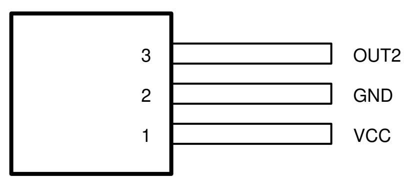


Figure 5-6. DU, FD Versions LPG Package 3-Pin TO-92 Top View

Table 5-1. Pin Functions

PIN							I/O	DESCRIPTION
NAME	SOT-23 (FA, FB, FC, AJ, ZE)	SOT-23 (DU)	TO-92 (FA, FB, FC, AJ, ZE)	TO-92 (DU, FD)	X2SON (FA, AJ)	X2SON (DU, DG, FD)		
GND	3	3	2	2	2	2	—	Ground reference
OUT	2	—	3	—	4	—	O	Omnipolar output that responds to north and south magnetic poles
OUT1	—	—	—	—	—	4	O	Unipolar output that responds to north magnetic poles near the top of the package
OUT2	—	2	—	3	—	3	O	Unipolar output that responds to south magnetic poles near the top of the package
NC	—	—	—	—	3	—	—	No-connect. This pin is not connected to the silicon. Leave this pin floating or tied to ground. Solder the pin to the board for mechanical support.
V_{CC}	1	1	1	1	1	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	PAD	—	No-connect. Leave this pin floating or tied to ground. Solder the pin 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, OUT1, OUT2	–0.3	V_{CC} + 0.3	V
Output current	OUT, OUT1, OUT2	–5	5	mA
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	1.65	5.5	V
V_O	Output voltage	0	5.5	V
I_O	Output current	–5	5	mA
T_A	Operating ambient temperature	–40	85	°C

6.4 Thermal Information

THERMAL METRIC[1]		DRV5032			UNIT
		DBZ (SOT-23)	DMR (X2SON)	LPG (TO-92)	
		3 PINS	4 PINS	3 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	356	159	183.1	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	128	77	74.2	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	94	102	158.8	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	11.4	0.9	15.2	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	92	100	158.8	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application note.

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
PUSH-PULL OUTPUT DRIVER						
V_{OH}	High-level output voltage	I_{OUT} = –1mA	V_{CC} – 0.35	V_{CC} – 0.1		V
V_{OL}	Low-level output voltage	I_{OUT} = 1mA		0.1	0.3	V
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
DG VERSION						
f_S	Frequency of magnetic sampling		40	80	120	Hz
t_S	Period of magnetic sampling		8	12.5	25	ms
$I_{CC(AVG)}$	Average current consumption	V_{CC} = 1.8V		5.2		µA
		V_{CC} = 3V		5.7	7.9	
		V_{CC} = 5V		6		
DU, FA, FC, FD, AJ, ZE VERSIONS						
f_S	Frequency of magnetic sampling		13.3	20	37	Hz
t_S	Period of magnetic sampling		27	50	75	ms
$I_{CC(AVG)}$	Average current consumption	V_{CC} = 1.8V		1.3		µA
		V_{CC} = 3V		1.6	3.5	
		V_{CC} = 5V		2.3		
FB VERSION						
f_S	Frequency of magnetic sampling		3.5	5	8.5	Hz
t_S	Period of magnetic sampling		117	200	286	ms
$I_{CC(AVG)}$	Average current consumption	V_{CC} = 1.8V		0.54		µA
	Average current consumption	V_{CC} = 3V		0.69	1.8	
	Average current consumption	V_{CC} = 5V		1.06		
ALL VERSIONS						
$I_{CC(PK)}$	Peak current consumption			2	2.7	mA
t_{ON}	Power-on time (see Figure 8-7)			55	100	µs
t_{ACTIVE}	Active time period (see Figure 8-7)			40		µs

6.6 Magnetic Characteristics

for V_{CC} = 1.65V to 5.5V, over operating free-air temperature range (unless otherwise noted)[(1)]

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
DG VERSION						
B_{OP}	Magnetic threshold operate point	OUT1 pin (north)[(2)] T_A = 25C	–3.32	–2.5	–1.72	mT
		OUT1 pin (north)[(2)]	–3.40	–2.5	–1.56	
		OUT2 pin (south) T_A = 25C	1.72	2.5	3.32	
		OUT2 pin (south)	1.56	2.5	3.40	
B_{RP}	Magnetic threshold release point	OUT1 pin (north)[(2)] T_A = 25C	–2.62	–1.8	–1.17	mT
		OUT1 pin (north)[(2)]	–2.73	–1.8	–0.9	
		OUT2 pin (south) T_A = 25C	1.17	1.8	2.62	
		OUT2 pin (south)	0.9	1.8	2.73	
B_{HYS}	Magnetic hysteresis: $\lvert B_{OP} – B_{RP}\rvert$	Each output T_A = 25C	0.21	0.7	1.19	mT
	Magnetic hysteresis: $\lvert B_{OP} – B_{RP}\rvert$	Each output	0.13	0.7	1.27	
DU VERSION						
B_{OP}	Magnetic threshold operate point	OUT1 pin (north)[(2)]	–3.9	–2.5	–1.2	mT
	Magnetic threshold operate point	OUT2 pin (south)	1.2	2.5	3.9	
B_{RP}	Magnetic threshold release point	OUT1 pin (north)[(2)]	–3.5	–1.8	–0.9	mT
	Magnetic threshold release point	OUT2 pin (south)	0.9	1.8	3.5	
B_{HYS}	Magnetic hysteresis: $\lvert B_{OP} – B_{RP}\rvert$	Each output	0.1	0.7	1.9	mT
FA, FB, FC VERSIONS						
B_{OP}	Magnetic threshold operate point		±1.5	±3	±4.8	mT
B_{RP}	Magnetic threshold release point		±0.5	±1.5	±3	mT
B_{HYS}	Magnetic hysteresis: $\lvert B_{OP} – B_{RP}\rvert$		0.8	1.5	3	mT
FD VERSION						
B_{OP}	Magnetic threshold operate point	OUT1 pin (north)[(2)]	–4.8	–3	–1.5	mT
		OUT2 pin (south)	1.5	3	4.8	
B_{RP}	Magnetic threshold release point	OUT1 pin (north)[(2)]	–3	–1.5	–0.5	mT
		OUT2 pin (south)	0.5	1.5	3	
B_{HYS}	Magnetic hysteresis: $\lvert B_{OP} – B_{RP}\rvert$	Each output	0.8	1.5	3	mT
AJ VERSION						
B_{OP}	Magnetic threshold operate point		±4	±7	±9.5	mT
B_{RP}	Magnetic threshold release point		±3	±5.6	±7.5	mT
B_{HYS}	Magnetic hysteresis: $\lvert B_{OP} – B_{RP}\rvert$		0.5	1.4	3	mT
ZE VERSION						
B_{OP}	Magnetic threshold operate point		±33	±47	±63	mT
B_{RP}	Magnetic threshold release point		±30	±43	±58	mT
B_{HYS}	Magnetic hysteresis: $\lvert B_{OP} – B_{RP}\rvert$		1.2	4	8.5	mT

(1) For a graphical description of magnetic thresholds, see the *Magnetic Response*section.
(2) X2SON package only.

6.7 Typical Characteristics

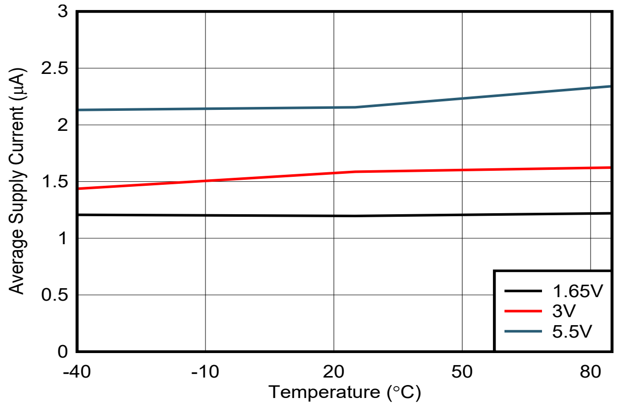


Figure 6-1. $I_{CC(AVG)}$ vs Temperature (20-Hz versions)

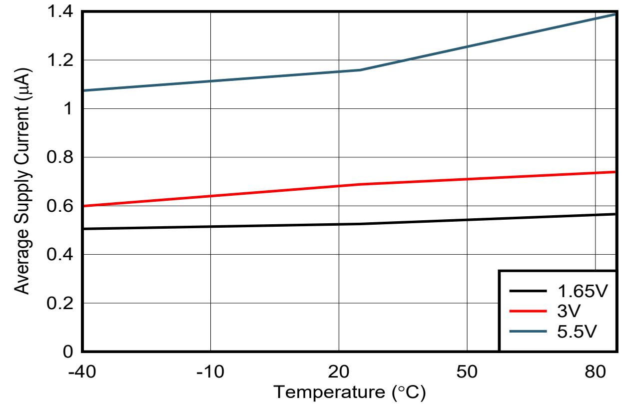


Figure 6-2. $I_{CC(AVG)}$ vs Temperature (5-Hz version)

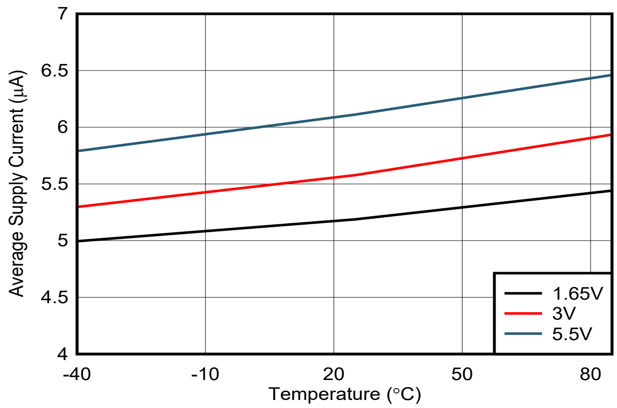


Figure 6-3. $I_{CC(AVG)}$ vs Temperature (40-Hz version)

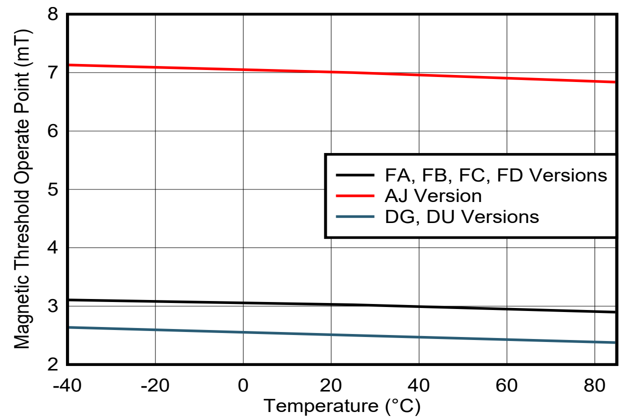


Figure 6-4. $|B_{OP}|$ vs Temperature

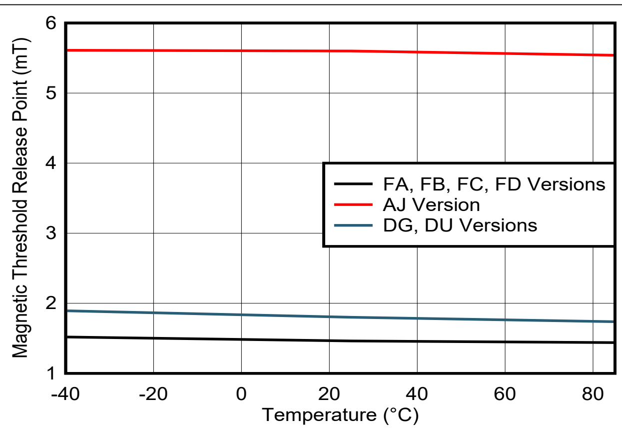


Figure 6-5. $|B_{RP}|$ vs Temperature

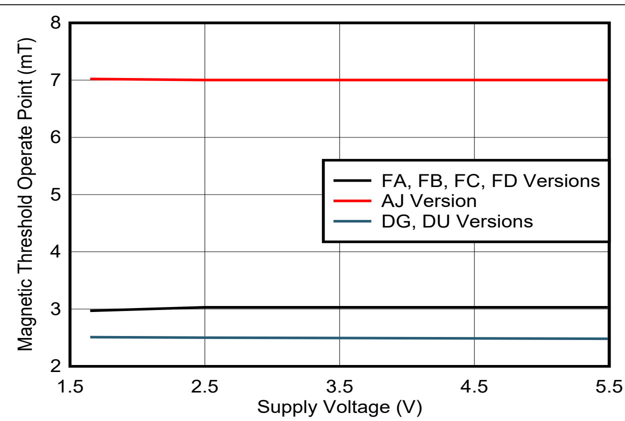


Figure 6-6. $|B_{OP}|$ vs V_{CC}

6.7 Typical Characteristics (continued)

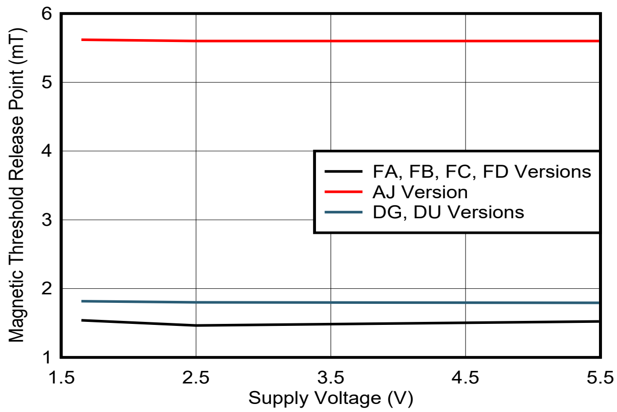


Figure 6-7. |B_{RP}| vs V_{CC}

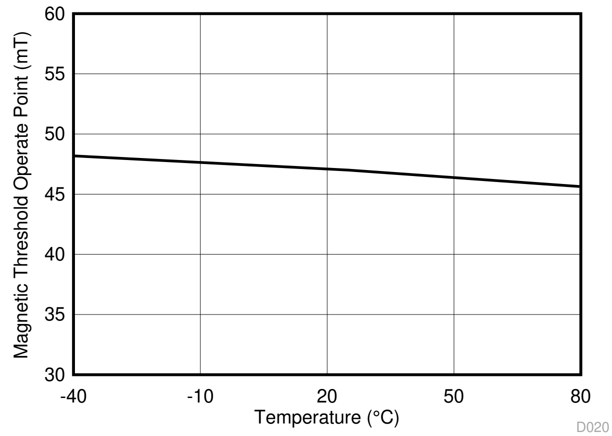


Figure 6-8. ZE Version |B_{OP}| vs Temperature

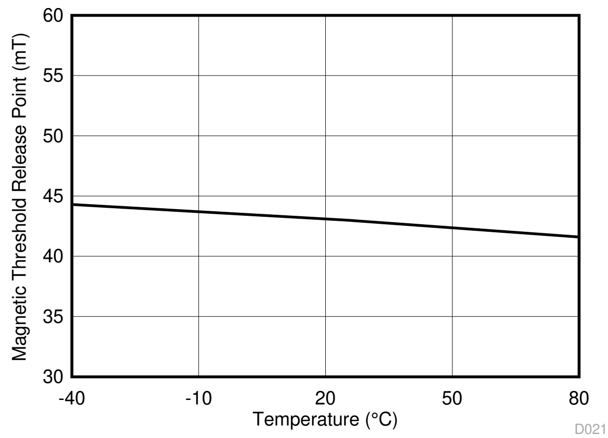


Figure 6-9. ZE Version |B_{RP}| vs Temperature

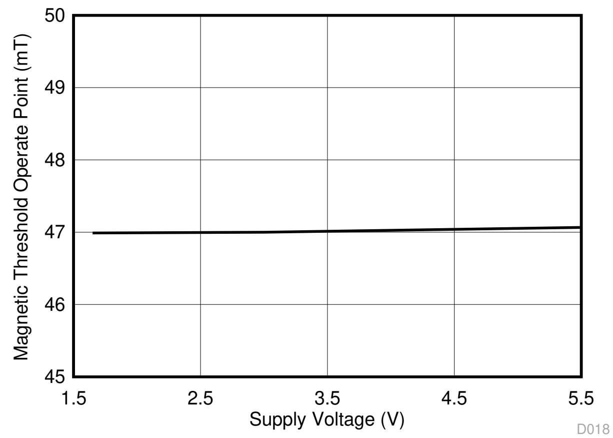


Figure 6-10. ZE Version |B_{OP}| vs V_{CC}

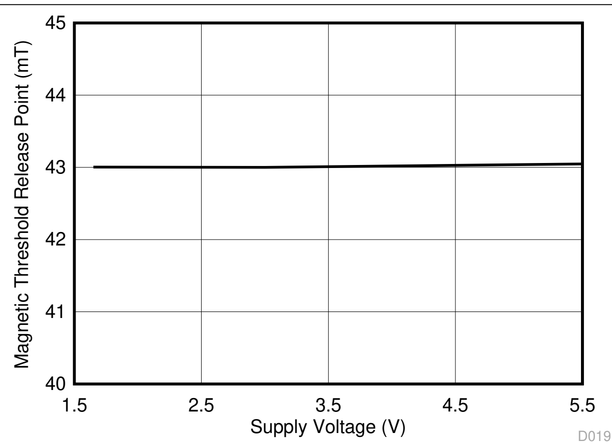
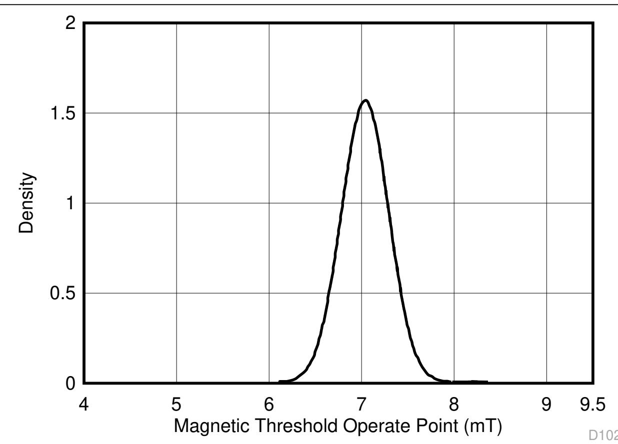


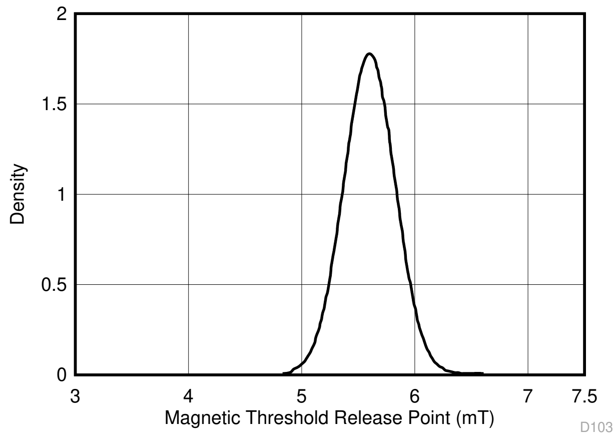
Figure 6-11. ZE Version |B_{RP}| vs V_{CC}



T_A = 25°C, V_{CC} = 1.65 V to 5.5 V

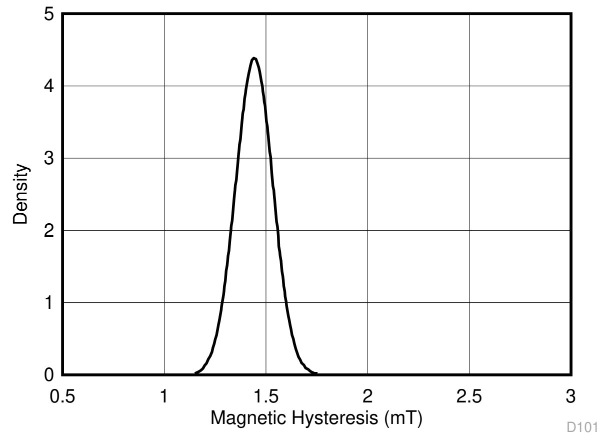
Figure 6-12. AJ Version B_{OP} Probability Density Function

6.7 Typical Characteristics (continued)



T_A = 25°C, V_{CC} = 1.65 V to 5.5 V

Figure 6-13. AJ Version B_{RP} Probability Density Function



T_A = 25°C, V_{CC} = 1.65 V to 5.5 V

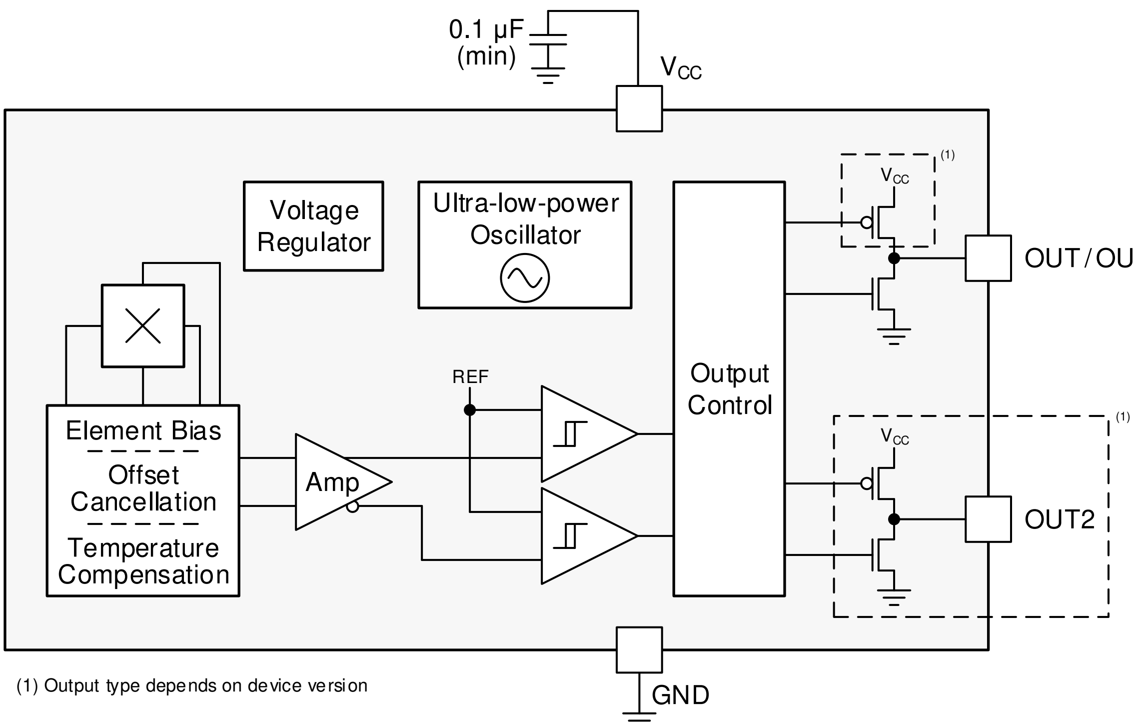
Figure 6-14. AJ Version B_{HYS} Probability Density Function

7 Detailed Description

7.1 Overview

The DRV5032 device is a magnetic sensor with a digital output that indicates when the magnetic flux density threshold has been crossed. 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.

7.2 Functional Block Diagram



(1) Output type depends on device version

7.3 Feature Description

7.3.1 Magnetic Flux Direction

The DRV5032 device is sensitive to the magnetic field component that is perpendicular to the top of the package (as shown in Figure 7-1).

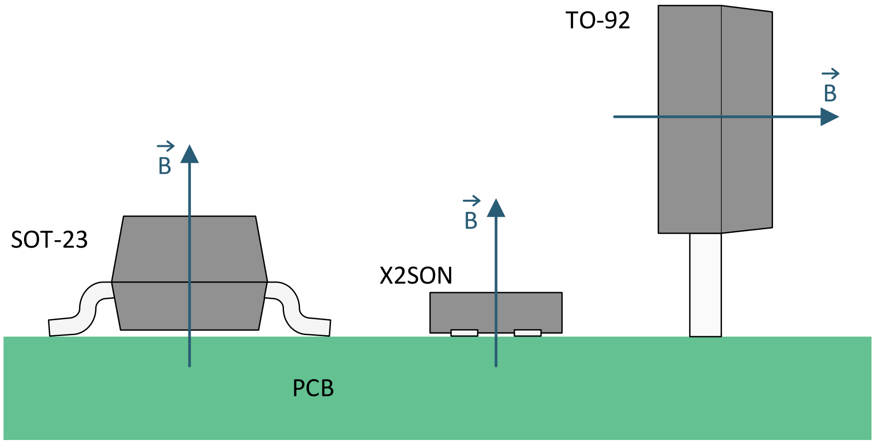


Figure 7-1. Direction of Sensitivity

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.

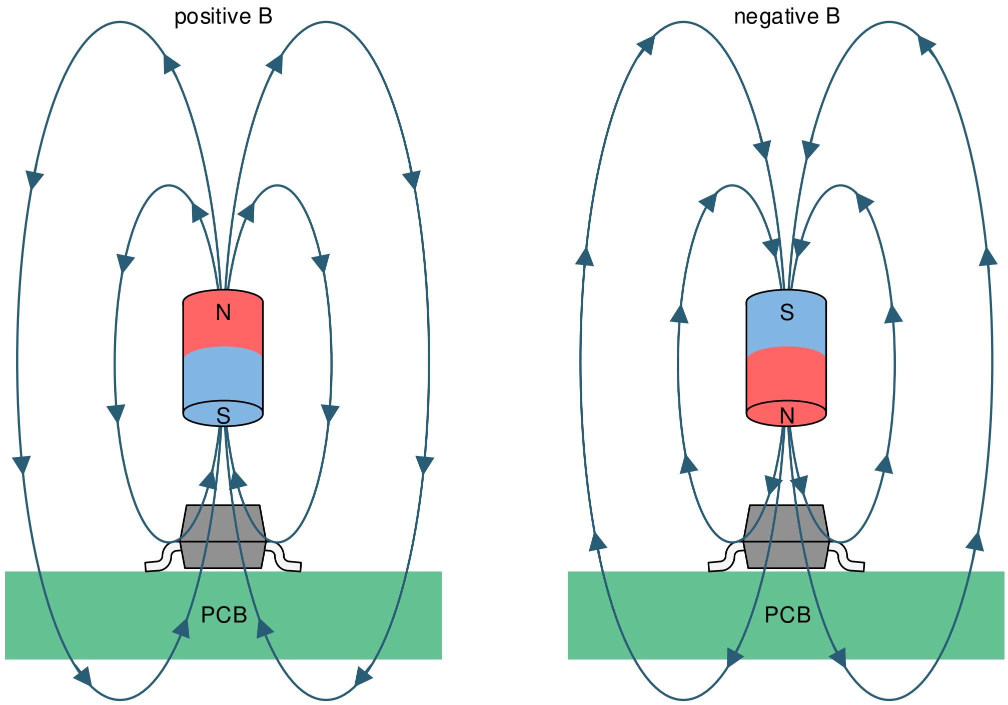


Figure 7-2. Flux Direction Polarity

7.3.2 Device Version Comparison

The following table lists the available device versions.

VERSION	MAXIMUM THRESHOLD	MAGNETIC RESPONSE	OUTPUT TYPE	SAMPLING RATE	PACKAGES AVAILABLE
DRV5032DG	3.4 mT	Unipolar	Push-pull	80 Hz	X2SON
DRV5032DU	3.9 mT	Unipolar	Push-pull	20 Hz	SOT-23, X2SON, TO-92
DRV5032FA	4.8 mT	Omnipolar	Push-pull	20 Hz	SOT-23, X2SON, TO-92
DRV5032FB		Omnipolar	Push-pull	5 Hz	SOT-23, X2SON [(1)], TO-92
DRV5032FC		Omnipolar	Open-drain	20 Hz	SOT-23, TO-92
DRV5032FD		Unipolar	Push-pull	20 Hz	X2SON, TO-92
DRV5032AJ	9.5 mT	Omnipolar	Open-drain	20 Hz	SOT-23, X2SON, TO-92
DRV5032ZE	63 mT	Omnipolar	Open-drain	20 Hz	SOT-23, TO-92

(1) Preview information (not Production Data).

7.3.2.1 Magnetic Threshold

Devices that have a lower magnetic threshold detect magnets at a farther distance. Higher thresholds generally require a closer distance or larger magnet.

7.3.2.2 Magnetic Response

The FA, FB, FC, AJ, and ZE device versions have omnipolar functionality, and these versions all respond to the north and south poles the same way as shown in Figure 7-3.

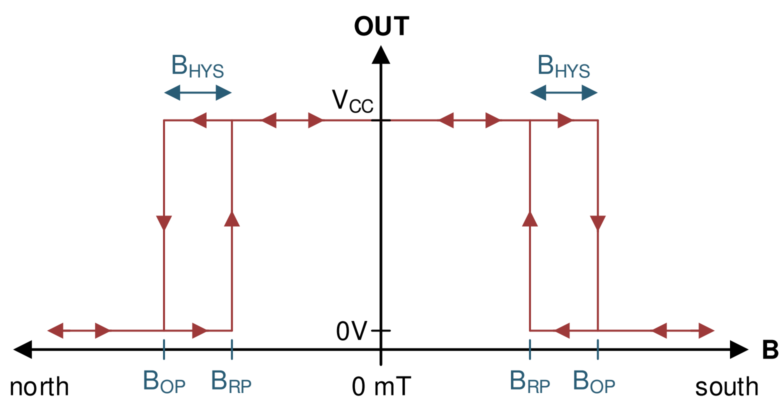


Figure 7-3. Omnipolar Functionality

The DU, DG and FD device versions have unipolar functionality. Pin OUT1 only responds to flux in the top-down direction (north), and pin OUT2 only responds to flux in the bottom-up direction (south).

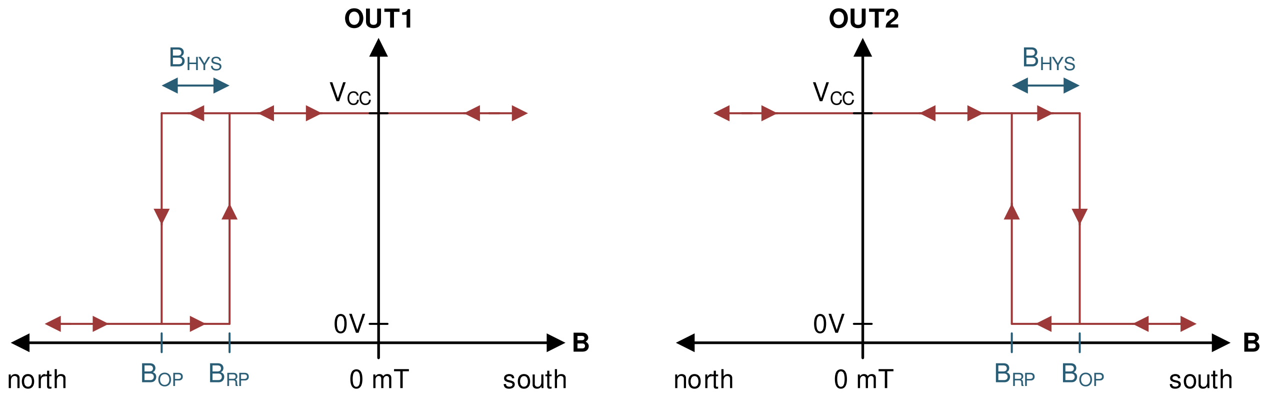


Figure 7-4. Unipolar Functionality

7.3.2.3 Output Type

The DU, DG, FA, FB, and FD device versions have push-pull CMOS outputs that can drive a V_{CC} or ground level. The FC, AJ, and ZE device versions have open-drain outputs that can become high impedance or drive ground. For these versions, an external pullup resistor must be used.

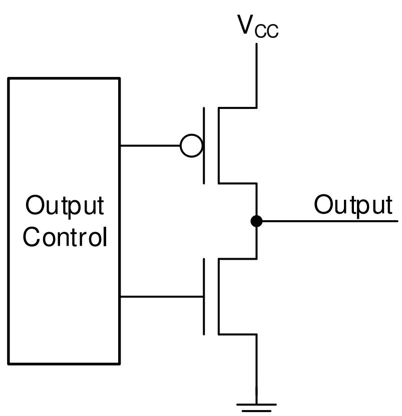


Figure 7-5. Push-Pull Output (Simplified)

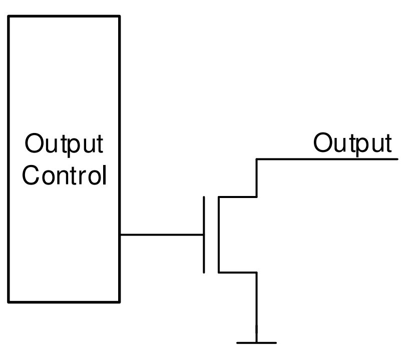


Figure 7-6. Open-Drain Output (Simplified)

7.3.2.4 Sampling Rate

When the DRV5032 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, the device measures a new sample and updates the output, if necessary. If the magnetic field does not change between periods, the output does not change.

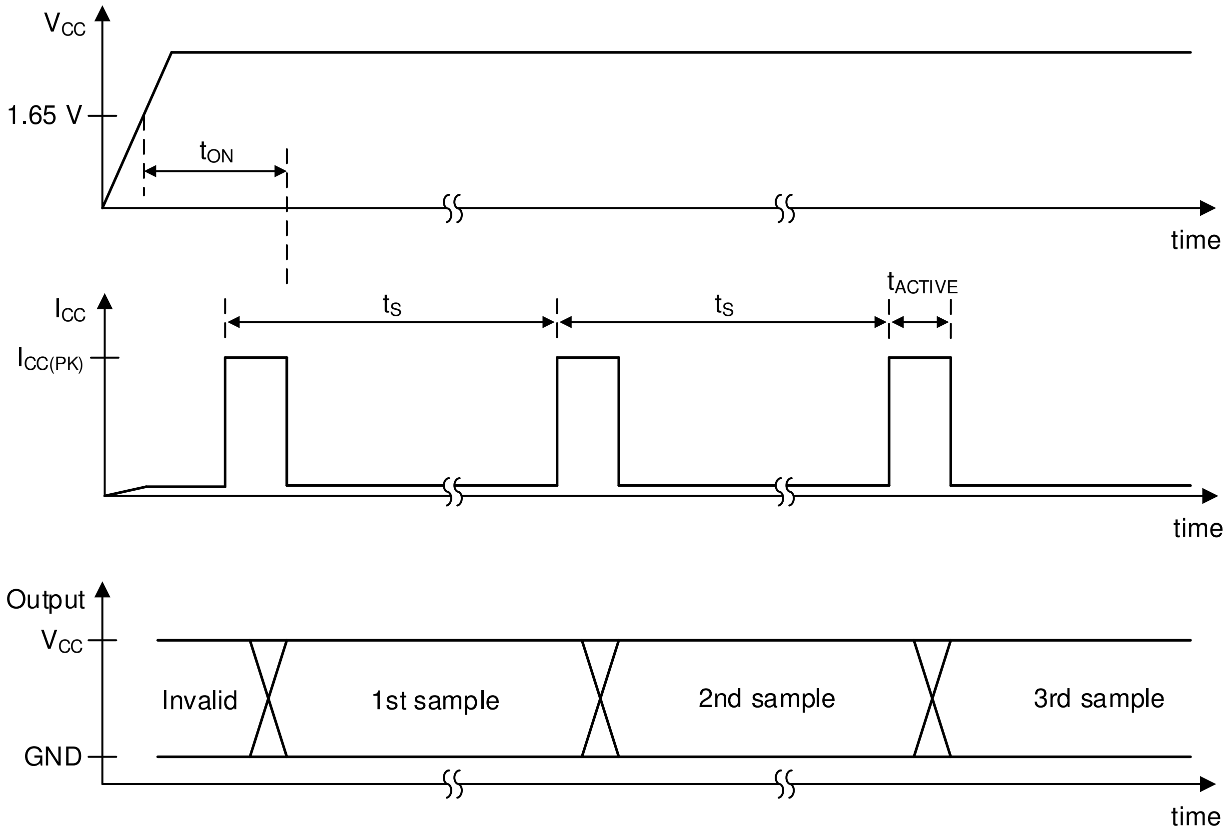


Figure 7-7. Timing Diagram

7.3.3 Hall Element Location

The sensing element inside the device is in the center of both packages when viewed from the top. Figure 7-8 shows the tolerances and side-view dimensions.

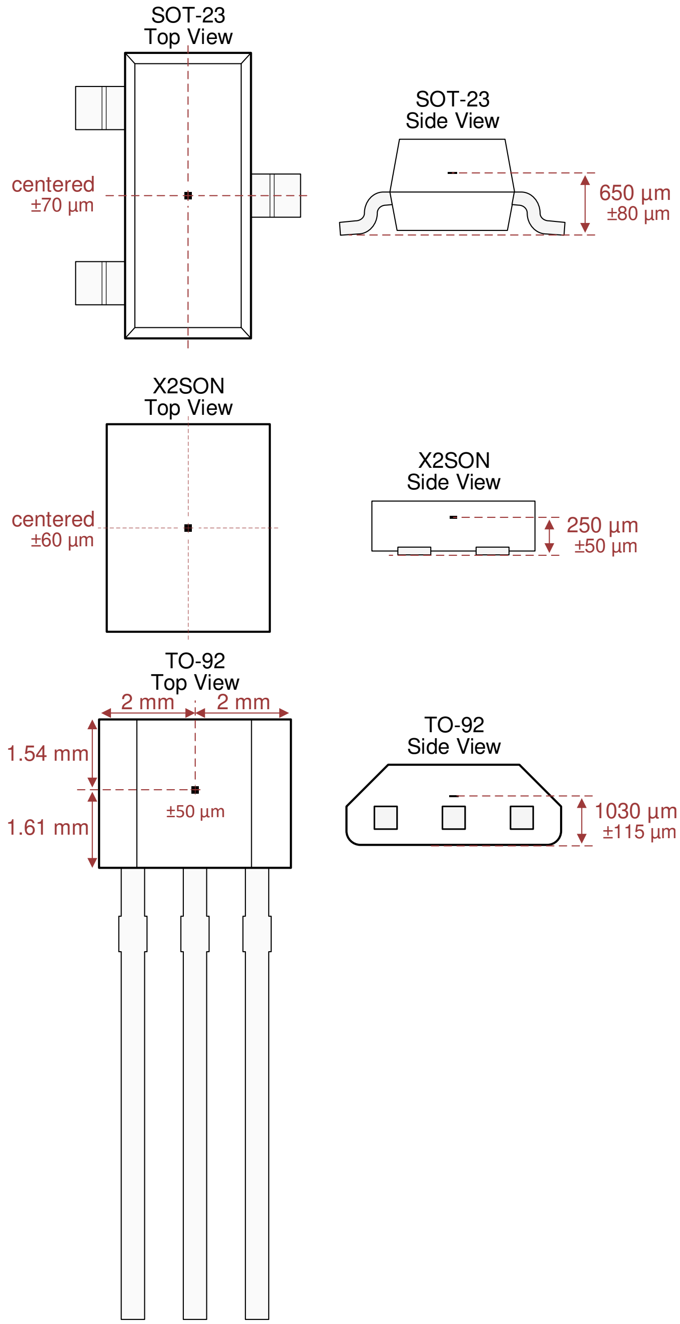


Figure 7-8. Hall Element Location

7.4 Device Functional Modes

The DRV5032 device has one mode of operation that applies when the *Recommended Operating Conditions* are met.

8 Application and Implementation

Note

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

8.1 Application Information

The DRV5032 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 Output Type Tradeoffs

The push-pull output allows for the lowest system power consumption because there is no current leakage path when the output drives high or low. The open-drain output involves a leakage path through the external pullup resistor when the output drives low.

The open-drain outputs of multiple devices can be tied together to form a logical AND. In this setup, if any sensor drives low, the voltage on the shared node becomes low. This can allow a single GPIO to measure an array of sensors.

8.2 Typical Applications

8.2.1 General-Purpose Magnet Sensing

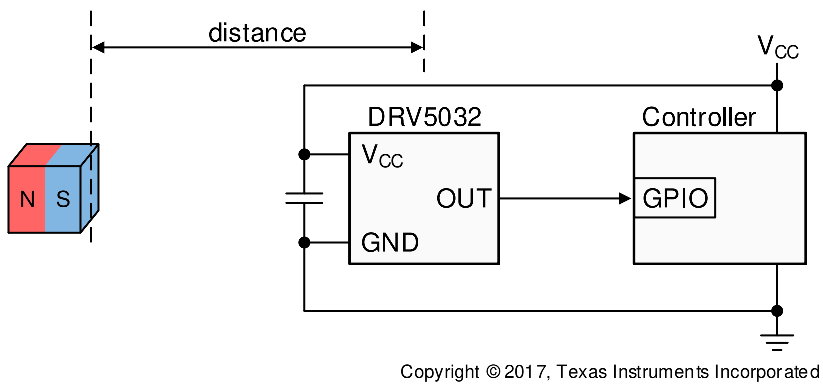


Figure 8-1. Typical Application Diagram

8.2.1.1 Design Requirements

For this design example, use the parameters listed in Table 8-1.

Table 8-1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
V_{CC}	3.3 V
Magnet	1-cm Cube NdFeB
Closest magnet distance	2.5 cm
Magnetic flux density at closest distance	7.8 mT
Magnetic flux density when magnet moves away	Close to 0 mT

8.2.1.2 Detailed Design Procedure

When designing a digital-switch magnetic sensing system, consider these three variables: the magnet, sensing distance, and threshold of the sensor.

The DRV5032 device has a detection threshold specified by parameter B_{OP}. To reliably activate the sensor, the magnet must apply greater than the maximum specified B_{OP}. In such a system, the sensor typically detects the magnet before the magnet moves to the closest position. When the magnet moves away from the sensor, the magnet must apply less than the minimum specified B_{RP} to reliably release the sensor.

Magnets are made from various ferromagnetic materials that have trade-offs in cost, drift with temperature, absolute max temperature ratings, remanence or residual induction (B_r), and coercivity (H_c). The B_r and the dimensions of a magnet determine the magnetic flux density (B) the magnet produces in 3-dimensional space. For simple magnet shapes, such as rectangular blocks and cylinders, there are simple equations that solve B at a given distance centered with the magnet.

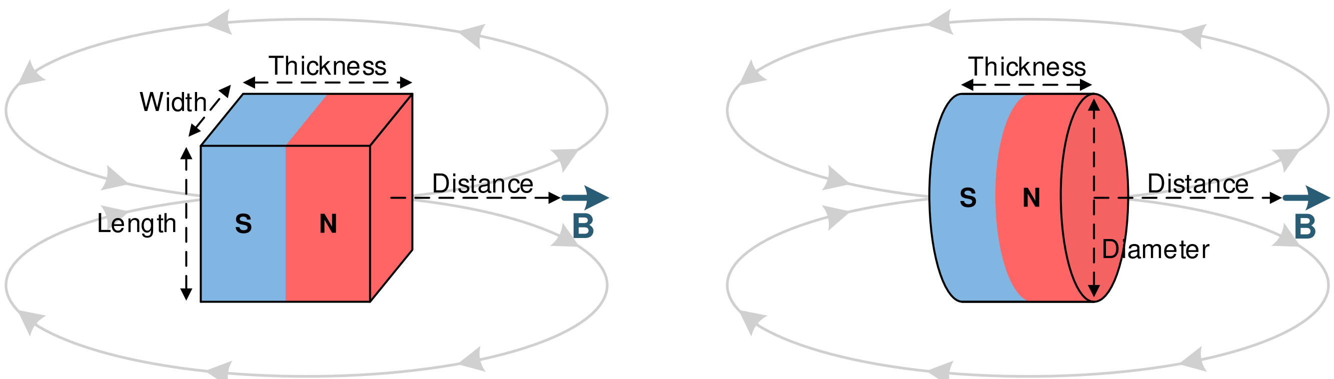


Figure 8-2. Rectangular Block and Cylinder Magnets

Use Equation 1 for the rectangular block shown in Figure 8-2:

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

Use Equation 2 for the cylinder shown in Figure 8-2:

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

where

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

An online tool that uses these formulas is located at http://www.ti.com/product/drv5033.

All magnetic materials generally have a lower B_r at higher temperatures. Make sure the systems have margin to account for this, as well as for mechanical tolerances.

8.2.1.3 Application Curve

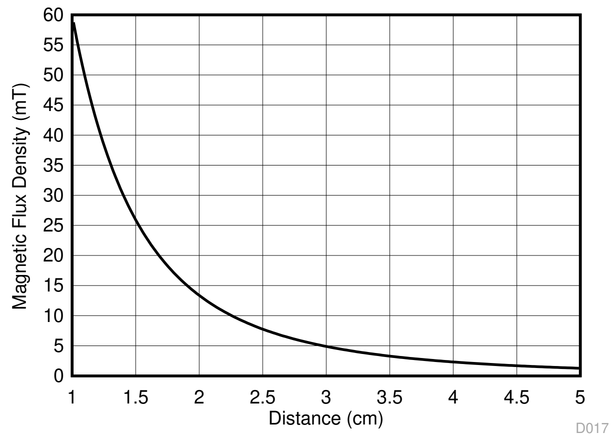


Figure 8-3. Magnetic Profile of a 1-cm Cube NdFeB Magnet

8.2.2 Three-Position Switch

This application uses the DRV5032FD for a three-position switch.

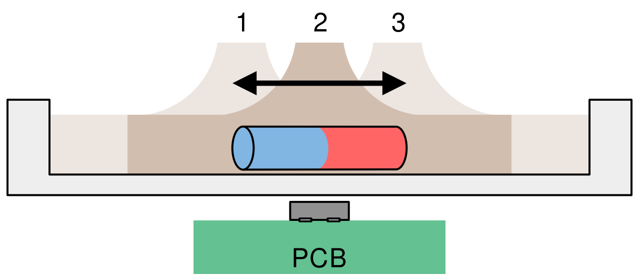


Figure 8-4. Three-Position Slider Switch With Embedded Magnet

8.2.2.1 Design Requirements

For this design example, use the parameters listed in Table 8-2.

Table 8-2. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Hall effect device	DRV5032FD
V_{CC}	5 V
Switch travel distance	5 mm in each direction
Magnet	10-mm cylinder
Mechanical tolerance per position	±0.5 mm

8.2.2.2 Detailed Design Procedure

A standard 2-pole magnet produces strong perpendicular flux components near the outer edges of the poles, and no perpendicular flux near the center at the north-south pole boundary. When the DRV5032FD is below the center of the magnet, the device receives close to 0 mT, and both outputs drive high. If the switch with the embedded magnet moves left or right, the sensor receives a north or south field, and OUT1 or OUT2 drive low. This provides 3 digital states of detection.

The length of the magnet should ideally be two times the distance of travel toward each side. Then, when the switch is pushed to either side, the outer edge of the magnet is positioned directly above the sensor where the magnet applies the strongest perpendicular flux component.

To determine the magnitude of magnetic flux density for a given magnet and distance, TI recommends to either use simulation software, test with a linear Hall effect sensor, or test with a gaussmeter.

8.2.2.3 Application Curve

Figure 8-5 shows the typical magnetic flux lines around a 2-pole magnet.

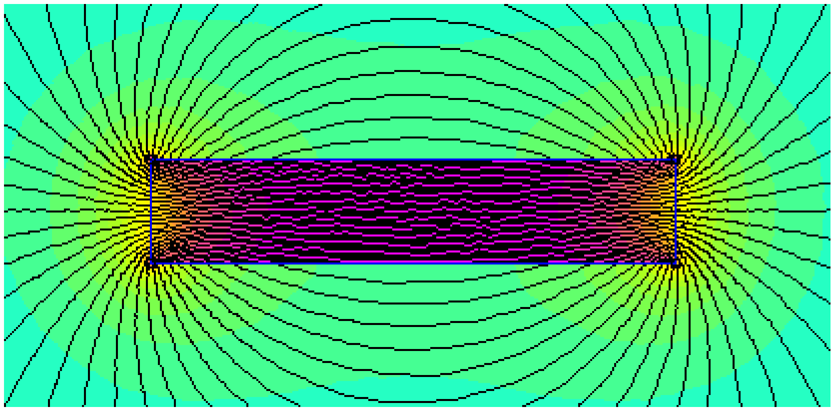


Figure 8-5. Typical Magnetic Flux Lines

8.3 Best Design Practices

The Hall element is sensitive to magnetic fields that are perpendicular to the top of the package, therefore a correct magnet approach must be used for the sensor to detect the field. Figure 8-6 shows correct and incorrect approaches.

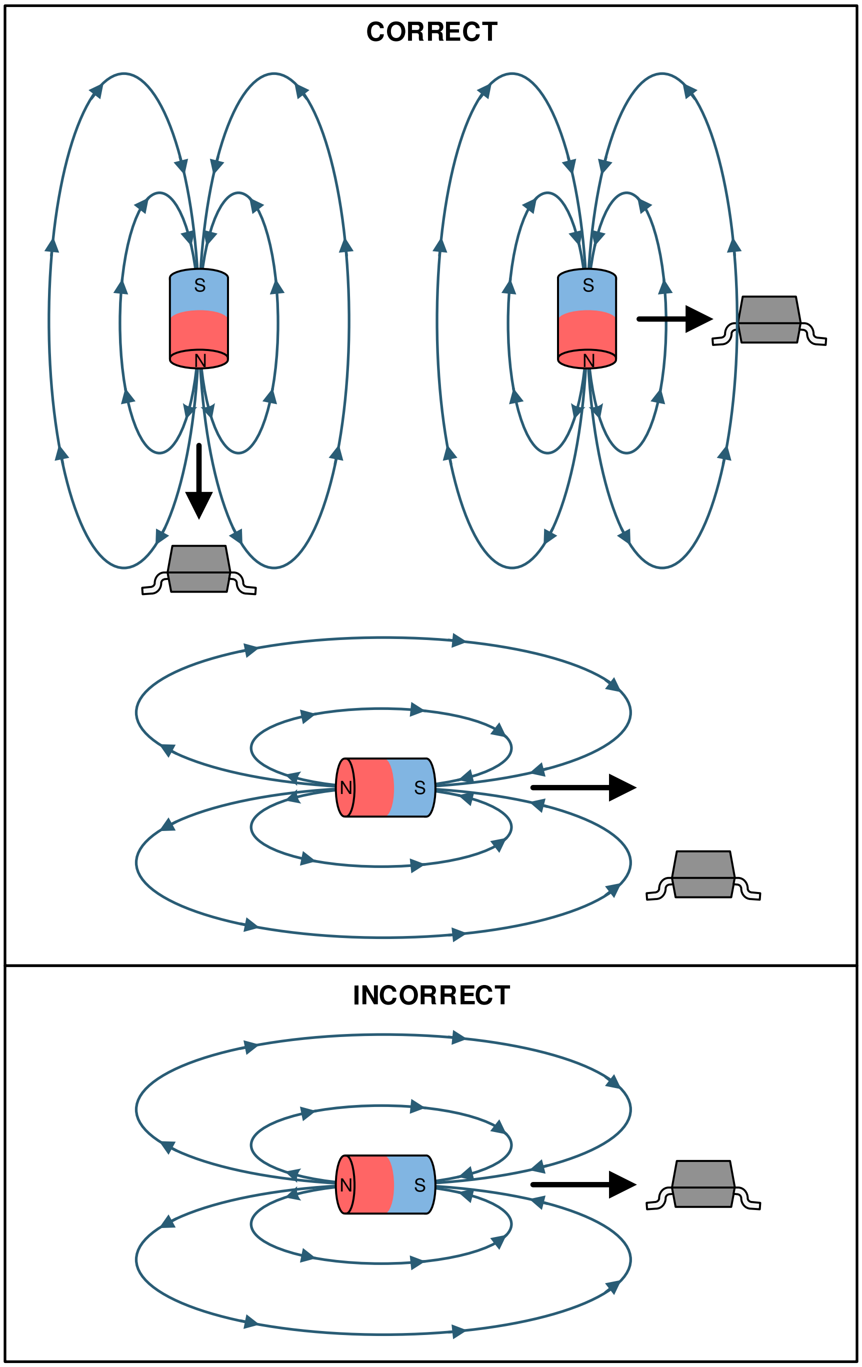


Figure 8-6. Correct and Incorrect Magnet Approaches

8.4 Power Supply Recommendations

The DRV5032 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.

8.5 Layout

8.5.1 Layout Guidelines

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

8.5.2 Layout Examples

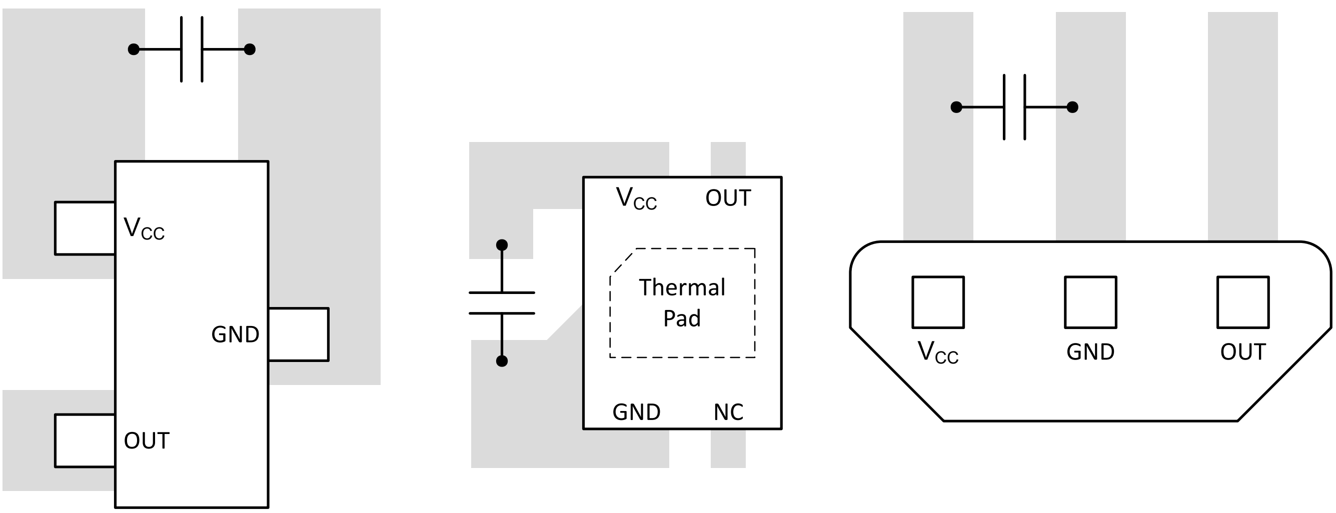


Figure 8-7. Layout Examples

9 Device and Documentation Support

9.1 Documentation Support

9.1.1 Related Documentation

For related documentation see the following:

- Texas Instruments, *DRV5032-SOLAR-EVM* user guide
- Texas Instruments, *Power Gating Systems with Magnetic Sensors* TI TechNote
- Texas Instruments, *Low-Power Door and Window Sensor With Sub-1GHz and 10-Year Coin Cell Battery Life*
- Texas Instruments, *Magnetic Tamper Detection Using Low-Power Hall Effect Sensors*
- Texas Instruments, *Fault Monitoring for Overhead Fault Indicators Using Ultra-Low-Power*

9.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

9.3 Support Resources

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.

9.4 Trademarks

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

9.5 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

9.6 Glossary

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

10 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision F (February 2022) to Revision G (July 2024) **Page**

- Added DG device version to the DMR (X2SON) package........ 1
- Added preview FB device version information for the DMR (X2SON) package........ 1
- Changed *Device Information* table to *Package Information* 1
- Changed the X2SON package in the layout examples image to match the pinout image in the *Pin Configuration and Functions* section........ 21

Changes from Revision E (January 2020) to Revision F (February 2022) **Page**

- Updated the numbering format for tables, figures, and cross-references throughout the document........ 1

Changes from Revision D (November 2017) to Revision E (January 2020) **Page**

- Added LPG (TO-92) package 1
- Added notes for the DU and FD package magnetic threshold operate points in the Magnetic Characteristics table........ 6
- Added probability density function plots for B_{OP}, B_{RP}, and B_{HYS} to the *Typical Characteristics* section........ 7

Changes from Revision C (September 2017) to Revision D (November 2017) **Page**

- Added the DU device version to the data sheet 2

Changes from Revision B (August 2017) to Revision C (September 2017) **Page**

- Changed the status of the AJ device version from *Preview* to *Active* 2

Changes from Revision A (May 2017) to Revision B (August 2017) **Page**

- Added the ZE device version and the preview AJ device version........ 2

Changes from Revision * (April 2017) to Revision A (May 2017) **Page**

- Added the FA and FD device versions........ 1

11 Mechanical, Packaging, and Orderable Information

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

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
DRV5032AJDBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	(1M6W, 2AJ)	Samples
DRV5032AJDBZT	OBSOLETE	SOT-23	DBZ	3		TBD	Call TI	Call TI	-40 to 85	(1M6W, 2AJ)	
DRV5032AJDMRR	ACTIVE	X2SON	DMR	4	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	2AJ	Samples
DRV5032AJDMRT	OBSOLETE	X2SON	DMR	4		TBD	Call TI	Call TI	-40 to 85	2AJ	
DRV5032AJLPG	ACTIVE	TO-92	LPG	3	1000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32AJ	Samples
DRV5032AJLPGM	ACTIVE	TO-92	LPG	3	3000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32AJ	Samples
DRV5032DGDMRR	ACTIVE	X2SON	DMR	4	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	2DG	Samples
DRV5032DUDBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	2DU	Samples
DRV5032DUDBZT	OBSOLETE	SOT-23	DBZ	3		TBD	Call TI	Call TI	-40 to 85	2DU	
DRV5032DUDMRR	ACTIVE	X2SON	DMR	4	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	2DU	Samples
DRV5032DUDMRT	OBSOLETE	X2SON	DMR	4		TBD	Call TI	Call TI	-40 to 85	2DU	
DRV5032DULPG	ACTIVE	TO-92	LPG	3	1000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32DU	Samples
DRV5032DULPGM	ACTIVE	TO-92	LPG	3	3000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32DU	Samples
DRV5032FADBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	(1LVW, 2FA)	Samples
DRV5032FADBZT	OBSOLETE	SOT-23	DBZ	3		TBD	Call TI	Call TI	-40 to 85	(1LVW, 2FA)	
DRV5032FADMRR	ACTIVE	X2SON	DMR	4	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	2FA	Samples
DRV5032FADMRT	OBSOLETE	X2SON	DMR	4		TBD	Call TI	Call TI	-40 to 85	2FA	
DRV5032FALPG	ACTIVE	TO-92	LPG	3	1000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32FA	Samples
DRV5032FALPGM	ACTIVE	TO-92	LPG	3	3000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32FA	Samples
DRV5032FBDBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	(1LWW, 2FB)	Samples
DRV5032FBDBZT	OBSOLETE	SOT-23	DBZ	3		TBD	Call TI	Call TI	-40 to 85	(1LWW, 2FB)	
DRV5032FBLPG	ACTIVE	TO-92	LPG	3	1000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32FB	Samples

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
DRV5032FBLPGM	ACTIVE	TO-92	LPG	3	3000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32FB	Samples
DRV5032FCDBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	(1M7W, 2FC)	Samples
DRV5032FCDBZT	OBSOLETE	SOT-23	DBZ	3		TBD	Call TI	Call TI	-40 to 85	(1M7W, 2FC)	
DRV5032FCLPG	ACTIVE	TO-92	LPG	3	1000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32FC	Samples
DRV5032FCLPGM	ACTIVE	TO-92	LPG	3	3000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32FC	Samples
DRV5032FDDMRR	ACTIVE	X2SON	DMR	4	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	2FD	Samples
DRV5032FDDMRT	OBSOLETE	X2SON	DMR	4		TBD	Call TI	Call TI	-40 to 85	2FD	
DRV5032FDLPG	ACTIVE	TO-92	LPG	3	1000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32FD	Samples
DRV5032FDLPGM	ACTIVE	TO-92	LPG	3	3000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32FD	Samples
DRV5032ZEDBZR	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	(1M8W, 2ZE)	Samples
DRV5032ZEDBZT	OBSOLETE	SOT-23	DBZ	3		TBD	Call TI	Call TI	-40 to 85	(1M8W, 2ZE)	
DRV5032ZELPG	ACTIVE	TO-92	LPG	3	1000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32ZE	Samples
DRV5032ZELPGM	ACTIVE	TO-92	LPG	3	3000	RoHS & Green	SN	N / A for Pkg Type	-40 to 85	32ZE	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.

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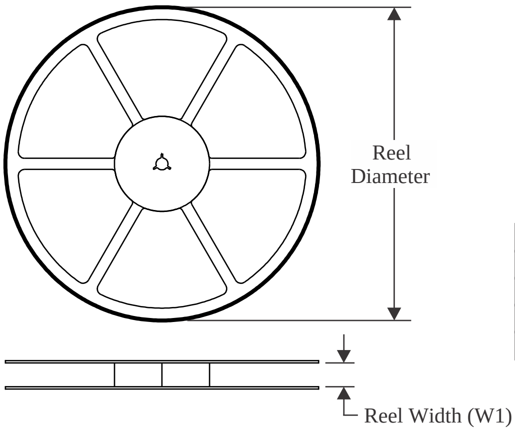
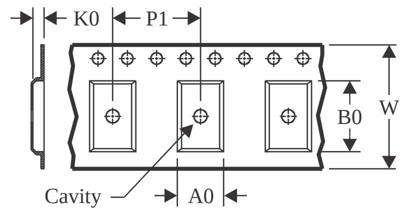
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

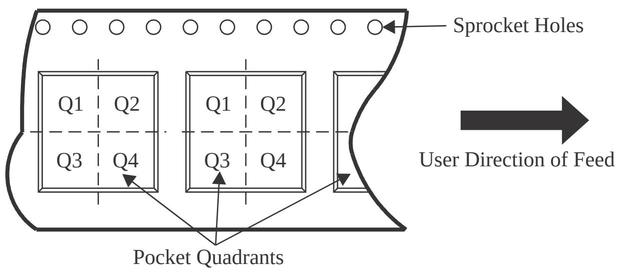


TAPE DIMENSIONS



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

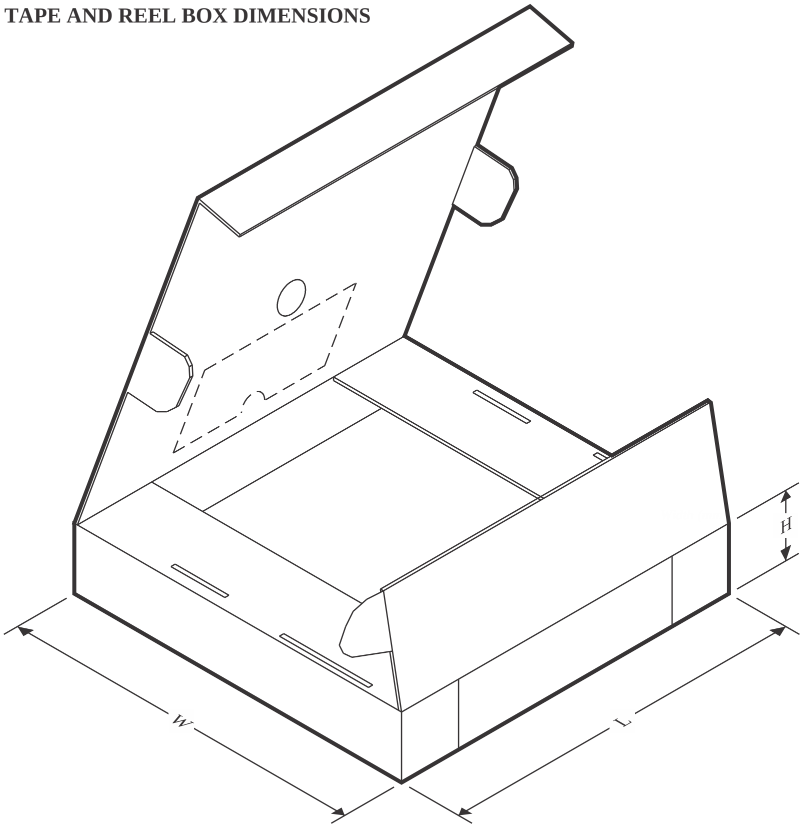
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

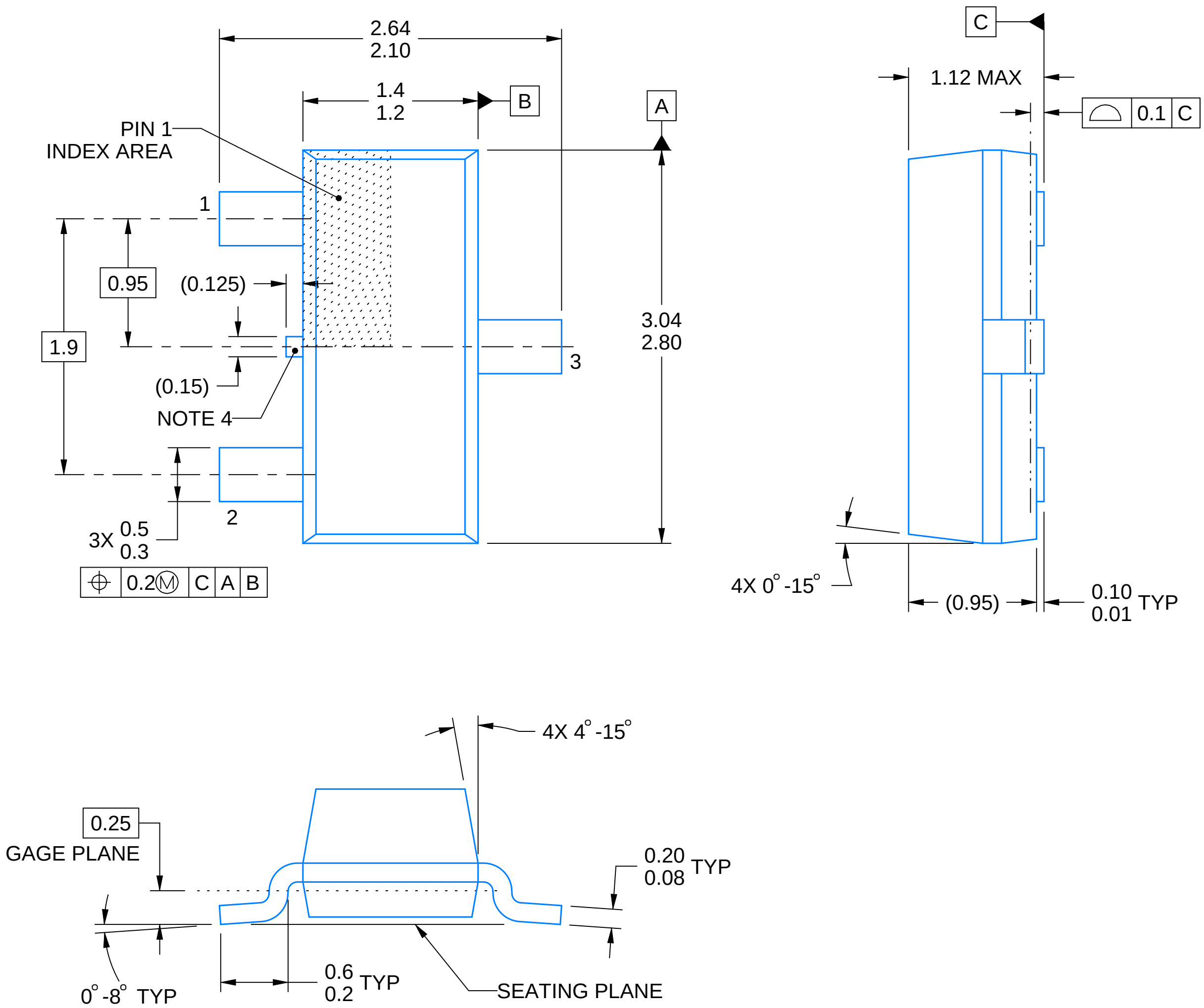
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DRV5032AJDBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.2	2.85	1.3	4.0	8.0	Q3
DRV5032AJDMRR	X2SON	DMR	4	3000	179.0	8.4	1.27	1.57	0.5	4.0	8.0	Q1
DRV5032DGDMRR	X2SON	DMR	4	3000	180.0	8.4	1.27	1.57	0.5	4.0	8.0	Q1
DRV5032DUDBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
DRV5032DUDMRR	X2SON	DMR	4	3000	180.0	8.4	1.27	1.57	0.5	4.0	8.0	Q1
DRV5032FADBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.2	2.85	1.3	4.0	8.0	Q3
DRV5032FADMRR	X2SON	DMR	4	3000	179.0	8.4	1.27	1.57	0.5	4.0	8.0	Q1
DRV5032FBDBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.2	2.85	1.3	4.0	8.0	Q3
DRV5032FCDBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.2	2.85	1.3	4.0	8.0	Q3
DRV5032FDDMRR	X2SON	DMR	4	3000	179.0	8.4	1.27	1.57	0.5	4.0	8.0	Q1
DRV5032ZEDBZR	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

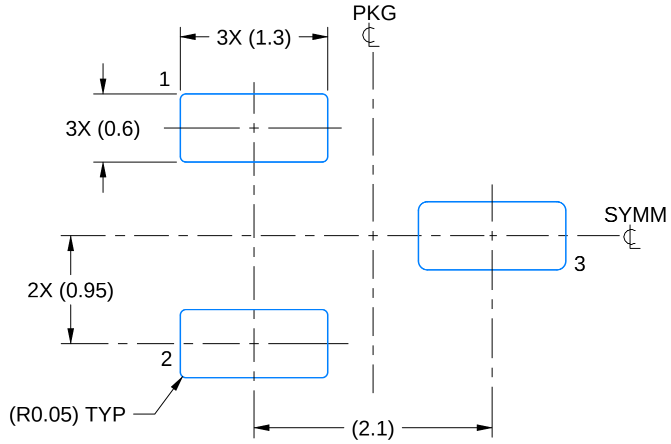
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DRV5032AJDBZR	SOT-23	DBZ	3	3000	210.0	185.0	35.0
DRV5032AJDMRR	X2SON	DMR	4	3000	200.0	183.0	25.0
DRV5032DGDMRR	X2SON	DMR	4	3000	200.0	183.0	25.0
DRV5032DUDBZR	SOT-23	DBZ	3	3000	183.0	183.0	20.0
DRV5032DUDMRR	X2SON	DMR	4	3000	200.0	183.0	25.0
DRV5032FADBZR	SOT-23	DBZ	3	3000	210.0	185.0	35.0
DRV5032FADMRR	X2SON	DMR	4	3000	200.0	183.0	25.0
DRV5032FBDBZR	SOT-23	DBZ	3	3000	210.0	185.0	35.0
DRV5032FCDBZR	SOT-23	DBZ	3	3000	210.0	185.0	35.0
DRV5032FDDMRR	X2SON	DMR	4	3000	200.0	183.0	25.0
DRV5032ZEDBZR	SOT-23	DBZ	3	3000	210.0	185.0	35.0



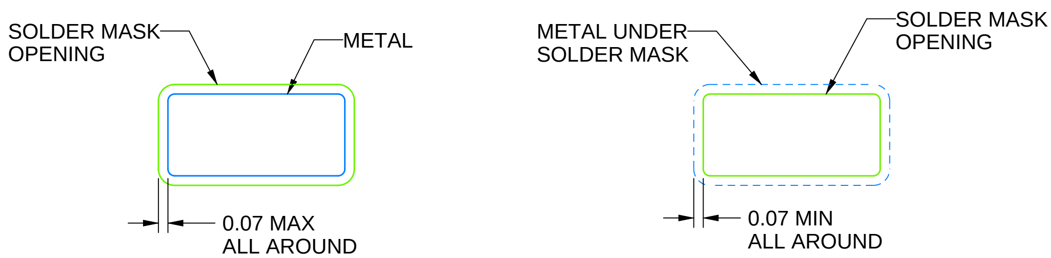
4214838/F 08/2024

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



NON SOLDER MASK DEFINED (PREFERRED)

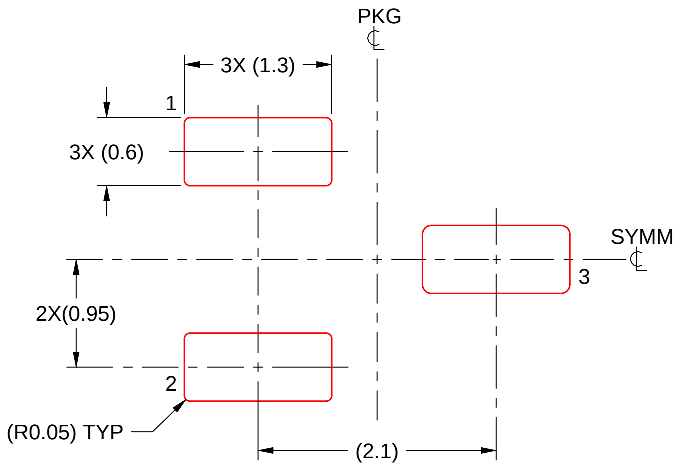
SOLDER MASK DEFINED

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)

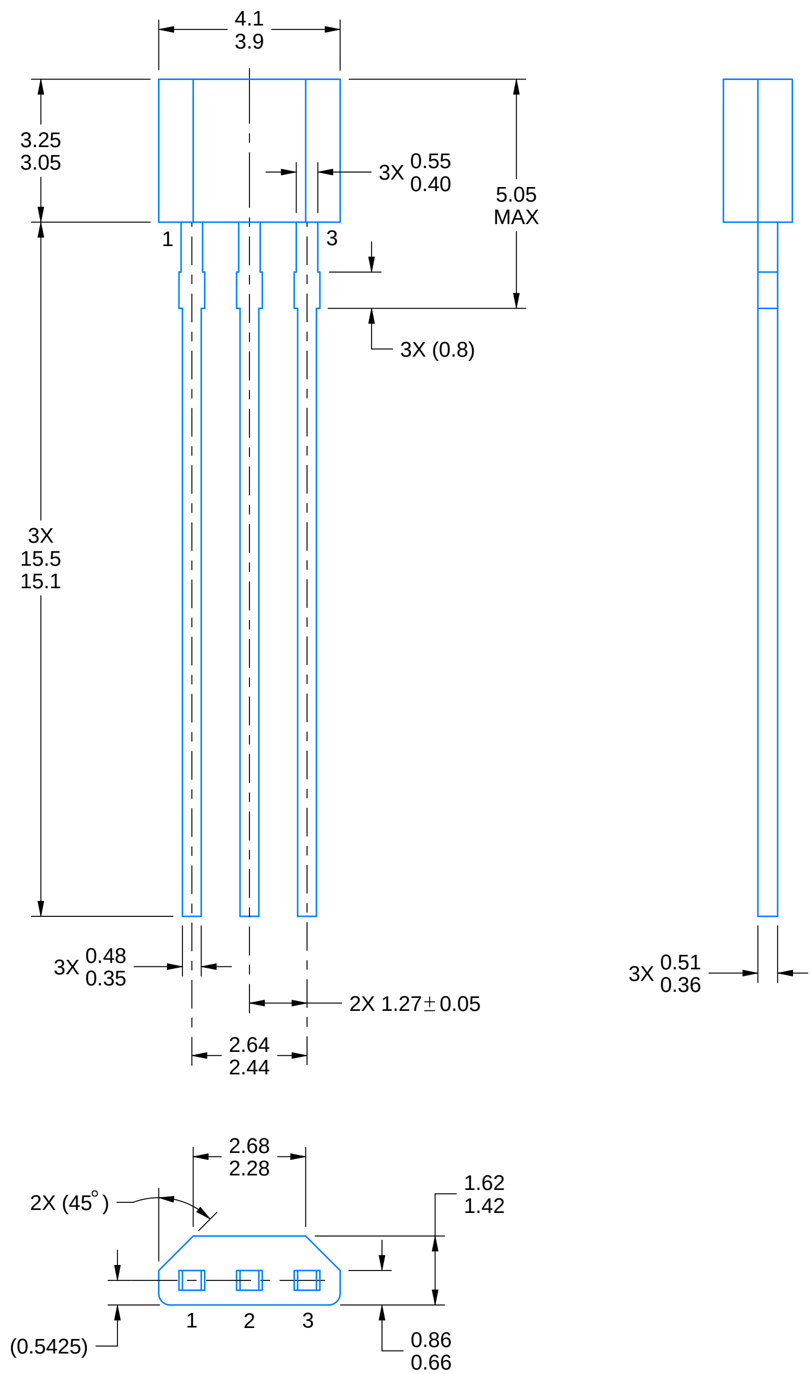
7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

PACKAGE OUTLINE

LPG0003A

TO-92 - 5.05 mm max height

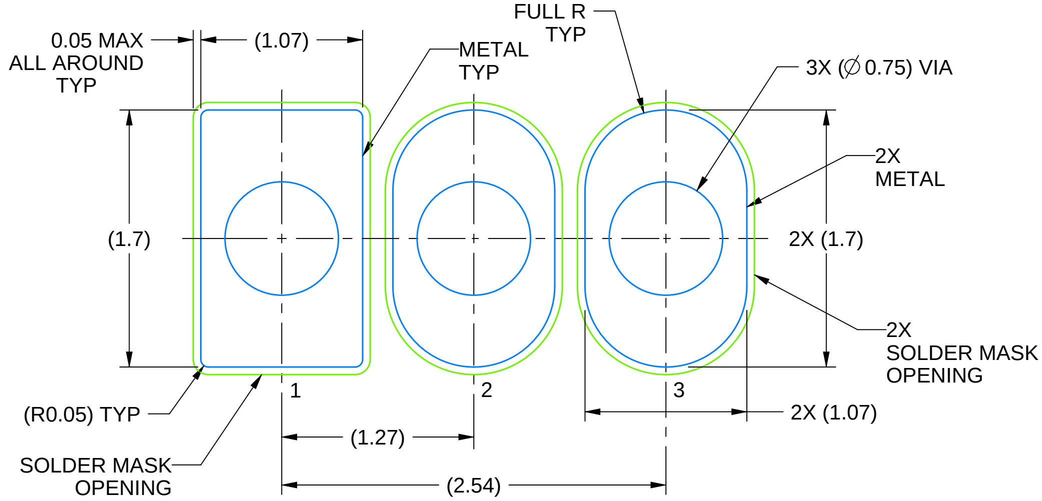
TRANSISTOR OUTLINE



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.

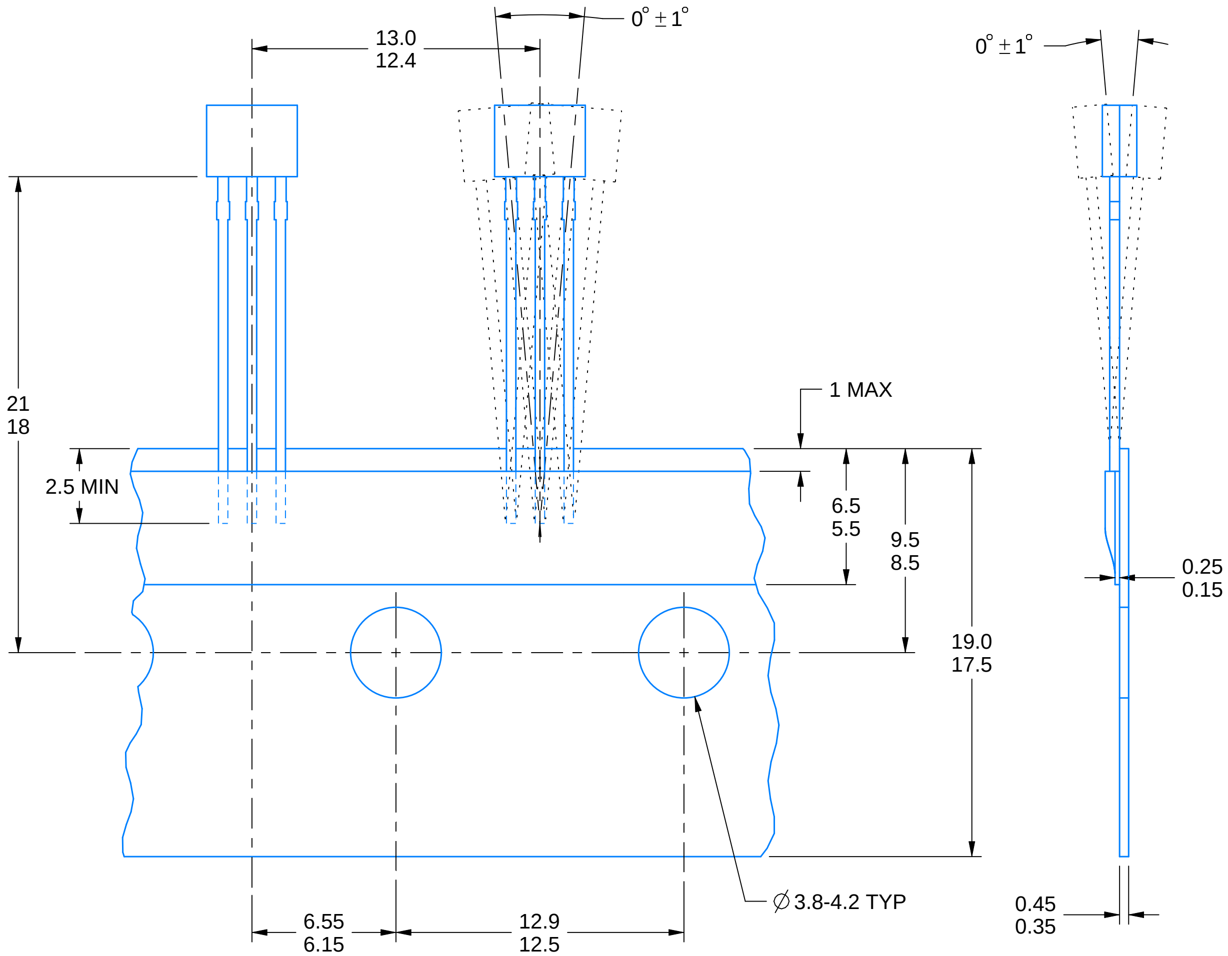


LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE:20X

LPG0003A

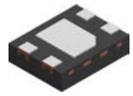
TO-92 - 5.05 mm max height

TRANSISTOR OUTLINE



4221343/C 01/2018

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

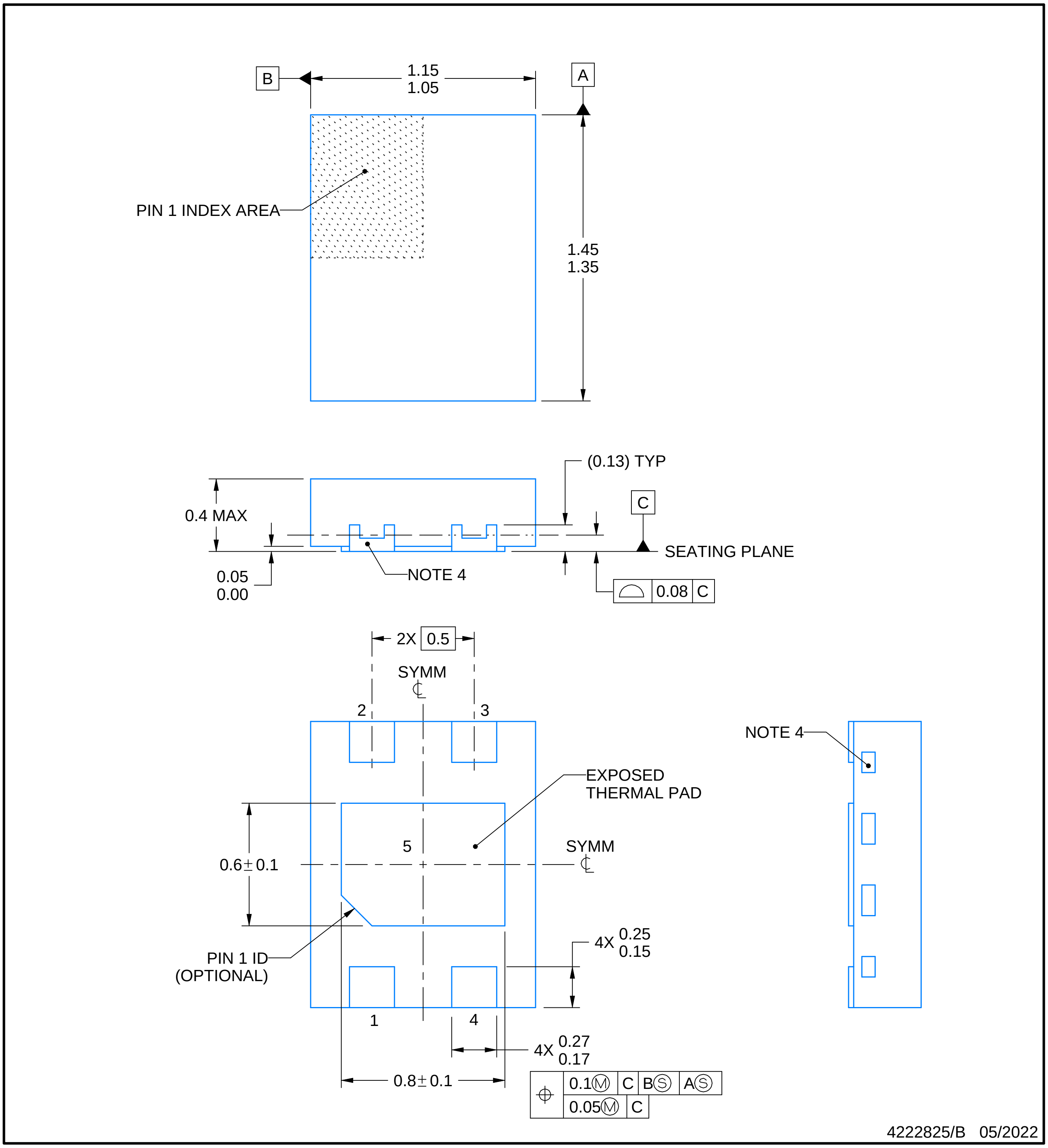


PACKAGE OUTLINE

DMR0004A

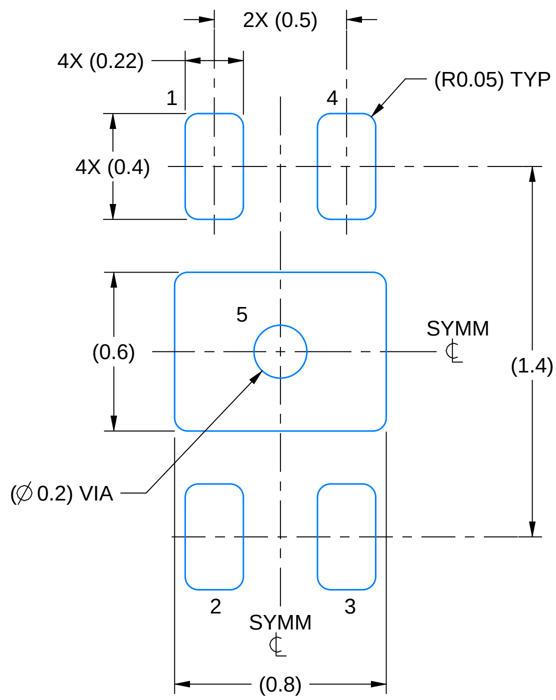
X2SON - 0.4 mm max height

PLASTIC SMALL OUTLINE - NO LEAD

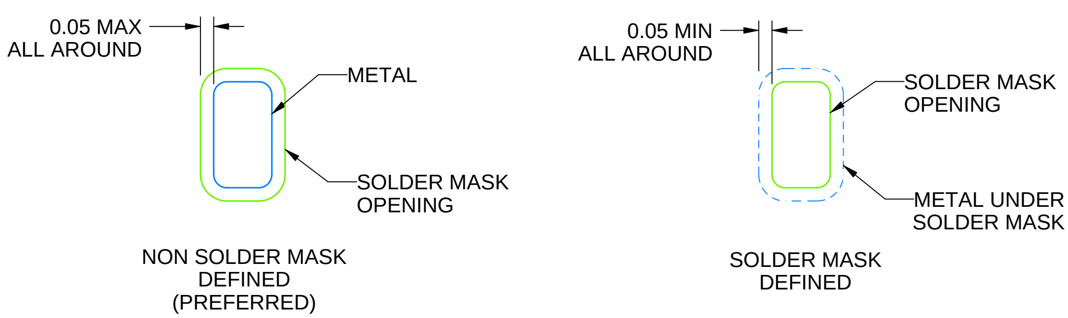


NOTES:

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

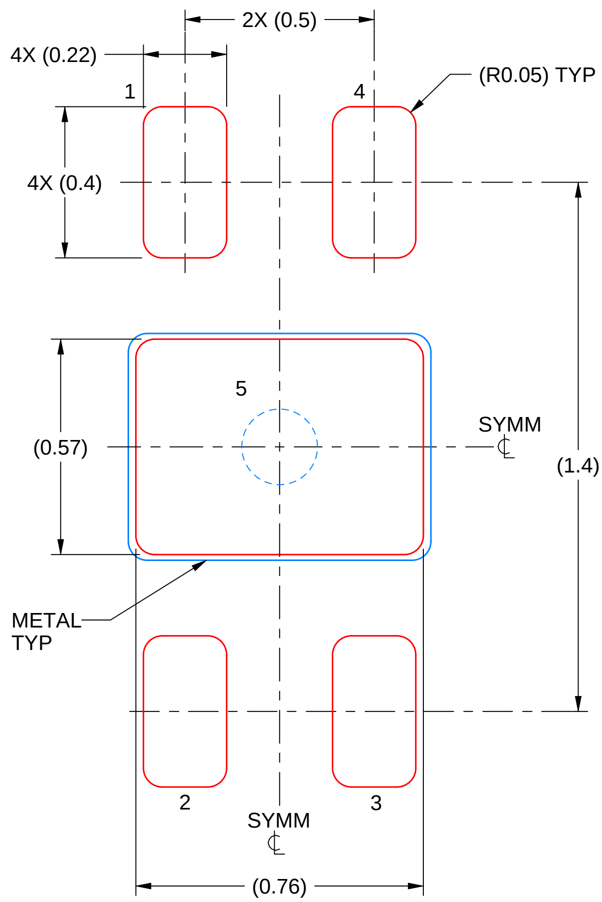


SOLDER MASK DETAILS

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.

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