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 µA
- Wide Supply Voltage range of 1.7V to 5.5V
- Linear Analog Voltage Response
- Operating Frequency of 25 Hz
- Temperature Rated up to 125°C
- Critical Performance Specs 100% Production Tested Throughout Complete Temperature Range
- RoHS & REACH Compliant

3 Applications

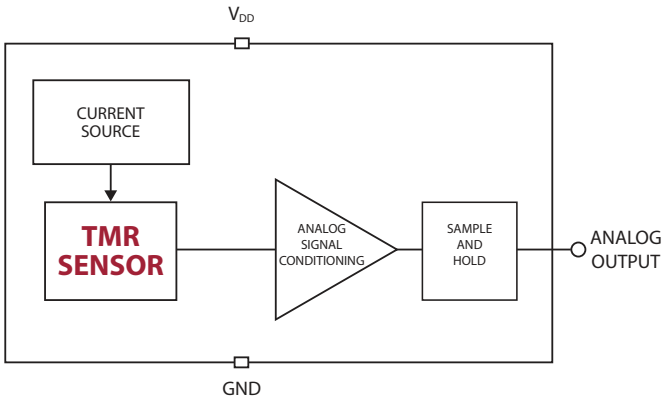
- Proximity Detection
- Rotary Sensing
- Fluid Level Detection
- Door & Lid Closure Detection
- Utility Meters
- Portable Medical Devices
- Consumer Electronics
- IoT Devices

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**
- **Magnetic Polarity Response**: 1 = Omnipolar
- **Magnetic Sensitivity (mV/V/G)**: D: -20; G: -5
- **Operating Frequency (Hz)**: 4: 25; 9: 2,500
- **Temp Rating (°C)**: 2: -40-+85; 3: -40-+125
- **Supply Voltage (V)**: 5: 1.7-5.5
- **Output Response**: 3: Analog
- **Package**: 1: SOT-23-3; 2: LGA-4

4 Specifications

4.1 Absolute Environmental Ratings[1]

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 Ratings[1]

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 Sensors[2]

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 Hysterisis ($V_{UV-HYST}$)	mV		70	

Notes:

1. 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.
2. 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 & RR112-1G43-531/532[1]

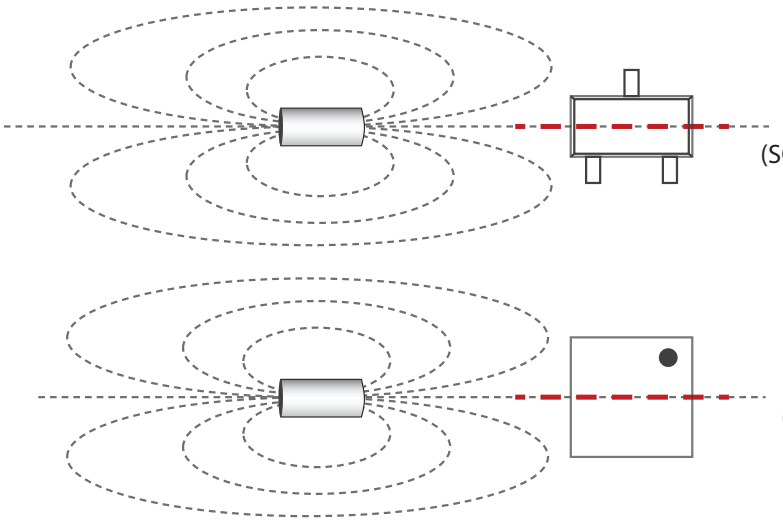
Parameters	Units	Min	Typ	Max
Operating Temperature (T_{OP}) (RR112-1G42-531/532)	°C	-40		+85
Operating Temperature (T_{OP}) (RR112-1G43-531/532)	°C	-40		+125
Average Supply Current ($I_{DD(AVG)}$)[2] @ V_{DD} = 1.7V, f_{OP} = 25 Hz	µA		1.2	
Average Supply Current ($I_{DD(AVG)}$)[2] @ V_{DD} = 3.0V, f_{OP} = 25 Hz	µA		1.5	
Operating Frequency (f_{OP})	Hz	15	25	35
Active Mode Time[3] (t_{ACTIVE})	µs		2.6	
Idle Mode Time[3] (t_{IDLE})	ms	7.1	10	16.6
Maximum Drive Capability ($I_{DRV(MAX)}$) Δ V_{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 (V_{OQ})[2]	%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. Active and idle times are based upon internal sample clock frequency.

5 Magnetic Response

For more information please contact Coto Technology at RedRock@cotorelay.com.

5.1 Axis of Sensitivity



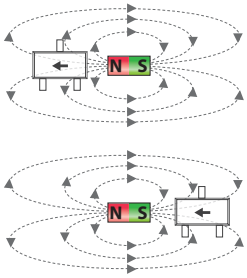
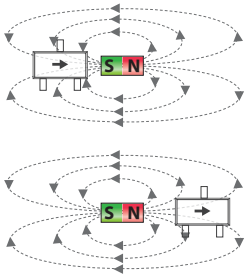
Note: The most straightforward way of aligning a magnet with a TMR sensor is by lining up the magnet's magnetization axis with the sensor's Axis of Sensitivity (as shown in Section 5.1). However, there are many other alignments and orientations that will also achieve proper operation. For any questions, 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"

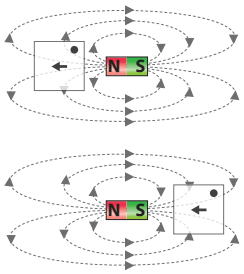
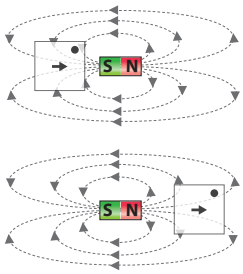
watch our video:
"Replacing Hall Effect Sensors with TMR Sensors – How and Why?"

5 Magnetic Response (cont.)

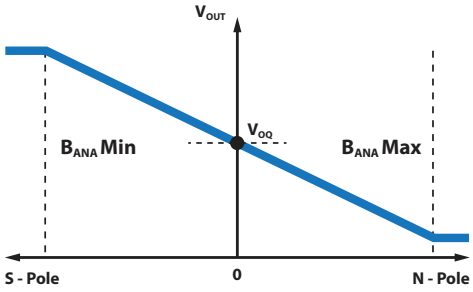
5.2 Magnetic Response Table (SOT-23-3 package)

	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



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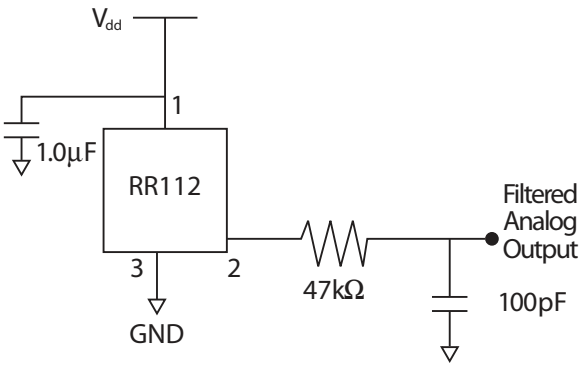
6 Application Information

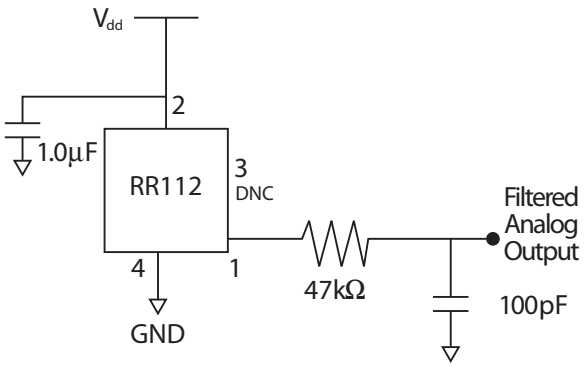
RR112 Output Application Circuit

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 µF 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 47kΩ and a capacitor value of 100 pF should suffice.

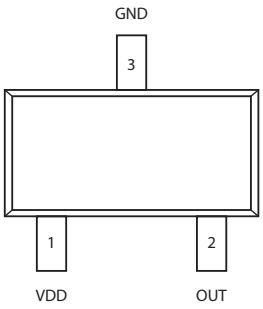
6.1 Application Circuit (SOT-23-3)



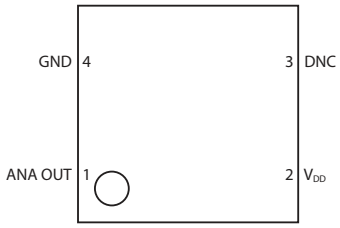
6.2 Application Circuit (LGA-4)



6.3 Package Pinout (SOT-23-3)

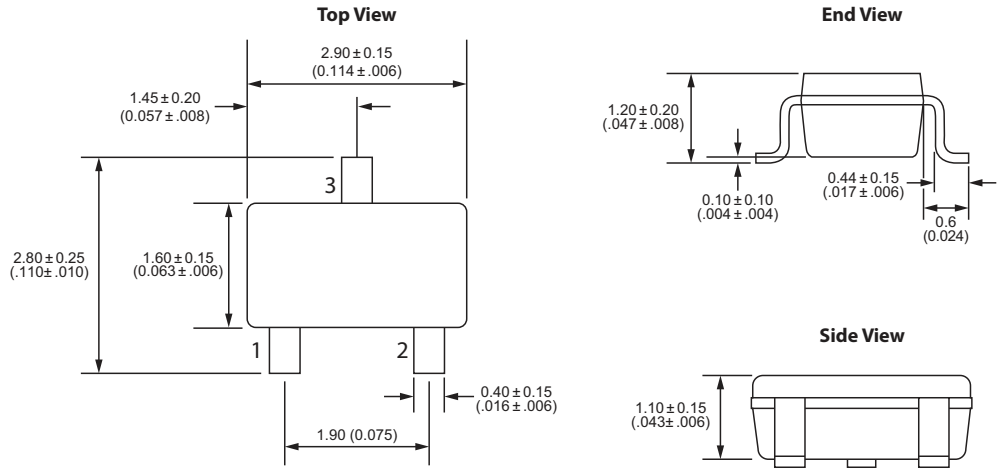


6.4 Package Pinout (LGA-4)



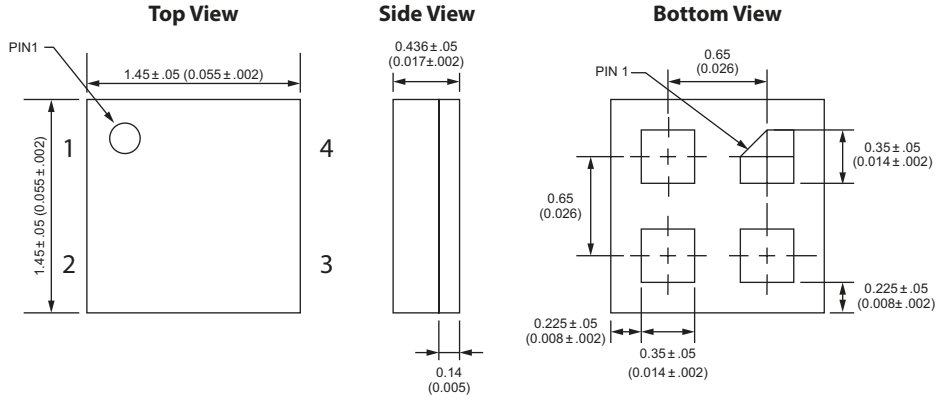
7 Dimensions *Millimeters (Inches)*

7.1 SOT-23-3 Package



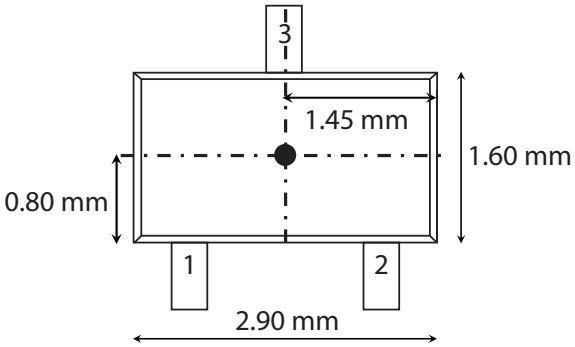
7 Dimensions *Millimeters (Inches)*

7.2 LGA-4 Package

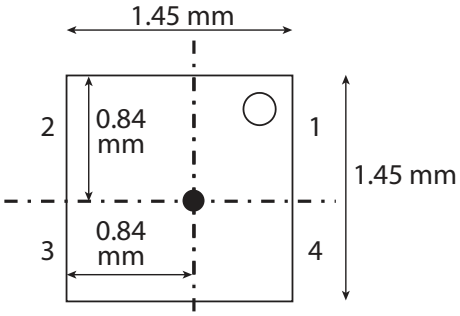


8 TMR Sensor Location

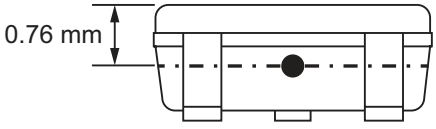
8.1 SOT-23-3 Package



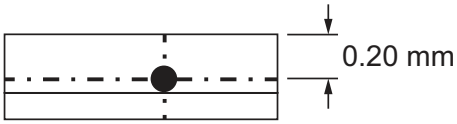
8.2 LGA-4 Package



8.3 SOT Package - Side View



8.4 LGA Package - Side View



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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.

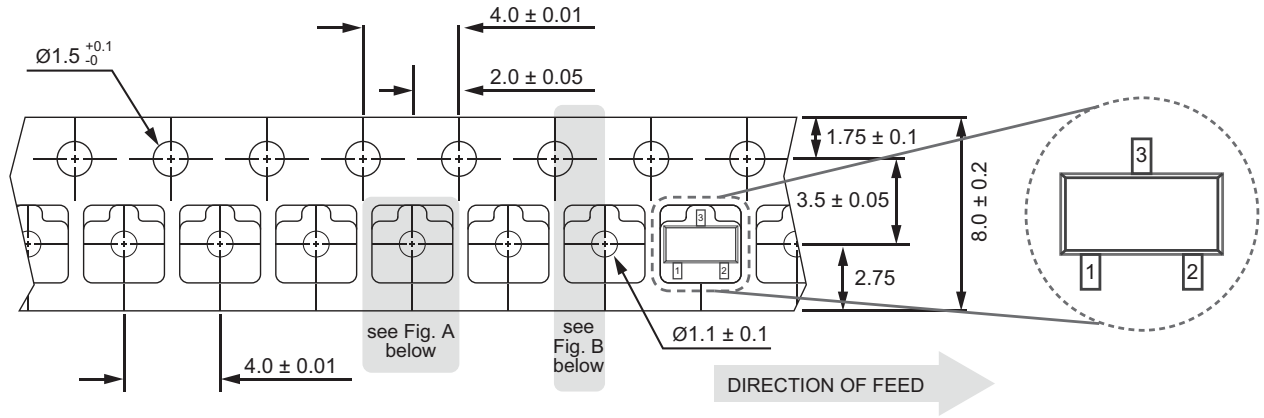


Fig. A

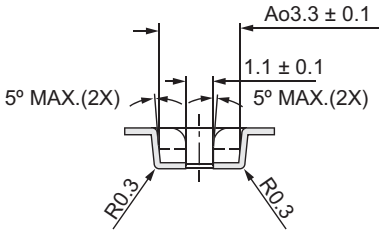
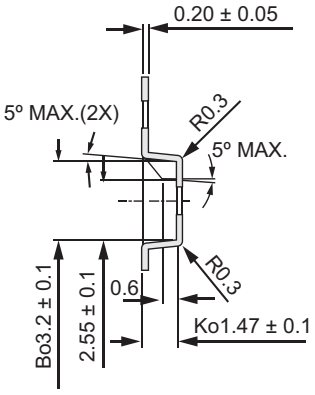
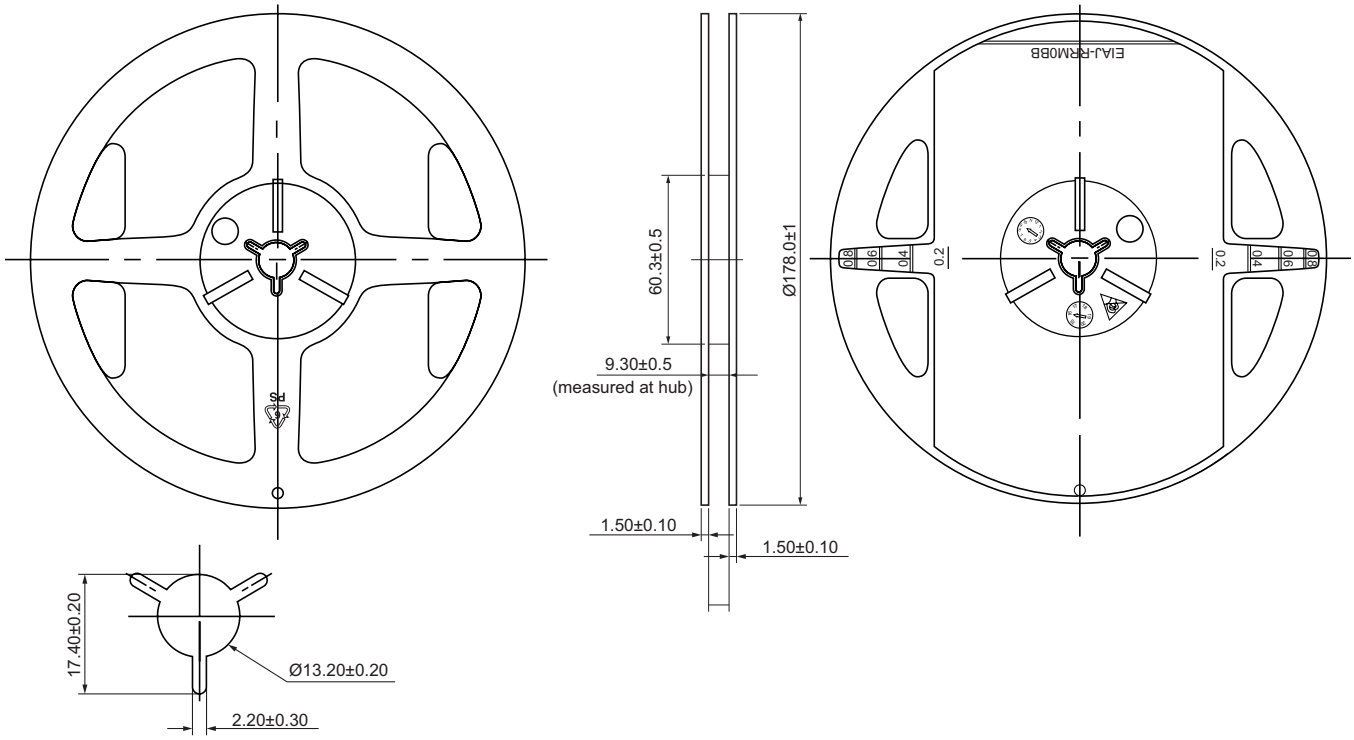


Fig. B





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.

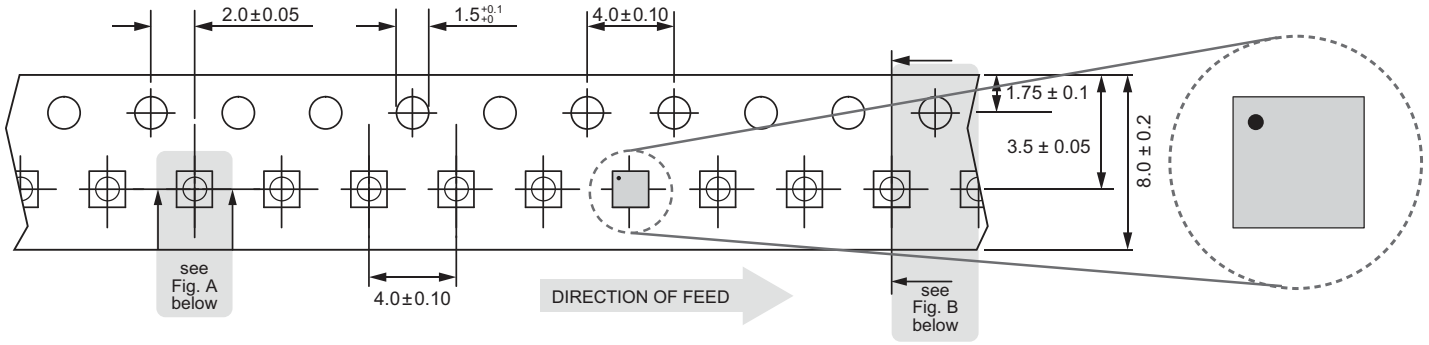


Fig. A

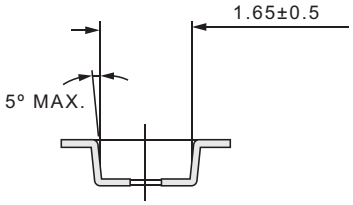
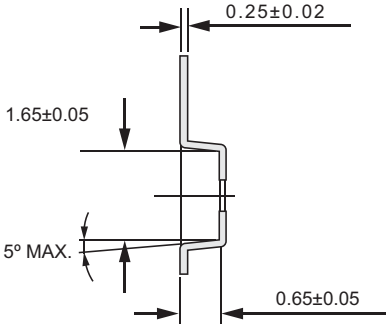
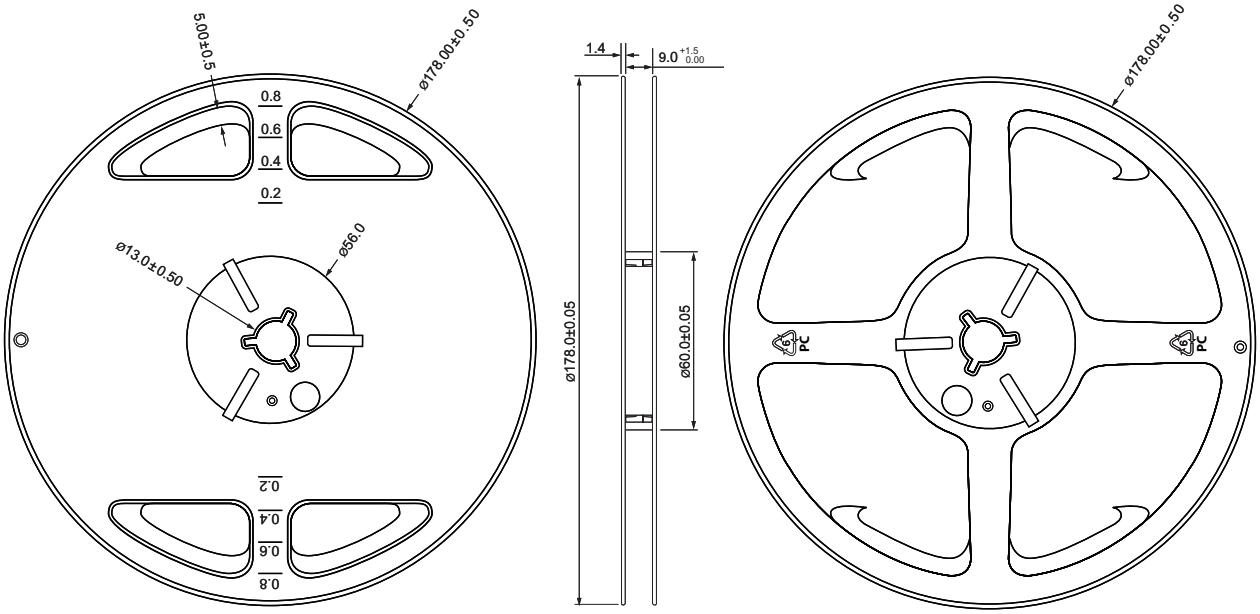


Fig. B





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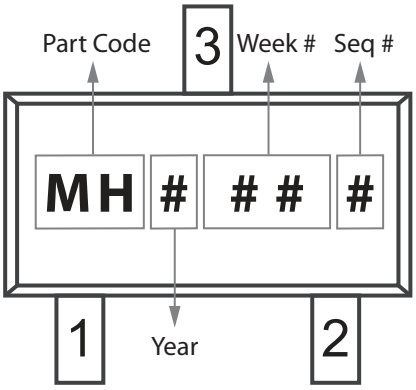
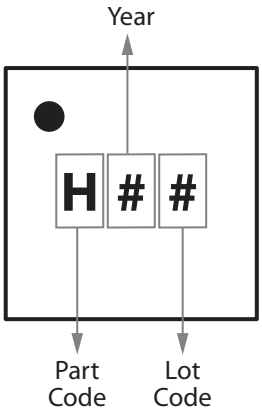
9 TMR Sensor & Switch Packaging

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

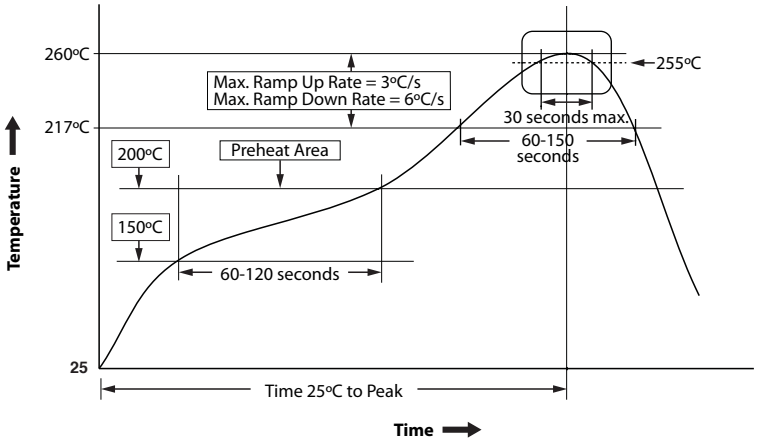
Box Dimensions – 14x10x6 inches
- Fits 1 to 3 reels = 3000 to 9000 pcs
- Weight for 3000 pcs = 0.90 kilos
- Weight for 9000 pcs = 1.00 kilos

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

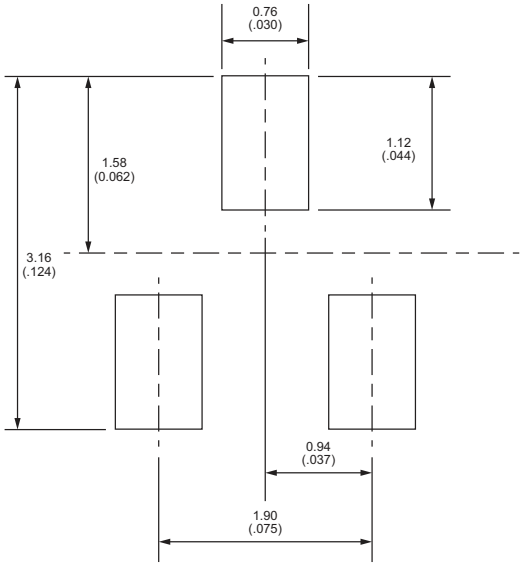
Notes:

1. Fully compatible with standard no-lead solder profile, 260 ºC 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 ºC, 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), Tp shall be within ± 2 °C of the live bug Tp and still meet the Tc 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.

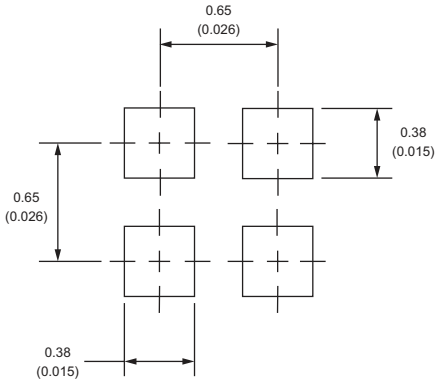


11 Suggested Solder Pad Layout

11.1 SOT-23-3 Solder Pad Layout



11.2 LGA-4 Solder Pad Layout



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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)