

## 1 Description

The RedRock® RR122-3C62-511 and RR122-3C63-511 digital magnetic sensors are ideal for use in medical, industrial, automotive, and consumer applications. They are based on patented Tunneling Magneto-resistance (TMR) technology with seamless CMOS integration.

The RR122-3C62-511 and RR122-3C63-511 feature an operate sensitivity of 10 G (1.0 mT) with a bipolar magnetic field response. They offer a wide supply voltage range from 1.7V up to 5.5V, ideal for applications ranging from small battery-powered electronics to industrial machinery. They have a low average current drain (1.7  $\mu$ A) for an active magnetic sensor, operating at 500 Hz and high operating temperature range from -40°C up to 125°C.

## Device Information

| Part Series           | Package  | Body Size (mm)  | Temp Rating °C |
|-----------------------|----------|-----------------|----------------|
| <b>RR122-3C62-511</b> | SOT-23-3 | 2.9 x 1.6 x 1.2 | -40 to +85     |
| <b>RR122-3C63-511</b> | SOT-23-3 | 2.9 x 1.6 x 1.2 | -40 to +125    |

## Device Package



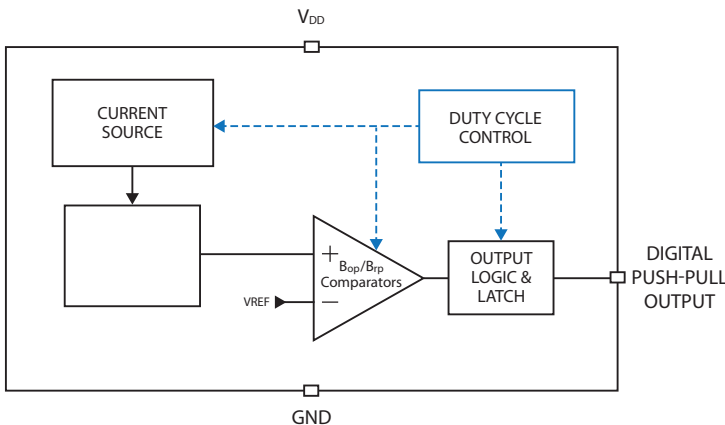
## 2 Features

- ▶ Operate sensitivity of 10 G
- ▶ Lowest Average Current < 1.7  $\mu$ A
- ▶ Wide Supply Voltage Range of 1.7V - 5.5V
- ▶ Bipolar Latching Push-Pull Response
- ▶ Operating Frequency of 500 Hz
- ▶ Temperature Rated up to 125°C
- ▶ RoHS & REACH Compliant

## 3 Applications

- ▶ Proximity Detection
- ▶ Linear Position Sensing
- ▶ Rotary Sensing
- ▶ Fluid Level Detection
- ▶ Door & Lid Closure Detection
- ▶ Utility Meters
- ▶ Portable Medical Devices
- ▶ Motor Controllers
- ▶ Consumer Electronics

**Functional Block Diagram for Digital Push-Pull Output**



## Device Nomenclature

### Ordering Information

| RR122-XXX-YYY                   |                   | Package                   |
|---------------------------------|-------------------|---------------------------|
| Series                          |                   | 1: SOT-23-3               |
| Magnetic Polarity Response      |                   | 2: LGA-4                  |
| 1 = Omnipolar                   | 3 = Bipolar/Latch | 5: SOT-23-5               |
| 2 = Unipolar                    |                   | <b>Output Response</b>    |
| <b>Magnetic Sensitivity (G)</b> |                   | 1: Active Low             |
| A: Op 9, Rel 5                  | E: Op 15, Rel 10  | <b>Supply Voltage (V)</b> |
| B: Op 30, Rel 20                | F: Op 70, Rel 50  | 5: 1.7 - 5.5              |
| C: Op 10, Rel -10               |                   | <b>Temp Rating (°C)</b>   |
| <b>Clock Frequency (Hz)</b>     |                   | 2: -40 - +85              |
| 1: 2                            | 5: 250            | 9: 10000                  |
| 2: 10                           | 6: 500            | U: 100+Turbo (10000)      |
| 3: 20                           | 7: 2500           | 3: -40 - +125             |

## 4 Specifications

### 4.1 Absolute Environmental Ratings<sup>1,2</sup>

| Parameters   | Units | Min   | Typ | Max  |
|--|-------|-------|-----|------|
| Operating Temperature (T <sub>OP</sub> ) (RR122-3C62-511)    | °C    | -40   |     | +85  |
| Operating Temperature (T <sub>OP</sub> ) (RR122-3C63-511)    | °C    | -40   |     | +125 |
| Storage Temperature (T <sub>STG</sub> )                      | °C    | -65   |     | +150 |
| Junction Temperature (T <sub>J</sub> )                       | °C    |       |     | +150 |
| Soldering Temperature (3 cycles, 1 min.) (T <sub>SOL</sub> ) | °C    |       |     | +260 |
| ESD Level Human Body Model per JESD22-A114                   | V     | ±4000 |     |      |
| Junction-to-Ambient Thermal Resistance                       | °C/W  |       | 215 |      |
| Maximum Magnetic Field Exposure (B <sub>MAX</sub> )          | G     |       |     | 600  |

### 4.2 Absolute Electrical Ratings<sup>1,2</sup>

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

**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, 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 Specifications (cont.)

### 4.3 Operating Electrical Characteristics for RR122-3C62-511 and RR122-3C63-511<sup>1</sup>

| Parameters  | Units   | Min          | Typ  | Max          |
|---|---------|--------------|------|--------------|
| Supply Voltage ( $V_{DD}$ )   | V       | 1.7          | 3.0  | 5.5          |
| Power-On Time ( $t_{ON}$ )( $V_{DD} > 90\%$ )   | $\mu$ s |              | 50   | 75           |
| Peak Power-On Current   | mA      |              |      | 1.4          |
| Output Voltage (High) ( $V_{OUTH}$ )  | V       | 90% $V_{DD}$ |      |              |
| Output Voltage (Low) ( $V_{OUTL}$ )   | V       |              |      | 10% $V_{DD}$ |
| 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      |              | 50   |              |
| Average Supply Current @ $V_{DD}=1.7$ V, $f_{SW}=500$ Hz ( $I_{DDAVG}$ ) <sup>2</sup> | $\mu$ A |              | 1.7  |              |
| Average Supply Current @ $V_{DD}=3.0$ V, $f_{SW}=500$ Hz ( $I_{DDAVG}$ ) <sup>2</sup> | $\mu$ A |              | 1.9  |              |

**Notes:**

1. Unless otherwise specified,  $V_{DD} = 1.7$  V to 5.5 V,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$  (3C62),  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$  (3C63). Typical values are  $V_{DD} = 3.0$  V and  $T_A = +25^\circ\text{C}$ .
2. Conditions:  $t = 10$  seconds



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.

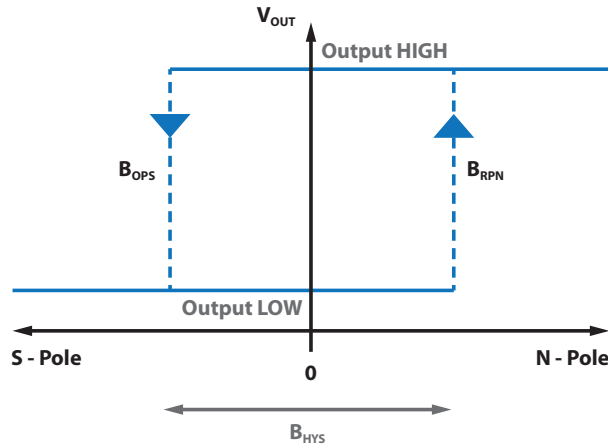
### 4.4 Operating Characteristics for RR122-3C62-511 and RR122-3C63-511<sup>1</sup>

| Parameters                                      | Units   | Min | Typ | Max |
|---|---------|-----|-----|-----|
| Switching Frequency ( $f_{SW}$ )                | Hz      | 300 | 500 | 700 |
| Active Mode Time ( $t_{ACT}$ )                  | $\mu$ s |     | 2.6 |     |
| Idle Mode Time @ $f_{SW}=500$ Hz ( $t_{IDLE}$ ) | ms      | 1.4 | 2   | 3.3 |
| Operate Point ( $B_{OPS}$ )                     | G       | -13 | -10 | -7  |
| Release Point ( $B_{RPN}$ )                     | G       | 7   | 10  | 13  |

**Notes:**

1. Unless otherwise specified,  $V_{DD} = 1.7$  V to 5.5 V,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$  (3C62),  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$  (3C63). Typical values are  $V_{DD} = 3.0$  V and  $T_A = +25^\circ\text{C}$ .

## 5 Output Response vs. Magnetic Flux

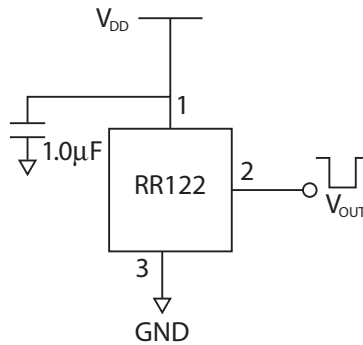


## 6 Application Information

### RR122 Push-Pull Output Application Circuit

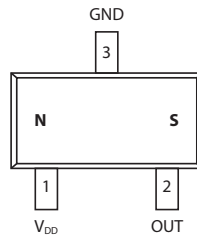
The output voltage on the RR122 is active low, meaning that while a sufficiently strong magnetic field is present, the output voltage is low. The output voltage can be connected to a digital I/O pin on a microcontroller. A decoupling capacitor with a minimum value of 1.0  $\mu F$  placed within 10 mm of the sensor is required.

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

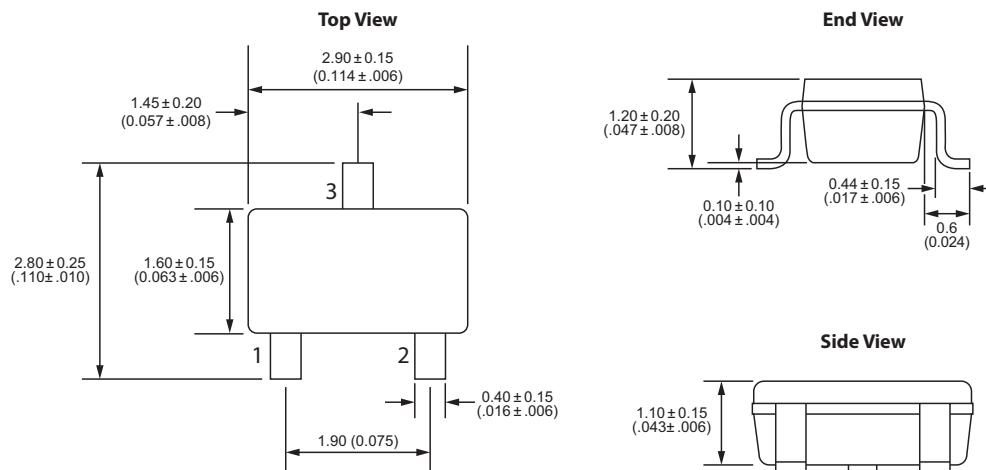


## 7 Axis of Sensitivity

### SOT-23-3

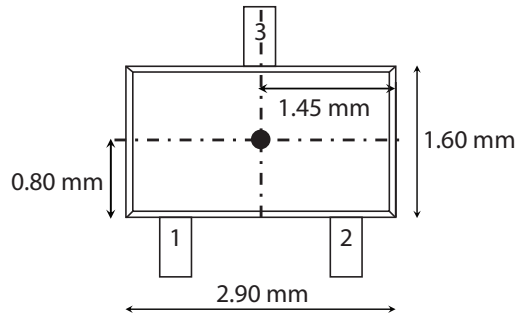


## 8 Dimensions SOT-23-3 Package *Millimeters (Inches)*

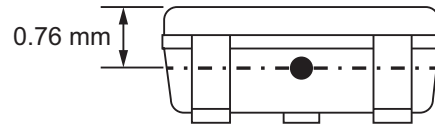


## 9 TMR Sensor Location

SOT-23-3 Package



SOT Package - Side View



## 10 Output Behavior vs. Magnetic Field Diagrams

Output Behavior vs. Magnetic Field - Bipolar

| Characteristics | Conditions    | Output     |
|-----------------|---------------|------------|
| South Pole      | $B < B_{OPS}$ | Low (ON)   |
| North Pole      | $B > B_{RPN}$ | High (OFF) |

## 12 TMR Sensor & Switch Packaging

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

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

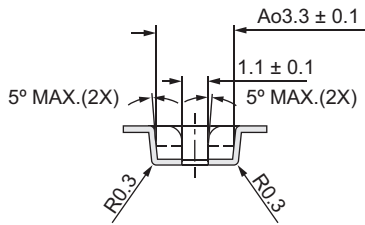
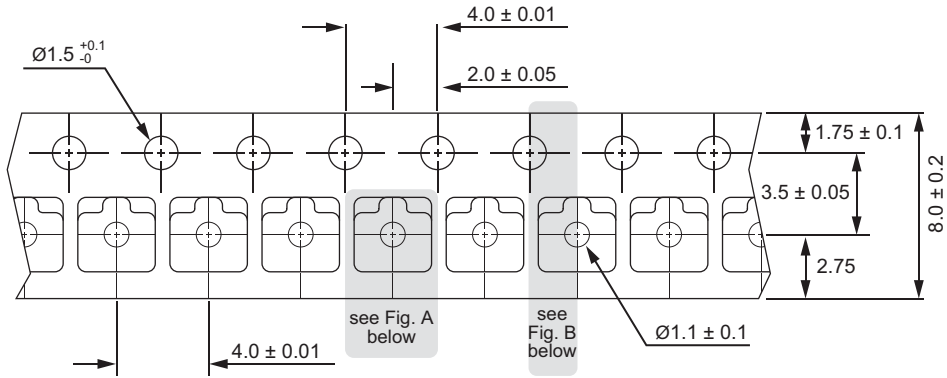


Fig. A

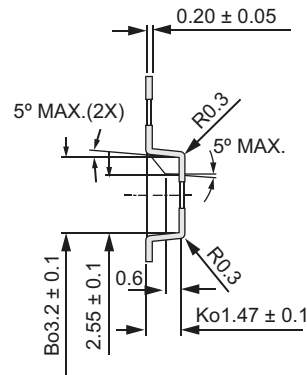
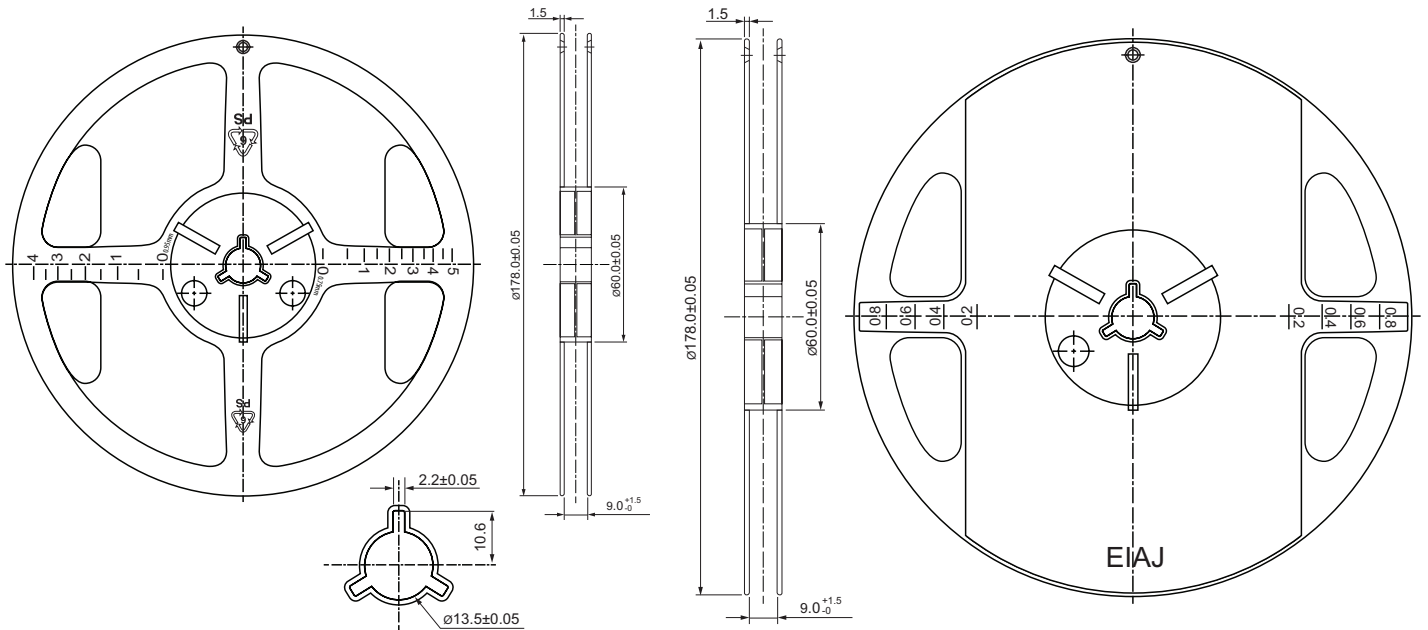


Fig. B



## 12 TMR Sensor & Switch Packaging

### 12.2 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

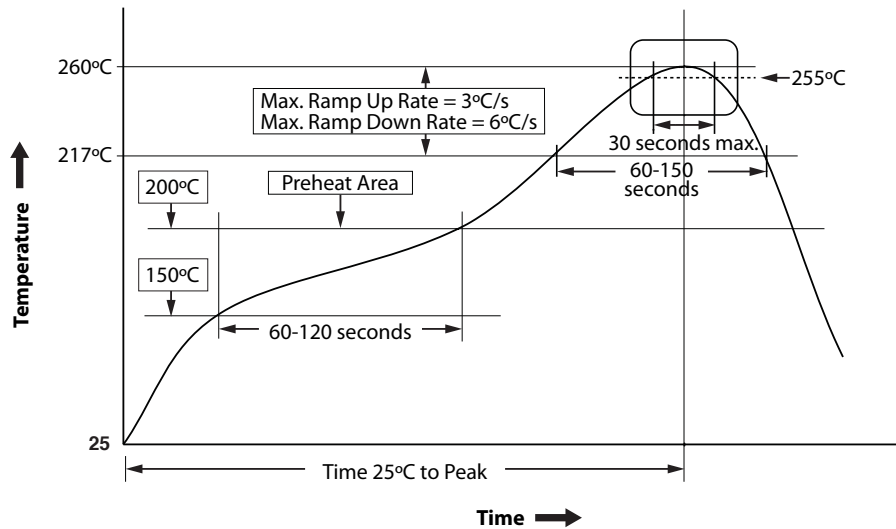
#### Box Dimensions – 18x14x12 inches

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

## 13 Suggested Pb-Free Reflow Profile

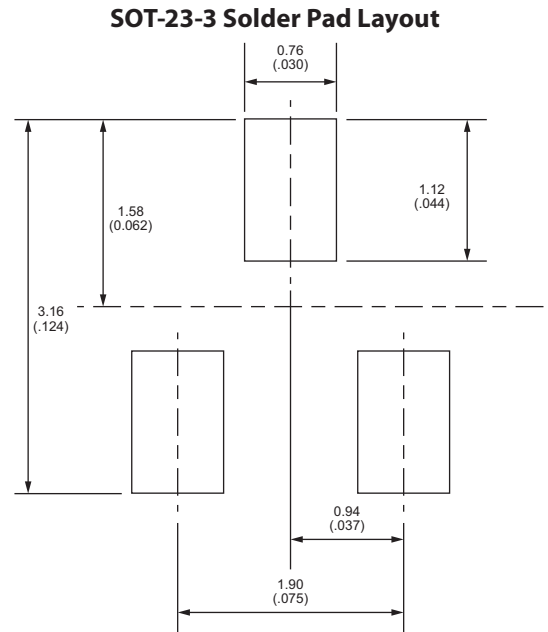
### Notes:

1. Fully compatible with standard no-lead solder profile, 260 °C for 30 seconds 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 and Leaded LGA-4) 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  $\pm 2$  °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.





## 14 Suggested Solder Pad Layout



## Revision History

|    | Date       | Description   |
|----|------------|---|
| 1  | 10/13/2020 | Added Maximum Magnetic Field Exposure Value (Table 4.1)   |
| 2  | 10/13/2020 | Modified Input and Output Current (Table 4.2)             |
| 3  | 10/13/2020 | Modified UVLO Rise Value (Table 4.3)                      |
| 4  | 10/13/2020 | Modified UVLO Fall Value (Table 4.3)                      |
| 5  | 10/13/2020 | Added Supply Voltage, Typical (Table 4.3)                 |
| 6  | 10/13/2020 | Modified Switching Frequency MIN & MAX Values (Table 4.4) |
| 7  | 10/13/2020 | Modified Active Mode Time Value (Table 4.4)               |
| 8  | 10/13/2020 | Added MIN & MAX Values to Idle Mode (Table 4.4)           |
| 9  | 10/13/2020 | Modified Operate Point (BopN) MIN Value (Table 4.4)       |
| 10 | 10/13/2020 | Modified Operate Point (BopS) MAX Value (Table 4.4)       |
| 11 | 10/14/2020 | Modified Supply Voltage MAX Value (Table 4.2)             |
|    |            |   |