



## 1 Description

The RedRock® RR122-2E32-511 and RR122-2E33-511 are digital magnetic sensors ideal for use in medical, industrial, automotive, and consumer applications. They are based on patented Tunneling Magnetoresistance (TMR) technology with seamless CMOS integration.

The RR122-2E32-511 and RR122-2E33-511 feature an operate sensitivity of 15 G (1.5 mT), with a unipolar magnetic field response. They offer 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. They have the world's lowest average current drain (100nA) for an active magnetic sensor operating at 20 Hz and high operating temperature ranges from -40°C up to +125°C.

## 2 Features

- ▶ Operate sensitivity of 15 G
- ▶ Lowest Average Current of 100 nA
- ▶ Wide Supply Voltage range of 1.7V – 5.5V
- ▶ Unipolar Push-Pull Response
- ▶ Operating Frequency of 20 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
- ▶ Motor Controllers
- ▶ Consumer Electronics
- ▶ Wake-Up  $\mu$ Processor

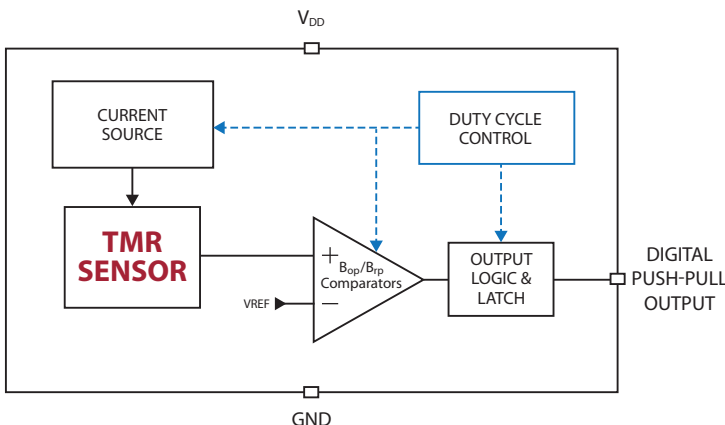
## Device Information

Part Series	Package	Body Size (mm)	Temp Rating °C
<b>RR122-2E32-511</b>	SOT-23-3	2.9 x 1.6 x 1.2	-40 to +85
<b>RR122-2E33-511</b>	SOT-23-3	2.9 x 1.6 x 1.2	-40 to +125

## Device Packages



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



## Device Nomenclature

### Ordering Information

**RR122-X X X X-YYY**

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

## 4 Specifications

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

Parameters	Units	Min	Typ	Max
Operating Temperature (T <sub>OP</sub> ) (RR122-2E32-511)	°C	-40		+85
Operating Temperature (T <sub>OP</sub> ) (RR122-2E33-511)	°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		
ESD Level Charged Device Model (CDM) per JESD22-C1010	V	±500		
Junction-to-Ambient Thermal Resistance (SOT-23-3)	°C/W		202	
Maximum Magnetic Field Exposure (B <sub>MAX</sub> )	G			±2000

### 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

### 4.3 Operating Electrical Characteristics for RR122-2E32-511 and RR122-2E33-511<sup>3</sup>

Parameters	Units	Min	Typ	Max
Supply Voltage (V <sub>DD</sub> )	V	1.7		5.5
Power-On Time (t <sub>ON</sub> )(V <sub>DD</sub> > 90%)	µs		50	75
Peak Power-On Current	mA			1.4
Active Mode Time (t <sub>ACT</sub> )	µs		1.4	
Output Voltage (High) (V <sub>OUTH</sub> )	V	90% V <sub>DD</sub>		
Output Voltage (Low) (V <sub>OUTL</sub> )	V			10% V <sub>DD</sub>
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	1.40	1.53	
Under Voltage Lockout Hysteresis (V <sub>UV-HYST</sub> )	mV		70	
Average Supply Current @ V <sub>DD</sub> = 1.7 V, f <sub>s</sub> = 20 Hz <sup>4</sup>	nA		100	900
Average Supply Current @ V <sub>DD</sub> = 3.0 V, f <sub>s</sub> = 20 Hz <sup>4</sup>	nA		125	900

#### Notes:

- Exceeding Absolute Ratings may cause permanent damage to the device.
- Unless otherwise specified, all characteristics are measured at 25°C.
- Unless otherwise specified, V<sub>DD</sub> = 1.7 V to 5.5 V, T<sub>A</sub> = -40°C to +85°C (2E32), -40°C to +125°C (2E33). Typical values are V<sub>DD</sub> = 3.0 V and T<sub>A</sub> = +25°C.
- 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.

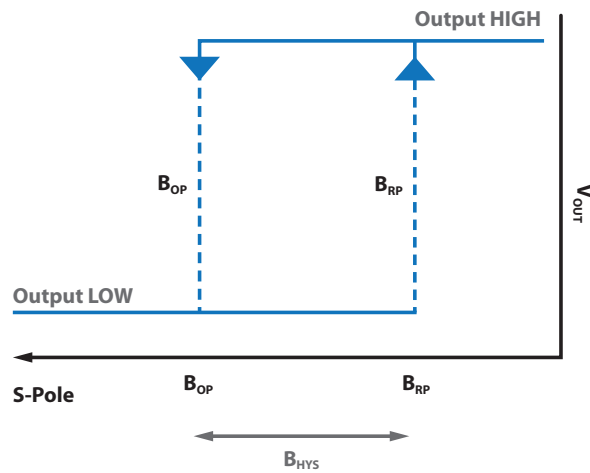
## 4 Specifications (cont.)

### 4.4 Operating Characteristics for RR122-2E32-511 and RR122-2E33-511<sup>1,2</sup>

Parameters	Units	Min	Typ	Max
Switching Frequency ( $f_{SW}$ )	Hz	14	20	26
Active Mode Time ( $t_{ACT}$ )	$\mu s$		1.4	
Idle Mode Time @ $f_{SW} = 20$ Hz ( $t_{IDLE}$ )	ms		50	
Operate Point ( $B_{OPN}$ )	G		N/A	
Operate Point ( $B_{OPS}$ )	G	-19	-15	-11
Release Point ( $B_{RPN}$ )	G		N/A	
Release Point ( $B_{RPS}$ )	G	-14	-10	-6
Hysteresis ( $B_{HYST}$ ) <sup>2</sup>	G	3	5	

- Notes:**
- Unless otherwise specified,  $V_{DD} = 1.7$  V to 5.5 V,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$  (2E32),  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$  (2E33). Typical values are  $V_{DD} = 3.0$  V and  $T_A = +25^\circ\text{C}$ .
  - Conditions:  $B_{HYST} = |B_{OP} - B_{RP}|$
-  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.

## 5 Output Response vs. Magnetic Flux

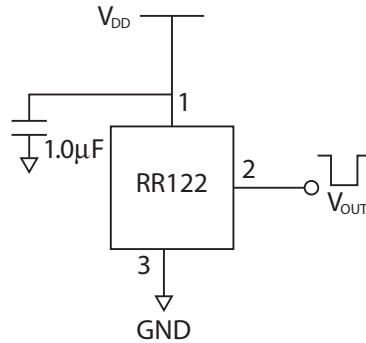


## 6 Application Information

### RR122 Push-Pull Output Application Circuit

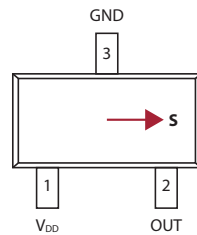
The output voltage on the RR122 is active low, meaning that while a sufficiently strong magnetic field is present, the output voltage is low. The output voltage can be connected to a digital I/O pin on a microcontroller. A decoupling capacitor between the supply voltage and ground is required with placement close to the magnetic sensor. A capacitor with a value of  $1\ \mu\text{F}$ , placed not more than 10 mm from the sensor, is required.

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



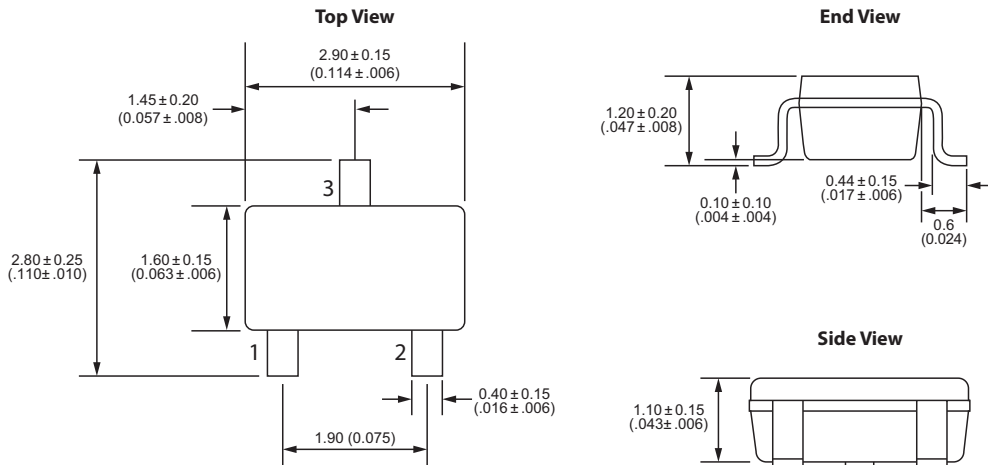
## 7 Axis of Sensitivity

### SOT-23-3



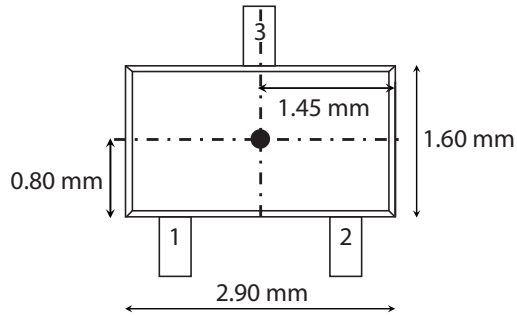
## 8 Dimensions *Millimeters (Inches)*

### SOT-23-3 Package

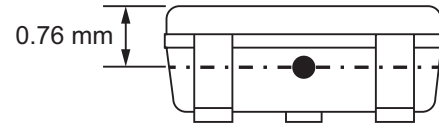


## 9 TMR Sensor Location

9.1 SOT-23-3 Package



9.3 SOT Package - Side View



## 10 Output Behavior vs. Magnetic Field Diagrams

Output Behavior vs. Magnetic Field - Omnipolar

Characteristics	Conditions	Output
South Pole	$B < B_{OPS}$ $0 > B > B_{RPS}$	Low (ON) High (OFF)

## 11 TMR Sensor & Switch Packaging

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

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

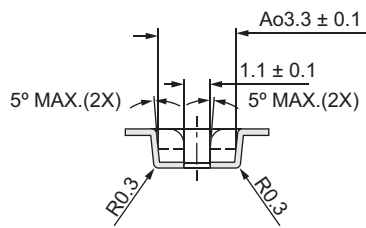
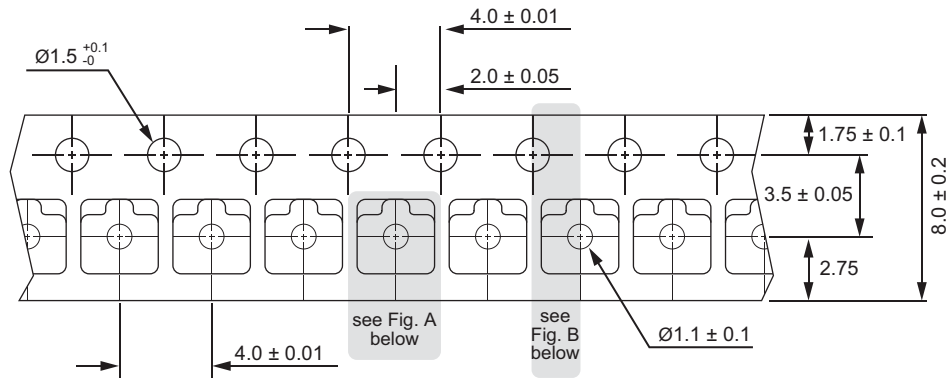


Fig. A

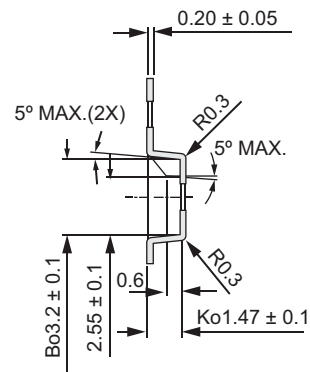
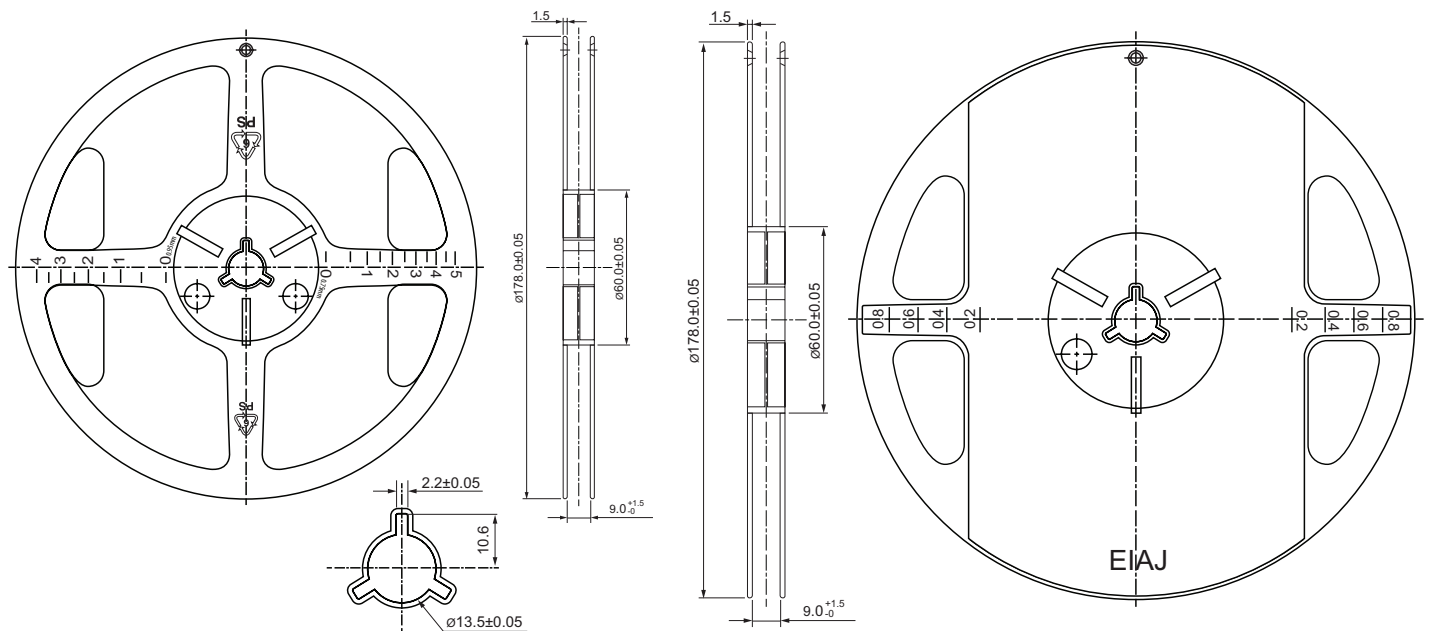


Fig. B



## 11 TMR Sensor & Switch Packaging

### 11.2 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

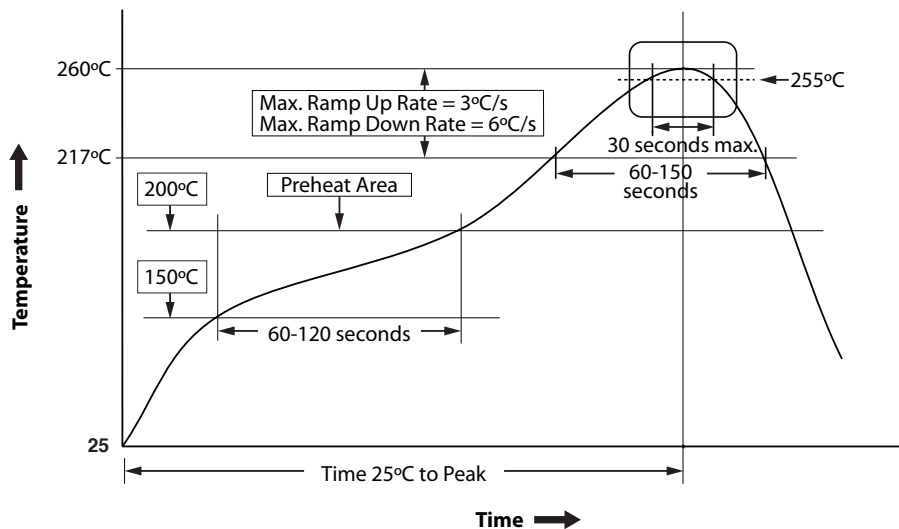
#### Box Dimensions – 18x14x12 inches

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

## 12 Suggested Pb-Free Reflow Profile

### Notes:

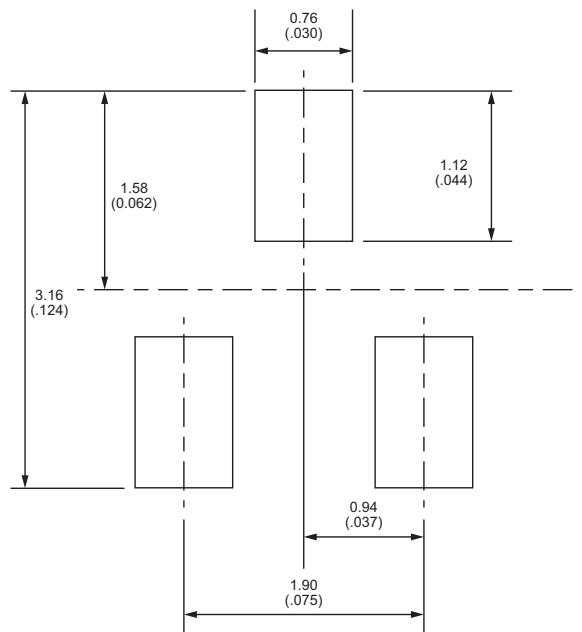
1. Fully compatible with standard no-lead solder profile, 260°C for 30 seconds max (3 cycles max).
2. Profile shown as example. Users are advised to develop their own board-level profile.
3. Suggested Pb-free reflow profile derived from IPC/JEDEC J-STD-020E.
4. Temperature tolerance: +0°C, as measured 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. 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  $\pm 2^\circ\text{C}$  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.
7. 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.



### 13 Suggested Solder Pad Layout

Dimensions in mm (inches)

#### SOT-23-3 Solder Pad Layout





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