DRV5056 unipolar ratiometric linear hall effect sensor

1 Features

- Unipolar linear hall effect magnetic sensor
- Operates from 3.3-V and 5-V power supplies
- Analog output with 0.6-V quiescent offset:
  - Maximizes voltage swing for high accuracy
- Magnetic sensitivity options (at V_{CC} = 5 V):
  - A1: 200 mV/mT, 20-mT range
  - A2: 100 mV/mT, 39-mT range
  - A3: 50 mV/mT, 79-mT range
  - A4: 25 mV/mT, 158-mT range
  - A6: 100 mV/mT, 39-mT range
- Fast 20-kHz sensing bandwidth
- Low-noise output with ±1-mA drive
- Compensation for magnet temperature drift
- Standard industry packages:
  - Surface-mount SOT-23
  - Through-hole TO-92

2 Applications

- Precise position sensing
- Industrial automation and robotics
- Home appliances
- Gamepads, pedals, keyboards, triggers
- Height leveling, tilt and weight measurement
- Fluid flow rate measurement
- Medical devices
- Current sensing

3 Description

The DRV5056 is a linear Hall effect sensor that responds proportionally to flux density of a magnetic south pole. The device can be used for accurate position sensing in a wide range of applications.

Featuring a unipolar magnetic response, the analog output drives 0.6 V when no magnetic field is present, and increases when a south magnetic pole is applied. This response maximizes the output dynamic range in applications that sense one magnetic pole. Four sensitivity options further maximize the output swing based on the required sensing range.

The device operates from 3.3-V or 5-V power supplies. Magnetic flux perpendicular to the top of the package is sensed, and the two package options provide different sensing directions.

The device uses a ratiometric architecture that can minimize error from V_{CC} tolerance when the external analog-to-digital converter (ADC) uses the same V_{CC} for its reference. Additionally, the device features magnet temperature compensation to counteract how magnets drift for linear performance across a wide temperature range.

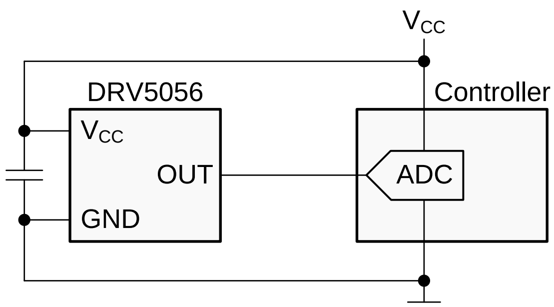
The A1 to A4 options support a temperature range of –40°C to +125°C. The A6 version supports a temperature range of 0°C to 85°C.

Device Information(1)

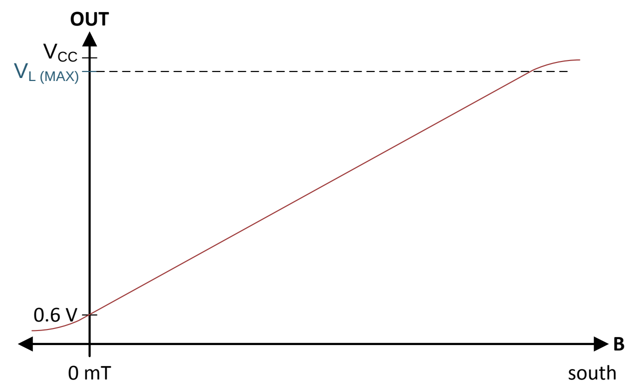
PART NUMBER	PACKAGE	BODY SIZE (NOM)
DRV5056	SOT-23 (3)	2.92 mm × 1.30 mm
	TO-92 (3)	4.00 mm × 3.15 mm

(1) For all available packages, see the package option addendum at the end of the data sheet.

Typical Schematic



Magnetic Response



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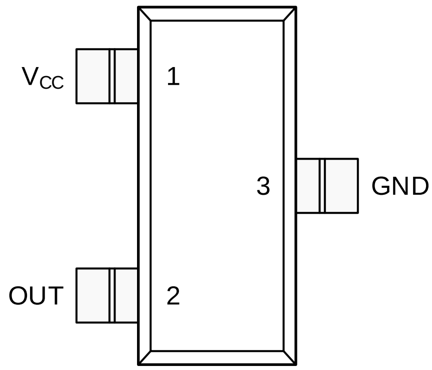
4 Revision History

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

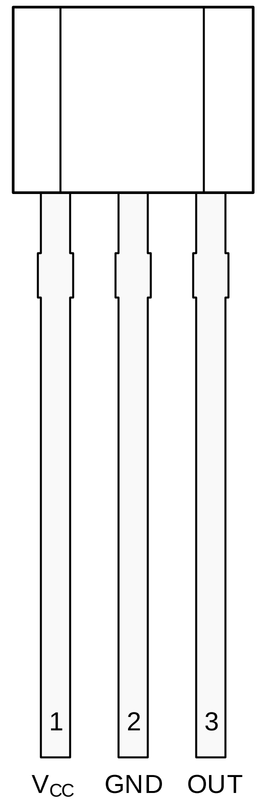
Changes from Original (April 2018) to Revision A	Page
• Added new A6 magnetic sensitivity option to the data sheet	1

5 Pin Configuration and Functions

DBZ Package
3-Pin SOT-23
Top View



LPG Package
3-Pin TO-92
Top View



Pin Functions

PIN			I/O	DESCRIPTION
NAME	SOT-23	TO-92		
GND	3	2	—	Ground reference
OUT	2	3	O	Analog output
V_{CC}	1	1	—	Power supply. TI recommends connecting this pin to a ceramic capacitor to ground with a value of at least 0.1 µF.

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	7	V
Output voltage	OUT	–0.3	V_{CC} + 0.3	V
Magnetic flux density, B_{MAX}		Unlimited		T
Operating junction temperature, T_J		–40	150	°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]	±2500	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]	3	3.6	V
		4.5	5.5	
I_O	Output continuous current	–1	1	mA
T_A	A1-A4 versions operating ambient temperature[2]	–40	125	°C
T_A	A6 version operating ambient temperature[2]	0	85	°C

(1) There are two isolated operating V_{CC} ranges. For more information see the *Operating V_{CC} Ranges* section.
(2) Power dissipation and thermal limits must be observed.

6.4 Thermal Information

THERMAL METRIC[1]		DRV5056		UNIT
		SOT-23 (DBZ)	TO-92 (LPG)	
		3 PINS	3 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	170	121	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	66	67	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	49	97	°C/W
Y_{JT}	Junction-to-top characterization parameter	1.7	7.6	°C/W
Y_{JB}	Junction-to-board characterization parameter	48	97	°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} = 3 V to 3.63 V and 4.5 V to 5.5 V, over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS[1]		MIN	TYP	MAX	UNIT
I_{CC}	Operating supply current				6	10	mA
t_{ON}	Power-on time (see Figure 19)	B = 0 mT, no load on OUT			150	300	µs
f_{BW}	Sensing bandwidth				20		kHz
t_d	Propagation delay time	From change in B to change in OUT			10		µs
B_{ND}	Input-referred RMS noise density	V_{CC} = 5 V			130		$nT/\sqrt{Hz}$
		V_{CC} = 3.3 V			215		
B_N	Input-referred noise	$B_{ND} \times 6.6 \times \sqrt{20\ kHz}$	V_{CC} = 5 V		0.12		mT_{PP}
			V_{CC} = 3.3 V		0.2		
V_N	Output-referred noise[2]	$B_N \times S$	DRV5056A1		24		mV_{PP}
			DRV5056A2, DRV5056A6		12		
			DRV5056A3		6		
			DRV5056A4		3		

(1) B is the applied magnetic flux density.
(2) V_N describes voltage noise on the device output. If the full device bandwidth is not needed, noise can be reduced with an RC filter.

6.6 Magnetic Characteristics

for V_{CC} = 3 V to 3.63 V and 4.5 V to 5.5 V, over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS[1]		MIN	TYP	MAX	UNIT
V_Q	Quiescent voltage	B = 0 mT, T_A = 25°C	DRV5056A1	0.535	0.6	0.665	V
			DRV5056A2, DRV5056A6	0.54	0.6	0.66	
			DRV5056A3, DRV5056A4	0.55	0.6	0.65	
$V_{Q\Delta T}$	Quiescent voltage temperature drift	B = 0 mT, T_A = –40°C to 125°C versus 25°C	V_{CC} = 5 V		0.08		V
			V_{CC} = 3.3 V		0.04		
$V_{Q\Delta L}$	Quiescent voltage lifetime drift	High-temperature operating stress for 1000 hours			< 0.5%		
S	Sensitivity	V_{CC} = 5 V, T_A = 25°C	DRV5056A1	190	200	210	mV/mT
			DRV5056A2, DRV5056A6	95	100	105	
			DRV5056A3	47.5	50	52.5	
			DRV5056A4	23.8	25	26.2	
		V_{CC} = 3.3 V, T_A = 25°C	DRV5056A1	114	120	126	
			DRV5056A2, DRV5056A6	57	60	63	
			DRV5056A3	28.5	30	31.5	
			DRV5056A4	14.3	15	15.8	
B_L	Linear magnetic sensing range[2]	V_{CC} = 5 V, T_A = 25°C	DRV5056A1	20			mT
			DRV5056A2, DRV5056A6	39			
			DRV5056A3	79			
			DRV5056A4	158			
		V_{CC} = 3.3 V, T_A = 25°C	DRV5056A1	19			
			DRV5056A2, DRV5056A6	39			
			DRV5056A3	78			
			DRV5056A4	155			
V_L	Linear range of output voltage[3]			V_Q		V_{CC} – 0.2	V
S_{TC}	Sensitivity temperature compensation for magnets[4]	DRV5056A6		0.05	0.12	0.19	%/°C
S_{TC}	Sensitivity temperature compensation for magnets[4]	DRV5056A1, DRV5056A2, DRV5056A3, DRV5056A4			0.12		%/°C
S_{LE}	Sensitivity linearity error[3]	V_{OUT} is within V_L			±1%		
S_{RE}	Sensitivity ratiometry error[5]	T_A = 25°C, with respect to V_{CC} = 3.3 V or 5 V		-2.5%		2.5%	
$S_{\Delta L}$	Sensitivity lifetime drift	High-temperature operating stress for 1000 hours			< 0.5%		

(1) B is the applied magnetic flux density.
(2) B_L describes the minimum linear sensing range at 25°C taking into account the maximum V_Q and Sensitivity tolerances.
(3) See the *Sensitivity Linearity* section.
(4) S_{TC} describes the rate the device increases Sensitivity with temperature. For more information, see the *Sensitivity Temperature Compensation For Magnets* section.
(5) See the *Ratiometric Architecture* section.

6.7 Typical Characteristics

at T_A = 25°C (unless otherwise noted)

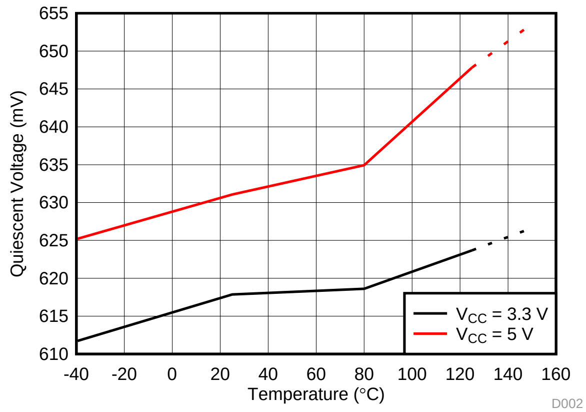


Figure 1. Quiescent Voltage vs Temperature

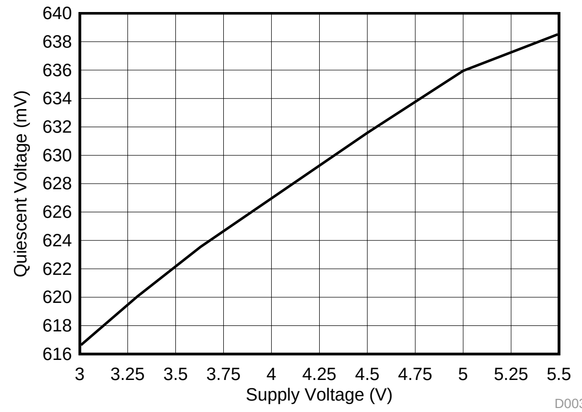
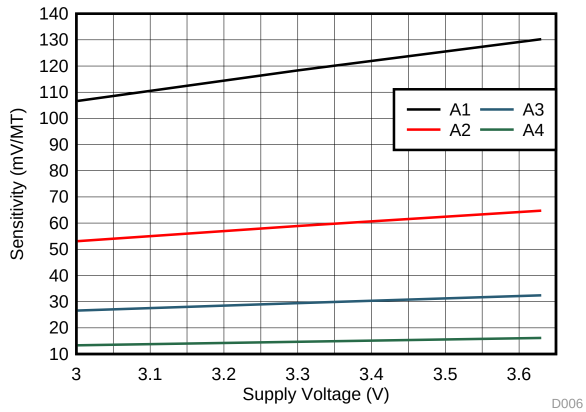
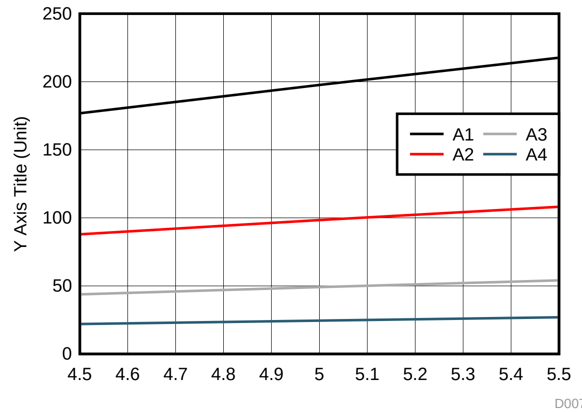


Figure 2. Quiescent Voltage vs Supply Voltage



V_{CC} = 3.3 V

Figure 3. Sensitivity vs Supply Voltage



V_{CC} = 5 V

Figure 4. Sensitivity vs Supply Voltage

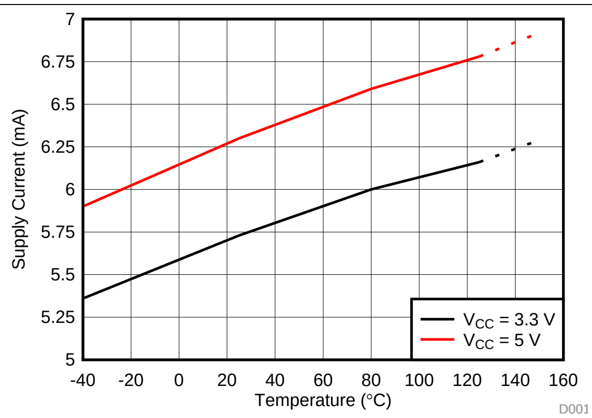
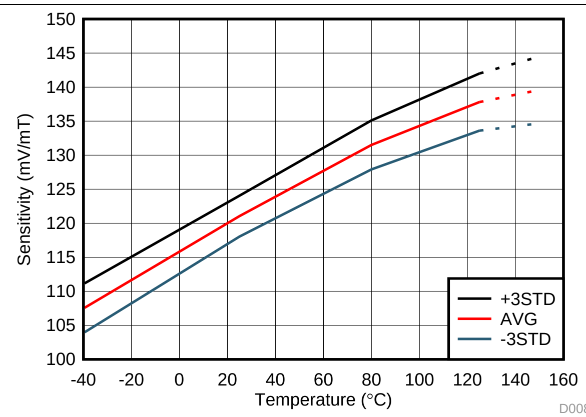


Figure 5. Supply Current vs Temperature

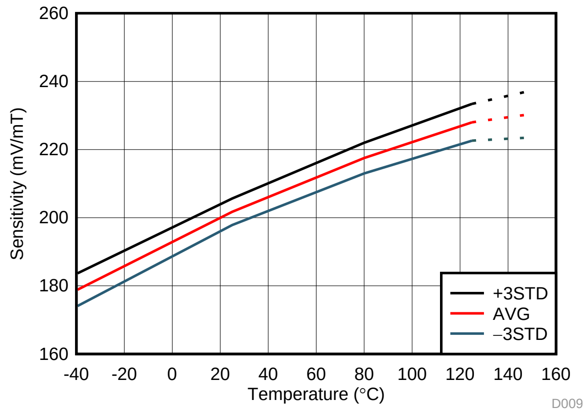


DRV5056A1, V_{CC} = 3.3 V

Figure 6. Sensitivity vs Temperature

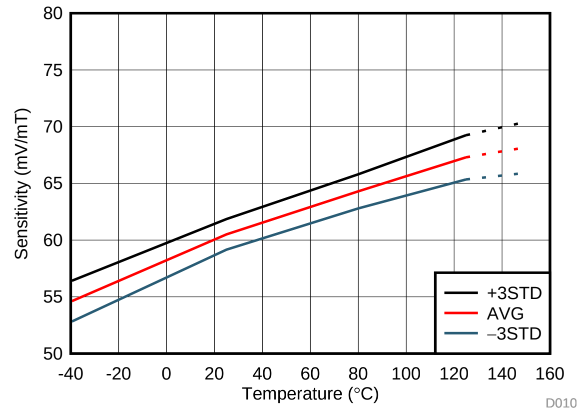
Typical Characteristics (continued)

at T_A = 25°C (unless otherwise noted)



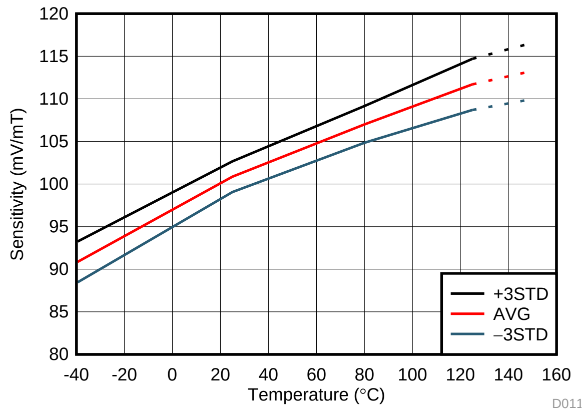
DRV5056A1, V_{CC} = 5.0 V

Figure 7. Sensitivity vs Temperature



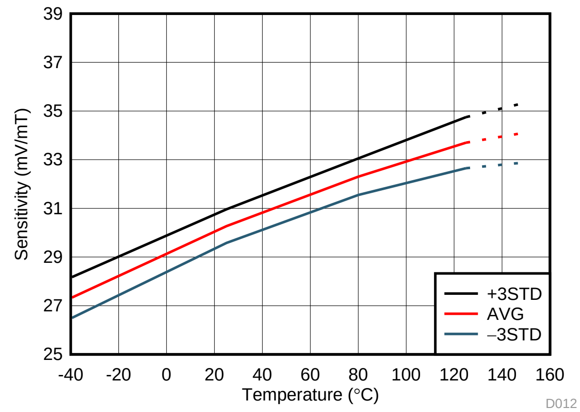
DRV5056A2, V_{CC} = 3.3 V

Figure 8. Sensitivity vs Temperature



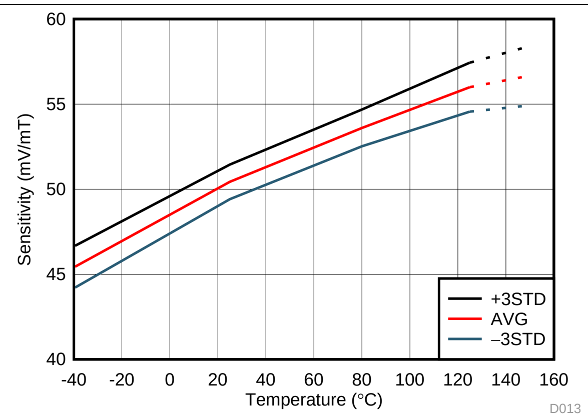
DRV5056A2, V_{CC} = 5.0 V

Figure 9. Sensitivity vs Temperature



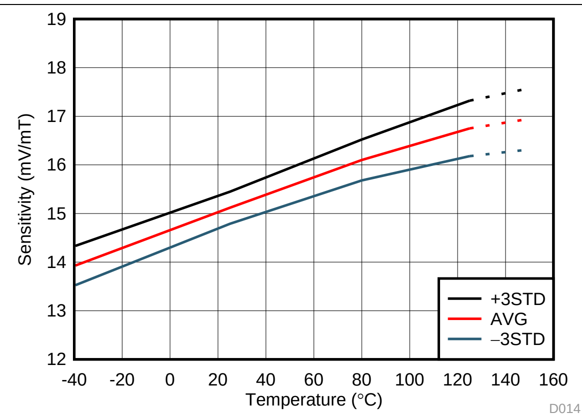
DRV5056A3, V_{CC} = 3.3 V

Figure 10. Sensitivity vs Temperature



DRV5056A3, V_{CC} = 5.0 V

Figure 11. Sensitivity vs Temperature

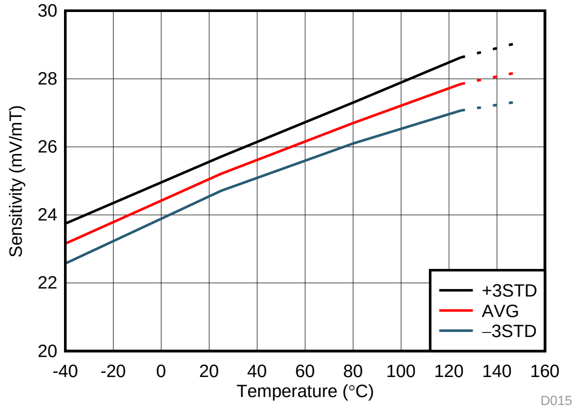


DRV5056A4, V_{CC} = 3.3 V

Figure 12. Sensitivity vs Temperature

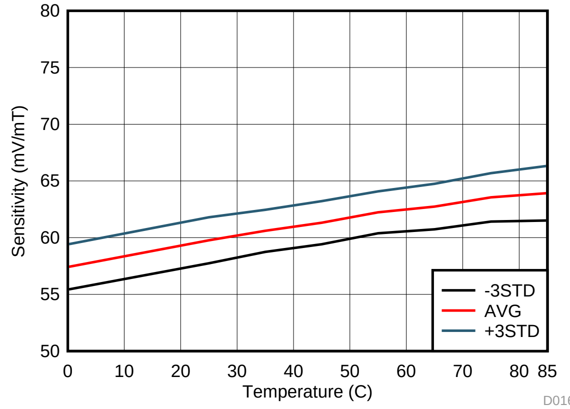
Typical Characteristics (continued)

at T_A = 25°C (unless otherwise noted)



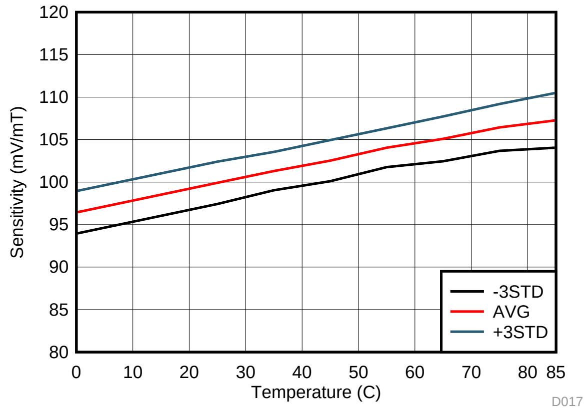
DRV5056A4, V_{CC} = 5.0 V

Figure 13. Sensitivity vs Temperature



DRV5056A6, V_{CC} = 3.3 V

Figure 14. Sensitivity vs Temperature



DRV5056A6, V_{CC} = 5.0 V

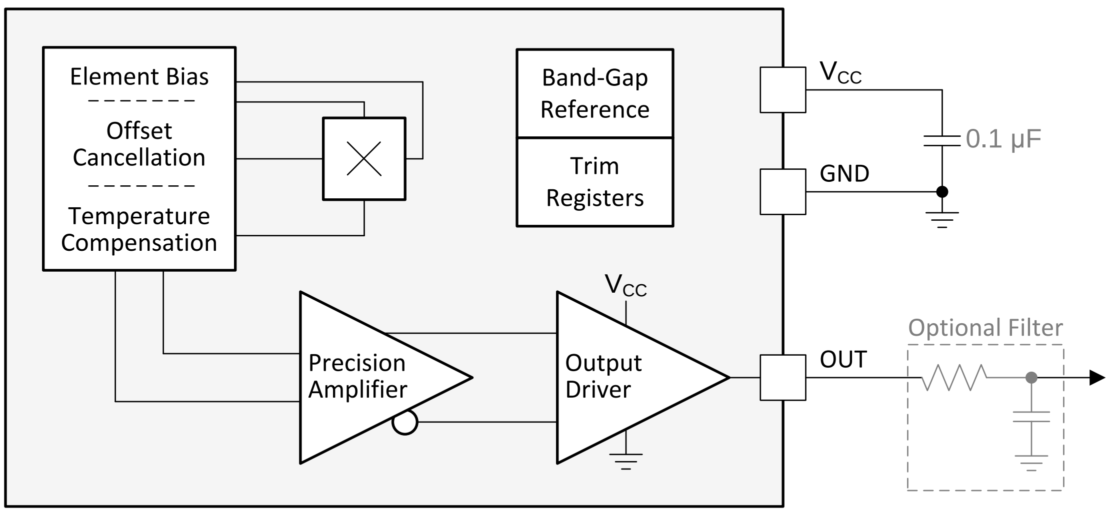
Figure 15. Sensitivity vs Temperature

7 Detailed Description

7.1 Overview

The DRV5056 is a 3-pin linear Hall effect sensor with fully integrated signal conditioning, temperature compensation circuits, mechanical stress cancellation, and amplifiers. The device operates from 3.3-V and 5-V (±10%) power supplies, measures magnetic flux density, and outputs a proportional analog voltage that is referenced to V_{CC}.

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 Magnetic Flux Direction

As shown in Figure 16, the DRV5056 is sensitive to the magnetic field component that is perpendicular to the die inside the package.

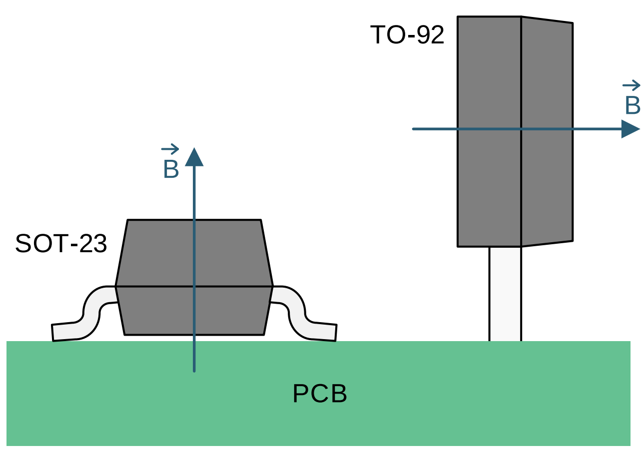


Figure 16. Direction of Sensitivity

Feature Description (continued)

Magnetic flux that travels from the bottom to the top of the package is considered positive. This condition exists when a south magnetic pole is near the top (marked-side) of the package. Magnetic flux that travels from the top to the bottom of the package results in negative millitesla values.

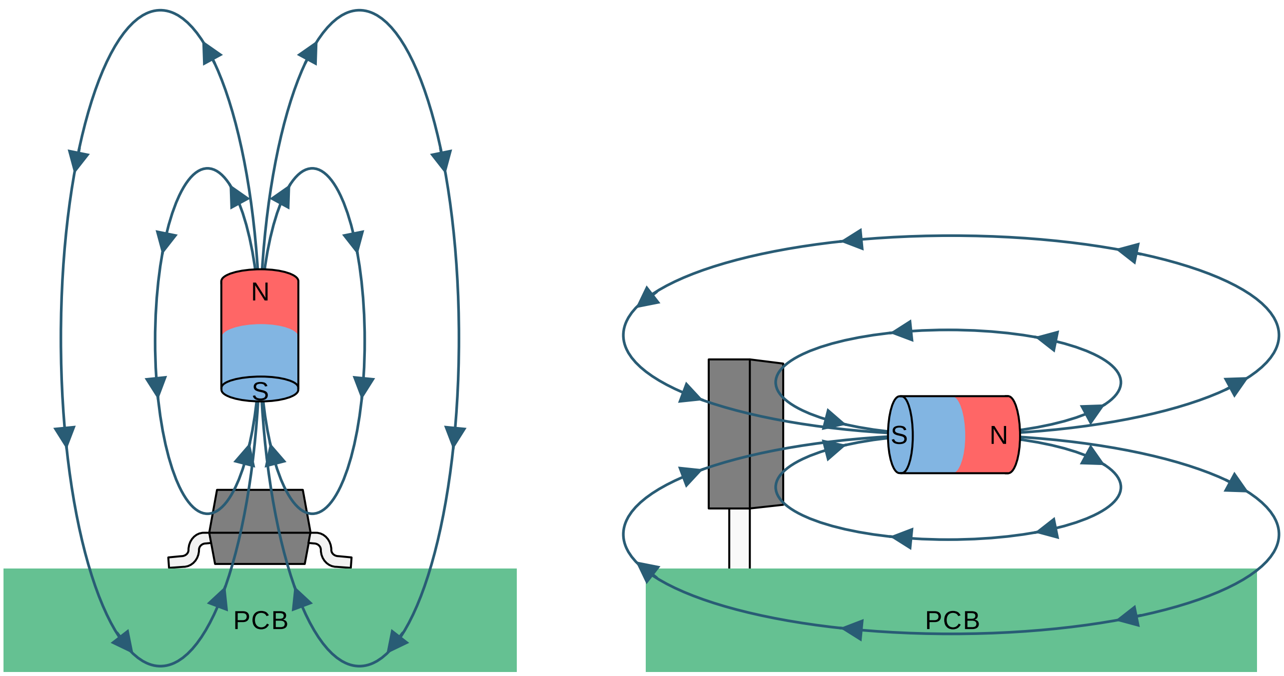


Figure 17. The Flux Direction for Positive B

7.3.2 Magnetic Response

The DRV5056 outputs an analog voltage according to Equation 1 when in the presence of a magnetic field:

$$V_{OUT} = V_Q + B \times \left(\text{Sensitivity}_{(25°C)} \times (1 + S_{TC} \times (T_A - 25°C))\right) \quad (1)$$

where

- V_Q is typically 600 mV
- B is the applied magnetic flux density
- $\text{Sensitivity}_{(25°C)}$ depends on the device option and V_{CC}
- S_{TC} is typically 0.12%/°C
- T_A is the ambient temperature
- V_{OUT} is within the V_L range

As an example, consider the DRV5056A3 with V_{CC} = 3.3 V, a temperature of 50°C, and 67 mT applied. Excluding tolerances, V_{OUT} = 600 mV + 67 mT × (30 mV/mT × [1 + 0.0012/°C × (50°C – 25°C)]) = 2.67 V.

The DRV5056 only responds to the flux density of a magnetic south pole.

Feature Description (continued)

7.3.3 Sensitivity Linearity

The device produces a linear response when the output voltage is within the specified V_L range. Outside this range, sensitivity is reduced and nonlinear. Figure 18 graphs the magnetic response.

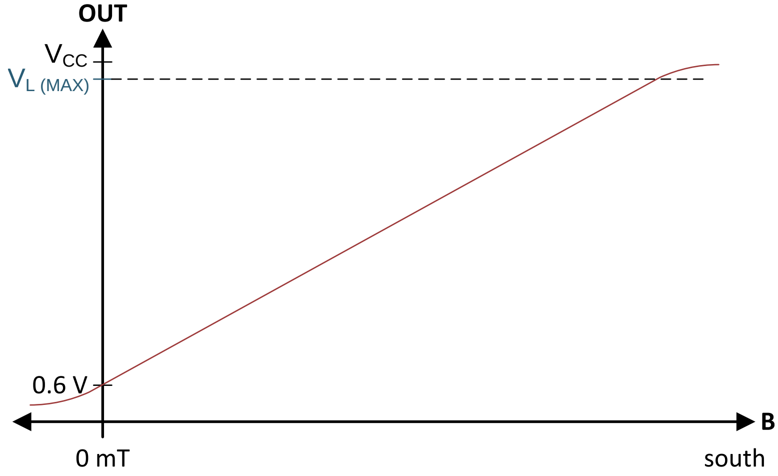


Figure 18. Magnetic Response

Equation 2 calculates parameter B_L, the minimum linear sensing range at 25°C taking into account the maximum quiescent voltage and sensitivity tolerances.

$$B_{L(MIN)} = \frac{V_{L(MAX)} - V_{Q(MAX)}}{S_{(MAX)}} \quad (2)$$

The parameter S_{LE} defines linearity error as the difference in sensitivity between any two positive B values when the output is within the V_L range.

7.3.4 Ratiometric Architecture

The DRV5056 has a ratiometric analog architecture that scales the sensitivity linearly with the power-supply voltage. For example, the sensitivity is 5% higher when V_{CC} = 5.25 V compared to V_{CC} = 5 V. This behavior enables external ADCs to digitize a more consistent value regardless of the power-supply voltage tolerance, when the ADC uses V_{CC} as its reference.

Equation 3 calculates sensitivity ratiometry error:

$$S_{RE} = 1 - \frac{S_{(VCC)} / S_{(5V)}}{V_{CC} / 5V} \text{ for } V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}, \qquad S_{RE} = 1 - \frac{S_{(VCC)} / S_{(3.3V)}}{V_{CC} / 3.3V} \text{ for } V_{CC} = 3 \text{ V to } 3.6 \text{ V}$$

where

- $S_{(VCC)}$ is the sensitivity at the current V_{CC} voltage
- $S_{(5V)}$ or $S_{(3.3V)}$ is the sensitivity when V_{CC} = 5 V or 3.3 V
- V_{CC} is the current V_{CC} voltage (3)

Feature Description (continued)

7.3.5 Operating V_{CC} Ranges

The DRV5056 has two recommended operating V_{CC} ranges: 3 V to 3.6 V and 4.5 V to 5.5 V. When V_{CC} is in the middle region between 3.6 V to 4.5 V, the device continues to function, but sensitivity is less known because there is a crossover threshold near 4 V that adjusts device characteristics.

7.3.6 Sensitivity Temperature Compensation For Magnets

Magnets generally produce weaker fields as temperature increases. The DRV5056 compensates by increasing sensitivity with temperature, as defined by the parameter S_{TC}. The sensitivity at T_A = 125°C is typically 12% higher than at T_A = 25°C.

7.3.7 Power-On Time

After the V_{CC} voltage is applied, the DRV5056 requires a short initialization time before the output is set. The parameter t_{ON} describes the time from when V_{CC} crosses 3 V until OUT is within 5% of V_Q, with 0 mT applied and no load attached to OUT. Figure 19 shows this timing diagram.

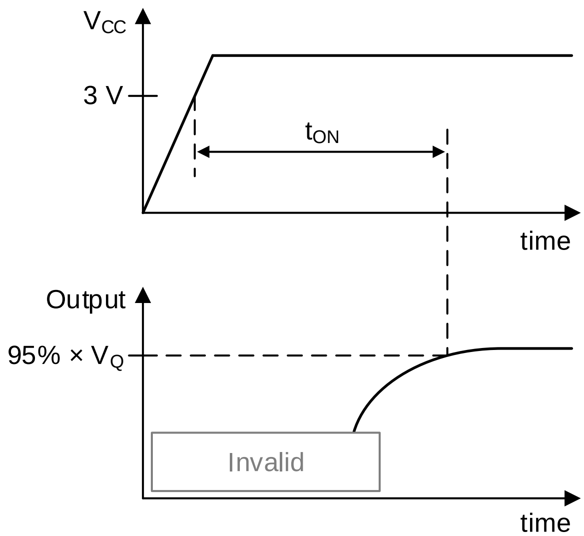


Figure 19. t_{ON} Definition

Feature Description (continued)

7.3.8 Hall Element Location

Figure 20 shows the location of the sensing element inside each package option.

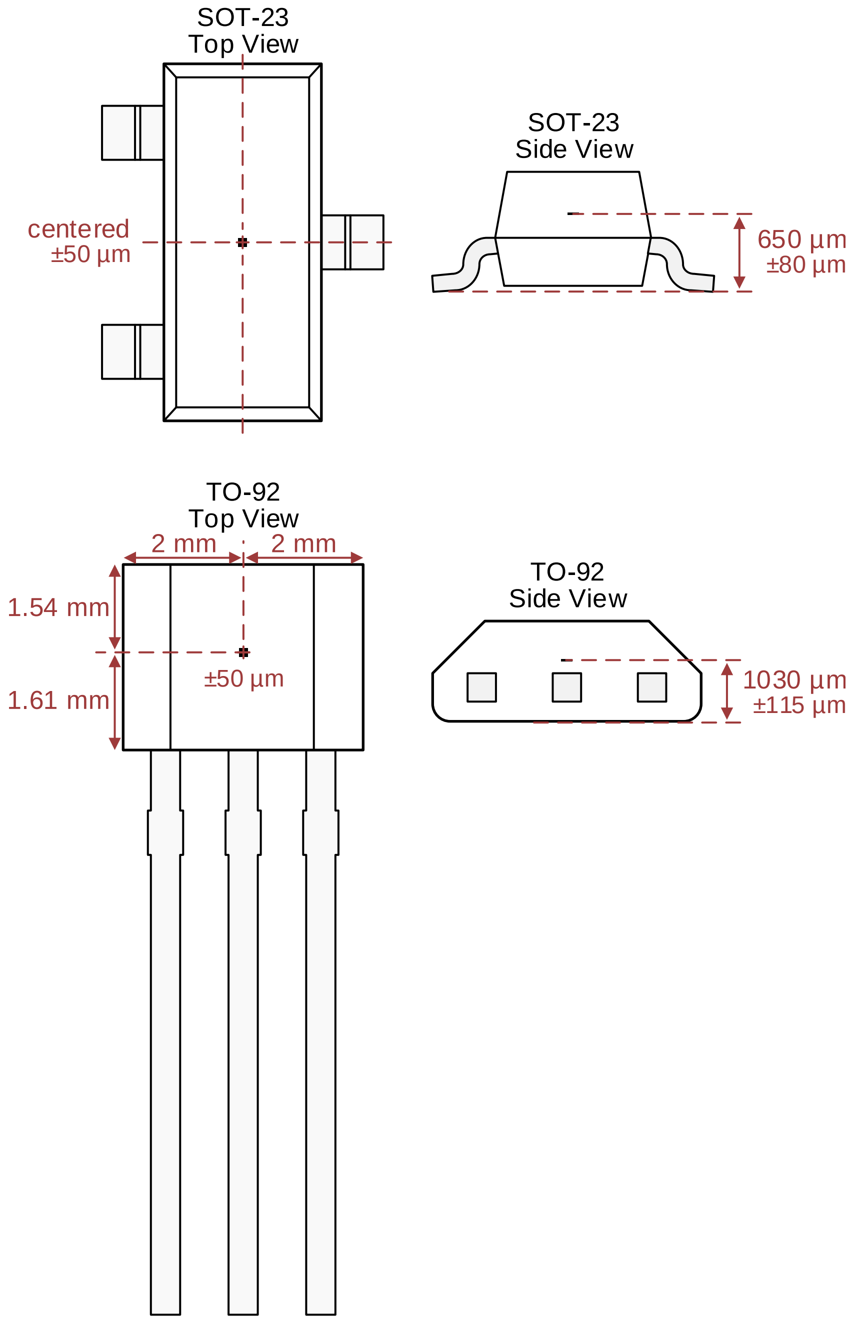


Figure 20. Hall Element Location

7.4 Device Functional Modes

The DRV5056 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. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information

8.1.1 Selecting the Sensitivity Option

Select the highest DRV5056 sensitivity option that can measure the required range of magnetic flux density, so that the output voltage swing is maximized.

Larger magnets and greater sensing distances can generally enable better positional accuracy than very small magnets at close distances, because magnetic flux density increases exponentially with the proximity to a magnet.

8.1.2 Temperature Compensation for Magnets

The DRV5056 temperature compensation is designed to directly compensate the average drift of neodymium (NdFeB) magnets and partially compensate ferrite magnets. The residual flux density (B_r) of a magnet typically reduces by 0.12%/°C for NdFeB, and 0.20%/°C for ferrite. When the operating temperature range of a system is reduced, temperature drift errors are also reduced.

8.1.3 Adding a Low-Pass Filter

As illustrated in the *Functional Block Diagram*, an RC low-pass filter can be added to the device output for the purpose of minimizing voltage noise when the full 20-kHz bandwidth is not needed. This filter can improve the signal-to-noise ratio (SNR) and overall accuracy. Do not connect a capacitor directly to the device output without a resistor in between because doing so can make the output unstable.

8.1.4 Designing for Wire Break Detection

Some systems must detect if interconnect wires become open or shorted. The DRV5056 can support this function.

First, select a sensitivity option that causes the output voltage to stay within the V_L range during normal operation. Second, add a pullup resistor between OUT and V_{CC}. TI recommends a value between 20 kΩ to 100 kΩ, and the current through OUT must not exceed the I_O specification, including current going into an external ADC. Then, if the output voltage is ever measured to be within 150 mV of V_{CC} or GND, a fault condition exists. Figure 21 shows the circuit, and Table 1 describes fault scenarios.

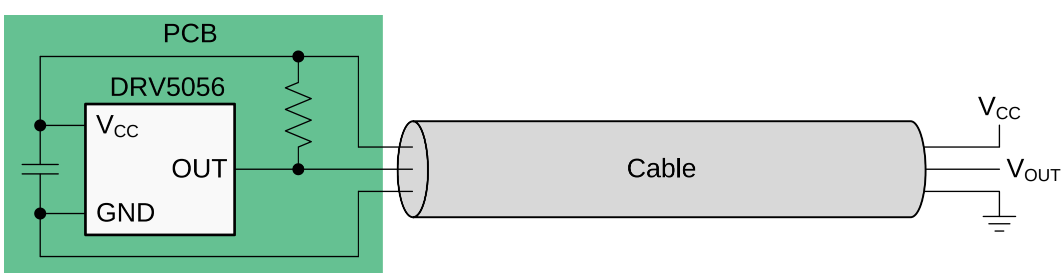


Figure 21. Wire Fault Detection Circuit

Table 1. Fault Scenarios and the Resulting V_{OUT}

FAULT SCENARIO	V_{OUT}
V_{CC} disconnects	Close to GND
GND disconnects	Close to V_{CC}
V_{CC} shorts to OUT	Close to V_{CC}
GND shorts to OUT	Close to GND

8.2 Typical Application

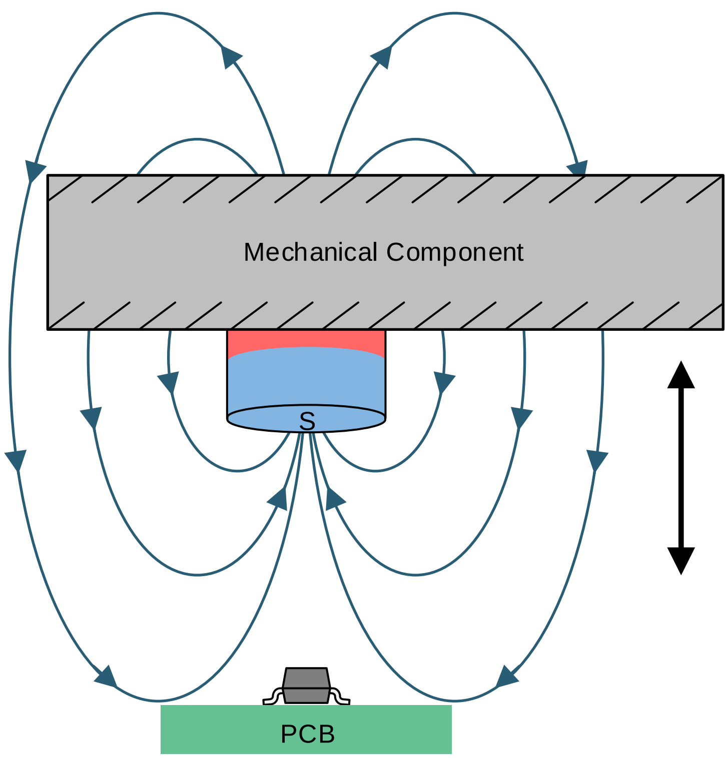


Figure 22. Unipolar Sensing Application

8.2.1 Design Requirements

Use the parameters listed in Table 2 for this design example.

Table 2. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
V_{CC}	3.3 V
Magnet	10-mm diameter × 6-mm long cylinder, ferrite
Distance from magnet to sensor	From 20 mm to 3 mm
Maximum B at the sensor at 25°C	72 mT at 3 mm
Device option	DRV5056A3-Q1

8.2.2 Detailed Design Procedure

This design example consists of a mechanical component that moves back and forth, an embedded magnet with the south pole facing the printed-circuit board, and a DRV5056. The DRV5056 outputs an analog voltage that describes the precise position of the component. The component must not contain ferromagnetic materials such as iron, nickel, and cobalt because these materials change the magnetic flux density at the sensor.

When designing a linear magnetic sensing system, always consider these three variables: the magnet, sensing distance, and range of the sensor. Select the DRV5056 with the highest sensitivity that has a B_L (linear magnetic sensing range) that is larger than the maximum magnetic flux density in the application.

Magnets are made from various ferromagnetic materials that have tradeoffs in cost, drift with temperature, absolute maximum 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) produced 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 23 shows diagrams for Equation 4 and Equation 5.

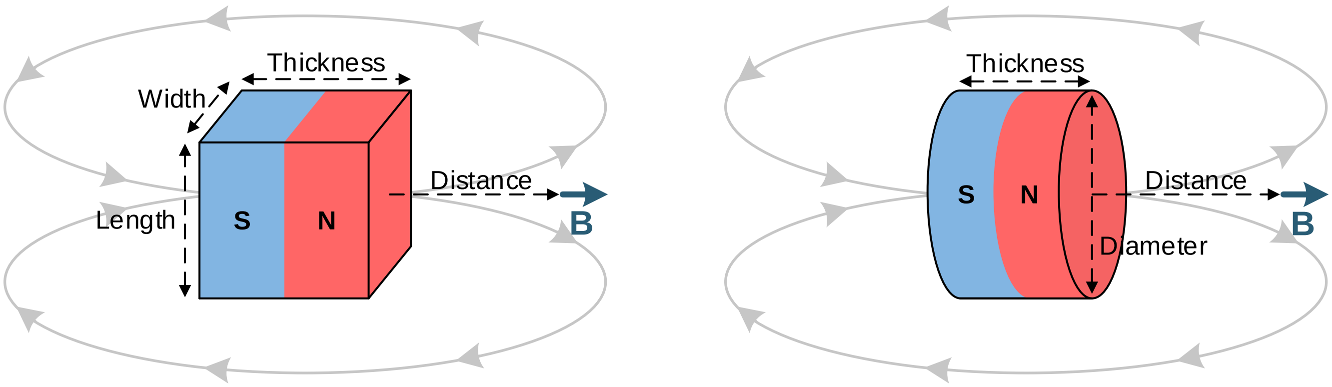


Figure 23. Rectangular Block and Cylinder Magnets

Use Equation 4 for the rectangular block shown in Figure 23:

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

Use Equation 5 for the cylinder shown in Figure 23:

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

where

- W is width
- L is length
- T is thickness (the direction of magnetization)
- D is distance
- C is diameter (5)

8.2.3 Application Curve

Figure 24 shows the magnetic flux density versus distance for a 10-mm × 6-mm cylinder ferrite magnet.

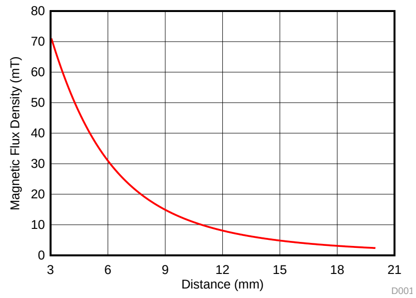


Figure 24. Magnetic Profile of a 10-mm × 6-mm Cylindrical Ferrite Magnet

8.3 What to Do and What Not to Do

Because the Hall element is sensitive to magnetic fields that are perpendicular to the top of the package, a correct magnet approach must be used for the sensor to detect the field. Figure 25 illustrates correct and incorrect approaches.

What to Do and What Not to Do (continued)

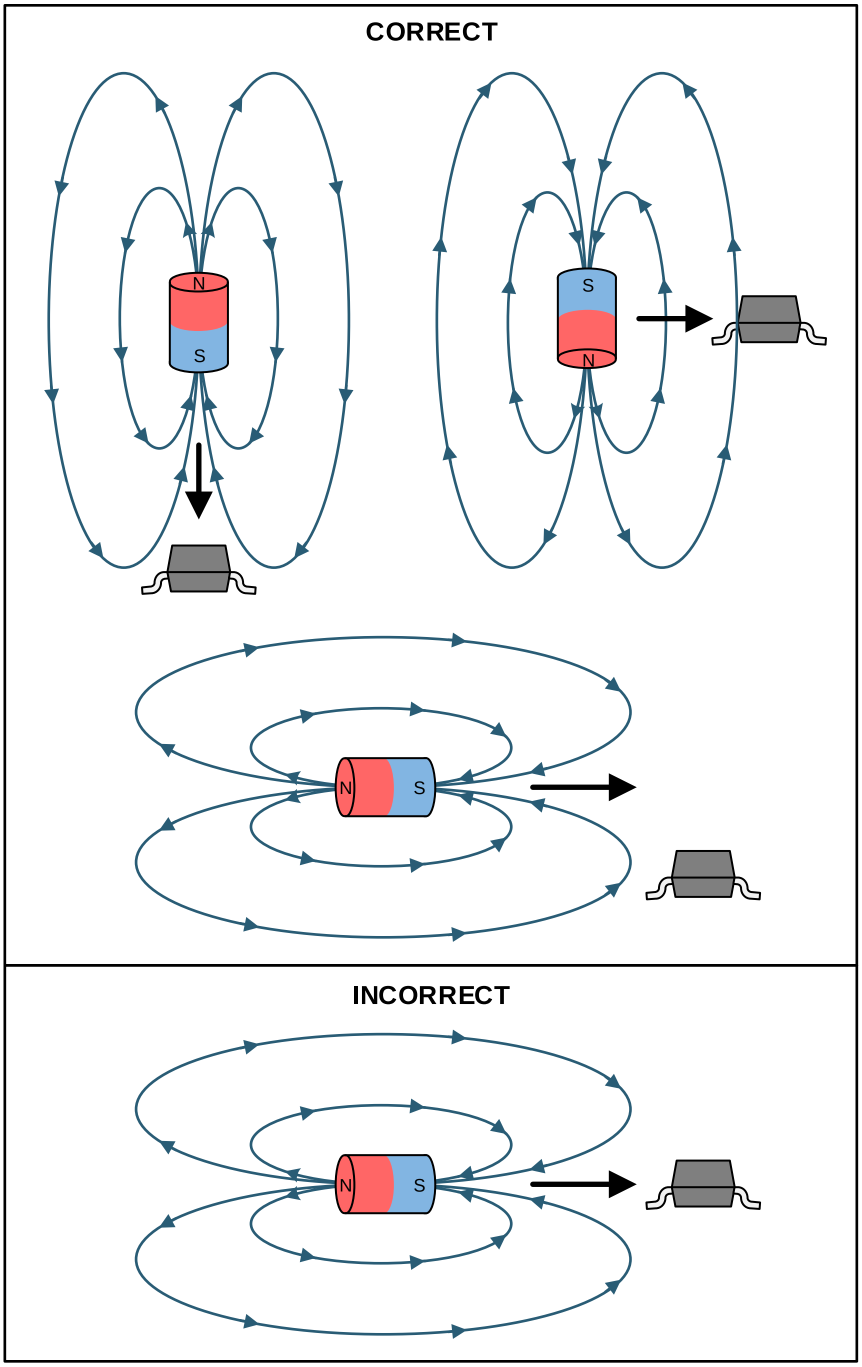


Figure 25. Correct and Incorrect Magnet Approaches

9 Power Supply Recommendations

A decoupling capacitor close to the device must be used to provide local energy with minimal inductance. TI recommends using a ceramic capacitor with a value of at least 0.01 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 printed-circuit boards, which makes placing the magnet on the opposite side possible.

10.2 Layout Examples

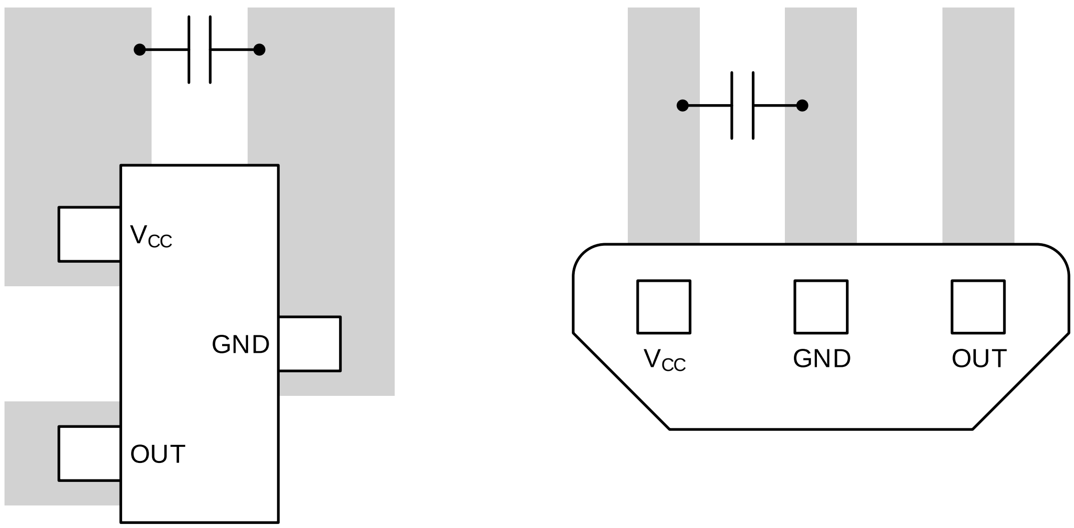


Figure 26. Layout Examples

11 Device and Documentation Support

11.1 Documentation Support

11.1.1 Related Documentation

For related documentation see the following:

- Texas Instruments, *Incremental rotary encoder design considerations application note*
- Texas Instruments, *Using linear hall effect sensors to measure angle application note*
- Texas Instruments, *Angle measurements with linear hall effect sensors*

11.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* 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.

11.3 Community Resources

The following links connect to TI community resources. Linked contents are 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.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

11.4 Trademarks

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11.5 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.

11.6 Glossary

SLYZ022 — *TI Glossary*.

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

12 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/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DRV5056A1QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	56A1	Samples
DRV5056A1QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	56A1	Samples
DRV5056A1QLPG	ACTIVE	TO-92	LPG	3	1000	Green (RoHS & no Sb/Br)	CU SN	N / A for Pkg Type	-40 to 125	56A1	Samples
DRV5056A1QLPGM	ACTIVE	TO-92	LPG	3	3000	Green (RoHS & no Sb/Br)	CU SN	N / A for Pkg Type	-40 to 125	56A1	Samples
DRV5056A2QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	56A2	Samples
DRV5056A2QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	56A2	Samples
DRV5056A2QLPG	ACTIVE	TO-92	LPG	3	1000	Green (RoHS & no Sb/Br)	CU SN	N / A for Pkg Type	-40 to 125	56A2	Samples
DRV5056A2QLPGM	ACTIVE	TO-92	LPG	3	3000	Green (RoHS & no Sb/Br)	CU SN	N / A for Pkg Type	-40 to 125	56A2	Samples
DRV5056A3QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	56A3	Samples
DRV5056A3QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	56A3	Samples
DRV5056A3QLPG	ACTIVE	TO-92	LPG	3	1000	Green (RoHS & no Sb/Br)	CU SN	N / A for Pkg Type	-40 to 125	56A3	Samples
DRV5056A3QLPGM	ACTIVE	TO-92	LPG	3	3000	Green (RoHS & no Sb/Br)	CU SN	N / A for Pkg Type	-40 to 125	56A3	Samples
DRV5056A4QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	56A4	Samples
DRV5056A4QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	56A4	Samples
DRV5056A4QLPG	ACTIVE	TO-92	LPG	3	1000	Green (RoHS & no Sb/Br)	CU SN	N / A for Pkg Type	-40 to 125	56A4	Samples
DRV5056A4QLPGM	ACTIVE	TO-92	LPG	3	3000	Green (RoHS & no Sb/Br)	CU SN	N / A for Pkg Type	-40 to 125	56A4	Samples
DRV5056A6QDBZR	ACTIVE	SOT-23	DBZ	3	3000	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	56A6	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DRV5056A6QDBZT	ACTIVE	SOT-23	DBZ	3	250	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	56A6	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/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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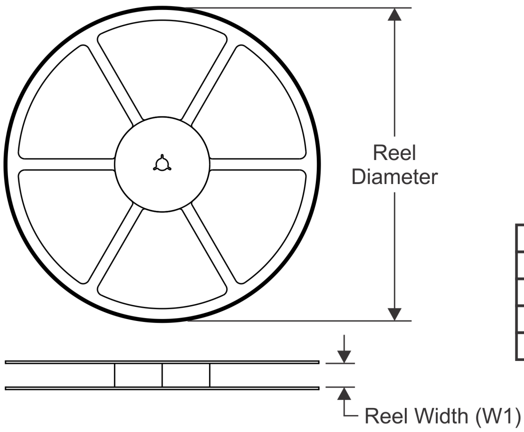
OTHER QUALIFIED VERSIONS OF DRV5056 :

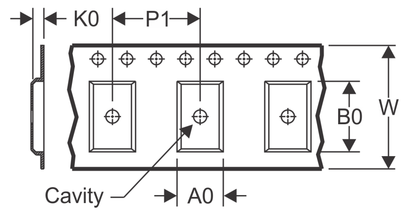
- Automotive: DRV5056-Q1

NOTE: Qualified Version Definitions:

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

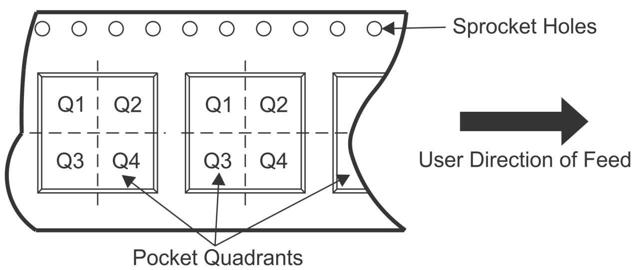
TAPE AND REEL INFORMATION





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

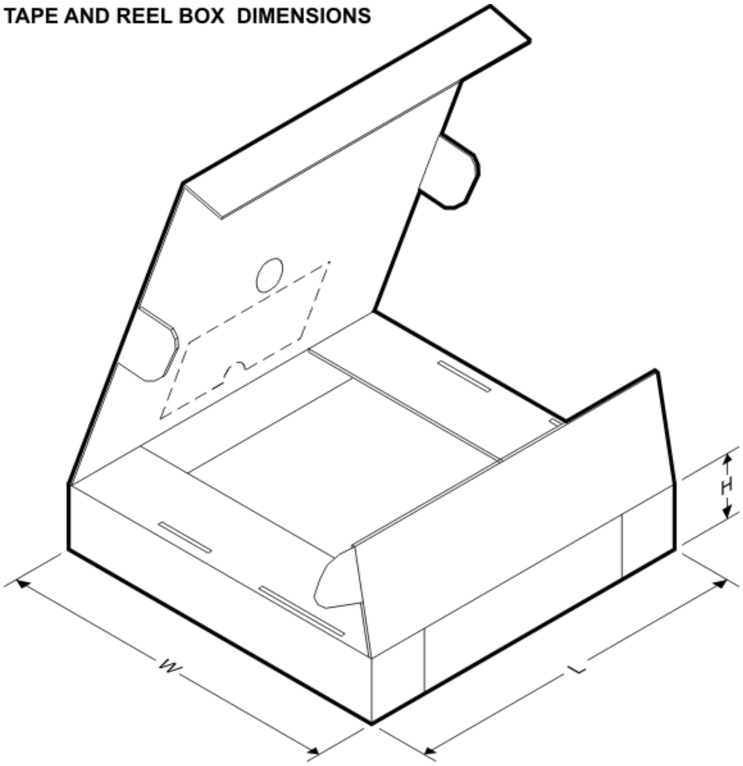
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
DRV5056A1QDBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
DRV5056A1QDBZT	SOT-23	DBZ	3	250	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
DRV5056A2QDBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
DRV5056A2QDBZT	SOT-23	DBZ	3	250	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
DRV5056A3QDBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
DRV5056A3QDBZT	SOT-23	DBZ	3	250	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
DRV5056A4QDBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
DRV5056A4QDBZT	SOT-23	DBZ	3	250	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
DRV5056A6QDBZR	SOT-23	DBZ	3	3000	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3
DRV5056A6QDBZT	SOT-23	DBZ	3	250	180.0	8.4	3.15	2.77	1.22	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



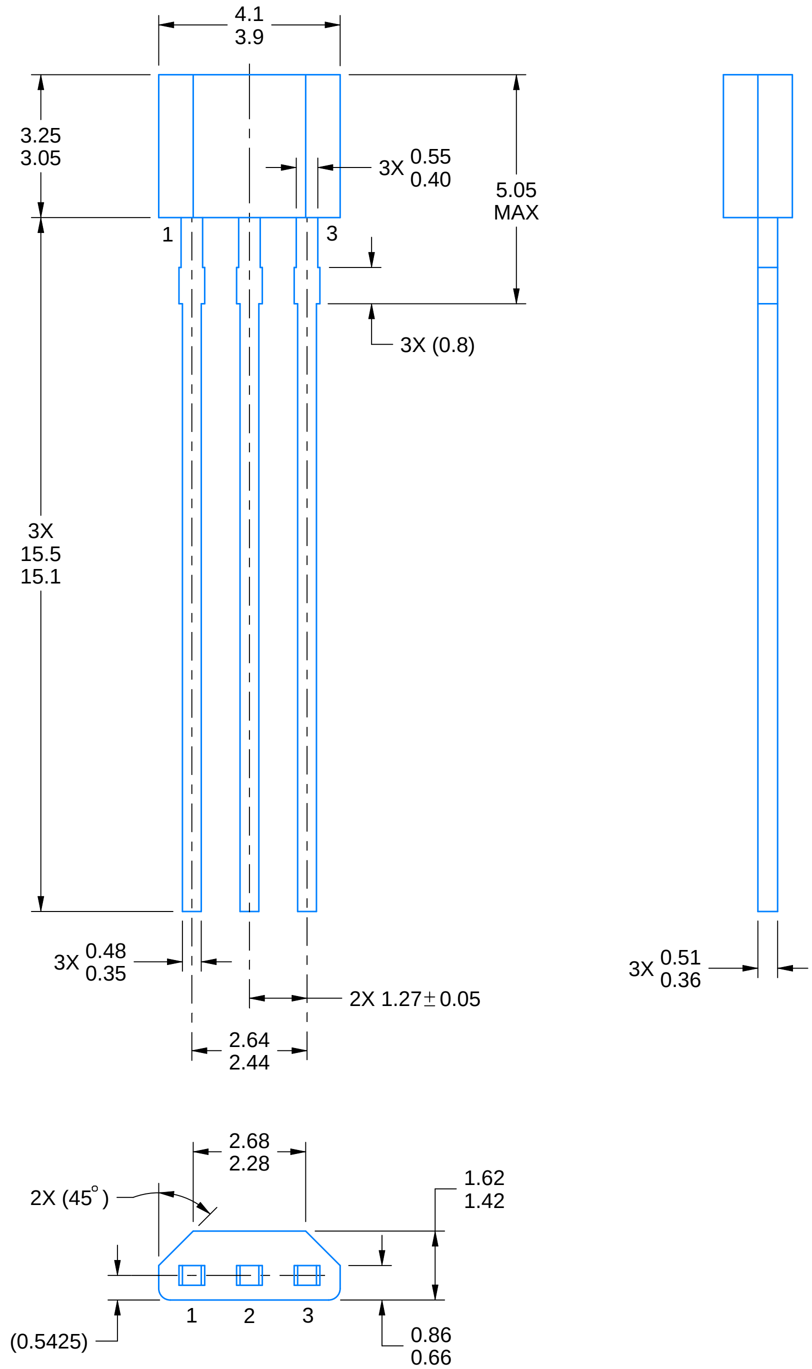
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DRV5056A1QDBZR	SOT-23	DBZ	3	3000	213.0	191.0	35.0
DRV5056A1QDBZT	SOT-23	DBZ	3	250	213.0	191.0	35.0
DRV5056A2QDBZR	SOT-23	DBZ	3	3000	213.0	191.0	35.0
DRV5056A2QDBZT	SOT-23	DBZ	3	250	213.0	191.0	35.0
DRV5056A3QDBZR	SOT-23	DBZ	3	3000	213.0	191.0	35.0
DRV5056A3QDBZT	SOT-23	DBZ	3	250	213.0	191.0	35.0
DRV5056A4QDBZR	SOT-23	DBZ	3	3000	213.0	191.0	35.0
DRV5056A4QDBZT	SOT-23	DBZ	3	250	213.0	191.0	35.0
DRV5056A6QDBZR	SOT-23	DBZ	3	3000	213.0	191.0	35.0
DRV5056A6QDBZT	SOT-23	DBZ	3	250	213.0	191.0	35.0

PACKAGE OUTLINE

TO-92 - 5.05 mm max height

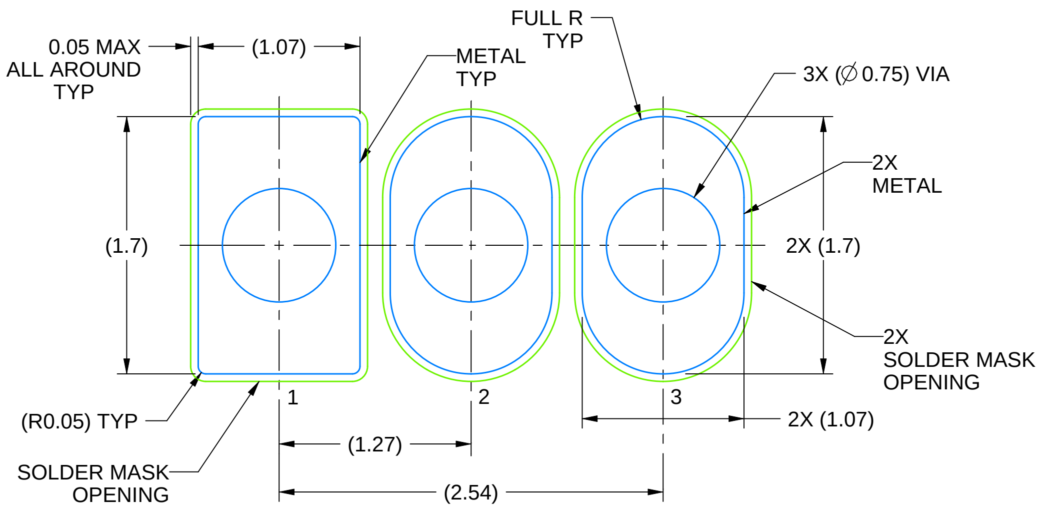
TRANSISTOR OUTLINE



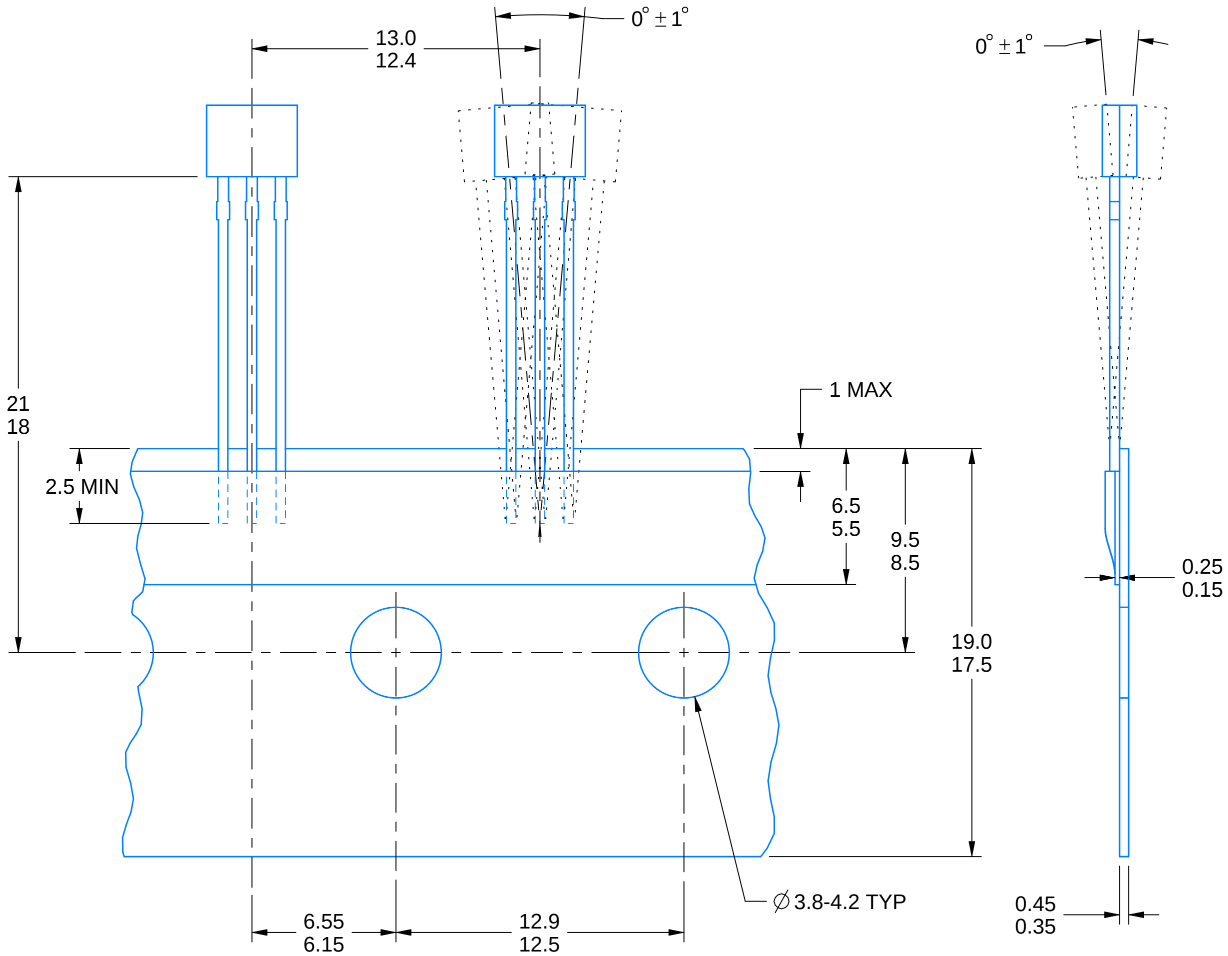
4221343/C 01/2018

NOTES:

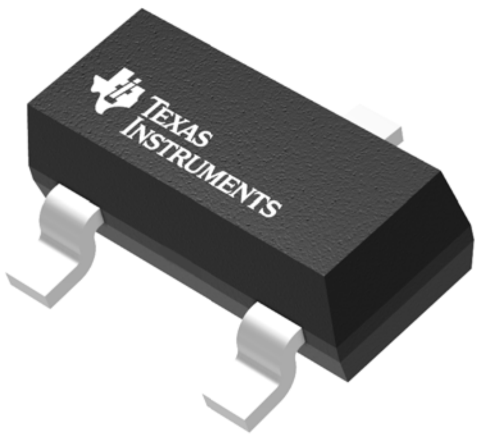
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.



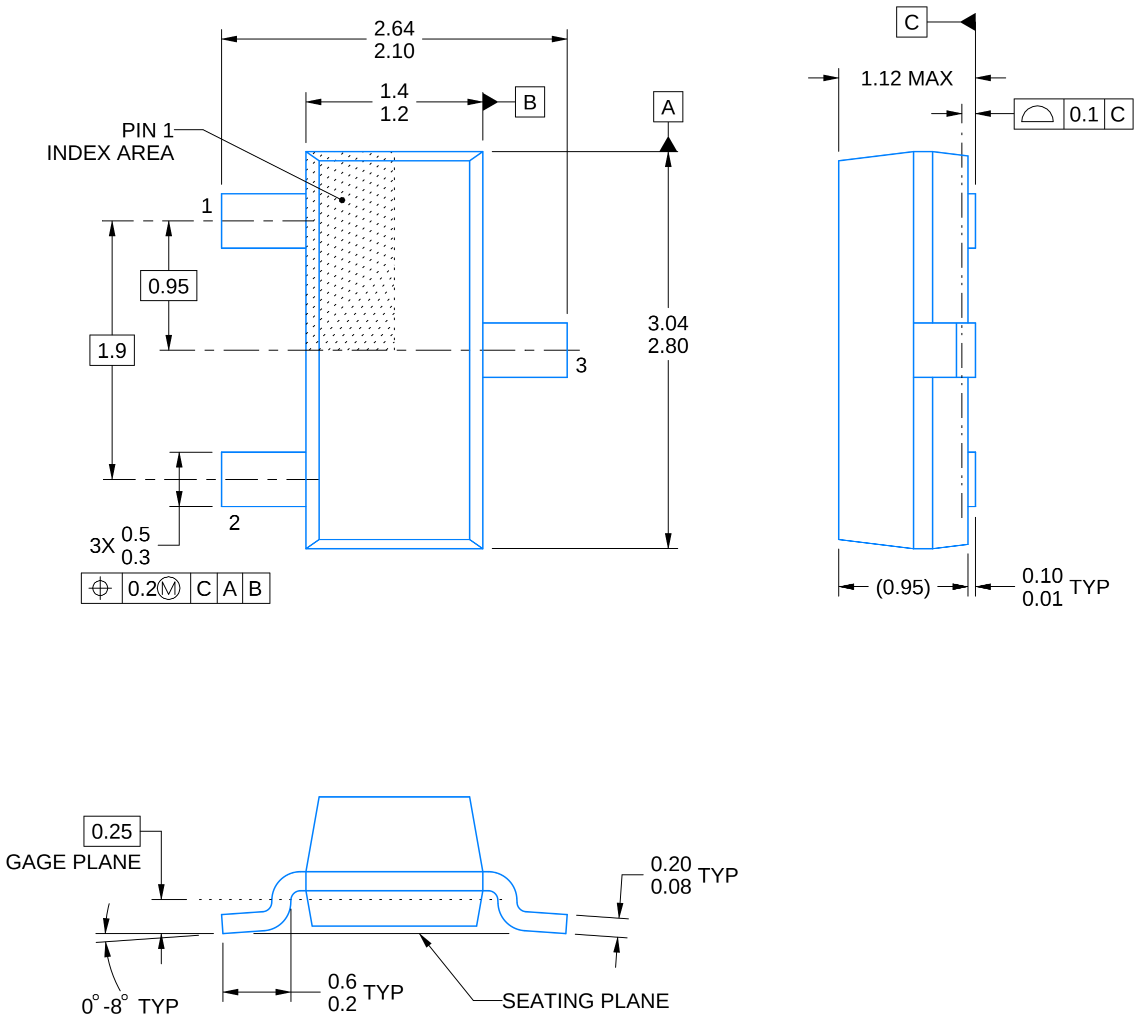
LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE:20X



4221343/C 01/2018



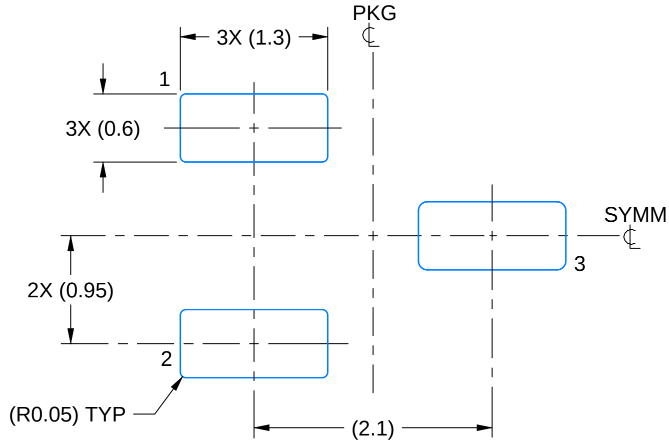
Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



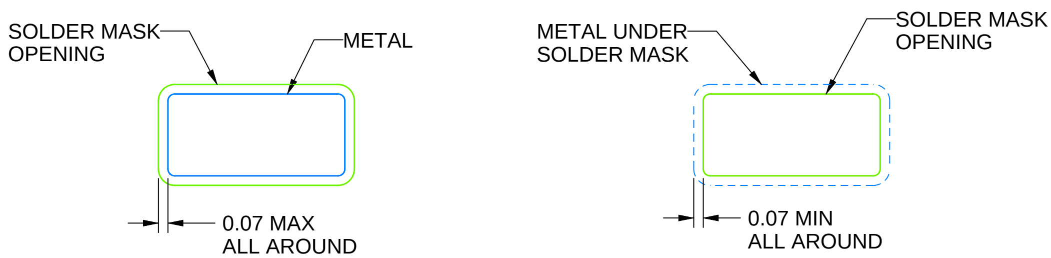
4214838/C 04/2017

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.



LAND PATTERN EXAMPLE
SCALE:15X



NON SOLDER MASK DEFINED (PREFERRED)

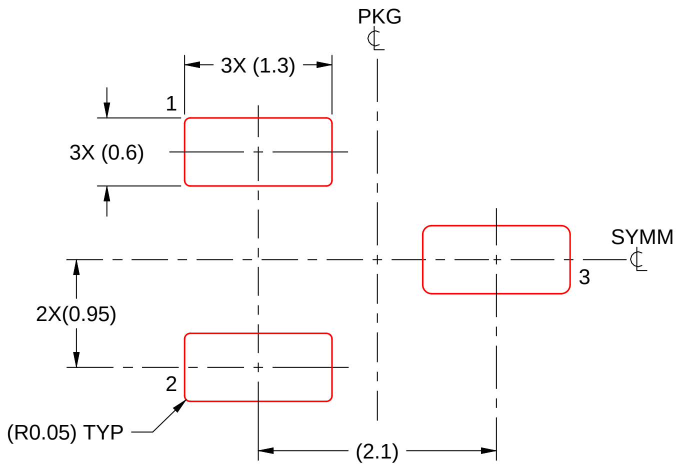
SOLDER MASK DEFINED

SOLDER MASK DETAILS

4214838/C 04/2017

NOTES: (continued)

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



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

4214838/C 04/2017

NOTES: (continued)

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

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