

## 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). It is rated to operate across a wide temperature range of -40°C up to 125°C. It offers a wide supply voltage range from 1.7 up to 5.5 V, 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  $\mu$ A
- ▶ Wide Supply Voltage range of 1.7V to 5.5V
- ▶ Linear Analog Voltage Response
- ▶ Operating Frequencies of 100 Hz
- ▶ Temperature Rated up to 125°C
- ▶ 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

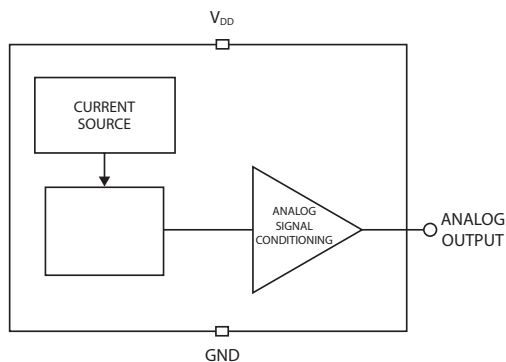
## Device Information

| Part Series           | Package  | Body Size (mm)     | Temp Rating °C |
|-----------------------|----------|--------------------|----------------|
| <b>RR112-1G42-531</b> | SOT-23-3 | 2.9 x 1.6 x 1.2    | -40 to +85     |
| <b>RR112-1G42-532</b> | LGA-4    | 1.45 x 1.45 x 0.44 | -40 to +85     |
| <b>RR112-1G43-531</b> | SOT-23-3 | 2.9 x 1.6 x 1.2    | -40 to +125    |
| <b>RR112-1G43-532</b> | 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               |                           |
|-----------------------------------|---------------------------|
| <b>Series</b>                     | 1: SOT-23-3<br>2: LGA-4   |
| <b>Magnetic Polarity Response</b> | 1 = Omnipolar             |
| <b>Magnetic Sensitivity</b>       | G: -5 mV/V/G              |
| <b>Clock Frequency (Hz)</b>       | 4: 100                    |
| <b>Output Response</b>            | 3: Analog                 |
| <b>Supply Voltage</b>             | 5: 1.7-5.5 V              |
| <b>Temp Rating (°C)</b>           | 2: -40-+85<br>3: -40-+125 |

## 4 Specifications

### 4.1 Absolute Environmental Ratings<sup>1</sup>

| Parameters  | Units | Min   | Typ | Max                   |
|---|-------|-------|-----|-----------------------|
| Operating Temperature (T <sub>OP</sub> ) (RR112-1G42-531/532) | °C    | -40   |     | +85                   |
| Operating Temperature (T <sub>OP</sub> ) (RR112-1G43-531/532) | °C    | -40   |     | +125                  |
| Input/Output Pins Maximum Voltage (V <sub>I/O</sub> )         | V     | -0.3  |     | V <sub>DD</sub> + 0.3 |
| Storage Temperature (T <sub>STG</sub> )                       | °C    | -65   |     | +150                  |
| Junction Temperature (T <sub>J</sub> )                        | °C    | -40   |     | +150                  |
| Soldering Temperature (3 cycles, 1 min.) (T <sub>SOL</sub> )  | °C    |       |     | +260                  |
| ESD Level Human Body Model 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 <sub>MAX</sub> )           | G     |       |     | ±2000                 |

### 4.2 Absolute Electrical Ratings<sup>1</sup>

| Parameters  | Units | Min  | Typ | Max |
|---|-------|------|-----|-----|
| Supply Voltage (V <sub>DD</sub> )                             | V     | -0.3 |     | 6.0 |
| Input and Output Current (I <sub>IN</sub> /I <sub>OUT</sub> ) | mA    |      |     | ±20 |

### 4.3 Operating Electrical Characteristics for all RR112 Series Sensors<sup>2</sup>

| Parameters  | Units | Min  | Typ  | Max             |
|---|-------|------|------|-----------------|
| Supply Voltage (V <sub>DD</sub> )   | V     | 1.7  | 3.0  | 5.5             |
| OUT Voltage Range   | V     | 0.0  |      | V <sub>DD</sub> |
| Power-On Time (t <sub>ON</sub> )(V <sub>DD</sub> > 1.7V)                          | µs    |      | 50   | 75              |
| Active Mode Time (t <sub>ACTIVE</sub> )   | µs    |      | 2.6  |                 |
| Under Voltage Lockout Threshold Rising V <sub>DD</sub> (V <sub>UVLO-RISE</sub> )  | V     |      | 1.60 | 1.64            |
| Under Voltage Lockout Threshold Falling V <sub>DD</sub> (V <sub>UVLO-FALL</sub> ) | V     | 1.44 | 1.53 |                 |
| Under Voltage Lockout Hysteresis (V <sub>UV-HYST</sub> )                          | 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<sub>DD</sub> = 1.7 V to 5.5 V, T<sub>A</sub> = -40°C to +85°C (1G42), -40°C to +125°C (1G43). Typical values are V<sub>DD</sub> = 3.0 V and T<sub>A</sub> = +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<sup>1</sup>

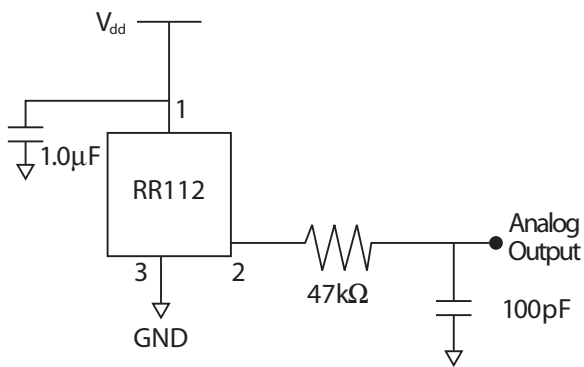
| Parameters   | Units            | Min                   | Typ | Max                   |
|--|------------------|-----------------------|-----|-----------------------|
| Operating Temperature (T <sub>OP</sub> ) (RR112-1G42-531/532)              | °C               | -40                   |     | +85                   |
| Operating Temperature (T <sub>OP</sub> ) (RR112-1G43-531/532)              | °C               | -40                   |     | +125                  |
| Average Supply Current @ 3.0V (I <sub>DD(AVG)</sub> ) <sup>2</sup>         | μA               |                       | 1.5 |                       |
| Average Supply Current @ 1.7V (I <sub>DD(AVG)</sub> ) <sup>2</sup>         | μA               |                       | 1.2 |                       |
| Sampling Frequency (f <sub>s</sub> )                                       | Hz               | 70                    | 100 | 130                   |
| Idle Mode Time (t <sub>idle</sub> ), f <sub>s</sub> = 100Hz                | ms               |                       | 10  |                       |
| Maximum Drive Capability (I <sub>DRV(MAX)</sub> ) ΔV <sub>OUT</sub> ≤ 10mV | μA               | -10                   |     | 10                    |
| Output Capacitive Load (C <sub>L</sub> )                                   | pF               |                       |     | 10                    |
| Magnetic Field Range (B <sub>ANA</sub> )                                   | G                | ±54                   | ±80 | ±100                  |
| Analog Output Voltage Range (V <sub>ANA</sub> )                            | V                | 0.1 x V <sub>DD</sub> |     | 0.9 x V <sub>DD</sub> |
| Voltage Output Quiescent (V <sub>OQ</sub> ) <sup>2</sup>                   | %V <sub>DD</sub> | 45                    | 50  | 55                    |
| Sensitivity @ T = +25°C  | mV/V/G           | -3.5                  | -5  | -6.5                  |
| Sensitivity @ Full Temperature Range (S <sub>FULL_RANGE</sub> )            | mV/V/G           |                       | -5  |                       |

#### Notes:

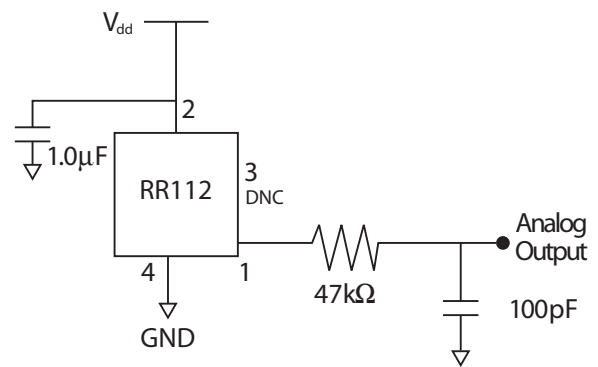
1. Unless otherwise specified, V<sub>DD</sub> = 1.7 V to 5.5 V, T<sub>A</sub> = -40°C to +85°C (1G42), -40°C to +125°C (1G43). Typical values are V<sub>DD</sub> = 3.0 V and T<sub>A</sub> = +25°C.
2. Conditions: t = 10 seconds

## 5 Application Information

### 5.1 Application Circuit (SOT-23-3)



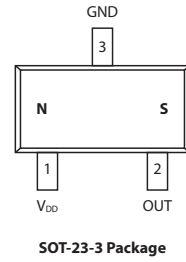
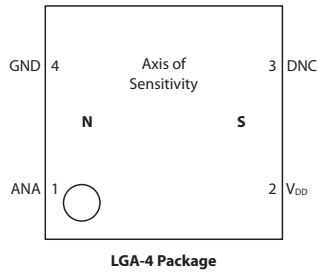
### 5.2 Application Circuit (LGA-4)



#### RR112 Output Application Circuit

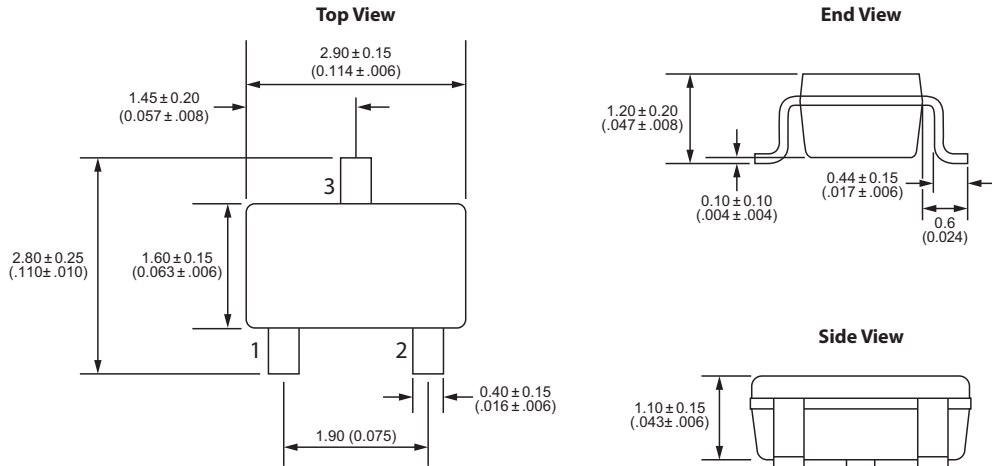
The output voltage can be connected to an analog I/O pin on a microcontroller. A decoupling capacitor between the supply voltage and ground is required with placement close to the magnetic sensor. A typical capacitor value of 1.0 μF will suffice. The analog output voltage is proportional to the strength 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 Axis of Sensitivity (Top View)

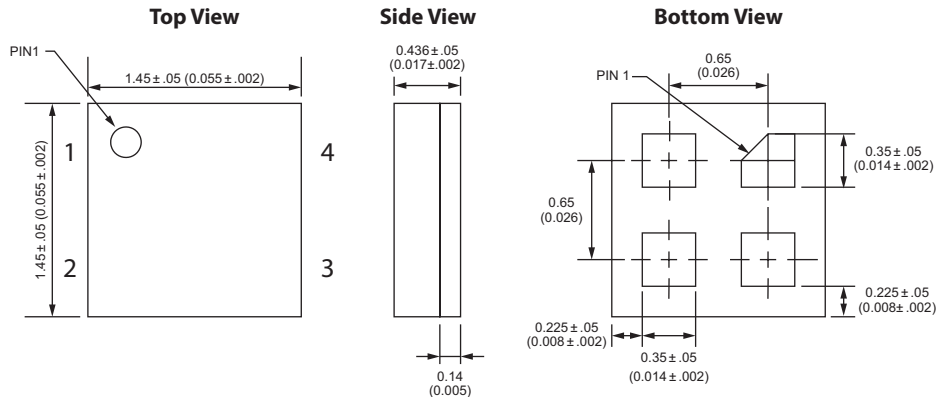


### 7 Dimensions Millimeters (Inches)

#### 7.1 SOT-23-3 Package

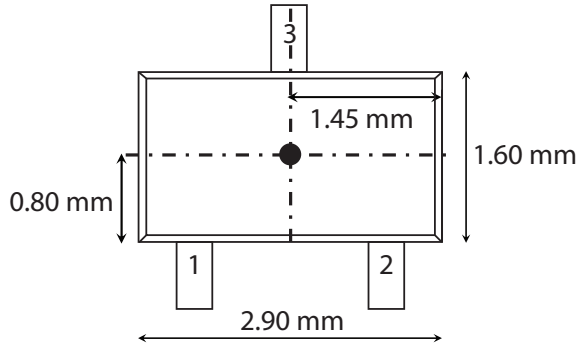


#### 7.2 LGA-4 Package

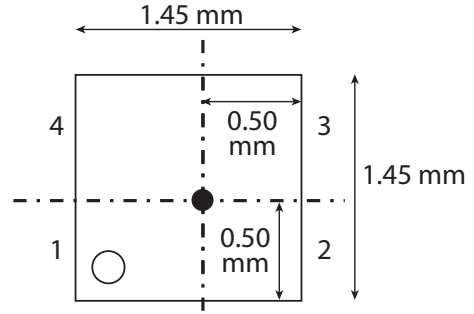


## 8 TMR Sensor Location

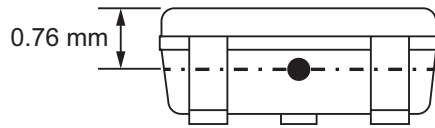
8.1 SOT-23-3 Package



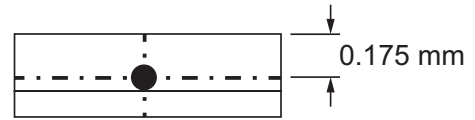
8.2 LGA-4 Package



8.3 SOT Package - Side View

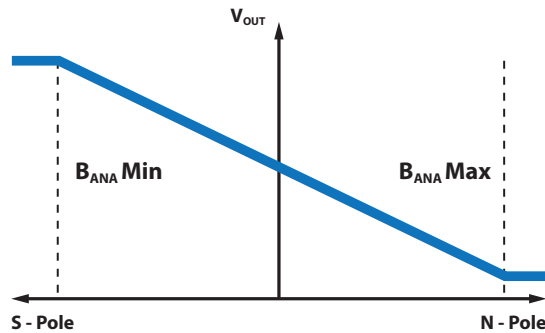


8.4 LGA Package - Side View

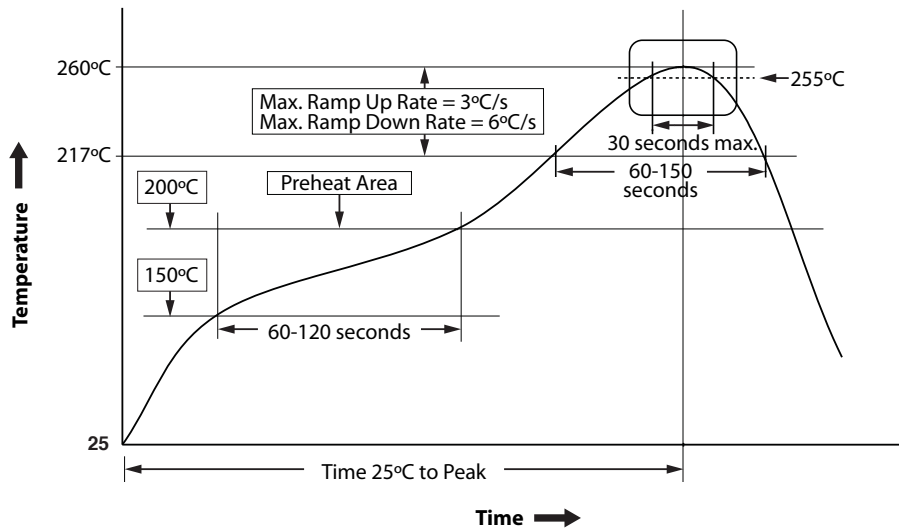


## 9 Magnetic Flux Response Diagram

Analog Magnetic Flux Response



## 10 Suggested Pb-Free Reflow Profile

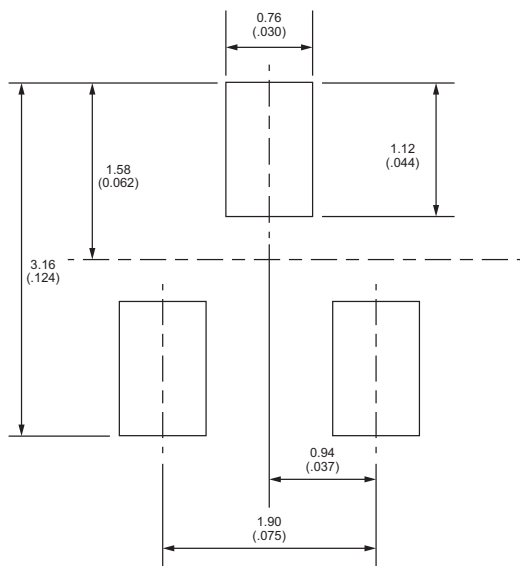


### Notes:

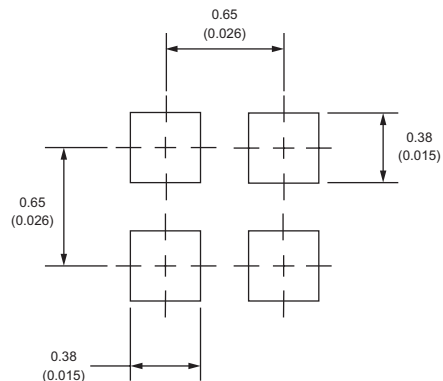
1. Fully compatible with standard no-lead solder profile, 260 °C for 1 minute max (3 cycles max).
2. Profile shown as example. Users are advised to develop their own board-level profile.
3. Suggested Pb-free reflow profile derived from IPC/JEDEC J-STD-020E.
4. Temperature tolerance: +0 °C, as measured 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  $\pm 2$  °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 TMR Sensor & Switch Packaging

### 12.1 SOT-23-3 Tape & Reel Packaging

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

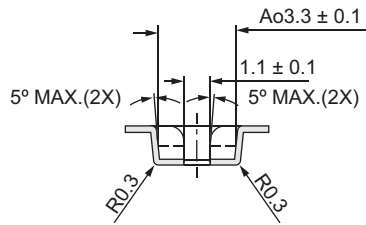
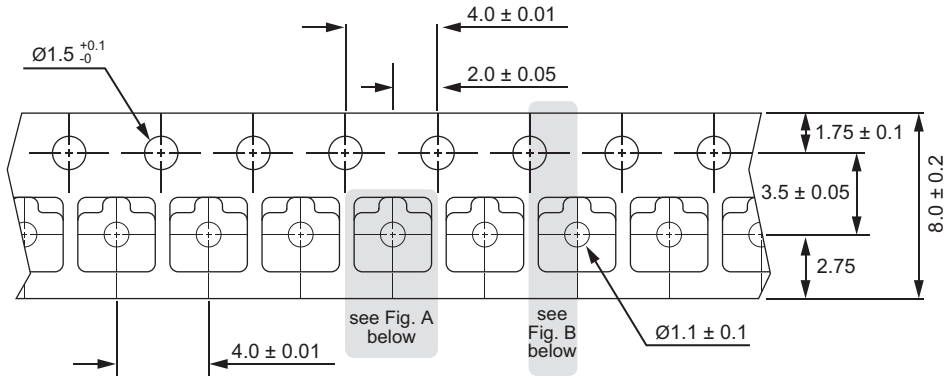


Fig. A

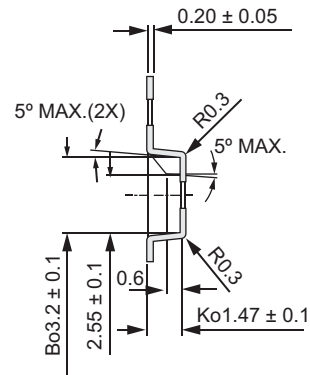
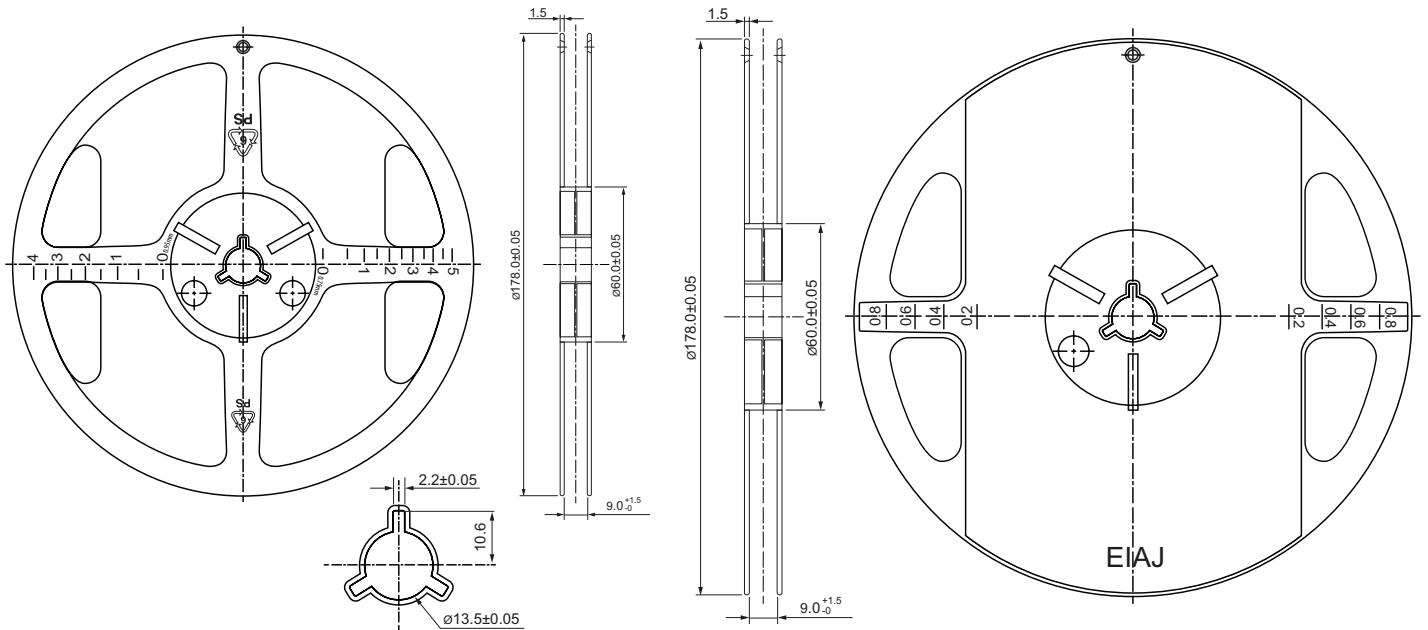


Fig. B







## 12 TMR Sensor & Switch Packaging

### 12.3 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

## 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)                    |
|   |            |  |