

### 1 Description

The RedRock® RR133-1E83-511 is a digital magnetic sensor ideal for use in medical, industrial, automotive, and consumer applications. It is based on patented Tunneling Magnetoresistance (TMR) technology with seamless CMOS integration.

The RR133-1E83-511 features an operate sensitivity of 14 G (1.4 mT), with an omnipolar magnetic field response. It offers a wide supply voltage range from 2.4 up to 5.5 V, ideal for applications ranging from high speed rotary sensing to liquid level detection. It has a current consumption of 1.5 µA with a sampling frequency of 1 kHz and a high operating temperature range from -40°C up to +125°C.

### 2 Features

- ▶ Operate sensitivity of 14 G
- ▶ Ultra Low Current Consumption of 1.5 µA
- ▶ Wide Supply Voltage range of 2.4 V – 5.5 V
- ▶ Open-Drain Output with Omnipolar Response
- ▶ Operating Frequency of 1 kHz
- ▶ Temperature Rated up to +125°C
- ▶ RoHS & REACH Compliant

### 3 Applications

- ▶ Proximity Detection
- ▶ Rotary Sensing
- ▶ Fluid Level Detection
- ▶ Utility Meters
- ▶ Motor Controllers
- ▶ Consumer Electronics

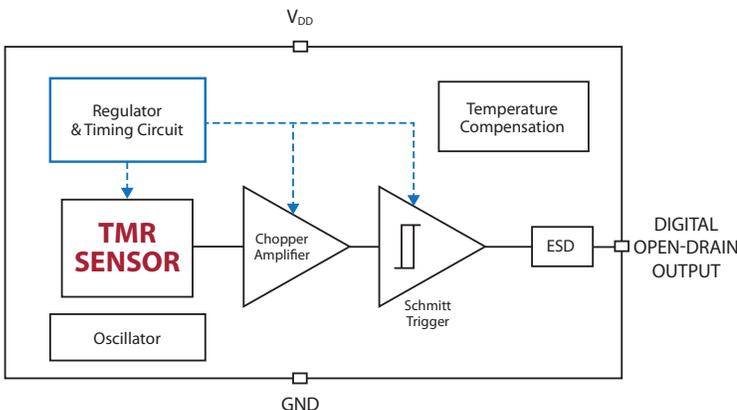
### Device Information

Part Series	Package	Body Size (mm)	Temp Rating °C
RR133-1E83-511	SOT-23-3	2.9 x 1.6 x 1.1	-40 to +125

### Device Package



### Functional Block Diagram for Digital Open-Drain Output



### Ordering Information

**RR133-X X X X-YYY**

<b>Series</b>	1: SOT-23-3
<b>Magnetic Polarity Response</b>	<b>Output Response</b>
1 = Omnipolar	5: Open Drain
<b>Magnetic Sensitivity (G)</b>	<b>Supply Voltage (V)</b>
E: Op 15, Rel 10	5: 2.4 – 5.5
<b>Clock Frequency (Hz)</b>	<b>Temp Rating (°C)</b>
8: 1000	3: -40 to +125

## 4 Specifications

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

Parameters	Units	Min	Typ	Max
Operating Temperature (T <sub>OP</sub> ) (RR133-1E83-511)	°C	-40		+150
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	±3000		
ESD Level Charged Device Model (CDM) per JESD22-C101	V	±1000		
Junction-to-Ambient Thermal Resistance (SOT-23-3)	°C/W		TBD	
Maximum Magnetic Field Exposure (B <sub>MAX</sub> )	G			±2800

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

Parameters	Units	Min	Typ	Max
Supply Voltage (V <sub>DD</sub> )	V	-0.3		7.0
Open-Drain Output Voltage (Active Low)(V <sub>OUT-OD</sub> )	V	-0.3		5.5
Input and Output Current (I <sub>IN</sub> /I <sub>OUT</sub> )	mA			±10

### 4.3 Operating Electrical Characteristics for RR133-1E83-511<sup>3</sup>

Parameters	Units	Min	Typ	Max
Supply Voltage (V <sub>DD</sub> )	V	2.4	3.3	5.5
Power-On Time (t <sub>ON</sub> )	ms		2.5	
Peak Power-On Current	mA			TBD
Output Voltage (Low) (V <sub>OUTL</sub> ) I <sub>OUT</sub> = 1 mA	V	-0.3	0.006	0.3
Output FET Resistance (R <sub>DS(ON)</sub> ) Output LOW V <sub>DD</sub> = 3.3 V	V			10
Output Leakage Current (I <sub>OFF</sub> ) V <sub>OUT</sub> = 3.3V, Output OFF	µA		0.1	1
Average Supply Current @ V <sub>DD</sub> =3.3 V, f <sub>SW</sub> =1 kHz (I <sub>DD(AVG)</sub> )	µA		1.5	1.8

**Notes:**

1. Exceeding Absolute Ratings may cause permanent damage to the device.
2. Unless otherwise specified, all characteristics are measured at 25°C.
3. Unless otherwise specified, V<sub>DD</sub> = 2.4 V to 5.5 V, T<sub>A</sub> = -40°C to +125°C. Typical values are V<sub>DD</sub> = 3.3 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 RR132-1B12-551/552 and RR132-1B13-551/552<sup>1</sup>

Parameters	Units	Min	Typ	Max
Switching Frequency ( $f_{SW}$ )	Hz		1000	
Operate Point ( $B_{OPN}$ )	G	10	14	18
Operate Point ( $B_{OPS}$ )	G	-18	-14	-10
Release Point ( $B_{RPN}$ )	G	5	10	14
Release Point ( $B_{RPS}$ )	G	-14	-10	-5
Hysteresis ( $B_{HYST}$ ) <sup>2</sup>	G	2	5	9

- Notes:**
1. Unless otherwise specified,  $V_{DD} = 2.4\text{ V to }5.5\text{ V}$ ,  $T_A = -40^\circ\text{C to }+125^\circ\text{C}$ . Typical values are  $V_{DD} = 3.3\text{ V}$  and  $T_A = +25^\circ\text{C}$ .
  2. Conditions:  $B_{HYST} = |B_{OP} - B_{RP}|$

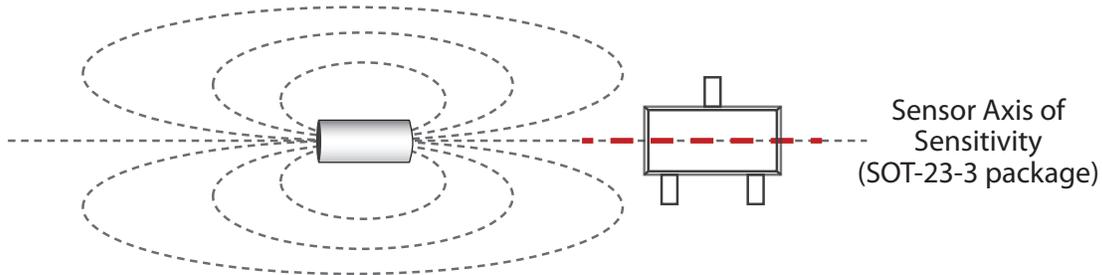


ESD Note: This product uses semiconductors that can be damaged by electrostatic discharge (ESD). When handling, proper ESD precautions should be taken to avoid performance degradation or loss of functionality. Damage due to inappropriate handling is not covered under warranty.

## 5 Magnetic Response

For more information please contact Coto Technology.

### 5.1 Axis of Sensitivity



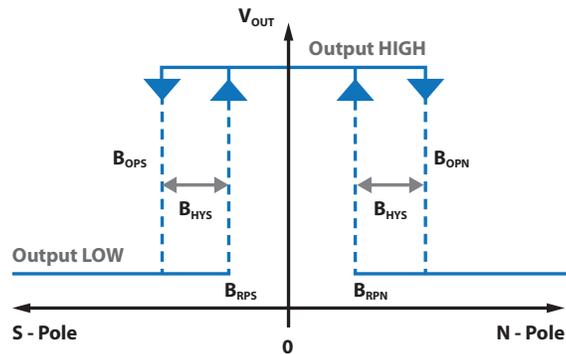
**Note:** The most straightforward way of aligning a magnet with a TMR sensor is by lining up the magnet's magnetization axis with the sensor's Axis of Sensitivity (as shown above). However, there are many other alignments and orientations that will also achieve proper operation. For any questions, or to learn more, please contact Coto Technology.

## 5 Magnetic Response (cont.)

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

Scenario	Step 1: Sensor is powered without magnetic field.	Step 2: Magnet applied, polarity <b>North</b> .	Step 3: Magnet removed.	Step 4: Magnet applied, polarity <b>South</b> .	Step 5: Magnet removed.
<b>OMNIPOLAR</b> SENSOR OUTPUT	HIGH	<b>LOW</b> (Activated)	HIGH	<b>LOW</b> (Activated)	HIGH

### 5.3 Magnetic Response Output Diagram

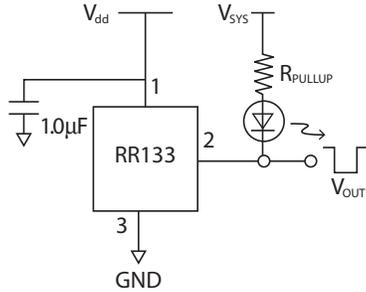


## 6 Application Information

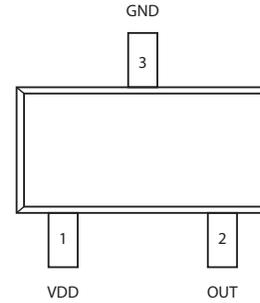
### RR133 Application Circuit

The output voltage of the RR133 is active low, meaning that while a sufficiently strong magnetic field is present, the output voltage is low. With the open-drain output, the system voltage can range from (V<sub>dd</sub> + 0.3 V) up to absolute max of 5.5 Vdc. A decoupling capacitor between the supply voltage and ground is required with placement close to the magnetic sensor. A capacitor with a value between 100-470 nF, placed not more than 10 mm from the sensor, is required.

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

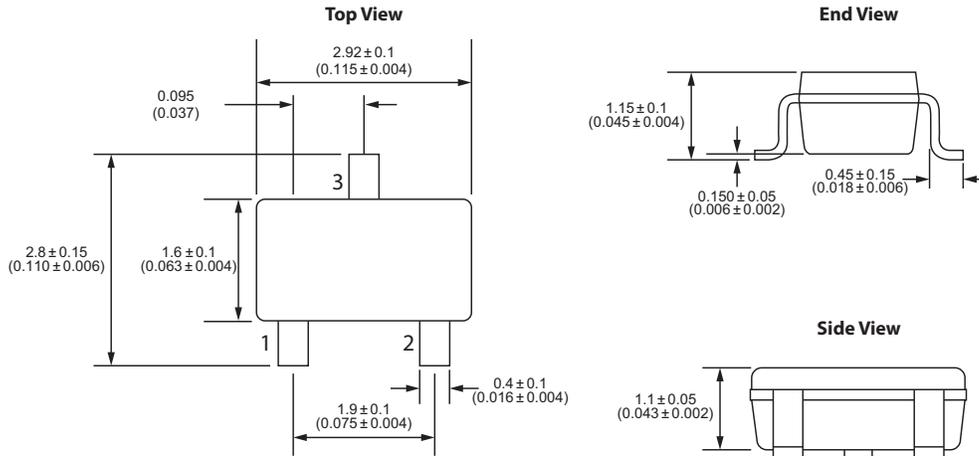


#### 6.2 Package Pinout (SOT-23-3)



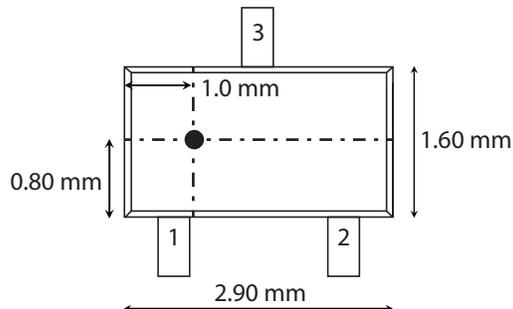
## 7 Dimensions *Millimeters (Inches)*

### SOT-23-3 Package

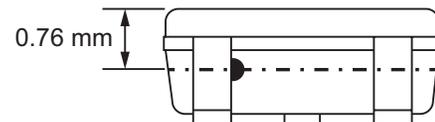


## 8 TMR Sensor Location

### 8.1 SOT-23-3 Package



### 8.3 SOT Package - Side View



## 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.

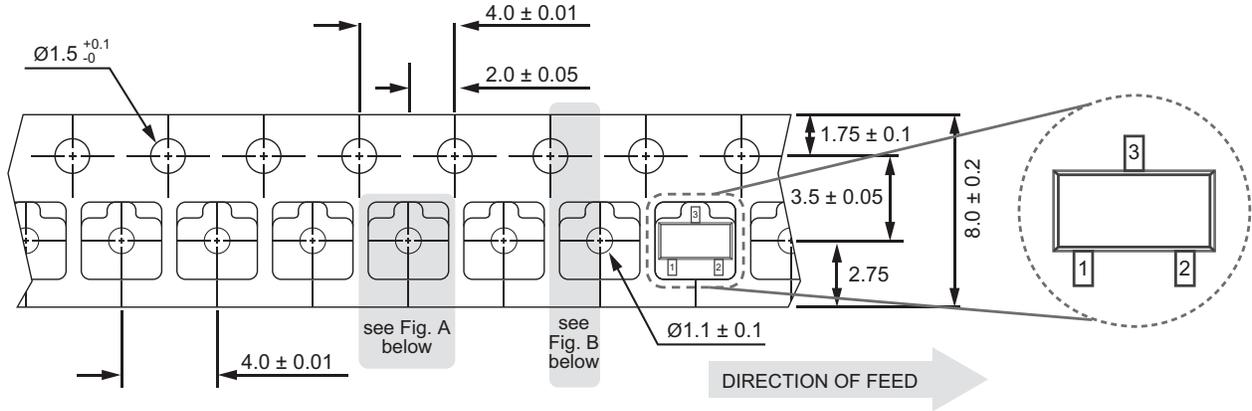


Fig. A

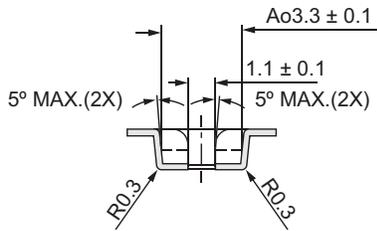
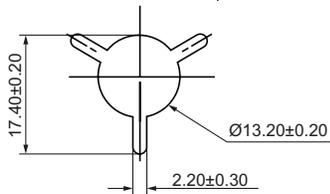
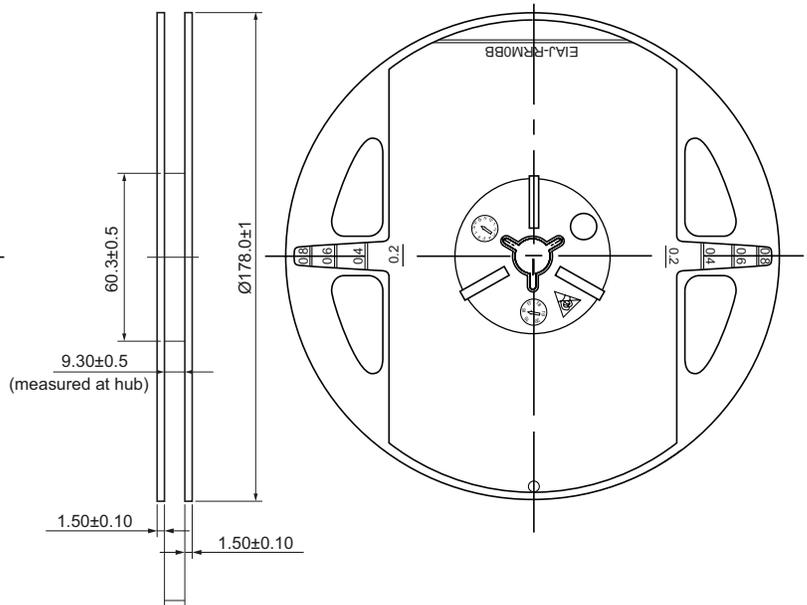
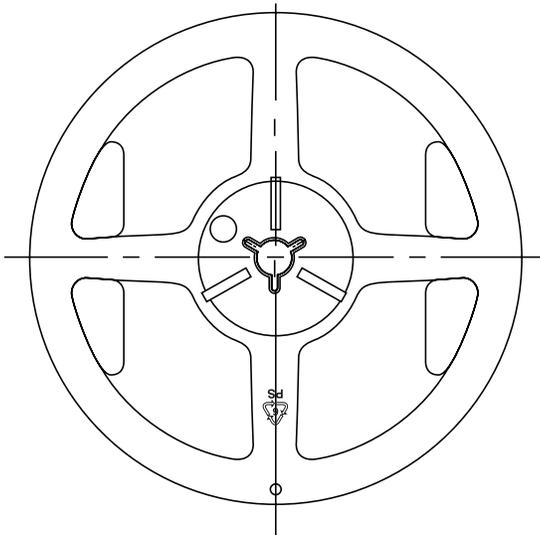
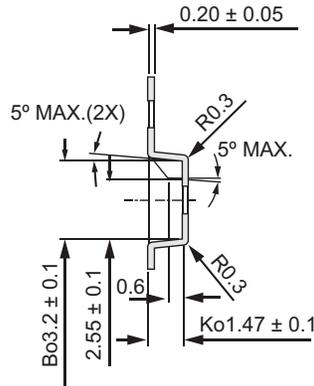


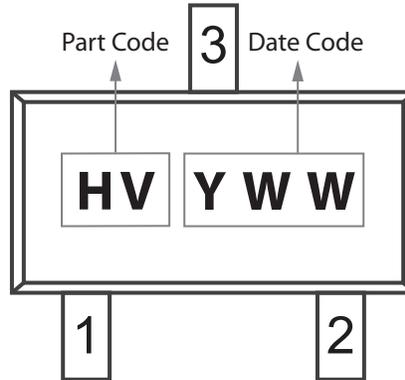
Fig. B



## 9 TMR Sensor & Switch Packaging

### 9.2 RedRock Package Codes

RR133-1E83-511 (SOT-23-3)



### 9.3 RedRock TMR Packaging

#### Box Dimensions – 14x10x6 inches

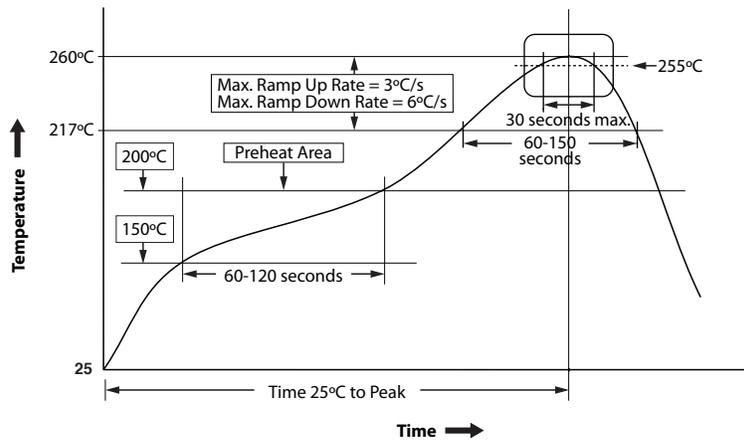
- Fits 1 to 3 reels = 3000 to 9000 pcs
- Weight for 3000 pcs = 0.90 kilos
- Weight for 9000 pcs = 1.00 kilos

#### 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

## 10 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),  $T_p$  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.
  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

Dimensions in mm (inches)

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

