

1 Description

The RedRock™ RR111 Series is a magnetic sensor with a continuous analog output linearly proportional to an applied magnetic field. Ideal for use in medical, industrial, automotive, and consumer applications, they are based on patented Tunneling Magnetoresistance (TMR) technology with seamless CMOS integration. The RR111 enables applications like proximity sensing, and continuous level detection.

The RR111 features a low average current drain (1.6 mA) for a continuously active magnetic sensor and temperature range from -40°C up to 85°C. It comes in an SOT-23-3 package measuring 2.9 x 1.6 x 1.2 mm as well as an LGA-4 package measuring just 1.4 x 1.4 x 0.45 mm.

Device Information

| Part Series | Package | Body Size (mm) |
|-------------|----------|------------------|
| RR111 | SOT-23-3 | 2.9 x 1.6 x 1.2 |
| | LGA-4 | 1.4 x 1.4 x 0.45 |

Device Packages



Please note: This Product Series is approaching end of life and is NOT recommended for new designs.

For new designs, please consult the [end of life announcement](#) which specifies recommended new RedRock series replacements.

Functional Block Diagram

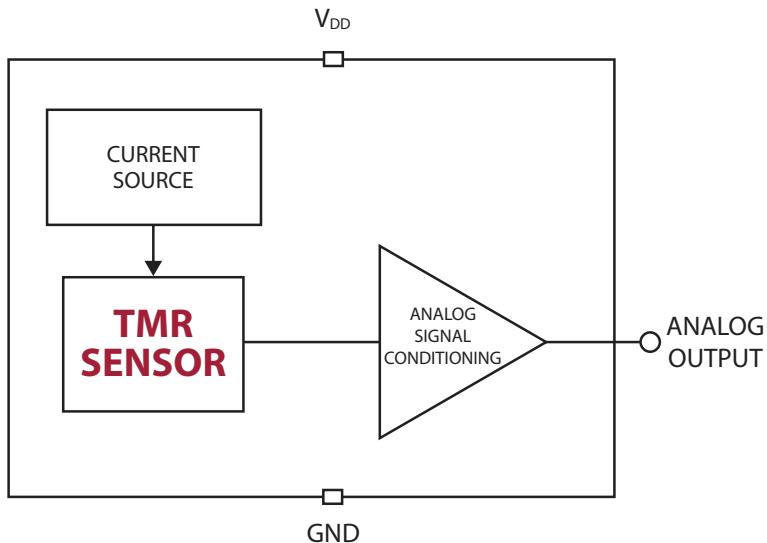


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4 Specifications

4.1 Absolute Environmental Ratings

| Parameters | Units | Min | Typ | Max |
|---|-------|-----|-----|------|
| Operating Temperature | °C | -40 | | 85 |
| Storage Temperature | °C | -55 | | 150 |
| Maximum Junction Temperature | °C | | | 150 |
| Soldering Temperature (3 cycles, 1 min.) | °C | | | 260 |
| ESD Level (HBM) | V | | | 4000 |
| Junction-to-Ambient Thermal Resistance (LGA-4) | °C/W | | 165 | |
| Junction-to-Ambient Thermal Resistance (SOT-23-3) | °C/W | | 215 | |
| Magnetic Field Exposure | G | | | 2000 |

4.2 Absolute Electrical Ratings¹

| Parameters | Units | Min | Typ | Max |
|---|-------|------|-----|------|
| Supply Voltage (V_{DD}) | V | -0.3 | | +4.0 |
| Input and Output Current (I_{IN}/I_{OUT}) | mA | -10 | | +10 |

4.3 Operating Electrical Characteristics¹

| Parameters | Units | Min | Typ | Max |
|---|-------|-------|-------|-------|
| Supply Voltage (V_{DD}) | V | +2.7 | +3.0 | +3.6 |
| Power-On Time (t_{ON}) ($V_{DD} > 2.7V$) | μs | | 500 | |
| Under-Voltage Lockout Threshold Rising V_{DD} (V_{UVLO_RISE}) | V | | +2.20 | +2.60 |
| Under-Voltage Lockout Threshold Falling V_{DD} (V_{UVLO_FALL}) | V | +1.90 | +2.15 | |
| Under-Voltage Lockout Hysteresis (V_{UV_HYST}) | mV | | +50 | |

Notes:

- Unless otherwise specified, all characteristics are measured at 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.

4.4 Operating Characteristics¹

| Parameters | Units | Min | Typ | Max |
|--|------------|-----------------|-----|-----------------|
| Operating Temperature (T_A) | °C | -40 | | +85 |
| Average Supply Current ($I_{DD(AVG)}$)($t = 10s$) | mA | | 1.5 | 2.7 |
| Maximum Drive Capability ($I_{DRV(MAX)}$) (V_{ANA} covers 20% V_{DD} to 80% V_{DD} span) | µA | -10 | | +10 |
| Output Capacitive Load (C_L) | pF | | | 10 |
| Analog Output Magnetic Field Range (B_{ANA}) | G | -10 | | +10 |
| Analog Output Voltage Range (V_{ANA}) | V | 0.19 x V_{DD} | | 0.81 x V_{DD} |
| Voltage Output Quiescent (V_{OQ}) ² | % V_{DD} | 45 | 50 | 55 |
| Sensitivity @ $T = +25^\circ\text{C}$ ($T_A = +25^\circ\text{C}$) | mV/V/G | -17.6 | -20 | -22.4 |
| Sensitivity @ Full Temperature Range (S_{FULL_RANGE}) ($T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$) | mV/V/G | -14 | -20 | -26 |

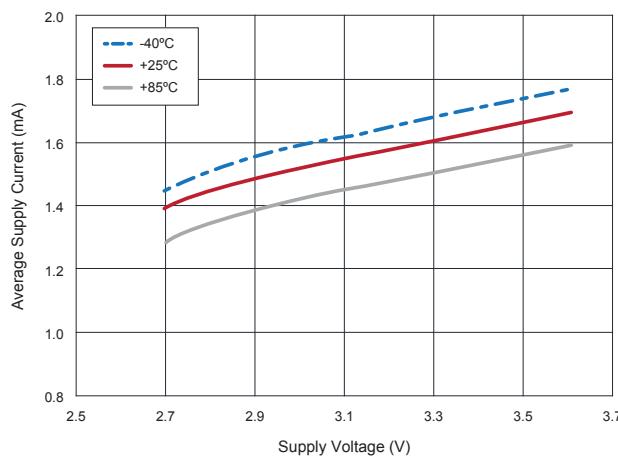
Notes:

1. Unless otherwise specified, all characteristics are measured at 25°C
2. No magnetic field present.

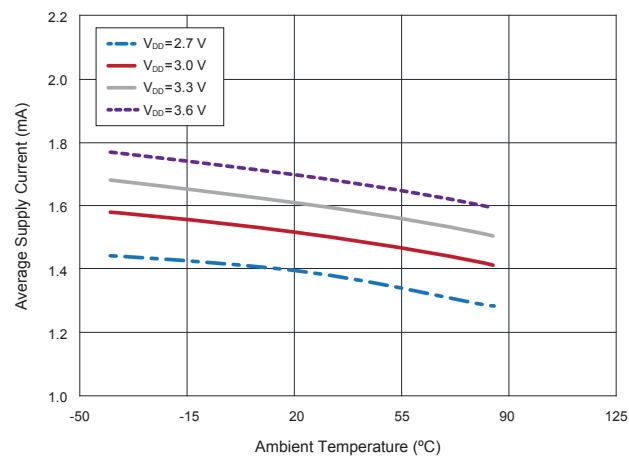
5 Typical Characteristics Graphs for RR111-1DC2-331 & RR111-1DC2-332

$V_{DD} = 3.0\text{ V}$ and $T_A = +25^\circ\text{C}$, $C_{DD} = 1.0\text{ }\mu\text{F}$ (unless otherwise specified)

**5.1 Average Supply Current vs.
Supply Voltage vs. Temperature**



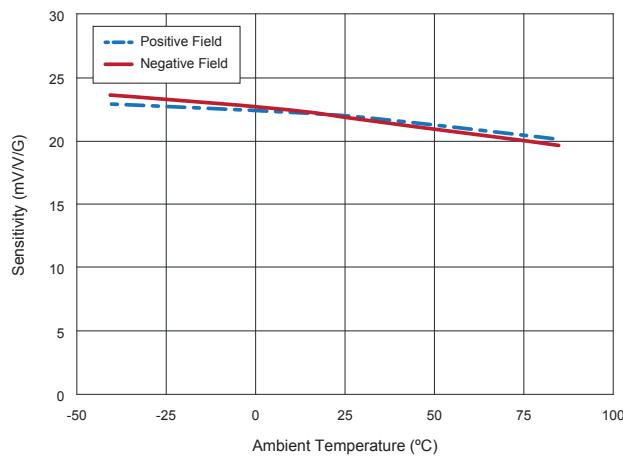
**5.2 Average Supply Current vs.
Temperature vs. Supply Voltage**



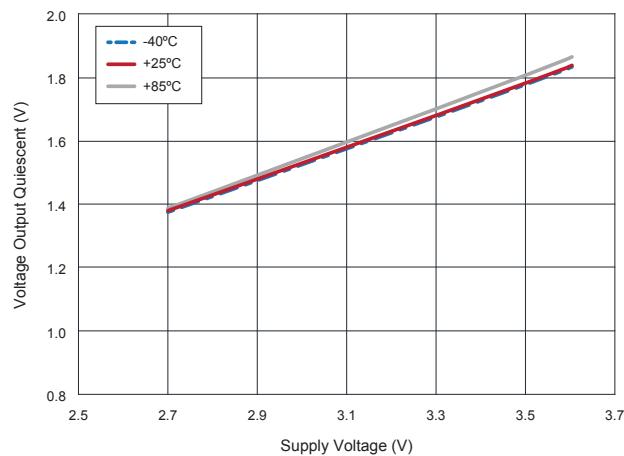
6 Typical Magnetic Characteristics Graphs for RR111-1DC2-331 & RR111-1DC2-332

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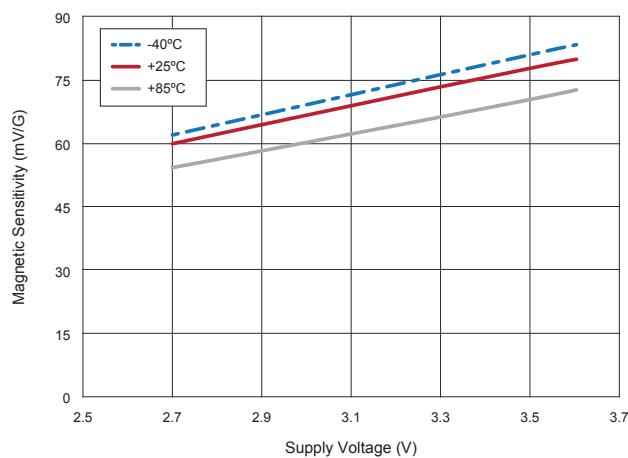
6.1 Magnetic Sensitivity vs. Temperature for Positive and Negative Fields



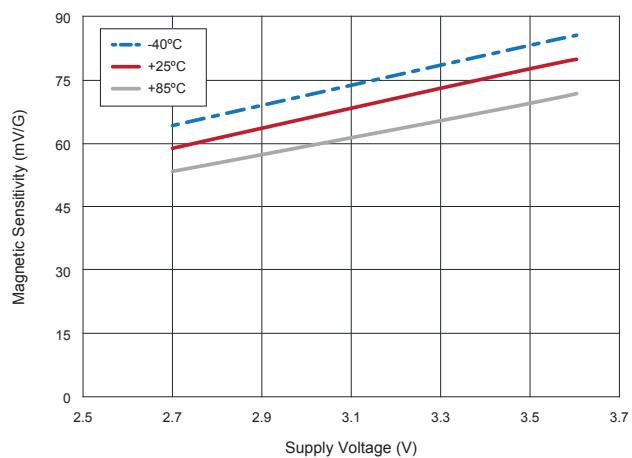
6.2 Voltage Output Quiescent (V_{OQ}) vs. Supply Voltage vs. Temperature



6.3 Magnetic Sensitivity vs. Supply Voltage vs. Temperature for Positive Field

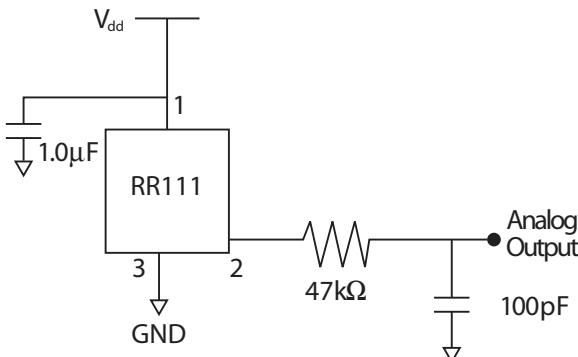


6.4 Magnetic Sensitivity vs. Supply Voltage vs. Temperature for Negative Field

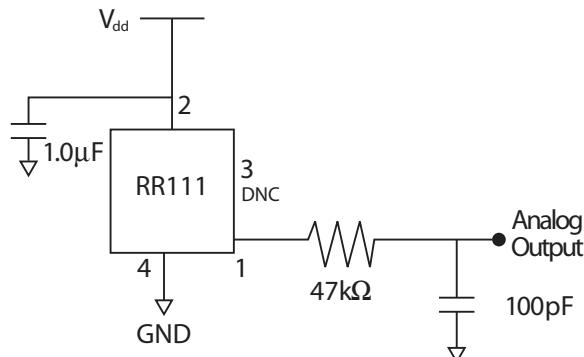


7 Application Information

7.1 Application Circuit (SOT-23-3)



7.2 Application Circuit (LGA-4)



RR111 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.

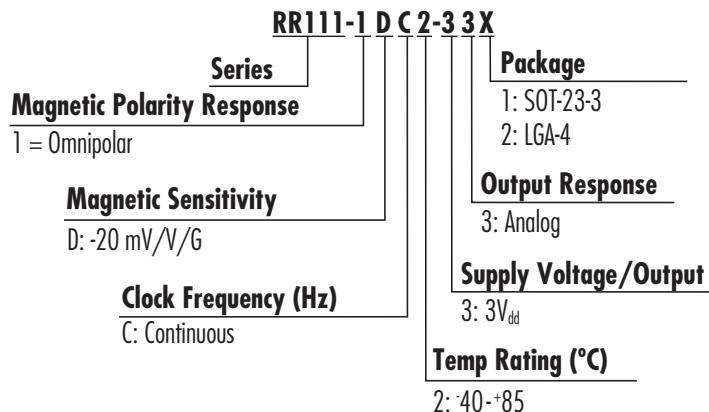
8 Part Selection and Ordering Information

8.1 Part Selection Table

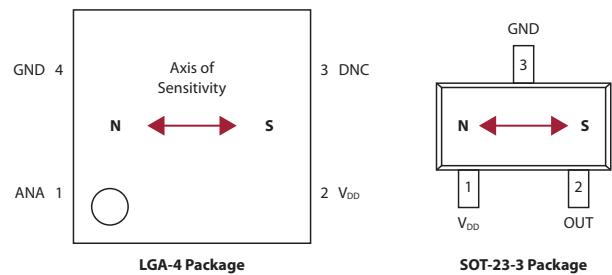
| Part Number | Magnetic Polarity Response | Frequency (Hz) | I_{avg} (mA) | Temp. Rating ($^{\circ}$ C) | Supply Voltage (V_{dd}) | Output Response | Package |
|----------------|----------------------------|----------------|----------------|------------------------------|-----------------------------|-----------------|----------|
| RR111-1DC2-331 | Omnipolar | Continuous | 1.5 | -40 - +85 | 3 | Analog | SOT-23-3 |
| RR111-1DC2-332 | Omnipolar | Continuous | 1.5 | -40 - +85 | 3 | Analog | LGA-4 |

8.2 Device Nomenclature

Ordering Information

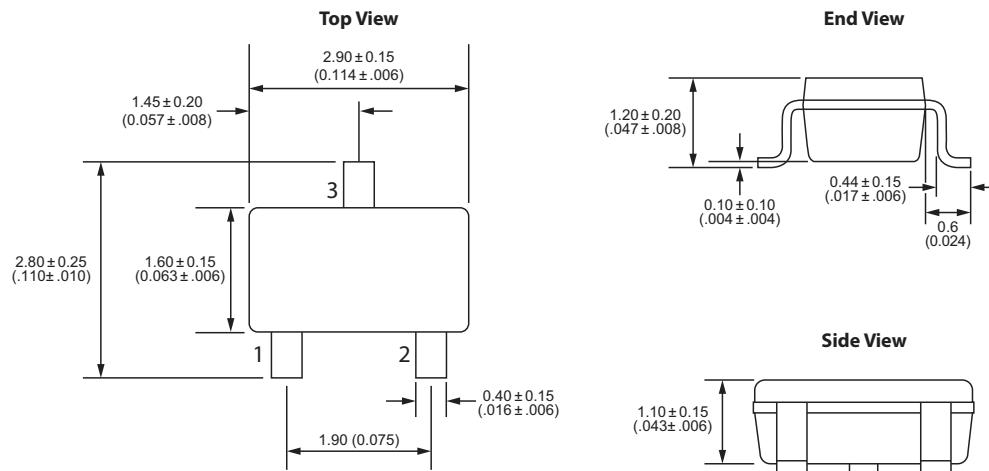


9 Axis of Sensitivity (*Top View*)

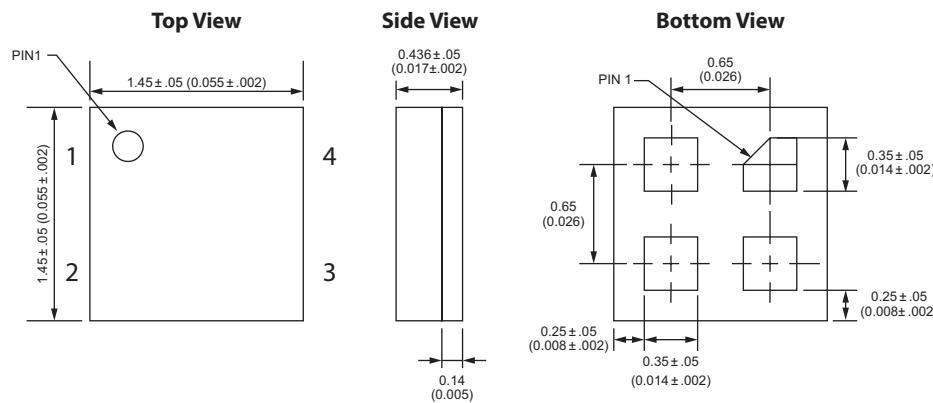


10 Dimensions Millimeters (Inches)

10.1 SOT-23-3 Package

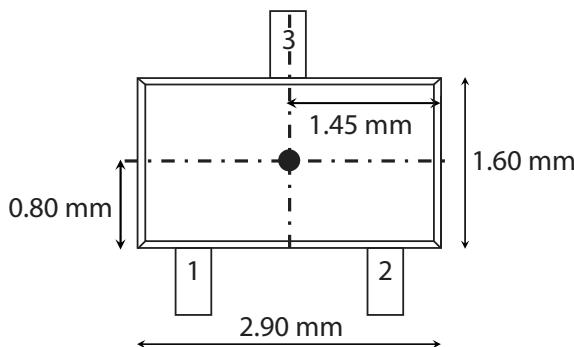


10.2 LGA-4 Package

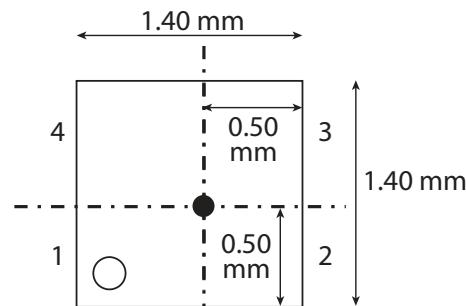


11 TMR Sensor Location

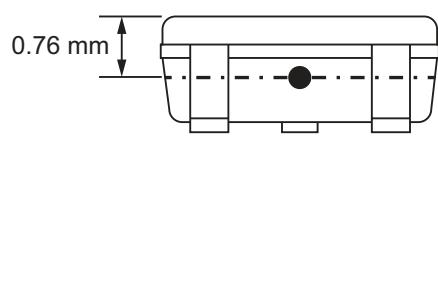
11.1 SOT-23-3 Package



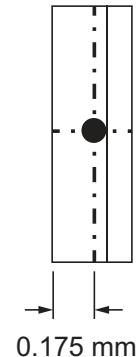
11.2 LGA-4 Package



11.3 SOT Package - Side View

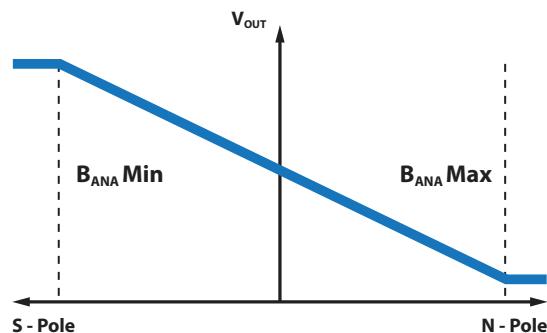


11.4 LGA Package - Side View

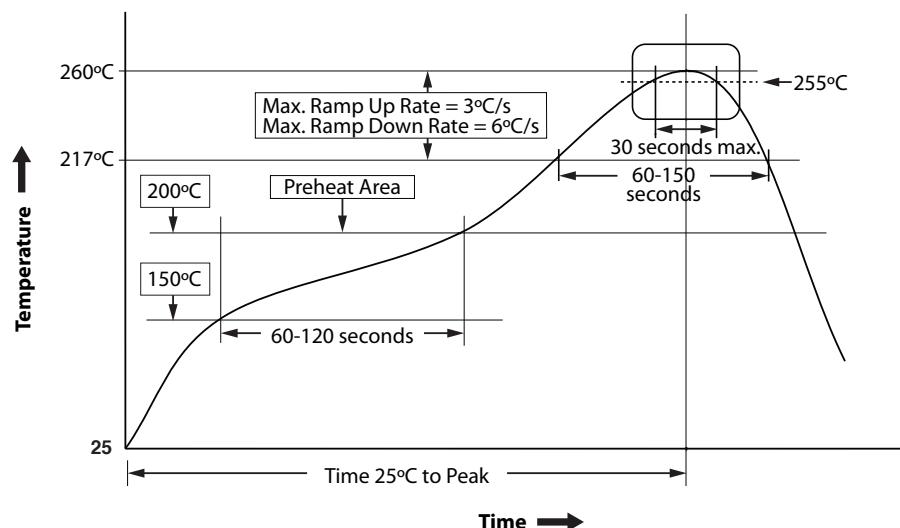


12 Magnetic Flux Response Diagram

Analog Magnetic Flux Response



13 Suggested Pb-Free Reflow Profile

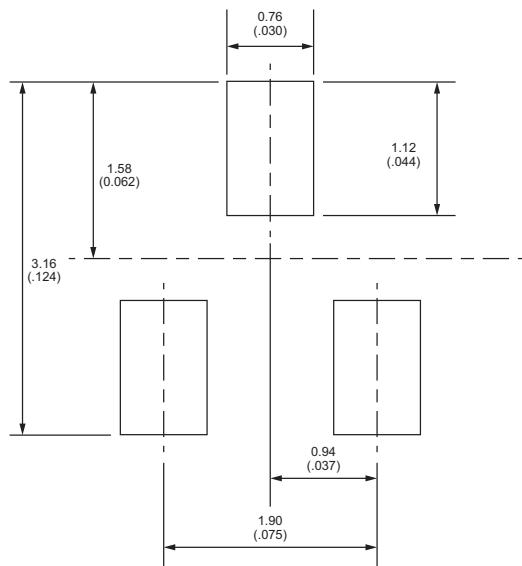


Notes:

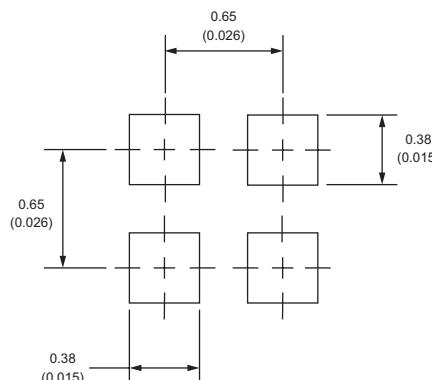
1. Fully compatible with standard no-lead solder profile, 260 °C for 1 minute max (3 cycles max).
2. Profile shown as example. Users are advised to develop their own board-level profile.
3. Suggested Pb-free reflow profile derived from IPC/JEDEC J-STD-020E.
4. Temperature tolerance: +0 °C, as measured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

14 Suggested Solder Pad Layout

14.1 SOT-23-3 Solder Pad Layout



14.2 LGA-4 Solder Pad Layout



15 TMR Sensor & Switch Packaging

15.1 SOT-23-3 Tape & Reel Packaging

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

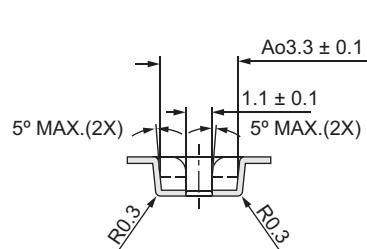
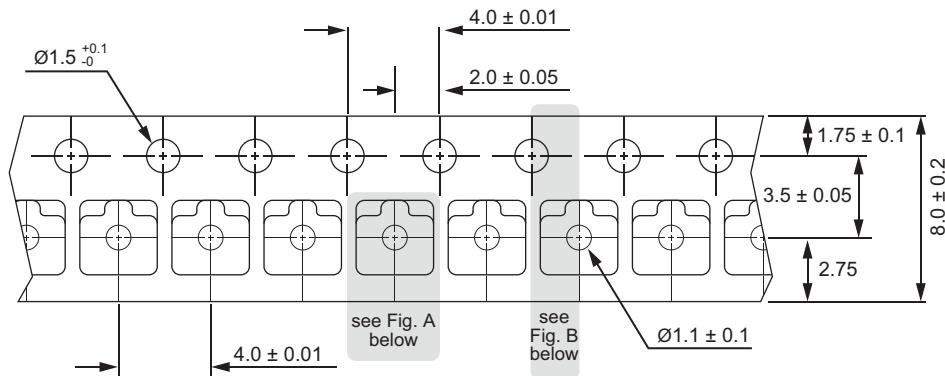


Fig. A

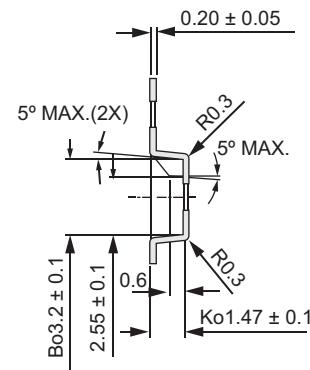
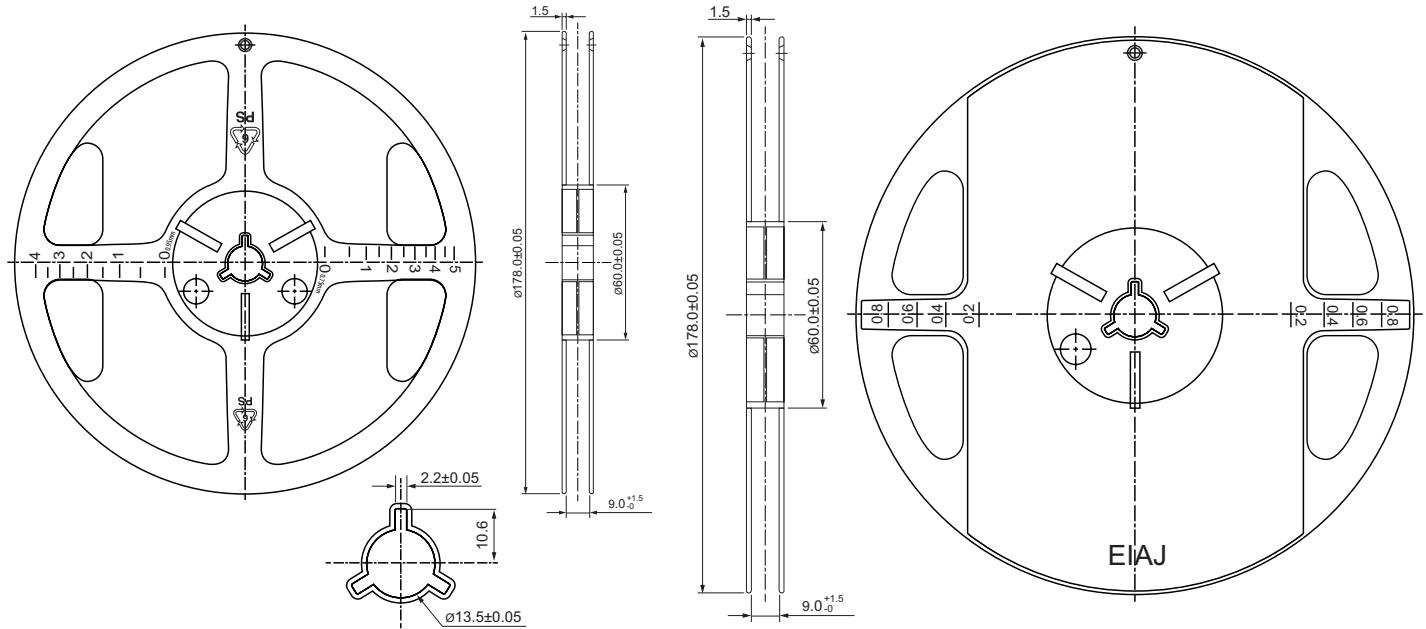


Fig. B



15 TMR Sensor & Switch Packaging

15.2 LGA-4 Tape & Reel Packaging

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

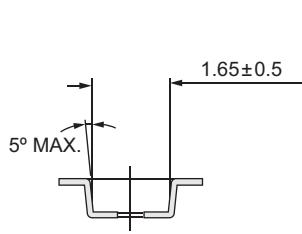
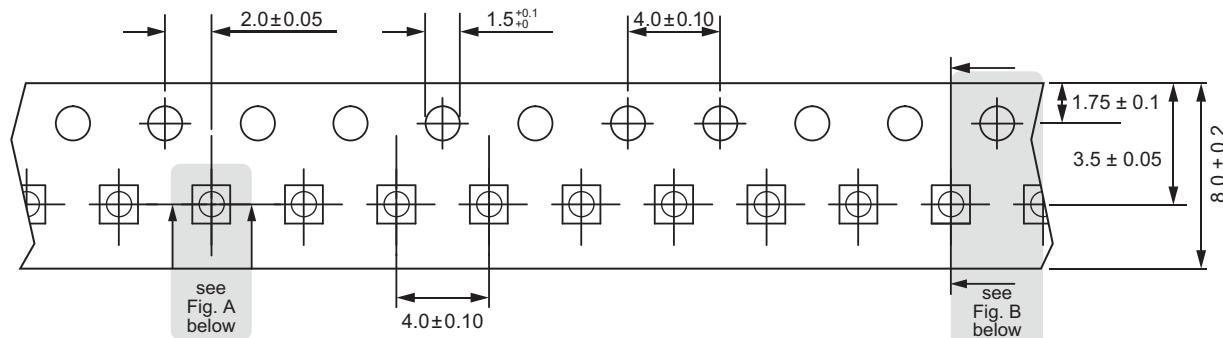


Fig. A

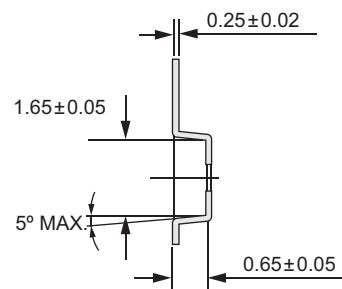
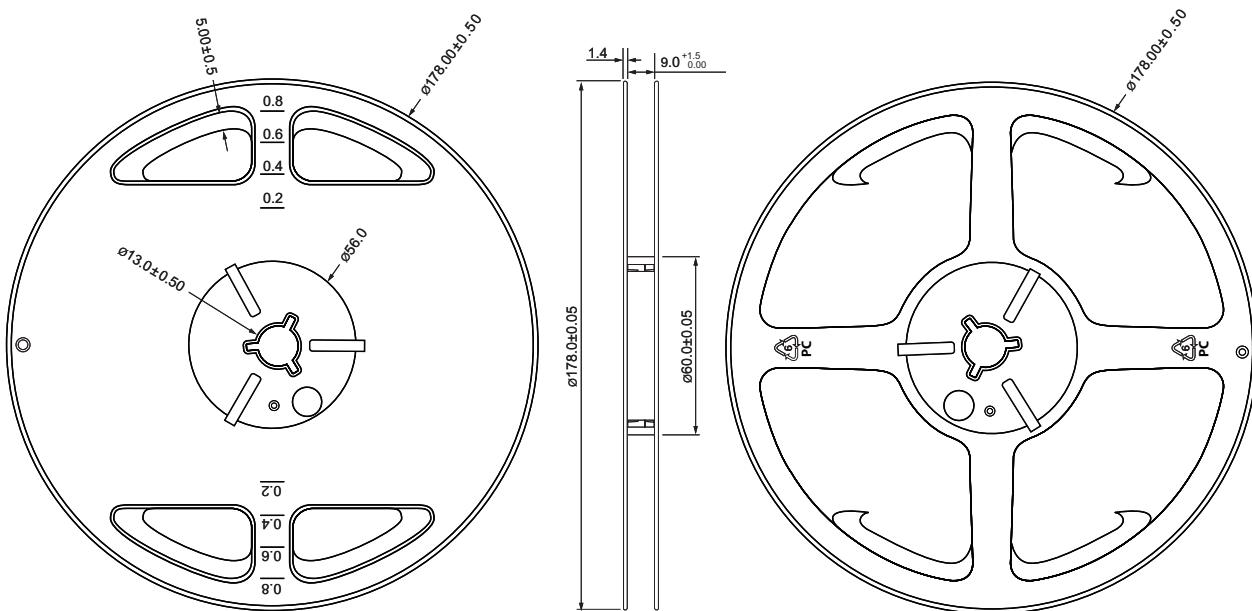


Fig. B



15 TMR Sensor & Switch Packaging

15.3 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