

## 1 Description

The RedRock® RR122-3CU2-515 and RR122-3CU3-515 are digital magnetic sensors ideal for use in medical, industrial, automotive, and consumer applications, based on patented Tunneling Magnetoresistance (TMR) technology with seamless CMOS integration.

The RR122-3CU2-515 and RR122-3CU3-515 feature an operate sensitivity of 10 G (1.0 mT) with a bipolar magnetic field response. The wide supply voltage range from 1.7 up to 5.5 V is ideal for applications ranging from small battery-powered electronics to industrial machinery. They have low average current drain (600 nA) for an active magnetic sensor with an operating frequency up to 10 kHz and high operating temperature ranges from -40°C up to 125°C.

The RR122-3CU2-515 and RR122-3CU3-515 have an available “turbo” mode that can be toggled via an input pin when faster than usual sampling is required. When provided a logic “high” signal from a microcontroller or similar, it switches the base internal clock frequency up to 100 Hz. This is particularly useful for maximizing battery life in applications involving intermittent high speed rotation sensing, where a slow clock is sufficient to detect the start of rotation but then a faster sampling period is needed to ensure that no rotations are missed.

## 2 Features

- ▶ Operate sensitivity from -10 G to +10 G
- ▶ Lowest Average Current < 600 nA
- ▶ Wide Supply Voltage Range of 1.7V – 5.5V
- ▶ Bipolar Latching Push-Pull Response
- ▶ Base Frequency of 100 Hz
- ▶ Turbo Mode Pin to Enable 10 kHz Operation for Fast Response when Required
- ▶ 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
- ▶ Wake-Up  $\mu$ Processor

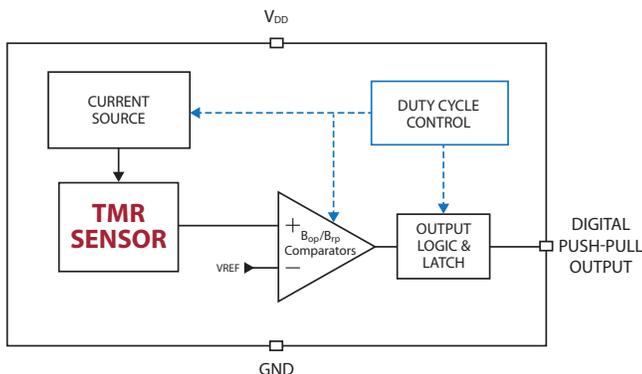
## Device Information

Part Series	Package	Body Size (mm)	Temp Rating °C
RR122-3CU2-515	SOT-23-5	2.9 x 1.6 x 1.2	-40 to +85
RR122-3CU3-515	SOT-23-5	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 = Omnipolar 2 = Unipolar 3 = Bipolar/Latch	1: SOT-23-3 2: LGA-4 5: SOT-23-5
<b>Magnetic Sensitivity (G)</b> A: Op 9, Rel 5 B: Op 30, Rel 20 C: Op 10, Rel -10 E: Op 15, Rel 10 F: Op 70, Rel 50 G: Op 100, Rel 70	<b>Output Response</b> 1: Active Low
<b>Clock Frequency (Hz)</b> 1: 2 2: 10 3: 20 5: 250 6: 500 7: 2500 9: 10000 U: 100+Turbo (10000)	<b>Supply Voltage (V)</b> 5: 1.7 - 5.5
	<b>Temp Rating (°C)</b> 2: -40 - +85 3: -40 - +125

## 4 Specifications

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

Parameters	Units	Min	Typ	Max
Operating Temperature ( $T_{OP}$ ) (RR122-3CU2-515)	°C	-40		+85
Operating Temperature ( $T_{OP}$ ) (RR122-3CU3-515)	°C	-40		+125
Storage Temperature ( $T_{STG}$ )	°C	-65		+150
Junction Temperature ( $T_J$ )	°C			+150
Soldering Temperature (3 cycles, 1 min.) ( $T_{SOL}$ )	°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-23-5)	°C/W		202	
Maximum Magnetic Field Exposure ( $B_{MAX}$ )	G			±600

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

Parameters	Units	Min	Typ	Max
Supply Voltage ( $V_{DD}$ )	V	-0.3		6.0
Push-pull Output (Active Low)( $V_{OUT\_PP}$ )	V	-0.3		$V_{DD}$
Input and Output Current ( $I_{IN}/I_{OUT}$ )	mA			±20

#### 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, 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.

### 4.3 Operating Electrical Characteristics for RR122-3CU2-515 and RR122-3CU3-515<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) <sup>3</sup> ( $V_{OUTH}$ )	V	90% $V_{DD}$		
Output Voltage (Low) <sup>3</sup> ( $V_{OUTL}$ )	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		70	
Average Supply Current @ $V_{DD} = 1.7V$ , $f_{SW} = 100$ Hz ( $I_{DD(AVG)}$ )	$\mu$ A		0.6	
Average Supply Current @ $V_{DD} = 3.0V$ , $f_{SW} = 100$ Hz ( $I_{DD(AVG)}$ )	$\mu$ A		0.8	
Average Supply Current @ $V_{DD} = 1.7V$ , $f_{SW} = 10$ kHz ( $I_{DD(AVG)}$ )	$\mu$ A		65	
Average Supply Current @ $V_{DD} = 3.0V$ , $f_{SW} = 10$ kHz ( $I_{DD(AVG)}$ )	$\mu$ A		75	

### 4.4 Operating Characteristics for RR122-3CU2-515 and RR122-3CU3-515<sup>1</sup>

Parameters	Units	Min	Typ	Max
<b>NORMAL MODE</b>				
Switching Frequency ( $f_{SW}$ ) (Base Frequency) <sup>2</sup>	Hz		100	
Idle Mode Time ( $t_{IDLE}$ ) (Base Frequency) <sup>2</sup>	ms		10	
Active Mode Time ( $t_{ACT}$ ) (Base Frequency) <sup>2</sup>	$\mu$ s		2.6	
<b>TURBO MODE</b>				
Switching Frequency ( $f_{SW}$ ) (Turbo Frequency) <sup>2</sup>	kHz		10	
Idle Mode Time ( $t_{IDLE}$ ) (Turbo Frequency) <sup>2</sup>	$\mu$ s		100	
Active Mode Time ( $t_{ACT}$ ) (Turbo Frequency) <sup>2</sup>	$\mu$ s		2.6	
<b>TURBO LOGIC CONTROL</b>				
Logic High Threshold ( $V_{IH}$ )	V	1.2		
Logic Low Threshold ( $V_{IL}$ )	V			0.5
Input Bias Current ( $I_{EN}$ )	$\mu$ A			1.0
Time Delay for 1st Sample After Turbo Mode Enabled	$\mu$ s		100	110
<b>MAGNETIC</b>				
Operate Point ( $B_{OPN}$ )	G	7	10	13
Release Point ( $B_{RPS}$ )	G	-13	-10	-7

**Notes:**

1. Unless otherwise specified,  $V_{DD} = 1.7$  V to 5.5 V,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$  (3CU2),  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$  (3CU3). Typical values are  $V_{DD} = 3.0$  V and  $T_A = +25^\circ\text{C}$ .

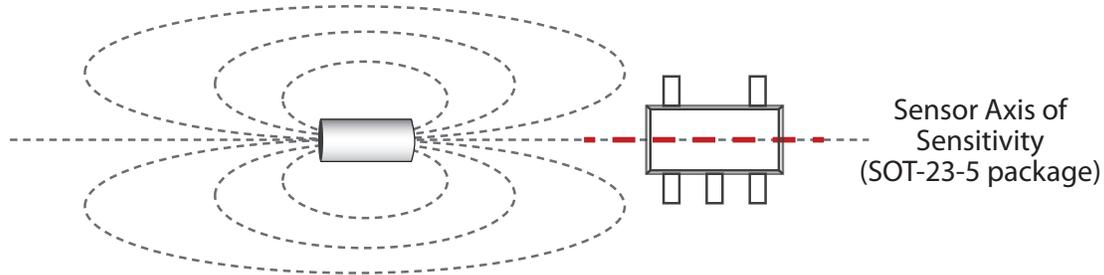
2. Turbo Mode Switching Frequency is activated by sending a logic "HIGH" signal to the turbo pin on the device. A logic "LOW" signal will set the switching frequency to the base frequency.

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 at [RedRock@cotorelay.com](mailto:RedRock@cotorelay.com).

### 5.1 Axis of Sensitivity

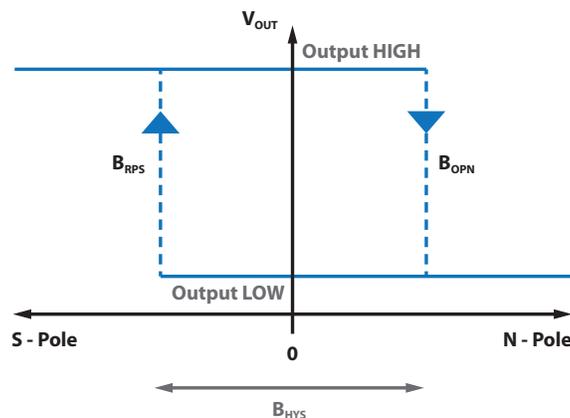


**Note:** The most straightforward way of aligning a magnet with a TMR sensor is by lining up the magnet's magnetization axis with the sensor's Axis of Sensitivity (as shown above). However, there are many other alignments and orientations that will also achieve proper operation. For any questions, or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

### 5.2 Magnetic Response Table (SOT-23-5 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>BIPOLAR SENSOR OUTPUT</b>	HIGH	<b>LOW</b> (Activated)	<b>LOW</b> (Activated)	HIGH	HIGH

### 5.3 Magnetic Response Diagram

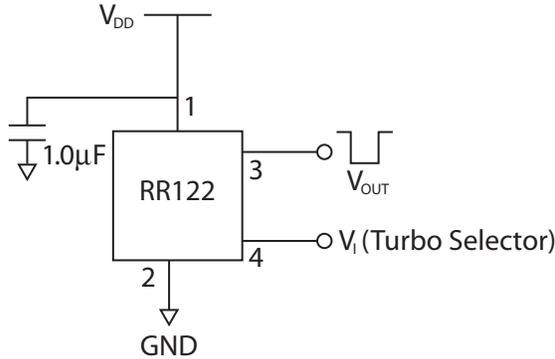


## 6 Application Information

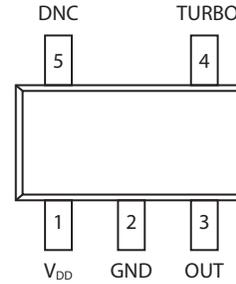
### RR122 Push-Pull Output Application Circuit

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 1.0µF, placed not more than 10 mm from the sensor, is required.

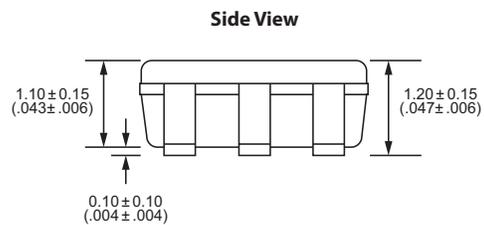
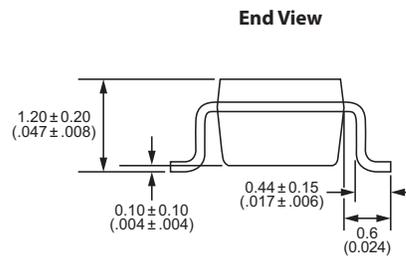
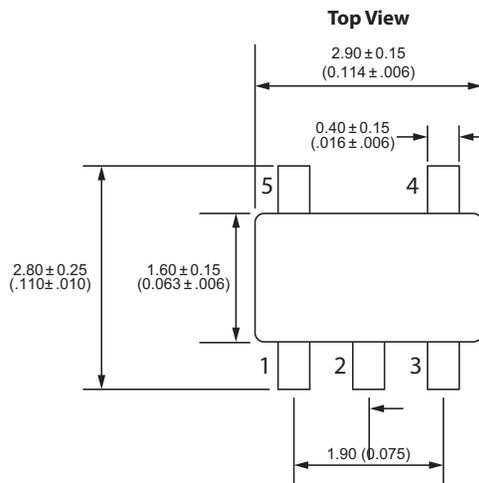
#### 6.1 Application Circuit (SOT-23-5)



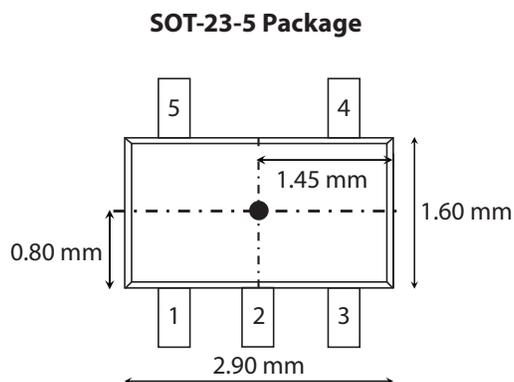
#### 6.2 Package Pinout (SOT-23-5)



## 7 Dimensions SOT-23-5 Package *Millimeters (Inches)*



## 8 TMR Sensor Location



## 9 Sample Frequency Selection for Turbo Mode Trims

Characteristics	Conditions	Sample Frequency
Turbo Pin Input Voltage	$V_i < 0.5\text{ V}$	Base Frequency (100 Hz)
	$V_i > 1.2\text{ V}$	10 kHz

## 10 TMR Sensor & Switch Packaging

### 10.1 SOT-23-5 Tape & Reel Packaging

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

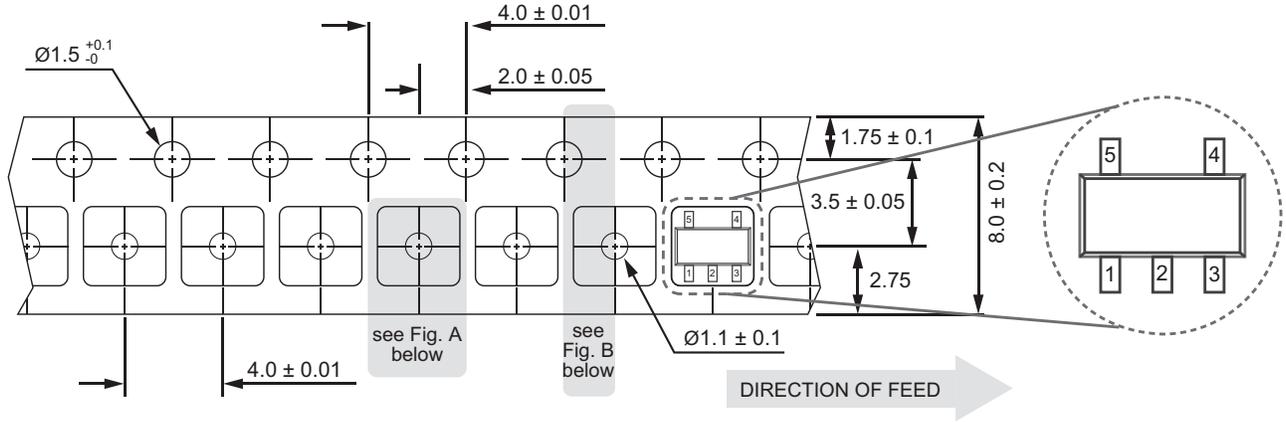


Fig. A

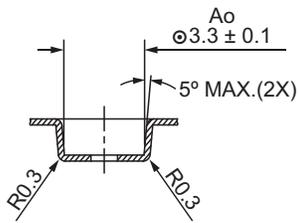
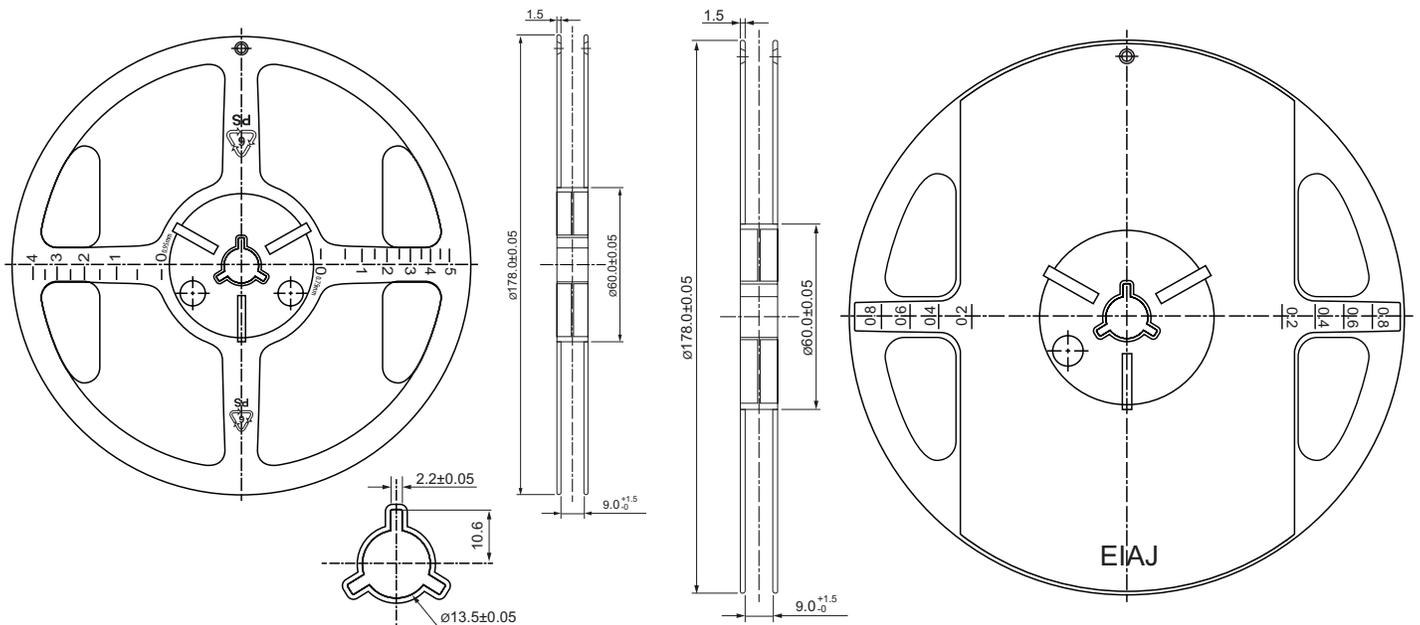
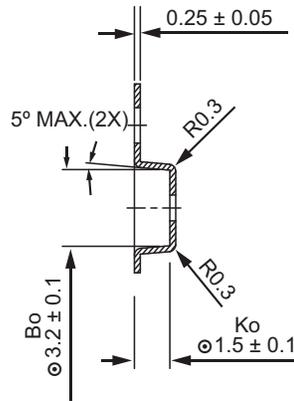


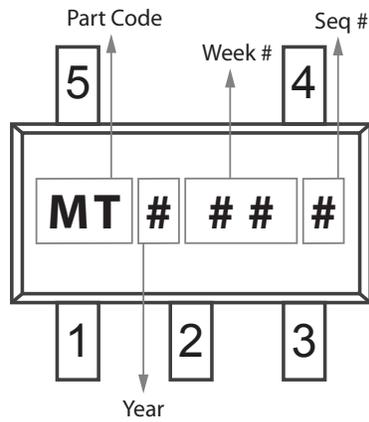
Fig. B



## 10 TMR Sensor & Switch Packaging

### 10.2 RedRock Package Codes

RR122-3CU2-515 (SOT-23-5)  
RR122-3CU3-515 (SOT-23-5)



### 10.3 RedRock TMR Packaging

#### Box Dimensions – 14x10x6 inches

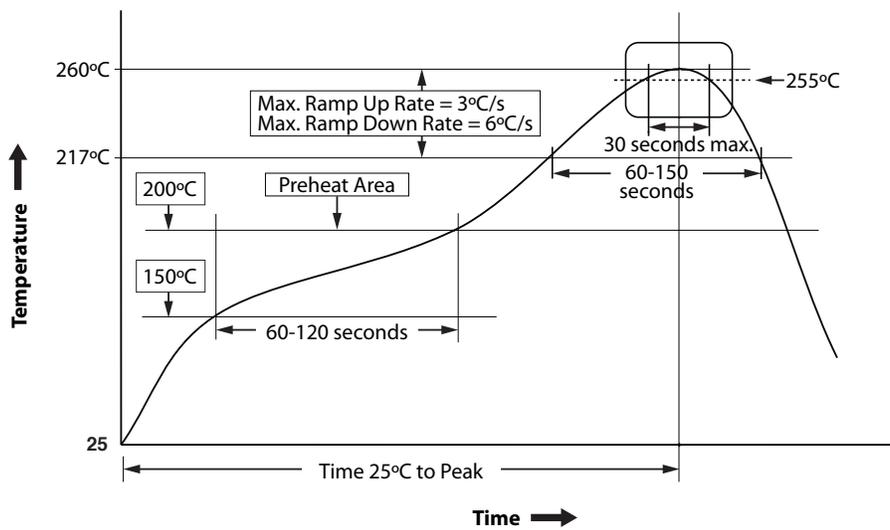
- Fits 1 to 3 reels = 3000 to 9000 pcs
- Weight for 3000 pcs = 0.90 kilos
- Weight for 9000 pcs = 1.00 kilos

#### 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

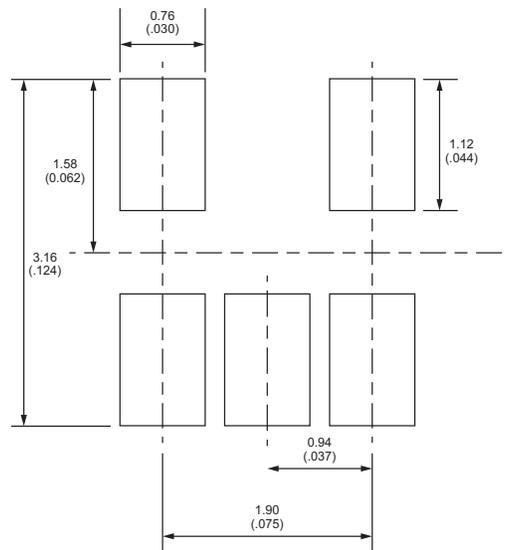
## 11 Suggested Pb-Free Reflow Profile

- 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), Tp shall be within ± 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.
  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.



## 12 Suggested Solder Pad Layout

### SOT-23-5 Solder Pad Layout





## Revision History

	Date	Description
1	09/14/2021	Modified Magnetic Parameters (Table 4.4)
2	09/14/2021	Modified Output Response vs. Magnetic Flux Drawing (Section 5)
3	09/14/2021	Modified Output Behavior vs. Magnetic Field Diagrams (Section 10)
4	10/29/2021	Modified Operate Point and Release Point Values (Table 4.4)
5	12/14/2021	Deleted Superfluous Note 4 on Page 3
6	07/28/2022	Revised/expanded Magnetic Response Section (Section 5)
7	07/28/2022	Removed sections 7 and 10, consolidating information within new Section 5
8	07/28/2022	Modified packaging drawings (10.1)
9	07/28/2022	Added RedRock Package Code section (10.2)
10	07/28/2022	Added Package Pinouts (Section 6)
11	08/02/2022	Modified Active Mode Time (Table 4.4)
12	08/02/2022	Added Supply Voltage Typ. (Table 4.3)
13	08/02/2022	Modified $V_{UVLO-FALL}$ Min. Value (Table 4.3)
14	08/02/2022	Modified Average Supply Current Typ. (Table 4.3)

