

1 Description

The RedRock® RR112-1G42-531/532 and RR112-1G43-531/532 are analog magnetic sensors with proportional linear voltage output ideal for use in medical, industrial, automotive, and consumer applications. Based on patented Tunneling Magnetoresistance (TMR) technology with seamless CMOS integration, the RR112 offers multiple configurations of several parameters to enable applications such as proximity sensing, rotary sensing, and level detection.

The RR112 series features a magnetic field range from -80 to +80 G (-8 mT to +8 mT) with a typical sensitivity of 5mV/V/G (50 mV/V/mT). Because it is rated to operate across a wide temperature range (-40°C up to 125°C) and it offers a wide supply voltage range (1.7 up to 5.5 V), the RR112 series is ideal for applications ranging from small battery-powered electronics to industrial machinery.

2 Features

- ▶ Operate sensitivity range from -80 G to +80 G
- ▶ Low Average Current < 1.2 μ A
- ▶ Wide Supply Voltage range of 1.7V to 5.5V
- ▶ Linear Analog Voltage Response
- ▶ Sampling Frequency of 100 Hz
- ▶ Temperature Rated up to 125°C
- ▶ Critical Performance Specs 100% Production Tested Throughout Complete Temperature Range
- ▶ RoHS & REACH Compliant

3 Applications

- ▶ Proximity Detection
- ▶ Rotary Sensing
- ▶ Fluid Level Detection
- ▶ Door & Lid Closure Detection
- ▶ Utility Meters
- ▶ Portable Medical Devices
- ▶ Consumer Electronics
- ▶ IoT Devices

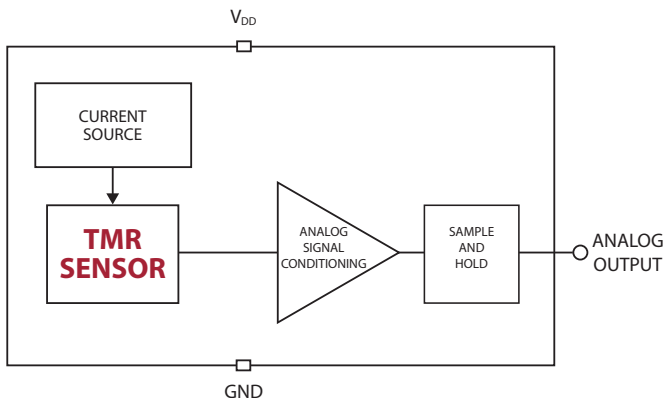
Device Information

Part Series	Package	Body Size (mm)	Temp Rating °C
RR112-1G42-531	SOT-23-3	2.9 x 1.6 x 1.2	-40 to +85
RR112-1G42-532	LGA-4	1.45 x 1.45 x 0.44	-40 to +85
RR112-1G43-531	SOT-23-3	2.9 x 1.6 x 1.2	-40 to +125
RR112-1G43-532	LGA-4	1.45 x 1.45 x 0.44	-40 to +125

Device Packages



Functional Block Diagram for Analog Output



Device Nomenclature

Ordering Information

RR112-1 G 4 X-5 3 X	
Series	RR112-1 G 4 X-5 3 X
Magnetic Polarity Response	1 = Omnipolar
Magnetic Sensitivity (mV/V/G)	D: -20 G: -5
Sampling Frequency (Hz)	4: 100 9: 10,000
Package	1: SOT-23-3 2: LGA-4
Output Response	3: Analog
Supply Voltage (V)	5: 1.7-5.5
Temp Rating (°C)	2: -40-+85 3: -40-+125

4 Specifications

4.1 Absolute Environmental Ratings¹

Parameters	Units	Min	Typ	Max
Operating Temperature (T _{OP}) (RR112-1G42-531/532)	°C	-40		+85
Operating Temperature (T _{OP}) (RR112-1G43-531/532)	°C	-40		+125
Input/Output Pins Maximum Voltage (V _{I/O})	V	-0.3		V _{DD} + 0.3
Storage Temperature (T _{STG})	°C	-65		+150
Junction Temperature (T _J)	°C	-40		+150
Soldering Temperature (3 cycles, 1 min.) (T _{SOL})	°C			+260
ESD Level Human Body Model (HBM) per JESD22-A114	V	±4000		
ESD Level Charged Device Model (CDM) per JESD22-C101	V	±500		
Junction-to-Ambient Thermal Resistance (SOT-23-3)	°C/W		202	
Junction-to-Ambient Thermal Resistance (LGA-4)	°C/W		165	
Maximum Magnetic Field Exposure (B _{MAX})	G			±2000

4.2 Absolute Electrical Ratings¹

Parameters	Units	Min	Typ	Max
Supply Voltage (V _{DD})	V	-0.3		6.0
Input and Output Current (I _{IN} /I _{OUT})	mA			±20

4.3 Operating Electrical Characteristics for all RR112 Series Sensors²

Parameters	Units	Min	Typ	Max
Supply Voltage (V _{DD})	V	1.7	3.0	5.5
Power-On Time (t _{ON})(V _{DD} > 1.7V)	µs		50	75
Active Mode Time (t _{ACTIVE})	µs		2.6	
Under Voltage Lockout Threshold Rising V _{DD} (V _{UVLO-RISE})	V		1.60	1.64
Under Voltage Lockout Threshold Falling V _{DD} (V _{UVLO-FALL})	V	1.44	1.53	
Under Voltage Lockout Hysteresis (V _{UV-HYST})	mV		70	

Notes:

- Exceeding Absolute Ratings may cause permanent damage to the device. Exposure at the maximum rated conditions for extended periods of time may also affect device reliability.
- Unless otherwise specified, V_{DD} = 1.7 V to 5.5 V, T_A = -40°C to +85°C (1G42), -40°C to +125°C (1G43). Typical values are V_{DD} = 3.0 V and T_A = +25°C.



ESD Note: This product uses semiconductors that can be damaged by electrostatic discharge (ESD). When handling, proper ESD precautions should be taken to avoid performance degradation or loss of functionality. Damage due to inappropriate handling is not covered under warranty.

4 Specifications (cont.)

4.4 Operating Characteristics for RR112-1G42-531/532 & RR112-1G43-531/532¹

Parameters	Units	Min	Typ	Max
Operating Temperature (T _{OP}) (RR112-1G42-531/532)	°C	-40		+85
Operating Temperature (T _{OP}) (RR112-1G43-531/532)	°C	-40		+125
Average Supply Current ² (I _{DD(AVG)}) @ V _{DD} = 1.7V, f _S = 100 Hz	μA		1.2	
Average Supply Current ² (I _{DD(AVG)}) @ V _{DD} = 3.0V, f _S = 100 Hz	μA		1.5	
Sampling Frequency ³ (f _S)	Hz	60	100	140
Active Mode Time (t _{ACTIVE})	μs		2.6	
Idle Mode Time (t _{IDLE})	ms	7.1	10	16.6
Maximum Drive Capability (I _{DRV(MAX)}) ΔV _{OUT} ≤ 10mV	μA	-10		10
Output Capacitive Load (C _{LOAD})	pF			10
Magnetic Field Range (B _{ANA})	G	±54	±80	±100
Analog Output Voltage Range (V _{ANA})	V	0.1 x V _{DD}		0.9 x V _{DD}
Voltage Output Quiescent ² (V _{OQ})	%V _{DD}	45	50	55
Sensitivity @ T = +25°C	mV/V/G	-3.5	-5	-6.5
Sensitivity @ Full Temperature Range (S _{FULL_RANGE})	mV/V/G		-5	

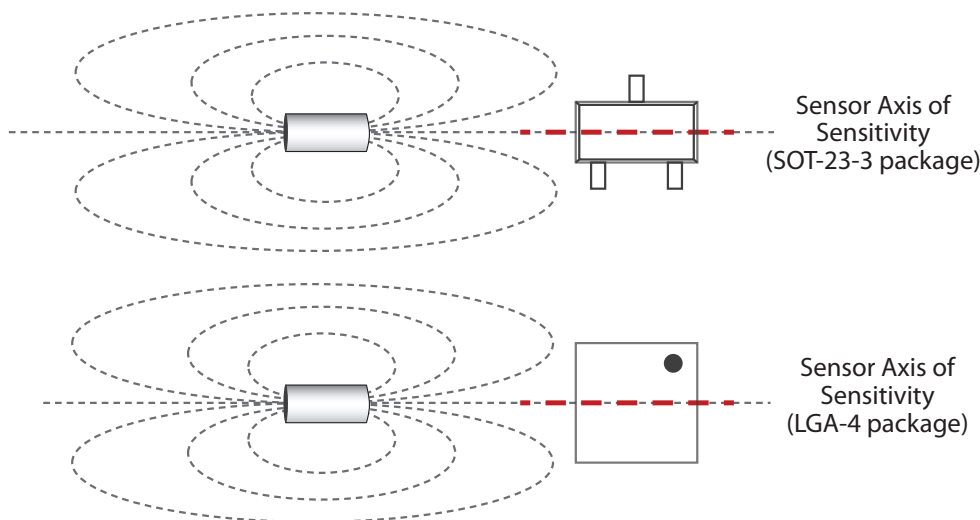
Notes:

1. Unless otherwise specified, V_{DD} = 1.7 V to 5.5 V, T_A = -40°C to +85°C (1G42), -40°C to +125°C (1G43). Typical values are V_{DD} = 3.0 V and T_A = +25°C.
2. Conditions: t = 10 seconds
3. The RR112-1G42/1G43-531/532 TMR sensor samples the magnetic field at 100Hz. The internal sample and hold circuitry may cause the output to take multiple sampling cycles to reflect the proper voltage level for a given magnetic flux density value.

5 Magnetic Response

For more information please contact Coto Technology at www.cotorelay.com.

5.1 Axis of Sensitivity



Note: The most straightforward way of aligning a magnet with a TMR sensor is by lining up the magnet's magnetization axis with the sensor's Axis of Sensitivity (as shown in Section 5.1). However, there are many other alignments and orientations that will also achieve proper operation. For any questions, or to learn more, please contact Coto Technology. For tips on proper magnetic orientation see our Applications Note:

download PDF
["How to Replace a Hall Effect Sensor with a TMR Sensor"](#)



watch our video:
["Replacing Hall Effect Sensors with TMR Sensors – How and Why?"](#)



5 Magnetic Response (cont.)

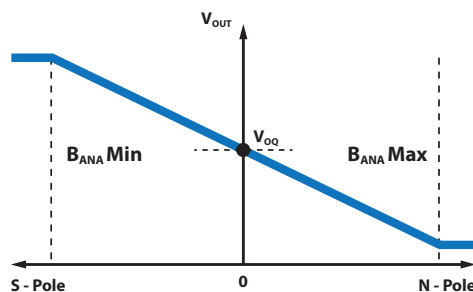
5.2 Magnetic Response Table (SOT-23-3 package)

	Step 1: Sensor is powered without magnetic field.	Step 2: Magnet applied, polarity North .	Step 3: Magnet removed.	Step 4: Magnet applied, polarity South .	Step 5: Magnet removed.
Scenario					
ANALOG OUTPUT (ANA OUT)	$\frac{V_{dd}}{2}$ Output is half of V_{dd}	$0 < V_{out} < \frac{V_{dd}}{2}$ Output is between 0V and half of V_{dd}	$\frac{V_{dd}}{2}$ Output is half of V_{dd}	$\frac{V_{dd}}{2} < V_{out} < V_{dd}$ Output is between half of V_{dd} and full V_{dd}	$\frac{V_{dd}}{2}$ Output is half of V_{dd}

5.3 Magnetic Response Table (LGA-4 package)

	Step 1: Sensor is powered without magnetic field.	Step 2: Magnet applied, polarity North .	Step 3: Magnet removed.	Step 4: Magnet applied, polarity South .	Step 5: Magnet removed.
Scenario					
ANALOG OUTPUT (ANA OUT)	$\frac{V_{dd}}{2}$ Output is half of V_{dd}	$0 < V_{out} < \frac{V_{dd}}{2}$ Output is between 0V and half of V_{dd}	$\frac{V_{dd}}{2}$ Output is half of V_{dd}	$\frac{V_{dd}}{2} < V_{out} < V_{dd}$ Output is between half of V_{dd} and full V_{dd}	$\frac{V_{dd}}{2}$ Output is half of V_{dd}

5.4 Magnetic Response Diagram

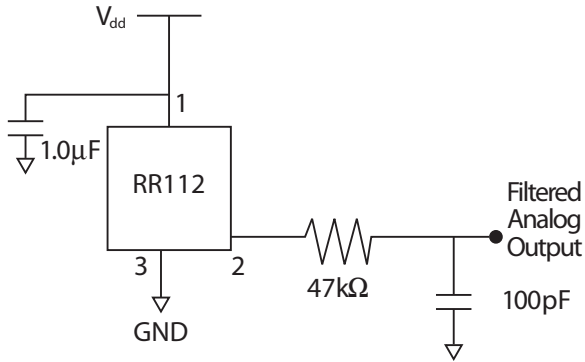


6 Application Information

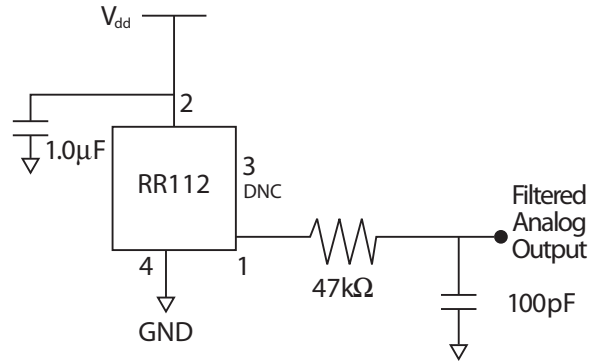
RR112 Output Application Circuit

The output voltage can be connected to an analog I/O pin on a microcontroller. A decoupling capacitor between the supply voltage and ground is required with placement close to the magnetic sensor. A typical capacitor value of 1.0 μ F will suffice. The analog output voltage is proportional to the strength of an applied magnetic field. A simple RC filter is recommended at the output. A resistor value of 47k Ω and a capacitor value of 100 pF should suffice.

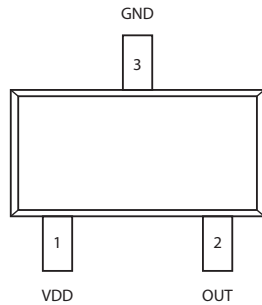
6.1 Application Circuit (SOT-23-3)



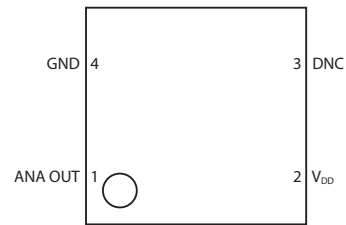
6.2 Application Circuit (LGA-4)



6.3 Package Pinout (SOT-23-3)

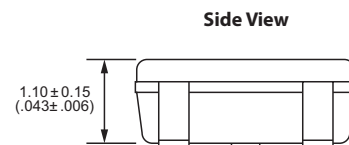
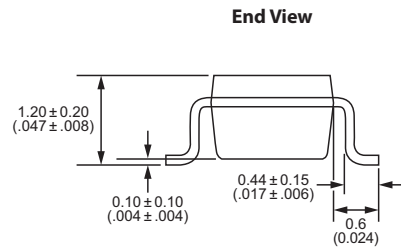
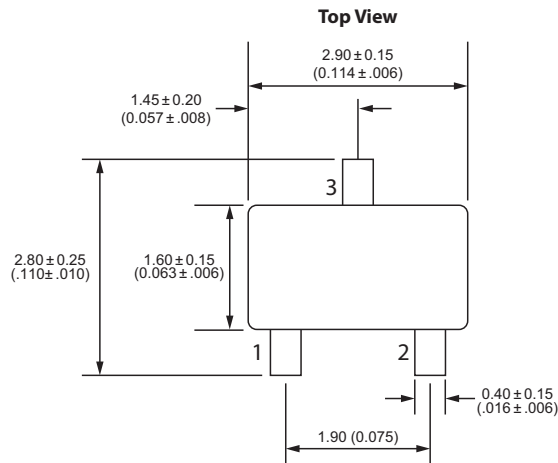


6.4 Package Pinout (LGA-4)



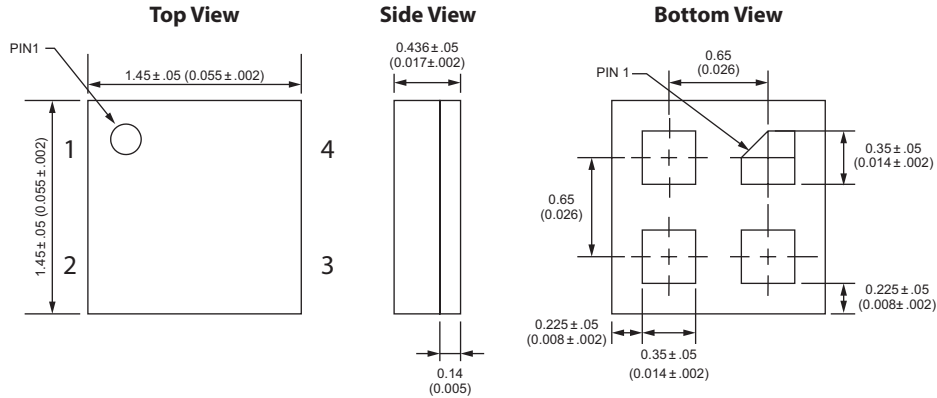
7 Dimensions *Millimeters (Inches)*

7.1 SOT-23-3 Package



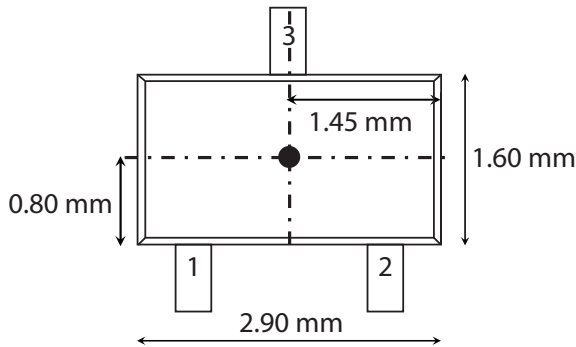
7 Dimensions *Millimeters (Inches)*

7.2 LGA-4 Package

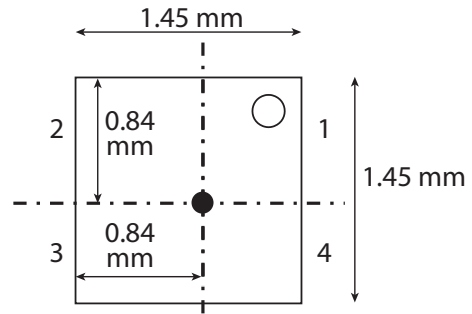


8 TMR Sensor Location

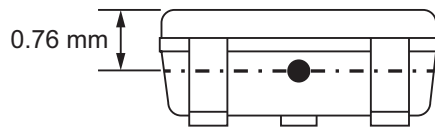
8.1 SOT-23-3 Package



8.2 LGA-4 Package



8.3 SOT Package - Side View



8.4 LGA Package - Side View



9 TMR Sensor & Switch Packaging

9.1 SOT-23-3 Tape & Reel Packaging

Standard packaging is Tape & Reel containing 3,000 pieces. MSL Rating is 1.

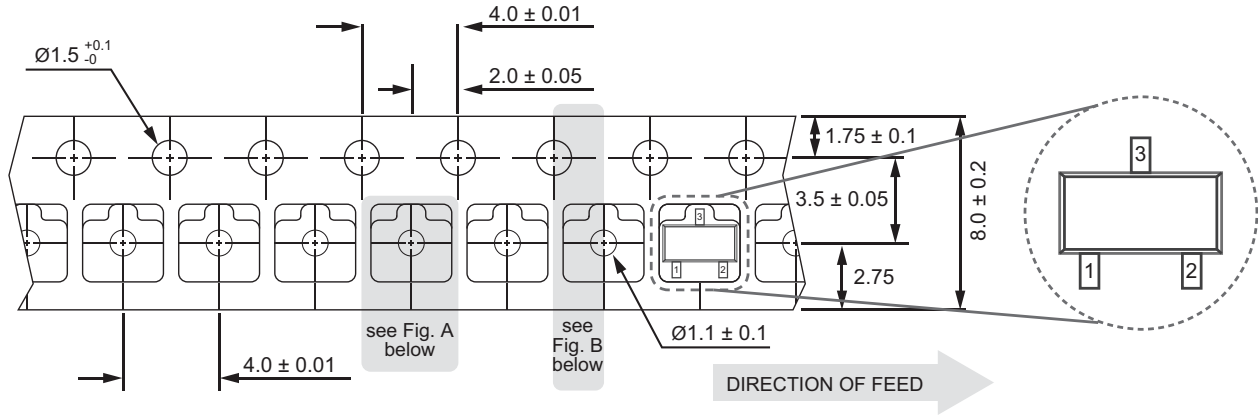


Fig. A

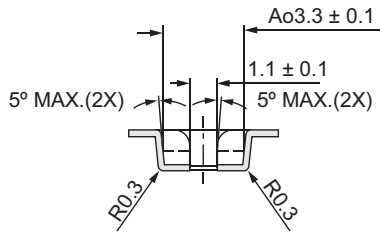
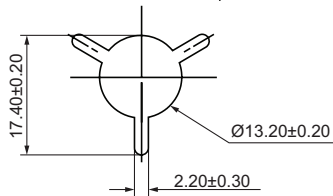
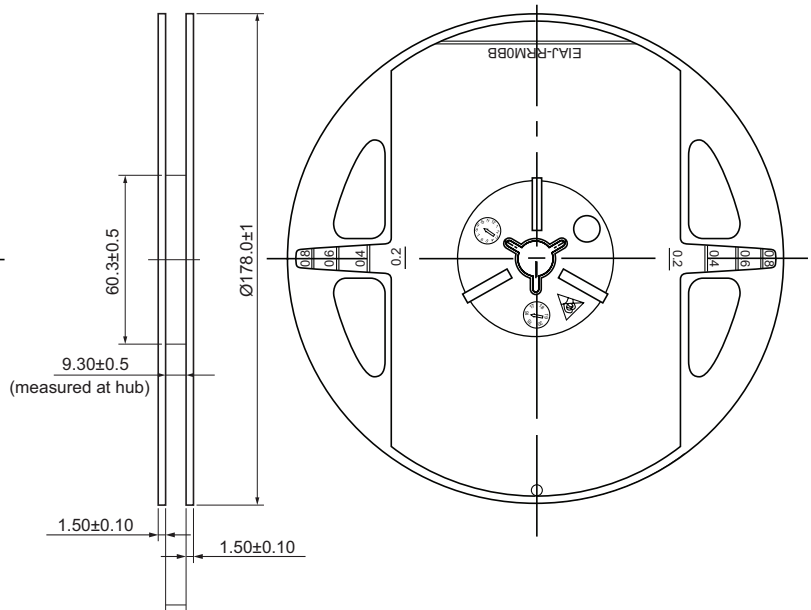
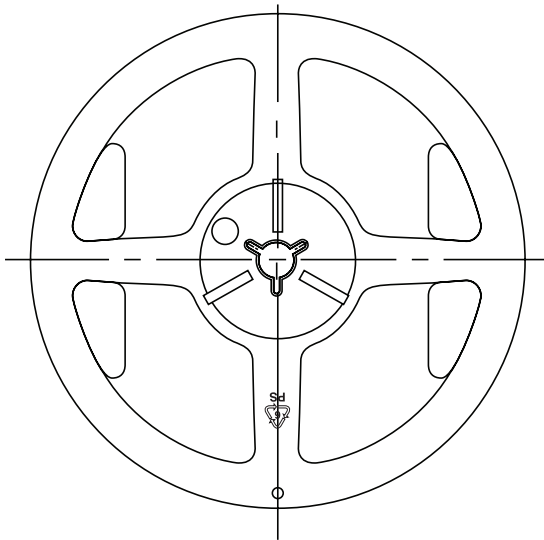
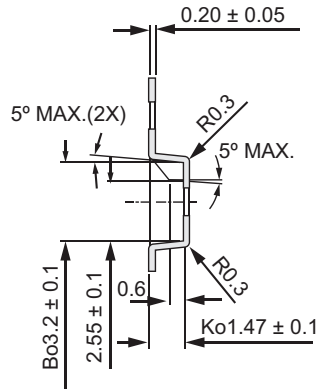


Fig. B



9 TMR Sensor & Switch Packaging

9.2 LGA-4 Tape & Reel Packaging

Standard packaging is Tape & Reel containing 3,000 pieces. MSL Rating is 3.

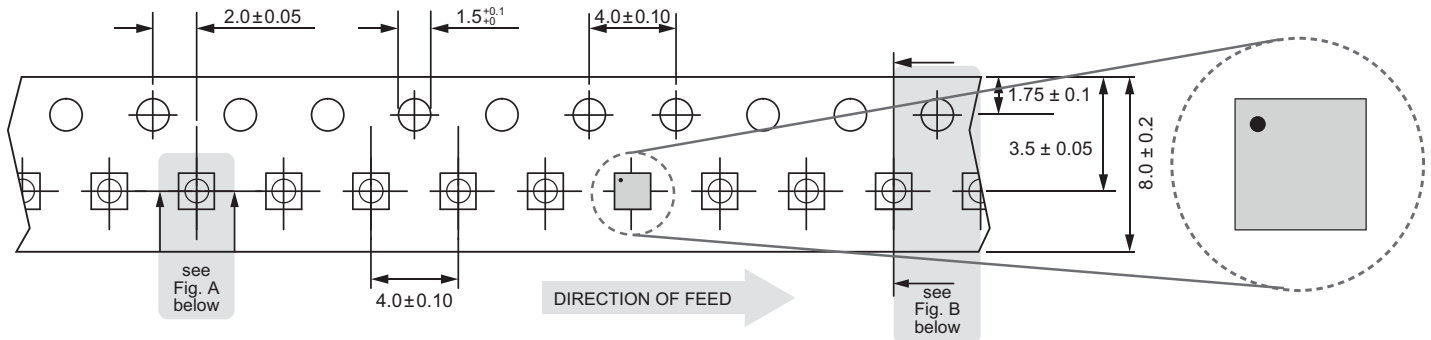


Fig. A

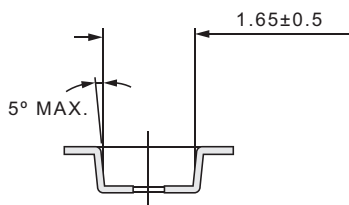
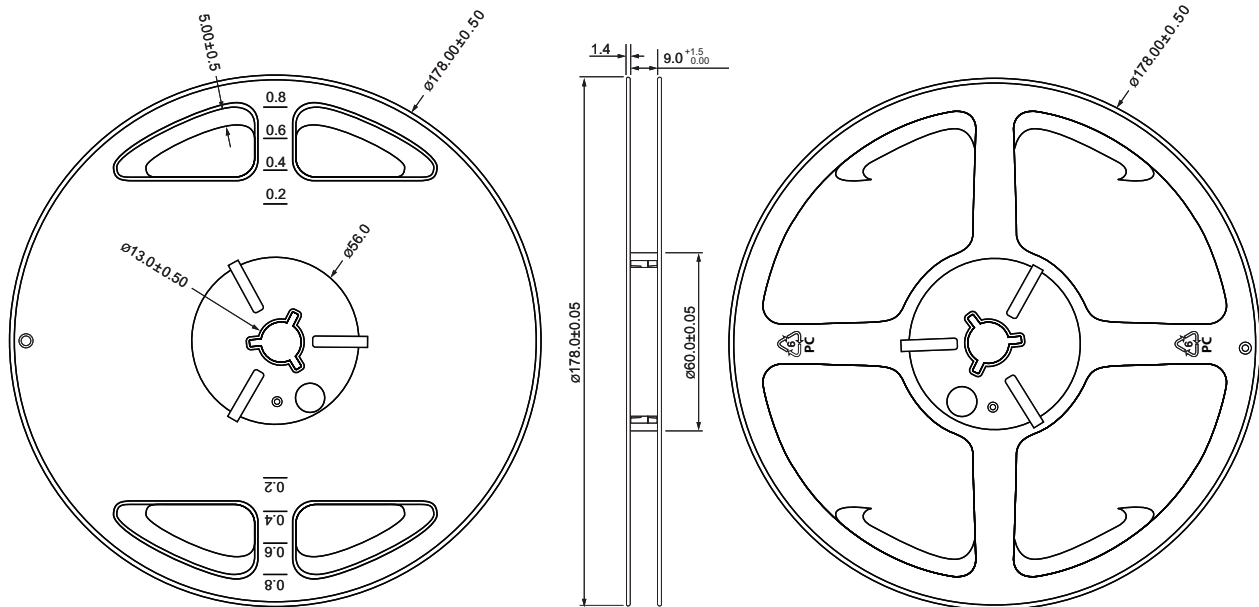
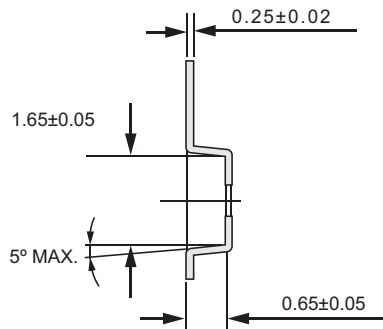


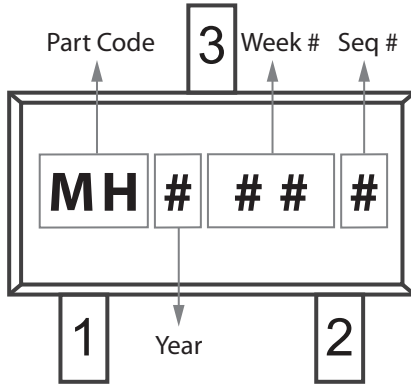
Fig. B



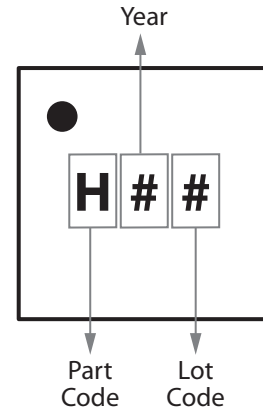
9 TMR Sensor & Switch Packaging

9.3 RedRock Package Codes

RR112-1G42-531 / RR112-1G43-531 (SOT-23-3)



RR112-1G42-532 / RR112-1G43-532 (LGA-4)



9.4 RedRock TMR Packaging

Box Dimensions – 14x10x6 inches

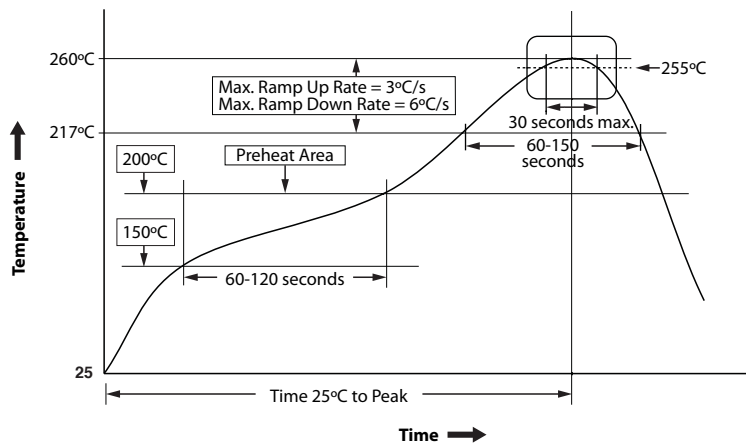
- Fits 1 to 3 reels = 3000 to 9000 pcs
- Weight for 3000 pcs = 0.90 kilos
- Weight for 9000 pcs = 1.00 kilos

Box Dimensions – 18x14x12 inches

- Fits 4 to 24 reels = 12000 to 72000 pcs
- Weight for 12000 pcs = 1.50 kilos
- Weight for 72000 pcs = 4.90 kilos

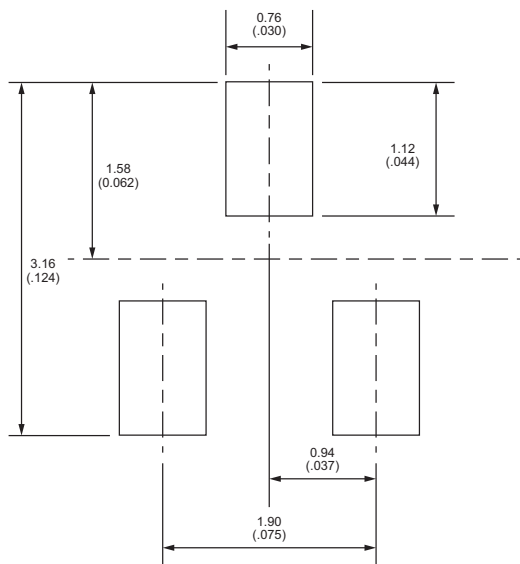
10 Suggested Pb-Free Reflow Profile

- Notes:**
1. Fully compatible with standard no-lead solder profile, 260 °C for 1 minute max (3 cycles max).
 2. Profile shown as example. Users are advised to develop their own board-level profile.
 3. Suggested Pb-free reflow profile derived from IPC/JEDEC J-STD-020E.
 4. Temperature tolerance: +0 °C, as measured at any point on the package or leads
 5. MSL rating of 1 (SOT-23-3 only) compatible with J-STD-020 or equivalent.
 6. MSL rating of 3 (LGA-4 only) compatible with J-STD-020 or equivalent.
 7. All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow (e.g., live-bug). If parts are reflowed in other than the normal live bug assembly reflow orientation (i.e., dead-bug), T_p shall be within ± 2 °C of the live bug T_p and still meet the T_c requirements, otherwise, the profile shall be adjusted to achieve the latter. To accurately measure actual peak package body temperatures, refer to JEP140 for recommended thermocouple use.
 8. Reflow profiles in this document are for classification/preconditioning and are not meant to specify board assembly profiles. Actual board assembly profiles should be developed based on specific process needs and board designs and should not exceed the parameters in this table.

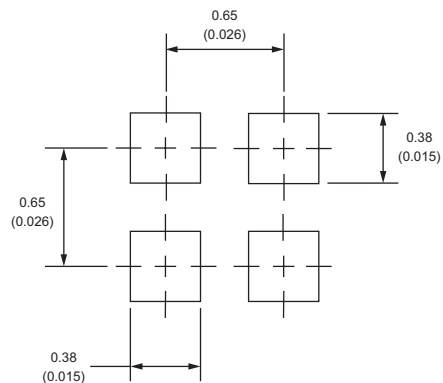


11 Suggested Solder Pad Layout

11.1 SOT-23-3 Solder Pad Layout



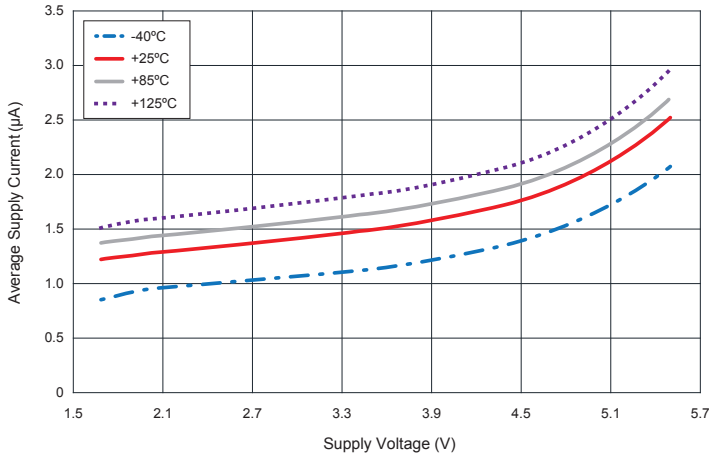
11.2 LGA-4 Solder Pad Layout



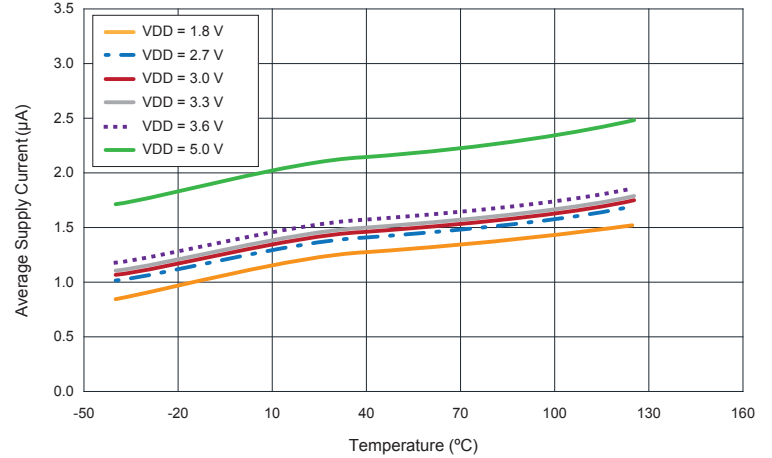
12 Graphs - Typical Electrical Characteristics

$V_{DD} = 3.3\text{ V}$, $T_A = +25^\circ\text{C}$ and $C_{BYP} = 1.0\ \mu\text{F}$ (unless otherwise specified)

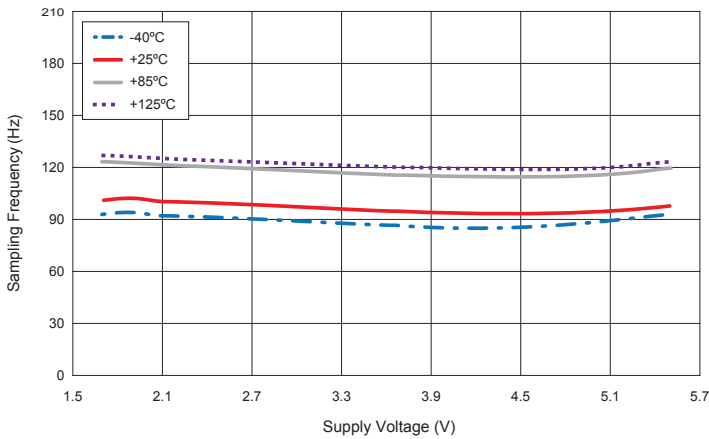
12.1 RR112-1G42-531/532 & RR112-1G43-531/532
Average Supply Current vs.
Supply Voltage vs. Temperature



12.2 RR112-1G42-531/532 & RR112-1G43-531/532
Average Supply Current vs.
Temperature vs. Supply Voltage



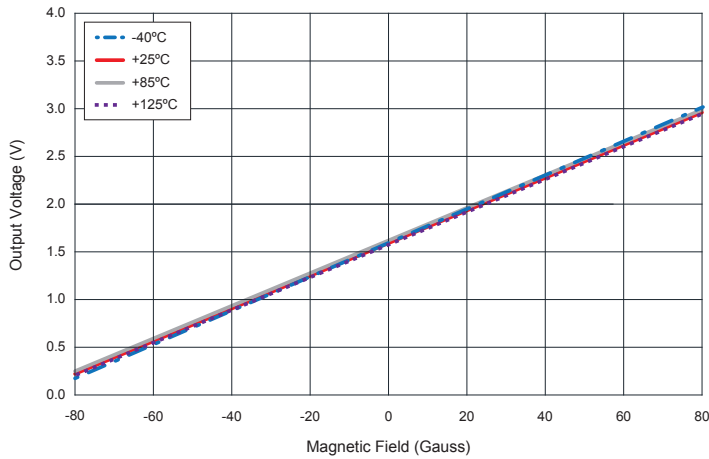
12.3 RR112-1G42-531/532 & RR112-1G43-531/532
Sampling Frequency vs.
Supply Voltage vs. Temperature



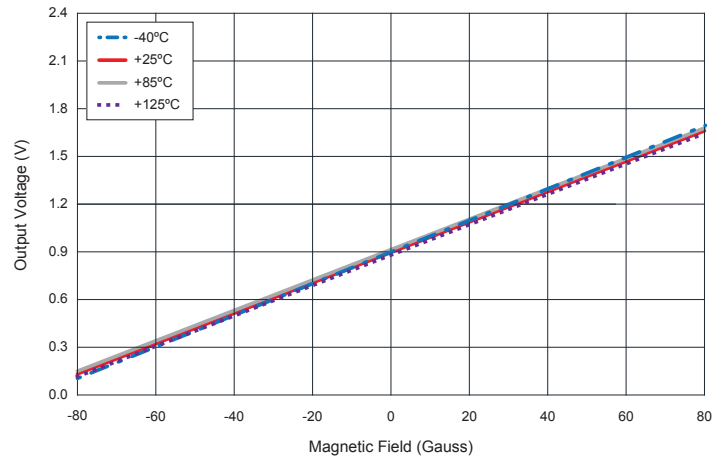
12 Graphs - Typical Magnetic Characteristics

$V_{DD} = 3.3\text{ V}$, $T_A = +25^\circ\text{C}$ and $C_{BYP} = 1.0\ \mu\text{F}$ (unless otherwise specified)

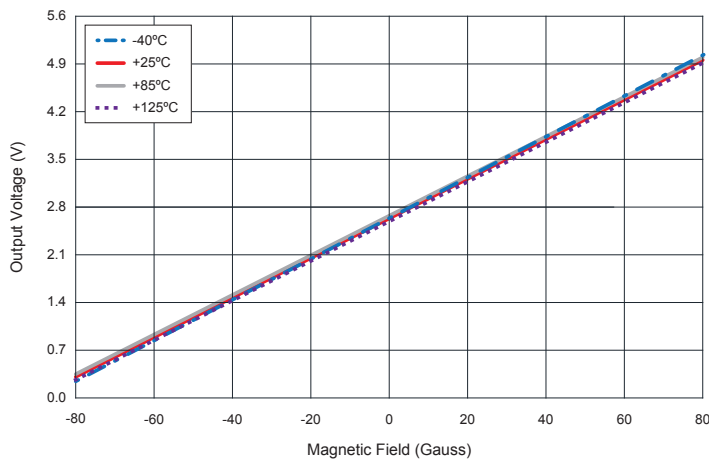
12.4 RR112-1G42-531/532 & RR112-1G43-531/532
Output Voltage vs. Magnetic Field
Over Temperature at $V_{DD} = 3.3\text{ V}$



12.5 RR112-1G42-531/532 & RR112-1G43-531/532
Output Voltage vs. Magnetic Field
Over Temperature at $V_{DD} = 1.8\text{ V}$



12.6 RR122-1A22-511 / 512 & RR112-1G43-531/532
Output Voltage vs. Magnetic Field
Over Temperature at $V_{DD} = 5.5\text{ V}$



13 IMPORTANT NOTICE AND DISCLAIMER

COTO TECHNOLOGY, INC. ("COTO") PROVIDES THIS DATA SHEET "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS AND IMPLIED, WITH RESPECT TO INFORMATION SET FORTH HEREIN, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF ACCURACY, COMPLETENESS, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS. Your receipt of this data sheet constitutes your acknowledgement and acceptance of, and agreement to, all of the terms, conditions, notes, notices, disclaimers and limitations set forth herein.

This data sheet is subject to change without notice. Coto reserves the right to make, from time to time, changes to specifications set forth herein as may be necessary or desirable to improve the performance, reliability and/or manufacturability of the products described herein. As such, before placing an order of any Coto product described herein, you must verify that the information set forth herein is current with respect to such product, and Coto assumes no responsibility for any damages which you may incur due to your failure to do so.

Coto grants you permission to use this data sheet only for information and reference purposes, and any other use of this data sheet by you is prohibited. No license to any intellectual property right of Coto or any third party is granted hereunder.

You are solely responsible for (1) deciding whether to purchase or use any Coto product, (2) selecting appropriate Coto products for your application, (3) designing, validating and testing your application incorporating or involving any Coto product and (4) ensuring that such application meets applicable safety, security, regulatory or other requirements or standards. Any purchase or use of any Coto product must fully comply with all applicable laws and regulations, including, without limitations, import and export regulations.

Coto products described herein have been designed, developed and manufactured to be used in the standard commercial applications similar to those shown herein ("Specific Applications"). Any application requiring measures of reliability, robustness, safety or certifications not shown or beyond those shown herein is at the user's risk and is not warranted or guaranteed by Coto. Therefore, you are advised to use Coto products described herein only in Specific Applications.

Your purchase and use of Coto products, including, without limitation, those products described herein, are subject to Coto's terms and conditions of sale and other applicable terms available on Coto's website or otherwise provided or made available in conjunction with such products. Unless such terms and conditions state otherwise, COTO PRODUCTS ARE PROVIDED "AS IS" AND WITH ALL FAULTS, AND ANY AND ALL WARRANTIES, EXPRESS AND IMPLIED, WITH RESPECT TO SUCH PRODUCTS, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS, ARE DISCLAIMED. Coto's provision of this data sheet does not expand or otherwise alter Coto's applicable warranties or warranty disclaimers for Coto products.

Coto disclaims responsibility for, and you will fully defend, indemnify and hold harmless Coto, its affiliates and its and their respective equity holders, directors, officers, employees, representatives, agents, successors and assigns against and for, any and all claims, damages, costs, losses and liabilities arising out of your use of this data sheet or your purchase or use of any Coto product described herein.

Revision History

	Date	Description
1	11/04/2020	Modified Junction-to-Ambient Thermal Resistance (SOT-23-3) Value (Table 4.1)
2	11/04/2020	Modified Junction-to-Ambient Thermal Resistance (LGA-4) Value (Table 4.1)
3	09/14/2021	Modified Axis of Sensitivity on LGA-4 Package (Section 6)
4	10/29/2021	Modified LGA-4 Package Dimensions (Section 8.2)
5	10/29/2021	Modified Bottom View Dimensions (Section 7.2 LGA-4 Package)
6	11/12/2021	Modified LGA-4 Package on Axis of Sensitivity (Section 6)
7	12/03/2021	Modified LGA-4 Package on Axis of Sensitivity (Section 6)
8	06/21/2022	Revised/expanded Magnetic Response Section (Section 5)
9	06/21/2022	Removed sections 7 and 10, consolidating information within new Section 5
10	06/21/2022	Modified packaging drawings (9.1 and 9.2)
11	06/21/2022	Modified LGA Sensor Location package drawings (8.2 and 8.4)
12	06/21/2022	Added RedRock Package Code section (9.3)
13	06/21/2022	Added Package Pinouts (Section 6)
14	07/18/2022	Minor Modifications (Section 5.2, 5.3 & 6)
15	07/18/2022	Added product RR112-1D92/93-531/532 to Section 3 Ordering Information
16	03/17/2023	Modified Functional Block Diagram for Analog Output
17	03/17/2023	Modified Ordering Information
18	03/17/2023	Modified Operating Characteristics Table (Section 4.4)
19	03/17/2023	Modified Magnetic Response Diagram (Section 5.4)
20	05/04/2023	Modified Package Pinout drawing (6.4)
21	05/09/2023	Modified Operating Characteristics Table (Section 4.4)
22	11/15/2023	Added Typical Magnetic & Electrical Characteristic Graphs (Section 12)
23	12/06/2023	Added Sampling Frequency to Table 4.4
24	02/28/2024	Clarified Product Description to include Analog Channel Sampling Frequency