

## 1 Description

The RedRock™ RR121 Series is a magnetic sensor with digital push-pull output ideal for use in medical, industrial, automotive, and consumer applications. Based on patented Tunneling Magnetoresistance (TMR) technology with seamless CMOS integration, the RR121 offers multiple configurations of several parameters to enable applications like proximity sensing, rotary sensing, and level detection.

The RR121 features available operate sensitivities from 9 G (0.9 mT) to 70 G (7 mT), and either omnipolar, unipolar, or bipolar magnetic field response. It has the world's lowest average current drain (200 nA) for an active magnetic sensor, as well as operating frequencies up to 10 kHz and high operating temperature ranges from -40°C up to 125°C.

## Device Information

| Part Series | Package      | Body Size (mm)   |
|-------------|--------------|------------------|
| RR121       | SOT-23-3     | 2.9 x 1.6 x 1.2  |
|             | LGA-4        | 1.4 x 1.4 x 0.45 |
|             | Leaded LGA-4 | 1.4 x 1.4 x 0.45 |

## Device Packages



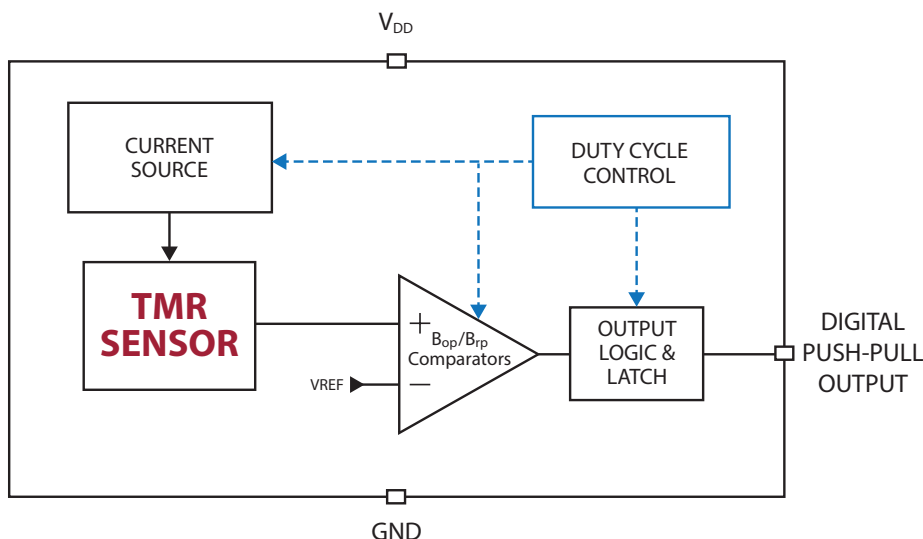
## 2 Features

- ▶ Operate sensitivity from 9 G to 70 G
- ▶ Lowest Average Current < 200 nA
- ▶ Omnipolar, Unipolar and Bipolar Latching Responses Available
- ▶ Operating Frequencies up to 10 kHz
- ▶ 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

## Functional Block Diagram



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## 4 Specifications for all RR121 Series Sensors

### 4.1 Absolute Environmental Ratings for all RR121 Series Sensors<sup>1</sup>

| Parameters                                             | Units | Min   | Typ | Max  |
|--------------------------------------------------------|-------|-------|-----|------|
| Operating Temperature ( $T_{OP}$ )                     | °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 |     |      |
| Magnetic Field Exposure                                | G     |       |     | 2000 |

### 4.2 Absolute Electrical Ratings for all RR121 Series Sensors<sup>1</sup>

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

### 4.3 Operating Electrical Characteristics for all RR121 Series Sensors<sup>2</sup>

| Parameters                                                            | Units | Min          | Typ   | Max          |
|-----------------------------------------------------------------------|-------|--------------|-------|--------------|
| Supply Voltage ( $V_{DD}$ )                                           | V     | +2.7         | +3.0  | +3.6         |
| Output Voltage (High) <sup>3</sup> ( $V_{OUTH}$ )                     | V     | 90% $V_{DD}$ |       |              |
| Output Voltage (Low) <sup>3</sup> ( $V_{OUTL}$ )                      | V     |              |       | 10% $V_{DD}$ |
| 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:

- 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.
- See "Magnetic Field vs. Output Status" for more details.



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 Operating Characteristics for RR121-1B13-311 and RR121-1B13-312<sup>1</sup>

| Parameters                                            | Units   | Min | Typ | Max |
|-------------------------------------------------------|---------|-----|-----|-----|
| Average Supply Current ( $I_{DD(AVG)}$ ) <sup>2</sup> | nA      |     | 200 | 700 |
| Switching Frequency ( $f_{SW}$ )                      | Hz      | 1   | 2   | 4   |
| Active Mode Time ( $t_{ACT}$ )                        | $\mu s$ |     | 1.4 |     |
| Idle Mode Time ( $t_{IDLE}$ )                         | ms      |     | 500 |     |
| Operate Point ( $B_{OPN}$ )                           | G       | 27  | 30  | 38  |
| Operate Point ( $B_{OPS}$ )                           | G       | -38 | -30 | -27 |
| Release Point ( $B_{RPN}$ )                           | G       | 18  | 20  | 27  |
| Release Point ( $B_{RPS}$ )                           | G       | -27 | -20 | -18 |
| Hysteresis ( $B_{HYST}$ ) <sup>3</sup>                | G       | 5   | 10  |     |

### Notes:

1. Unless otherwise specified,  $V_{DD} = 2.7\text{ V}$  to  $3.6\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ . Typical values are  $V_{DD} = 3.0\text{ V}$  and  $T_A = +25^\circ\text{C}$ .

2. Conditions:  $t = 10\text{ seconds}$

3. Conditions:  $B_{HYST} = |B_{OP} - B_{RP}|$

## 6 Operating Characteristics for RR121-1A23-311<sup>1</sup>

| Parameters                                            | Units   | Min | Typ | Max |
|-------------------------------------------------------|---------|-----|-----|-----|
| Average Supply Current ( $I_{DD(AVG)}$ ) <sup>2</sup> | nA      |     | 230 | 700 |
| Switching Frequency ( $f_{SW}$ )                      | Hz      | 7   | 10  | 13  |
| Active Mode Time ( $t_{ACT}$ )                        | $\mu s$ |     | 1.4 |     |
| Idle Mode Time ( $t_{IDLE}$ )                         | ms      |     | 100 |     |
| Operate Point ( $B_{OPN}$ )                           | G       | 8   | 9   | 12  |
| Operate Point ( $B_{OPS}$ )                           | G       | -12 | -9  | -8  |
| Release Point ( $B_{RPN}$ )                           | G       | 3   | 5   | 7   |
| Release Point ( $B_{RPS}$ )                           | G       | -7  | -5  | -3  |
| Hysteresis ( $B_{HYST}$ ) <sup>3</sup>                | G       | 3   | 4   |     |

### Notes:

1. Unless otherwise specified,  $V_{DD} = 2.7\text{ V}$  to  $3.6\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ . Typical values are  $V_{DD} = 3.0\text{ V}$  and  $T_A = +25^\circ\text{C}$ .

2. Conditions:  $t = 10\text{ seconds}$

3. Conditions:  $B_{HYST} = |B_{OP} - B_{RP}|$

## 7 Operating Characteristics for RR121-1F23-311<sup>1</sup>

| Parameters                                            | Units   | Min | Typ | Max |
|-------------------------------------------------------|---------|-----|-----|-----|
| Average Supply Current ( $I_{DD(AVG)}$ ) <sup>2</sup> | nA      |     | 230 | 700 |
| Switching Frequency ( $f_{SW}$ )                      | Hz      | 7   | 10  | 13  |
| Active Mode Time ( $t_{ACT}$ )                        | $\mu s$ |     | 1.4 |     |
| Idle Mode Time ( $t_{IDLE}$ )                         | ms      | 77  | 100 | 143 |
| Operate Point ( $B_{OPN}$ )                           | G       |     | 70  |     |
| Operate Point ( $B_{OPS}$ )                           | G       |     | -70 |     |
| Release Point ( $B_{RPN}$ )                           | G       |     | 50  |     |
| Release Point ( $B_{RPS}$ )                           | G       |     | -50 |     |
| Hysteresis ( $B_{HYST}$ ) <sup>3</sup>                | G       |     | 20  |     |

### Notes:

1. Unless otherwise specified,  $V_{DD} = 2.7\text{ V}$  to  $3.6\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ . Typical values are  $V_{DD} = 3.0\text{ V}$  and  $T_A = +25^\circ\text{C}$ .

2. Conditions:  $t = 10\text{ seconds}$

3. Conditions:  $B_{HYST} = |B_{OP} - B_{RP}|$

## 8 Operating Characteristics for RR121-1B53-311<sup>1</sup>

| Parameters                                            | Units   | Min | Typ | Max |
|-------------------------------------------------------|---------|-----|-----|-----|
| Average Supply Current ( $I_{DD(AVG)}$ ) <sup>2</sup> | $\mu A$ |     | 1.4 | 2.5 |
| Switching Frequency ( $f_{SW}$ )                      | Hz      | 165 | 250 | 300 |
| Active Mode Time ( $t_{ACT}$ )                        | $\mu s$ |     | 1.4 |     |
| Idle Mode Time ( $t_{IDLE}$ )                         | ms      |     | 4.0 |     |
| Operate Point ( $B_{OPN}$ )                           | G       | 27  | 30  | 38  |
| Operate Point ( $B_{OPS}$ )                           | G       | -38 | -30 | -27 |
| Release Point ( $B_{RPN}$ )                           | G       | 18  | 20  | 27  |
| Release Point ( $B_{RPS}$ )                           | G       | -27 | -20 | -18 |
| Hysteresis ( $B_{HYST}$ ) <sup>3</sup>                | G       | 5   | 10  |     |

### Notes:

1. Unless otherwise specified,  $V_{DD} = 2.7\text{ V}$  to  $3.6\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ . Typical values are  $V_{DD} = 3.0\text{ V}$  and  $T_A = +25^\circ\text{C}$ .

2. Conditions:  $t = 10\text{ seconds}$

3. Conditions:  $B_{HYST} = |B_{OP} - B_{RP}|$

## 9 Operating Characteristics for RR121-1A53-311<sup>1</sup>

| Parameters                                            | Units | Min | Typ | Max |
|-------------------------------------------------------|-------|-----|-----|-----|
| Average Supply Current ( $I_{DD(AVG)}$ ) <sup>2</sup> | μA    |     | 1.2 | 2.5 |
| Switching Frequency ( $f_{SW}$ )                      | Hz    | 165 | 250 | 300 |
| Active Mode Time ( $t_{ACT}$ )                        | μs    |     | 1.4 |     |
| Idle Mode Time ( $t_{IDLE}$ )                         | ms    | 3.3 | 4.0 | 6.0 |
| Operate Point ( $B_{OPN}$ )                           | G     | 8   | 9   | 12  |
| Operate Point ( $B_{OPS}$ )                           | G     | -12 | -9  | -8  |
| Release Point ( $B_{RPN}$ )                           | G     | 3   | 5   | 7   |
| Release Point ( $B_{RPS}$ )                           | G     | -7  | -5  | -3  |
| Hysteresis ( $B_{HYST}$ ) <sup>3</sup>                | G     | 3   | 4   |     |

## 10 Operating Characteristics for RR121-1E73-311<sup>1</sup>

| Parameters                                            | Units | Min  | Typ  | Max  |
|-------------------------------------------------------|-------|------|------|------|
| Average Supply Current ( $I_{DD(AVG)}$ ) <sup>2</sup> | μA    |      | 8    | 13   |
| Switching Frequency ( $f_{SW}$ )                      | kHz   | 1.63 | 2.50 | 3.25 |
| Active Mode Time ( $t_{ACT}$ )                        | μs    |      | 1.4  |      |
| Idle Mode Time ( $t_{IDLE}$ )                         | μs    | 308  | 400  | 614  |
| Operate Point ( $B_{OPN}$ )                           | G     | 13   | 15   | 18   |
| Operate Point ( $B_{OPS}$ )                           | G     | -18  | -15  | -13  |
| Release Point ( $B_{RPN}$ )                           | G     | 8    | 10   | 13   |
| Release Point ( $B_{RPS}$ )                           | G     | -13  | -10  | -8   |
| Hysteresis ( $B_{HYST}$ ) <sup>3</sup>                | G     | 3    | 5    |      |

## 11 Operating Characteristics for RR121-1B93-312<sup>1</sup>

| Parameters                                            | Units | Min | Typ | Max |
|-------------------------------------------------------|-------|-----|-----|-----|
| Average Supply Current ( $I_{DD(AVG)}$ ) <sup>2</sup> | μA    |     | 36  |     |
| Switching Frequency ( $f_{SW}$ )                      | kHz   | 7   | 10  | 13  |
| Active Mode Time ( $t_{ACT}$ )                        | μs    |     | 1.4 |     |
| Idle Mode Time ( $t_{IDLE}$ )                         | μs    | 77  | 100 | 143 |
| Operate Point ( $B_{OPN}$ )                           | G     | 27  | 30  | 38  |
| Operate Point ( $B_{OPS}$ )                           | G     | -38 | -30 | -27 |
| Release Point ( $B_{RPN}$ )                           | G     | 18  | 20  | 27  |
| Release Point ( $B_{RPS}$ )                           | G     | -27 | -20 | -18 |
| Hysteresis ( $B_{HYST}$ ) <sup>3</sup>                | G     | 5   | 10  |     |

### Notes:

1. Unless otherwise specified,  $V_{DD} = 2.7\text{ V to }3.6\text{ V}$ ,  $T_A = -40^\circ\text{C to }+125^\circ\text{C}$ . Typical values are  $V_{DD} = 3.0\text{ V}$  and  $T_A = +25^\circ\text{C}$ .

2. Conditions:  $t = 10\text{ seconds}$

3. Conditions:  $B_{HYST} = |B_{OP} - B_{RP}|$

## 12 Operating Characteristics for RR121-2A32-364<sup>1</sup>

| Parameters                                            | Units   | Min | Typ | Max |
|-------------------------------------------------------|---------|-----|-----|-----|
| Average Supply Current ( $I_{DD(AVG)}$ ) <sup>2</sup> | nA      |     | 280 | 700 |
| Switching Frequency ( $f_{SW}$ )                      | Hz      | 12  | 20  | 28  |
| Active Mode Time ( $t_{ACT}$ )                        | $\mu s$ |     | 1.4 |     |
| Idle Mode Time ( $t_{IDLE}$ )                         | ms      | 36  | 50  | 83  |
| Operate Point ( $B_{OPN}$ )                           | G       | 8   | 9   | 12  |
| Operate Point ( $B_{OPS}$ )                           | G       | -12 | -9  | -8  |
| Release Point ( $B_{RPN}$ )                           | G       | 3   | 5   | 7   |
| Release Point ( $B_{RPS}$ )                           | G       | -7  | -5  | -3  |
| Hysteresis ( $B_{HYST}$ ) <sup>3</sup>                | G       | 3   | 4   |     |

## 13 Operating Characteristics for RR121-3C63-311<sup>1</sup>

| Parameters                                            | Units   | Min | Typ | Max |
|-------------------------------------------------------|---------|-----|-----|-----|
| Average Supply Current ( $I_{DD(AVG)}$ ) <sup>2</sup> | $\mu A$ |     | 1.7 | 3.3 |
| Switching Frequency ( $f_{SW}$ )                      | Hz      | 325 | 500 | 600 |
| Active Mode Time ( $t_{ACT}$ )                        | $\mu s$ |     | 1.4 |     |
| Idle Mode Time ( $t_{IDLE}$ )                         | ms      |     | 2.0 |     |
| Operate Point ( $B_{OPS}$ )                           | G       | -14 | -10 | -8  |
| Release Point ( $B_{RPN}$ )                           | G       | 8   | 10  | 14  |

## 14 Operating Characteristics for RR121-3C73-311<sup>1</sup>

| Parameters                                            | Units   | Min  | Typ  | Max  |
|-------------------------------------------------------|---------|------|------|------|
| Average Supply Current ( $I_{DD(AVG)}$ ) <sup>2</sup> | $\mu A$ |      | 8    | 13   |
| Switching Frequency ( $f_{SW}$ )                      | kHz     | 1.63 | 2.50 | 3.25 |
| Active Mode Time ( $t_{ACT}$ )                        | $\mu s$ |      | 1.4  |      |
| Idle Mode Time ( $t_{IDLE}$ )                         | $\mu s$ | 308  | 400  | 614  |
| Operate Point ( $B_{OPS}$ )                           | G       | -14  | -10  | -8   |
| Release Point ( $B_{RPN}$ )                           | G       | 8    | 10   | 14   |

### Notes:

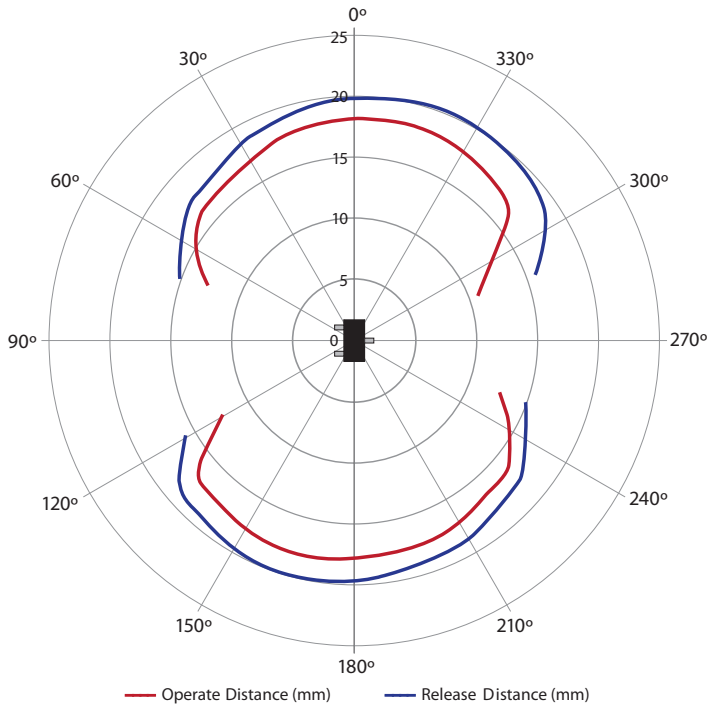
1. Unless otherwise specified,  $V_{DD} = 2.7 \text{ V to } 3.6 \text{ V}$ ,  $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ . Typical values are  $V_{DD} = 3.0 \text{ V}$  and  $T_A = +25^\circ\text{C}$ .
2. Conditions:  $t = 10 \text{ seconds}$
3. Conditions:  $B_{HYST} = |B_{OP} - B_{RP}|$



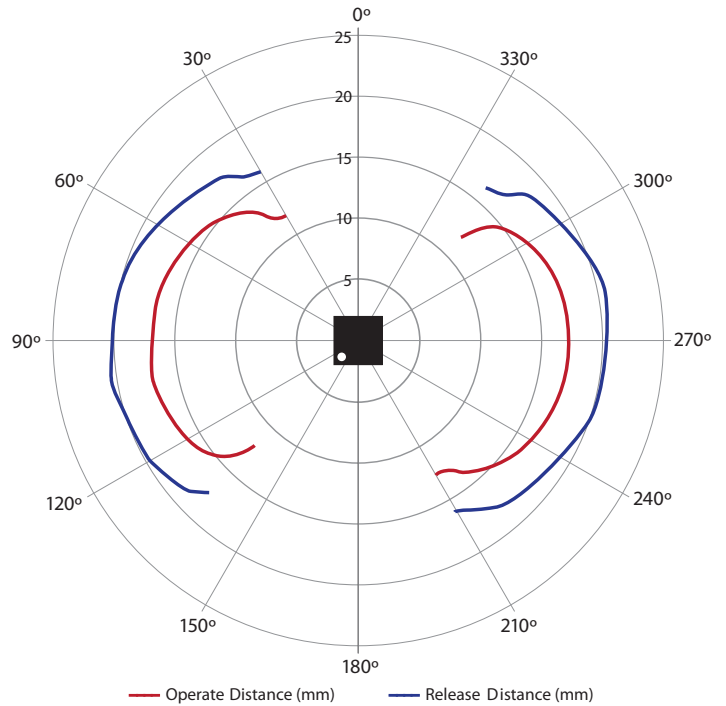
## 15 Operate & Release Lobe Plots

Operate and release distances show are relative. The actual operate and release distances will depend on the type of magnet that is used.

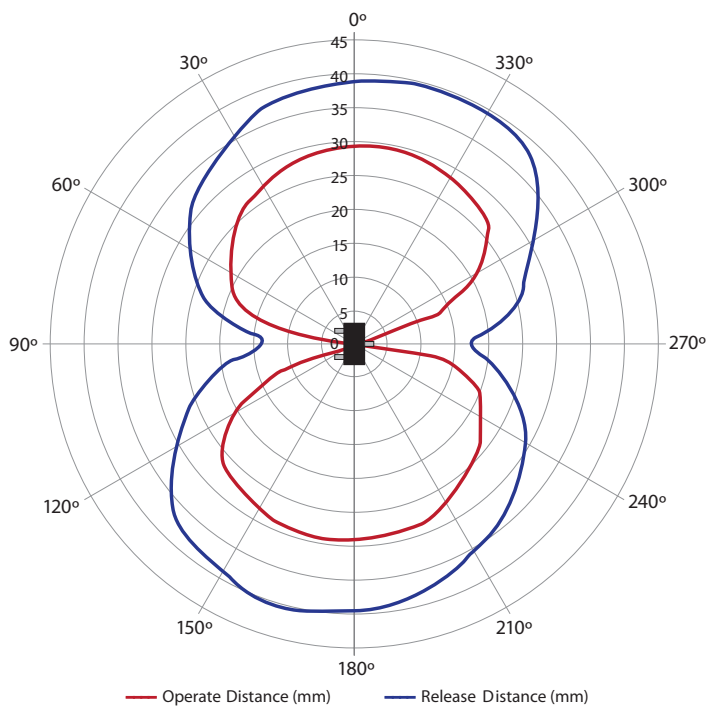
15.1 RR121-1B13-311



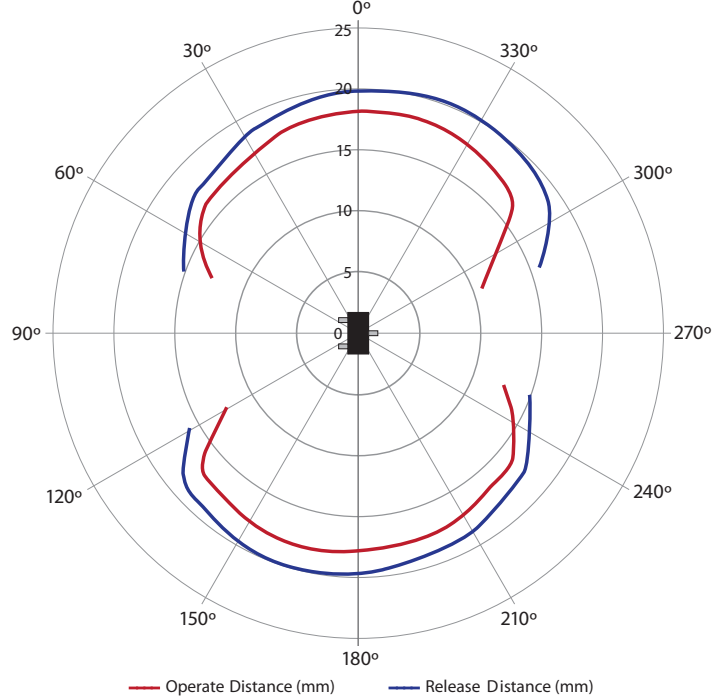
15.2 RR121-1B13-312



15.3 RR121-1A23-311



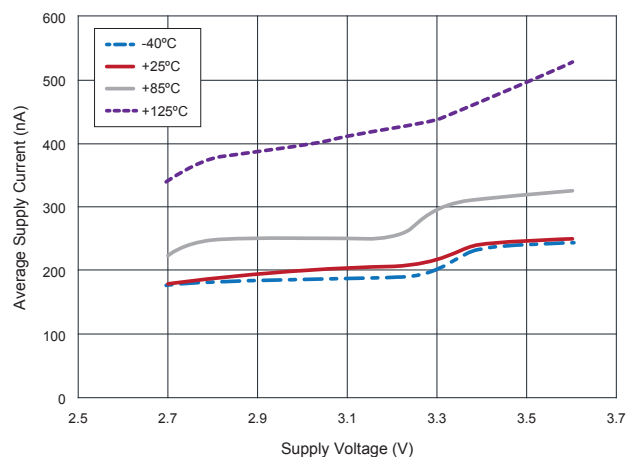
15.4 RR121-1B53-311



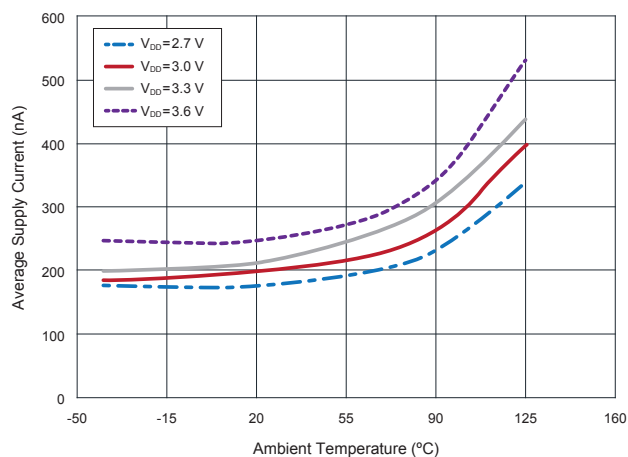
## 16 Graphs - Typical Electrical Characteristics

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

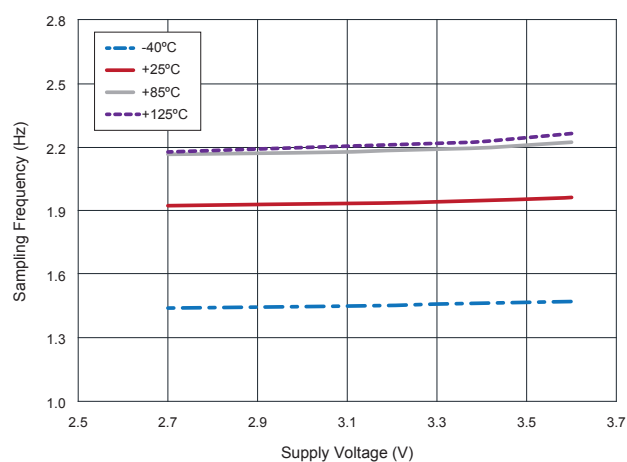
**16.1 RR121-1B13-311 and RR121-1B13-312**  
Average Supply Current vs.  
Supply Voltage vs. Temperature



**16.2 RR121-1B13-311 and RR121-1B13-312**  
Average Supply Current vs.  
Temperature vs. Supply Voltage



**16.3 RR121-1B13-311 and RR121-1B13-312**  
Sampling Frequency vs.  
Supply Voltage vs. Temperature

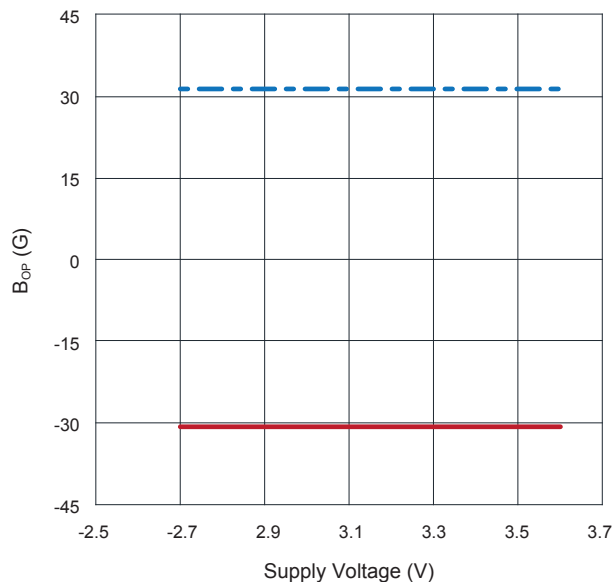


## 16 Graphs - Typical Magnetic Characteristics

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

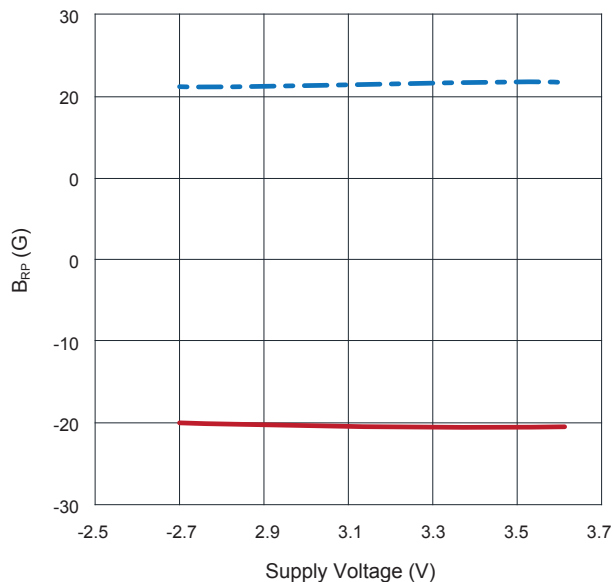
**16.4 RR121-1B13-311 and RR121-1B13-312**

**$B_{OPN}$  (Blue) and  $B_{OPS}$  (Red) vs.  
Supply Voltage at  $+25^\circ\text{C}$**



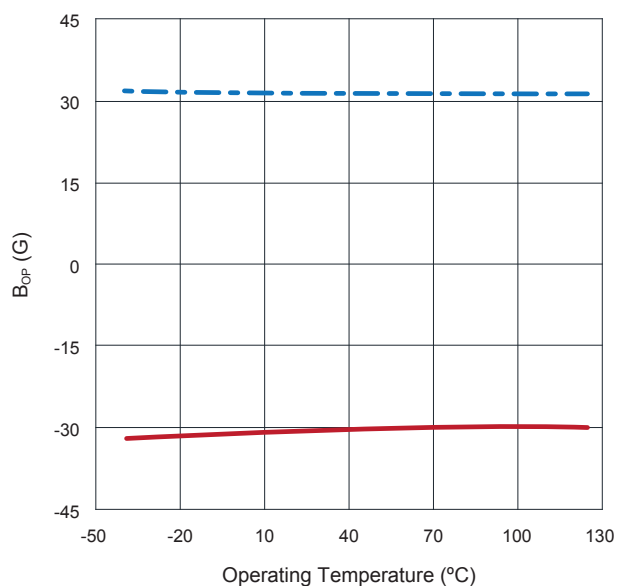
**16.5 RR121-1B13-311 and RR121-1B13-312**

**$B_{RPN}$  (Blue) and  $B_{RPS}$  (Red) vs.  
Supply Voltage at  $+25^\circ\text{C}$**



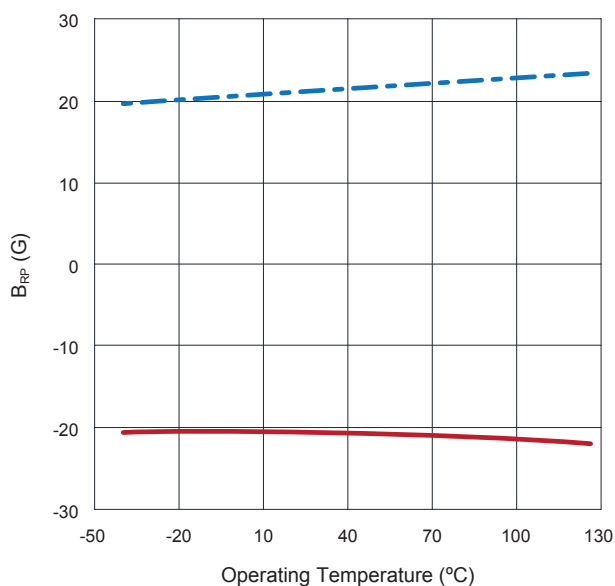
**16.6 RR121-1B13-311 and RR121-1B13-312**

**$B_{OPN}$  (Blue) and  $B_{OPS}$  (Red) vs.  
Operating Temperature at  $V_{DD}=3.0\text{ V}$**



**16.7 RR121-1B13-311 and RR121-1B13-312**

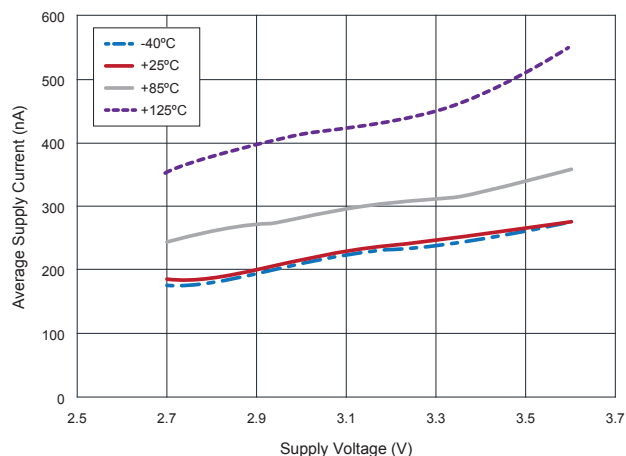
**$B_{RPN}$  (Blue) and  $B_{RPS}$  (Red) vs.  
Operating Temperature at  $V_{DD}=3.0\text{ V}$**



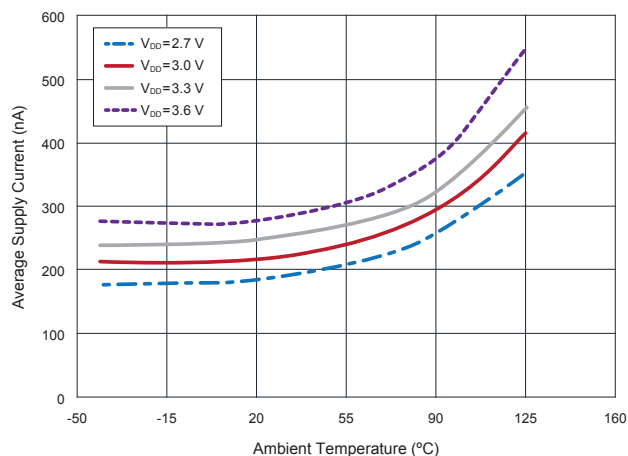
## 16 Graphs - Typical Characteristics

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

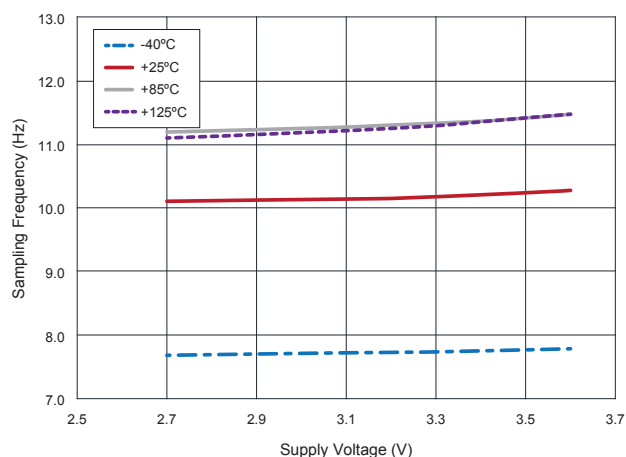
**16.8 RR121-1A23-311 and RR121-1F23-311**  
Average Supply Current vs.  
Supply Voltage vs. Temperature



**16.9 RR121-1A23-311 and RR121-1F23-311**  
Average Supply Current vs.  
Temperature vs. Supply Voltage



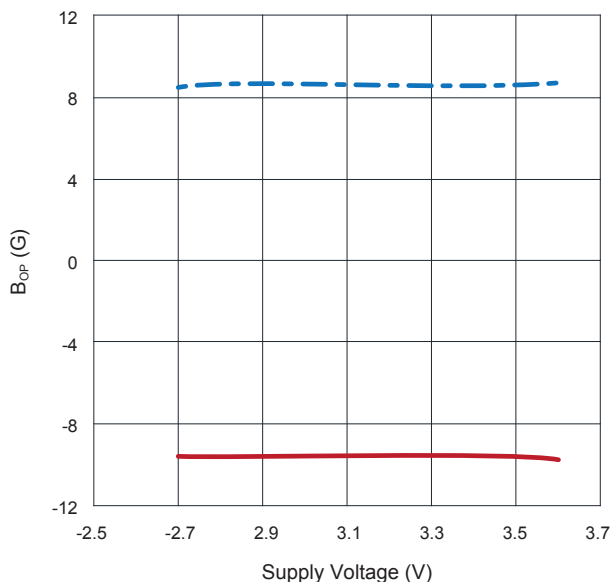
**16.10 RR121-1A23-311 and RR121-1F23-311**  
Sampling Frequency vs.  
Supply Voltage vs. Temperature



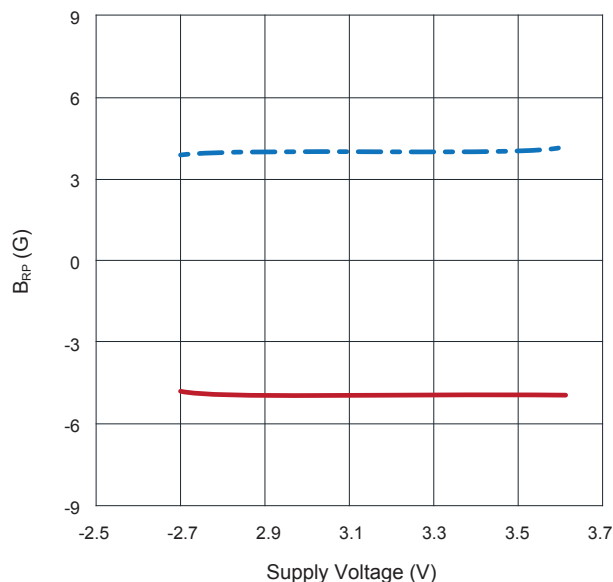
## 16 Graphs - Typical Magnetic Characteristics

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

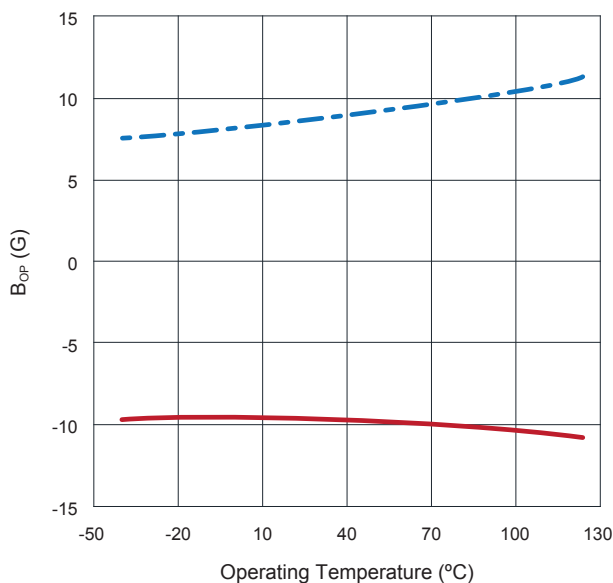
**16.11 RR121-1A23-311**  
 **$B_{OPN}$  (Blue) and  $B_{OPS}$  (Red) vs.**  
**Supply Voltage at  $+25^\circ\text{C}$**



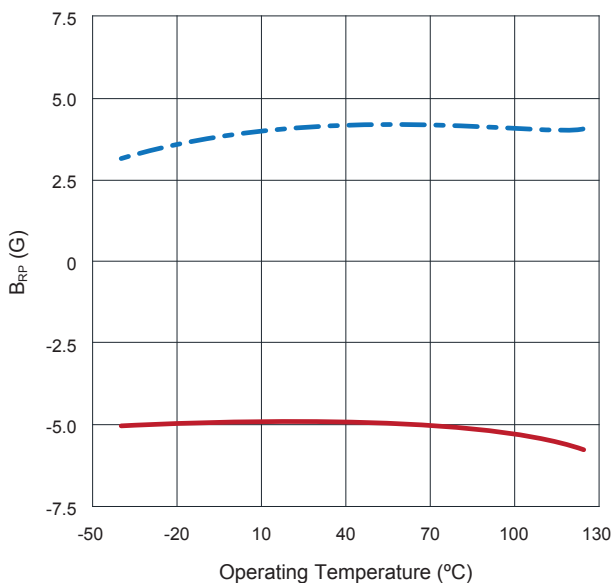
**16.12 RR121-1A23-311**  
 **$B_{RPN}$  (Blue) and  $B_{RPS}$  (Red) vs.**  
**Supply Voltage at  $+25^\circ\text{C}$**



**16.13 RR121-1A23-311**  
 **$B_{OPN}$  (Blue) and  $B_{OPS}$  (Red) vs.**  
**Operating Temperature at  $V_{DD}=3.0\text{ V}$**



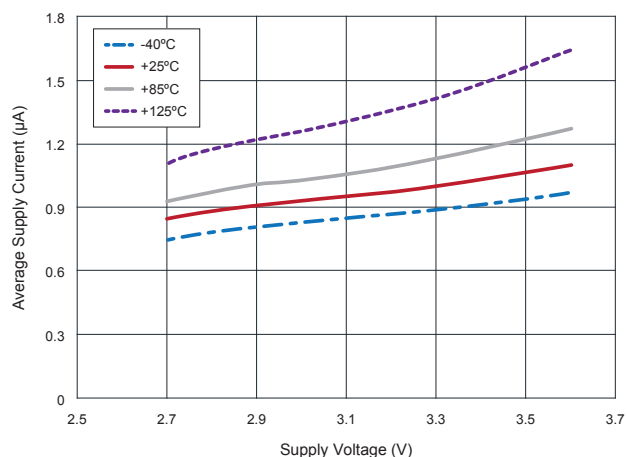
**16.14 RR121-1A23-311**  
 **$B_{RPN}$  (Blue) and  $B_{RPS}$  (Red) vs.**  
**Operating Temperature at  $V_{DD}=3.0\text{ V}$**



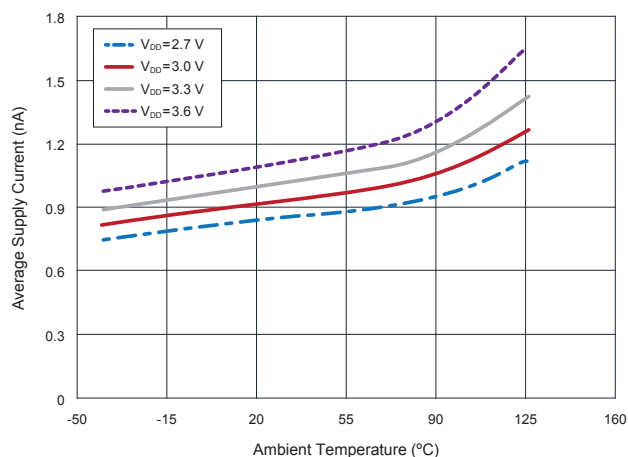
## 16 Graphs - Typical Characteristics

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

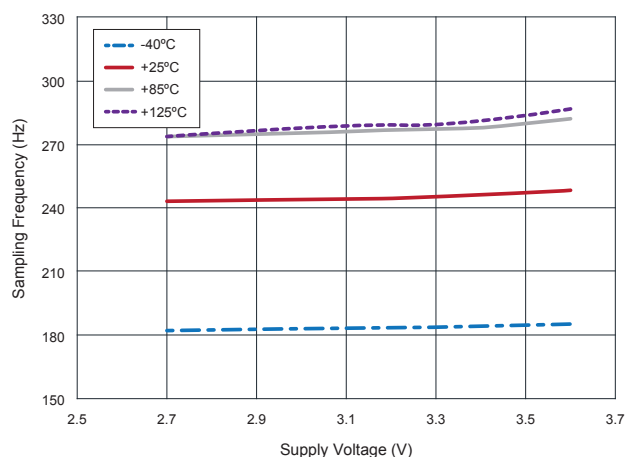
**16.15 RR121-1B53-311 and RR121-1A53-311**  
Average Supply Current vs.  
Supply Voltage vs. Temperature



**16.16 RR121-1B53-311 and RR121-1A53-311**  
Average Supply Current vs.  
Temperature vs. Supply Voltage



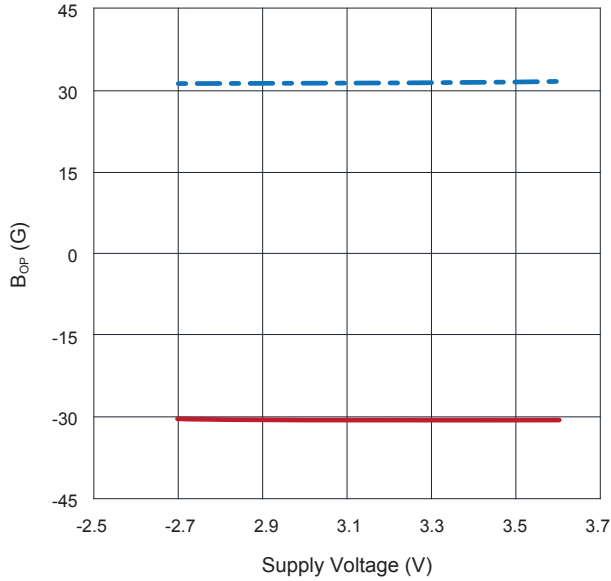
**16.17 RR121-1B53-311 and RR121-1A53-311**  
Sampling Frequency vs.  
Supply Voltage vs. Temperature



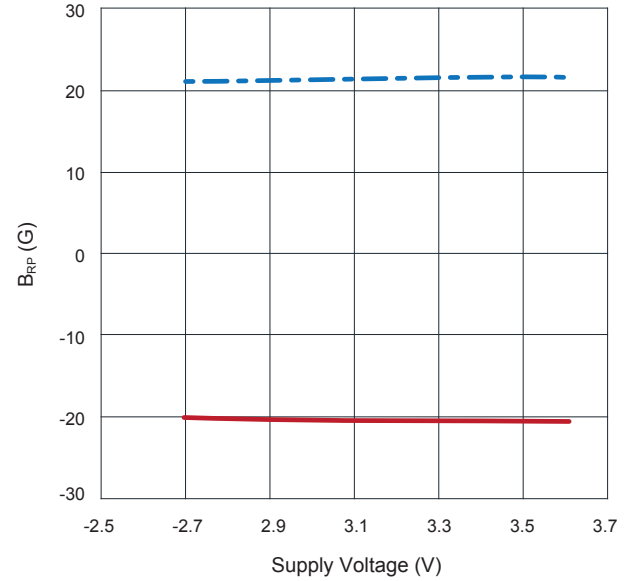
## 16 Graphs - Typical Magnetic Characteristics

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

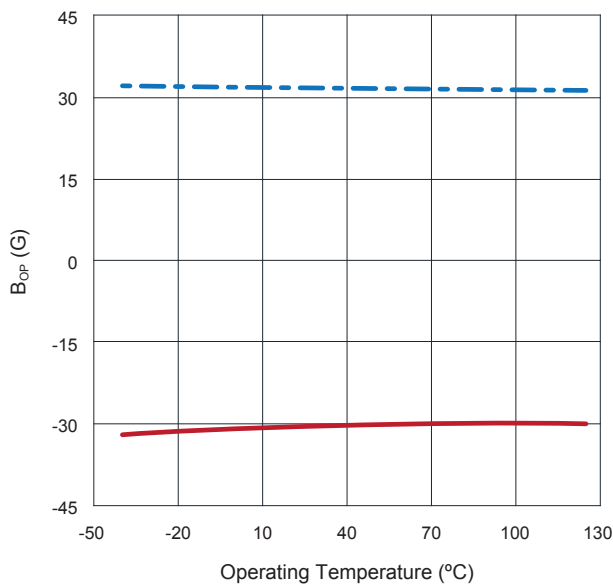
**16.18 RR121-1B53-311**  
 **$B_{OPN}$  (Blue) and  $B_{OPS}$  (Red) vs.**  
**Supply Voltage at  $+25^{\circ}\text{C}$**



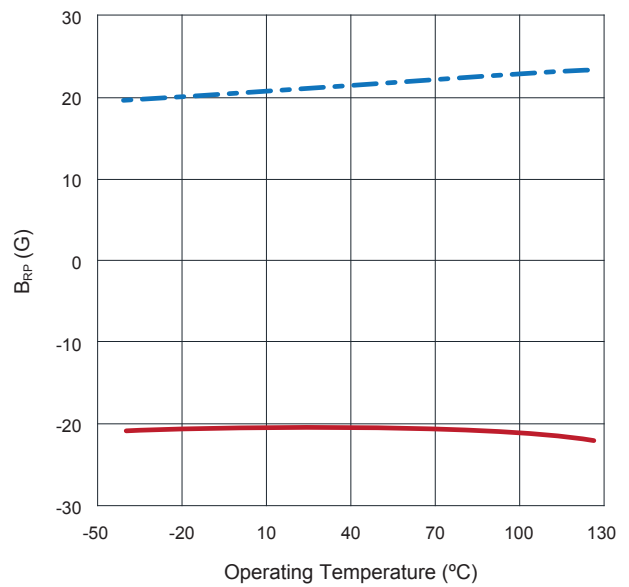
**16.19 RR121-1B53-311**  
 **$B_{RPN}$  (Blue) and  $B_{RPS}$  (Red) vs.**  
**Supply Voltage at  $+25^{\circ}\text{C}$**



**16.20 RR121-1B53-311**  
 **$B_{OPN}$  (Blue) and  $B_{OPS}$  (Red) vs.**  
**Operating Temperature at  $V_{DD}=3.0\text{ V}$**



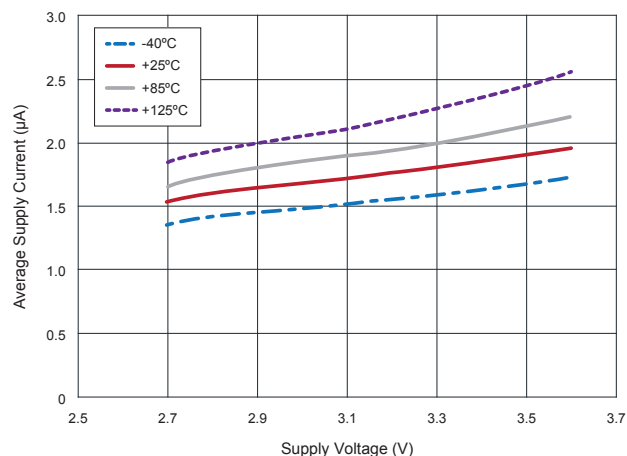
**16.21 RR121-1B53-311**  
 **$B_{RPN}$  (Blue) and  $B_{RPS}$  (Red) vs.**  
**Operating Temperature at  $V_{DD}=3.0\text{ V}$**



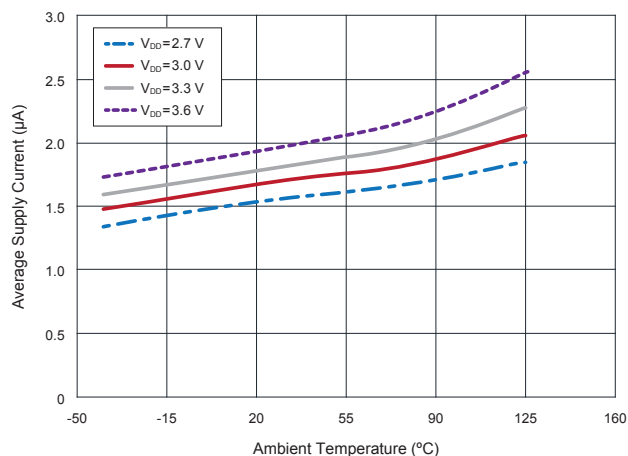
## 16 Graphs - Typical Characteristics

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

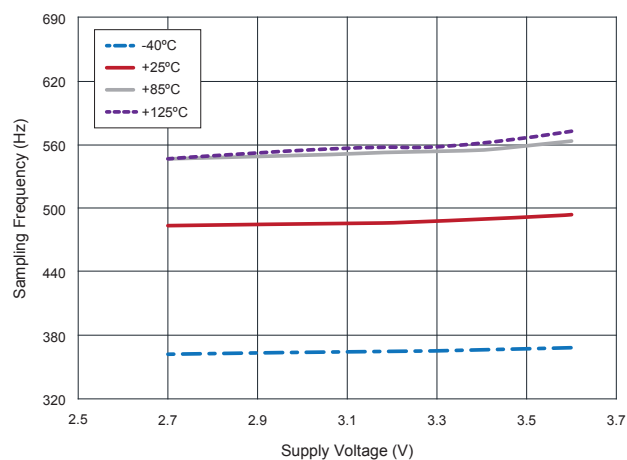
**16.22 RR121-3C63-311**  
Average Supply Current vs.  
Supply Voltage vs. Temperature



**16.23 RR121-3C63-311**  
Average Supply Current vs.  
Temperature vs. Supply Voltage



**16.24 RR121-3C63-311**  
Sampling Frequency vs.  
Supply Voltage vs. Temperature

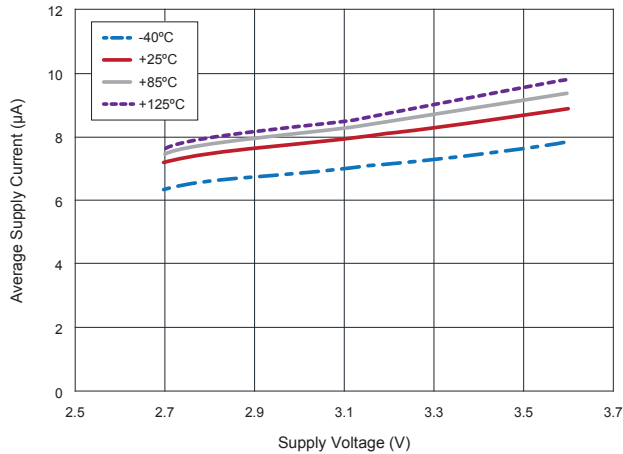




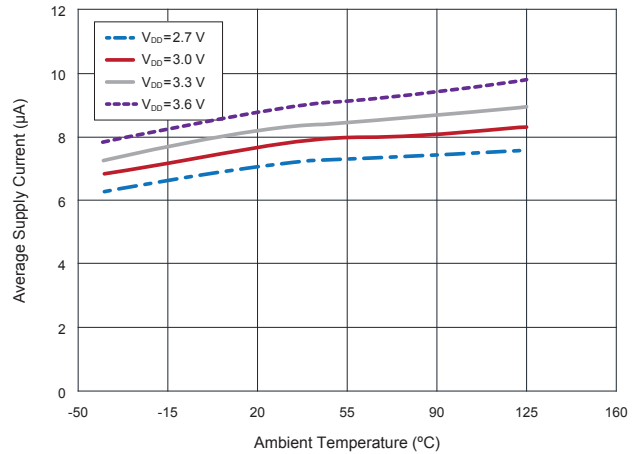
## 16 Graphs - Typical Characteristics

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

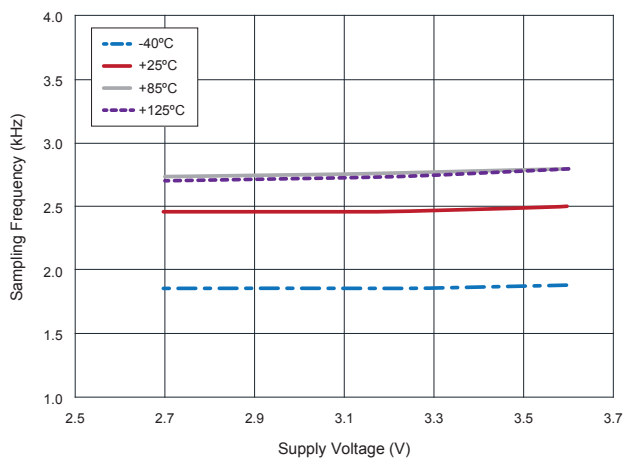
**16.25 RR121-1E73-311 and RR121-3C73-311**  
Average Supply Current vs.  
Supply Voltage vs. Temperature



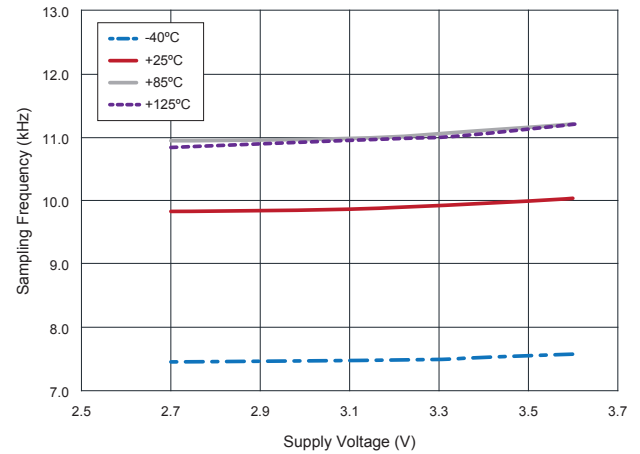
**16.26 RR121-1E73-311 and RR121-3C73-311**  
Average Supply Current vs.  
Temperature vs. Supply Voltage



**16.27 RR121-1E73-311 and RR121-3C73-311**  
Sampling Frequency vs.  
Supply Voltage vs. Temperature



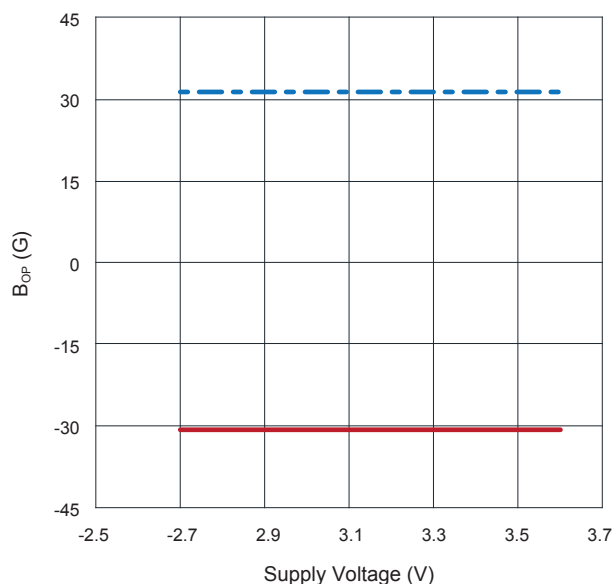
**16.28 RR121-1B93-312**  
Sampling Frequency vs.  
Supply Voltage vs. Temperature



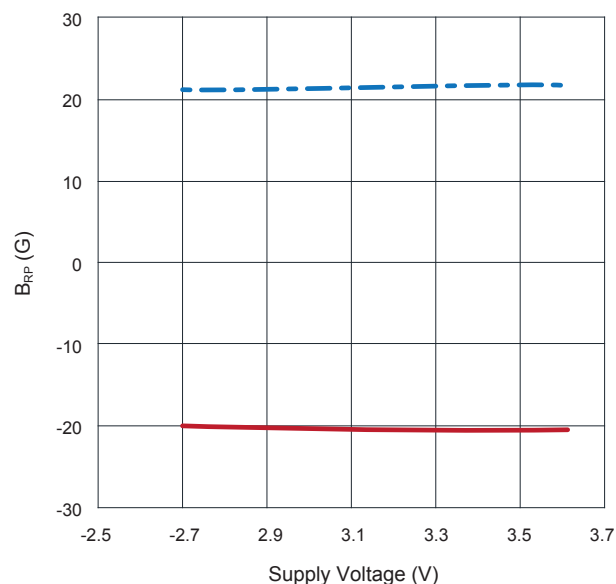
## 16 Graphs - Typical Magnetic Characteristics

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

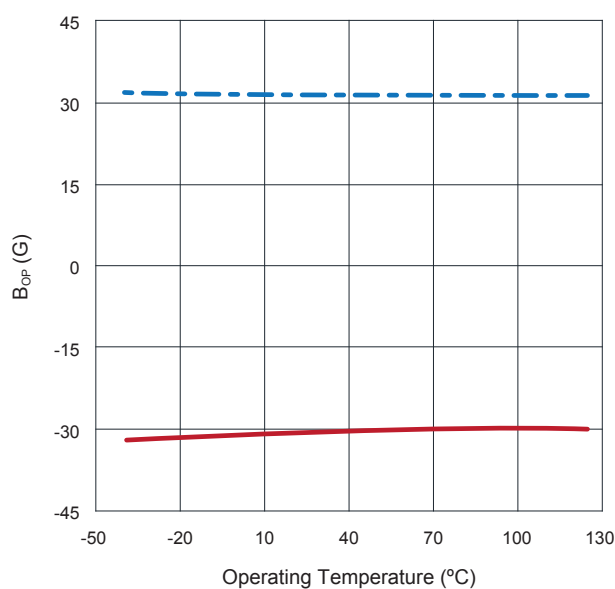
**16.29 RR121-1B93-312**  
 **$B_{OPN}$  (Blue) and  $B_{OPS}$  (Red) vs.**  
**Supply Voltage at  $+25^\circ\text{C}$**



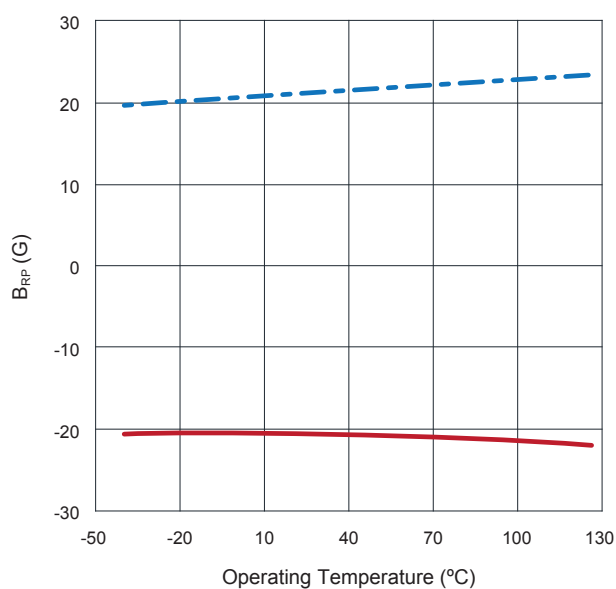
**16.30 RR121-1B93-312**  
 **$B_{RPN}$  (Blue) and  $B_{RPS}$  (Red) vs.**  
**Supply Voltage at  $+25^\circ\text{C}$**



**16.31 RR121-1B93-312**  
 **$B_{OPN}$  (Blue) and  $B_{OPS}$  (Red) vs.**  
**Operating Temperature at  $V_{DD}=3.0\text{ V}$**



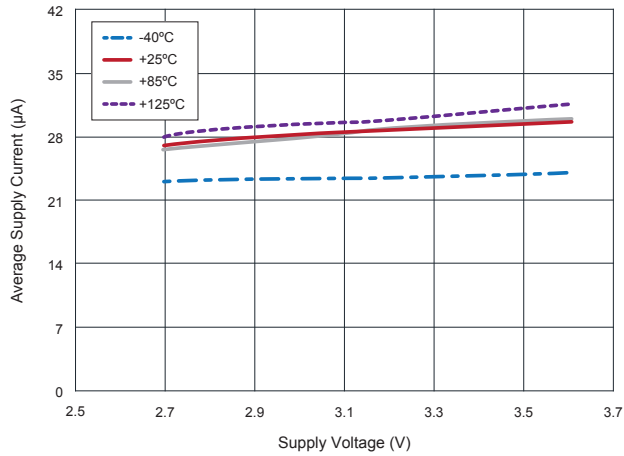
**16.32 RR121-1B93-312**  
 **$B_{RPN}$  (Blue) and  $B_{RPS}$  (Red) vs.**  
**Operating Temperature at  $V_{DD}=3.0\text{ V}$**



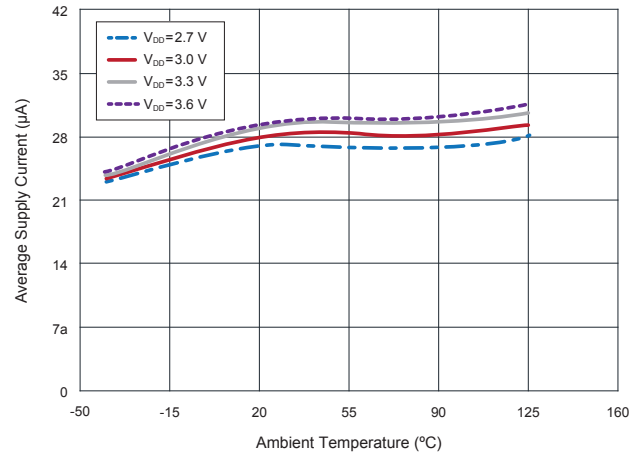
## 16 Graphs - Typical Electrical Characteristics

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

**16.33 RR121-1B93-312**  
Average Supply Current vs.  
Supply Voltage vs. Temperature

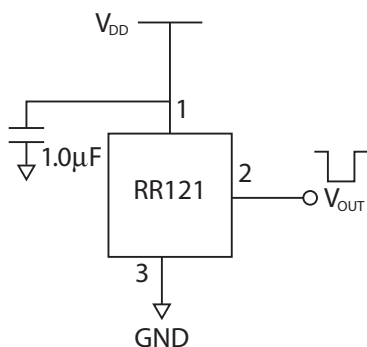


**16.34 RR121-1B93-312**  
Average Supply Current vs.  
Temperature vs. Supply Voltage

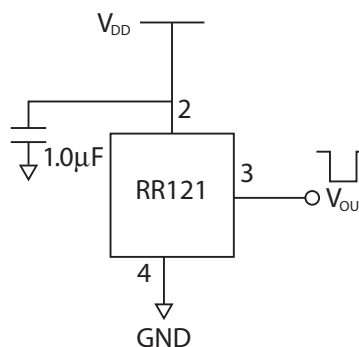


## 17 Application Information

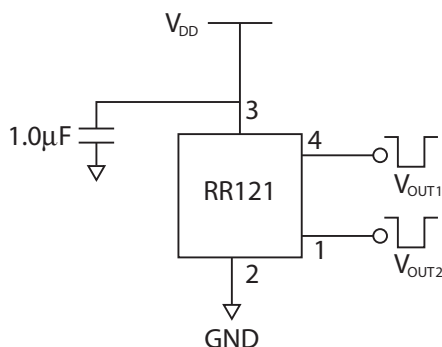
**17.1 Application Circuit  
(SOT-23-3)**



**17.2 Application Circuit  
(LGA-4)**



**17.3 Application Circuit  
(Leaded LGA-4)**



### RR121 Push-Pull Output Application Circuit

The output voltage on the RR121 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 typical capacitor value of 1.0  $\mu\text{F}$  will suffice.

## 18 Part Selection and Ordering Information

### 18.1 Part Selection Table

| Part Number    | Magnetic Polarity Response | Operate Sensitivity (G) | Release Sensitivity (G) | Frequency (Hz) | I <sub>avg</sub> (μA) | Temp. Rating (°C) | Supply Voltage (V <sub>dd</sub> ) | Output Response | Package      |
|----------------|----------------------------|-------------------------|-------------------------|----------------|-----------------------|-------------------|-----------------------------------|-----------------|--------------|
| RR121-1B13-312 | Omnipolar                  | 30                      | 20                      | 2              | 0.20                  | -40 - +125        | 2.7 - 3.6                         | Active Low      | LGA-4        |
| RR121-1B13-311 | Omnipolar                  | 30                      | 20                      | 2              | 0.20                  | -40 - +125        | 2.7 - 3.6                         | Active Low      | SOT-23-3     |
| RR121-1B53-311 | Omnipolar                  | 30                      | 20                      | 250            | 1.44                  | -40 - +125        | 2.7 - 3.6                         | Active Low      | SOT-23-3     |
| RR121-1A23-311 | Omnipolar                  | 9                       | 5                       | 10             | 0.24                  | -40 - +125        | 2.7 - 3.6                         | Active Low      | SOT-23-3     |
| RR121-1F23-311 | Omnipolar                  | 70                      | 50                      | 10             | 0.24                  | -40 - +125        | 2.7 - 3.6                         | Active Low      | SOT-23-3     |
| RR121-1A53-311 | Omnipolar                  | 9                       | 5                       | 250            | 1.44                  | -40 - +125        | 2.7 - 3.6                         | Active Low      | SOT-23-3     |
| RR121-1E73-311 | Omnipolar                  | 15                      | 10                      | 2500           | 8                     | -40 - +125        | 2.7 - 3.6                         | Active Low      | SOT-23-3     |
| RR121-1B93-312 | Omnipolar                  | 30                      | 20                      | 10000          | 36                    | -40 - +125        | 2.7 - 3.6                         | Active Low      | LGA-4        |
| RR121-2A32-364 | Unipolar                   | 9                       | 5                       | 20             | 0.28                  | -40 - +85         | 2.7 - 3.6                         | Dual Active Low | Leaded LGA-4 |
| RR121-3C63-311 | Bipolar                    | -10                     | 10                      | 500            | 1.70                  | -40 - +125        | 2.7 - 3.6                         | Active Low      | SOT-23-3     |
| RR121-3C73-311 | Bipolar                    | -10                     | 10                      | 2500           | 8                     | -40 - +125        | 2.7 - 3.6                         | Active Low      | SOT-23-3     |

#### Note:

- Custom options available for Sensitivity, Frequency, Temperature Rating, Supply Voltage, Output Response & more.  
Please contact [redrock@cotorelay.com](mailto:redrock@cotorelay.com) for more details.

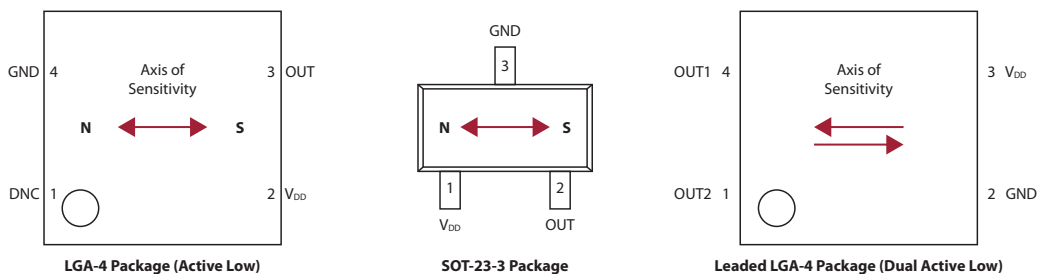
### 18.2 Device Nomenclature

#### Ordering Information

**RR121-X X X X-YYY**

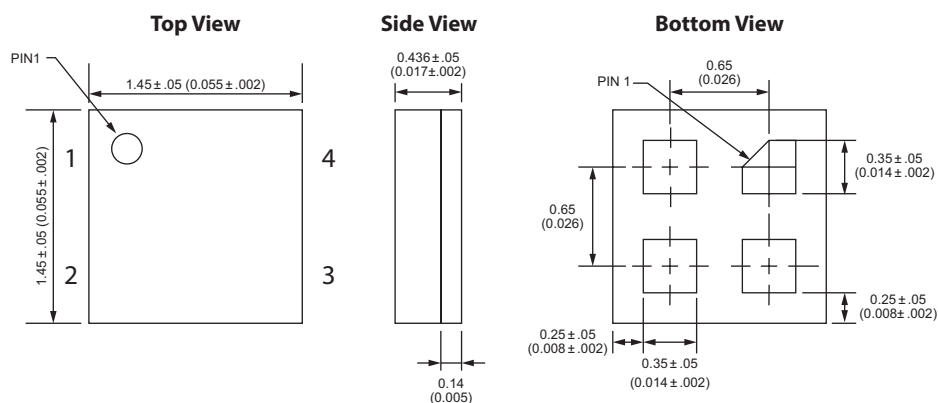
| Series                                                                                                                         | Package                                                                     |
|--------------------------------------------------------------------------------------------------------------------------------|-------------------------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

## 19 Axis of Sensitivity

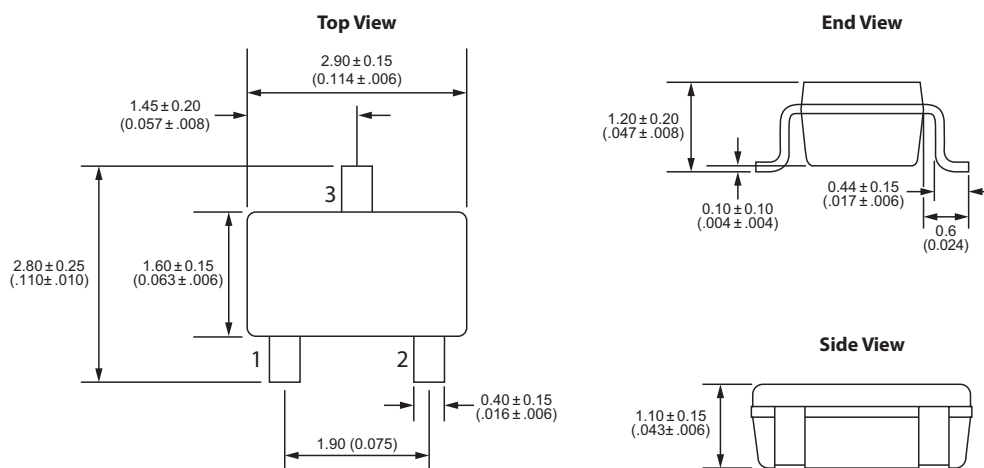


20 Dimensions *Millimeters (Inches)*

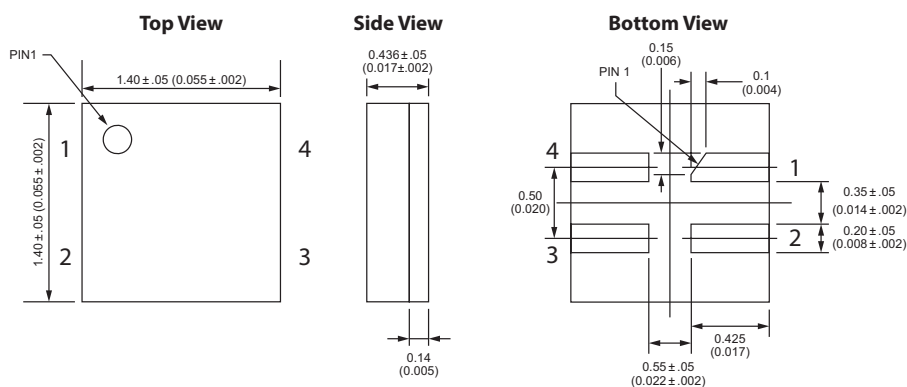
## 20.1 LGA-4 Package



## 20.2 SOT-23-3 Package

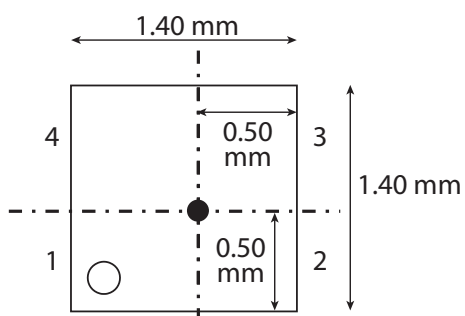


## 20.3 Leaded LGA-4 Package

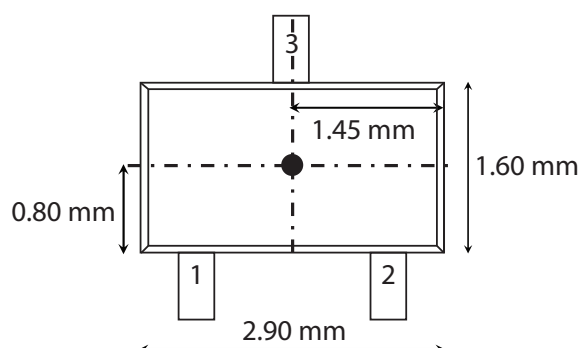


## 21 TMR Sensor Location

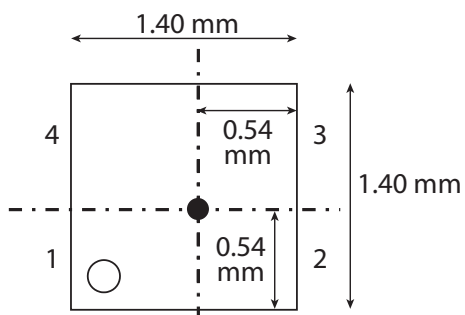
### 21.1 LGA Package



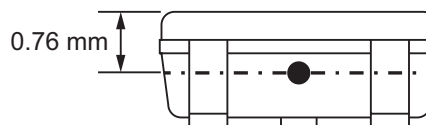
### 21.2 SOT Package



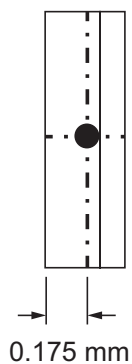
### 21.3 Leaded LGA Package



### 21.4 SOT Package - Side View



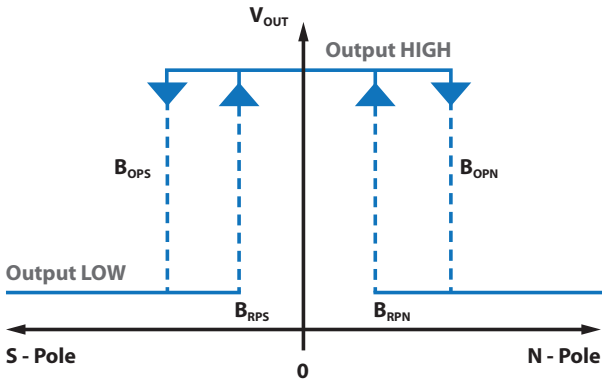
### 21.5 LGA & Leaded LGA Package - Side View



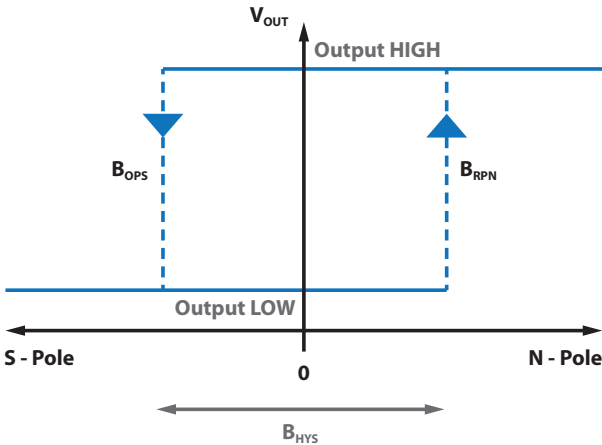


22 Magnetic Flux Response Diagrams

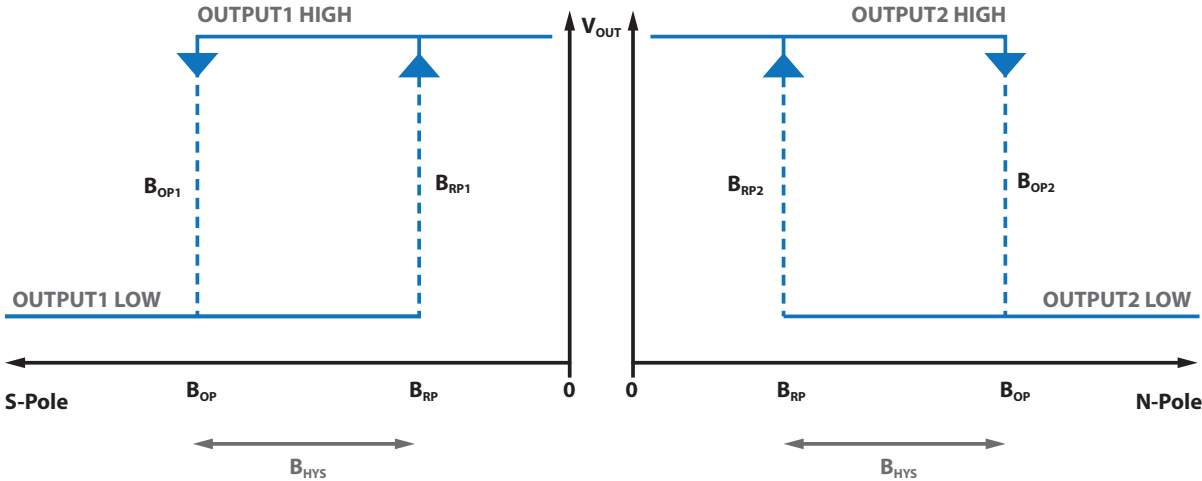
22.1 Omnipolar Magnetic Flux Response  
(Active Low Option)



22.2 Bipolar Magnetic Flux Response  
(Active Low Option)



22.3 Unipolar Magnetic Flux Response  
(Dual Active Low Option)





## 23 Output Behavior vs. Magnetic Field Diagrams

### 23.1 Output Behavior vs. Magnetic Field - Omnipolar

| Characteristics | Conditions                         | Output                 |
|-----------------|------------------------------------|------------------------|
| South Pole      | $B < B_{OPS}$<br>$0 > B > B_{RPS}$ | Low (ON)<br>High (OFF) |
| North Pole      | $B > B_{OPN}$<br>$0 < B < B_{RPN}$ | Low (ON)<br>High (OFF) |

### 23.2 Output Behavior vs. Magnetic Field - Bipolar

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

### 23.3 Output Behavior vs. Magnetic Field - Unipolar (Dual Output)

#### OUTPUT2: North Field

| Characteristics             | Conditions   | Output     |
|-----------------------------|--------------|------------|
| South Field                 | $B > B_{OP}$ | High (OFF) |
| Null or Weak Magnetic Field | $B < B_{RP}$ | High (OFF) |
| North Field                 | $B > B_{OP}$ | Low (ON)   |

#### OUTPUT1: South Field

| Characteristics             | Conditions   | Output     |
|-----------------------------|--------------|------------|
| North Field                 | $B > B_{OP}$ | High (OFF) |
| Null or Weak Magnetic Field | $B < B_{RP}$ | High (OFF) |
| South Field                 | $B > B_{OP}$ | Low (ON)   |

## 24 TMR Sensor & Switch Packaging

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

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

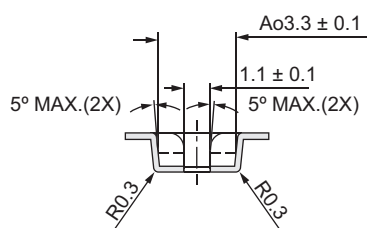
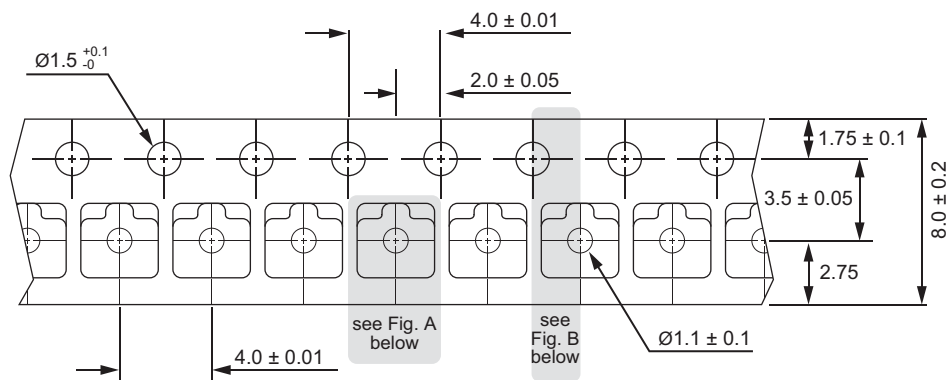


Fig. A

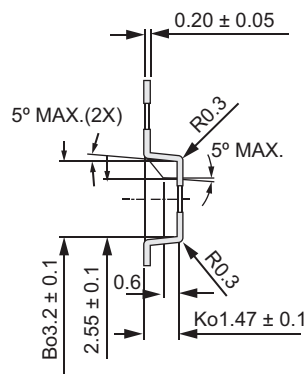
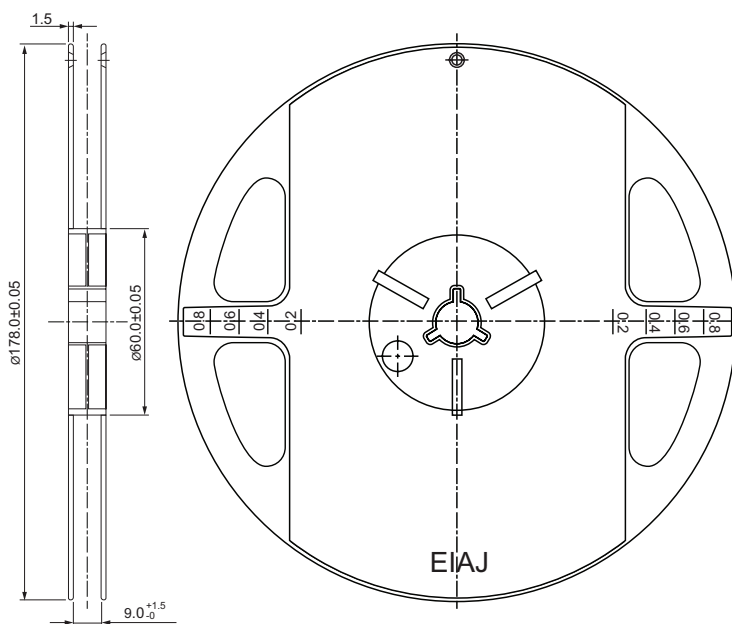
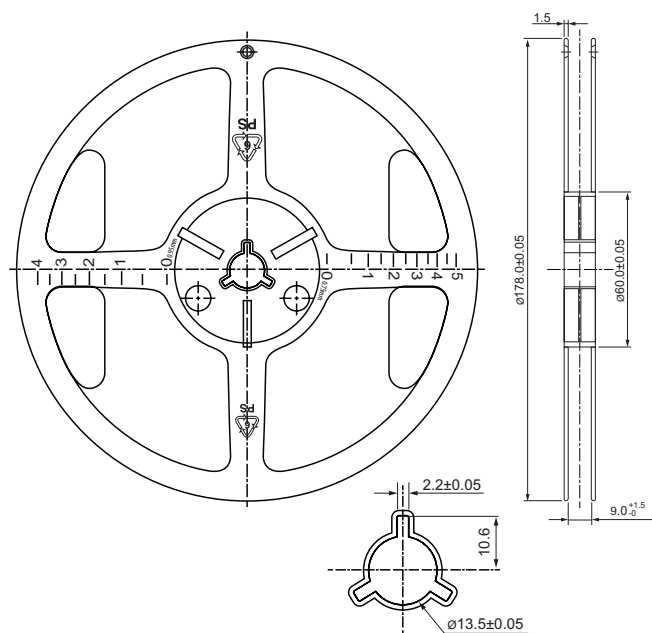


Fig. B



## 24.2 LGA-4 & Leaded LGA-4 Tape & Reel Packaging

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

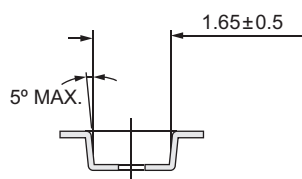


Fig. A

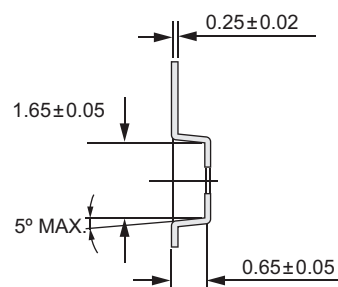
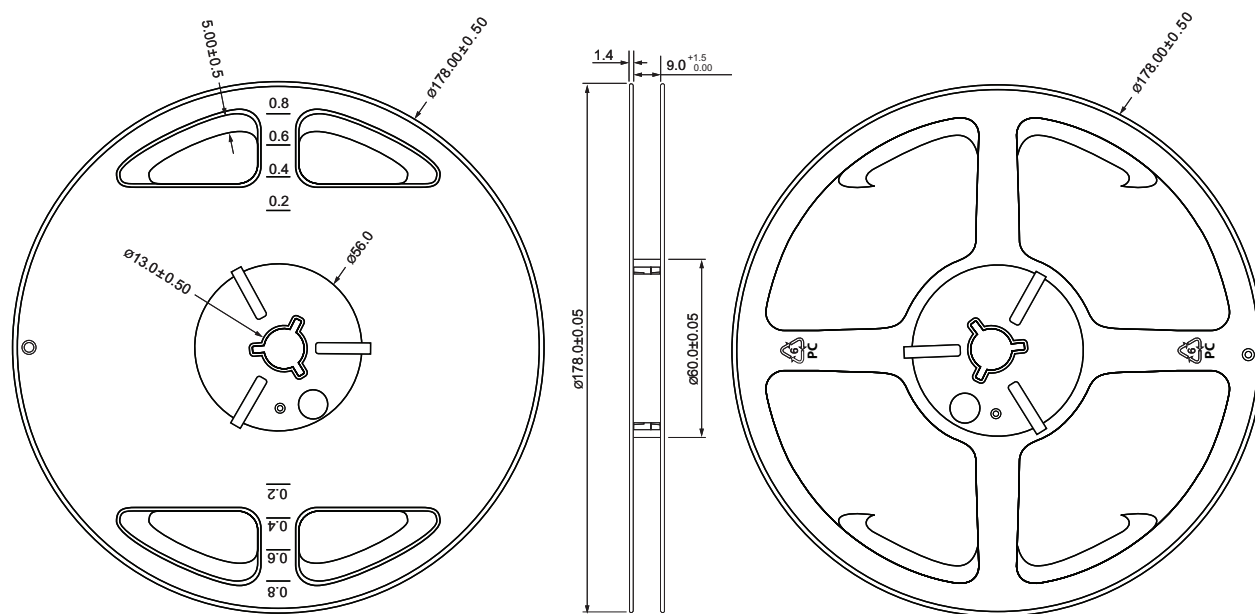


Fig. B



## 24 TMR Sensor & Switch Packaging

### 24.3 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

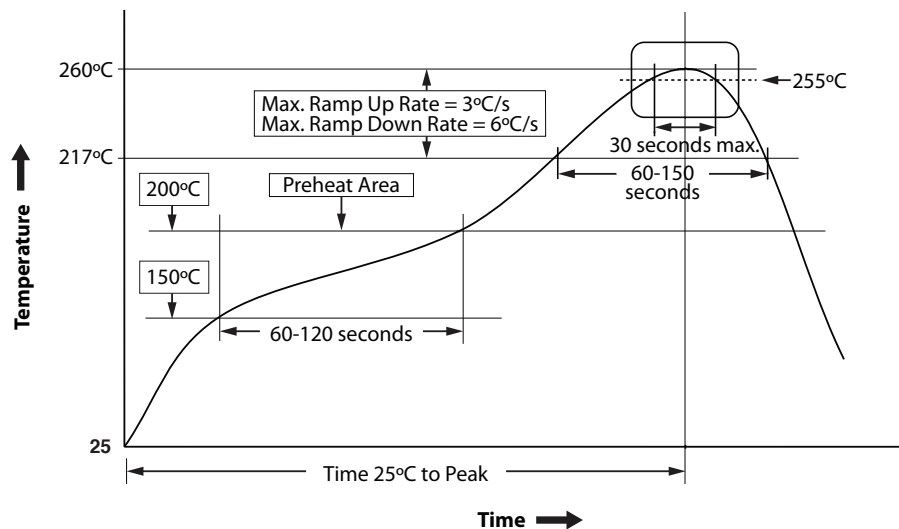
#### Box Dimensions – 18x14x12 inches

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

## 25 Suggested Pb-Free Reflow Profile

#### Notes:

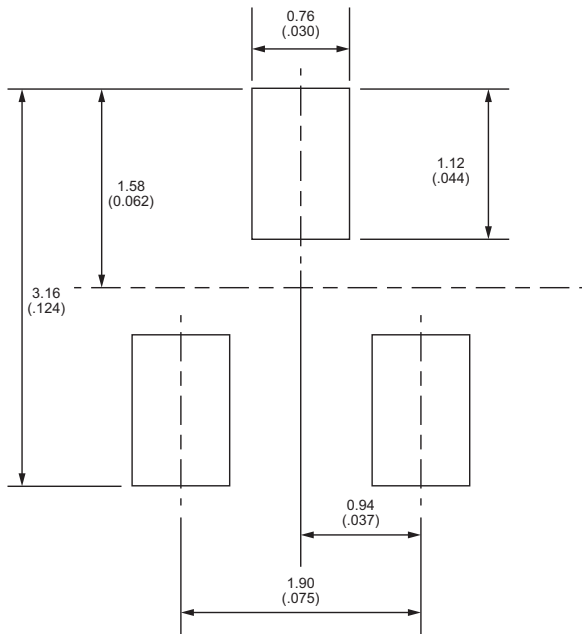
1. Fully compatible with standard no-lead solder profile, 260 °C for 30 seconds max (3 cycles max).
2. Profile shown as example. Users are advised to develop their own board-level profile.
3. Suggested Pb-free reflow profile derived from IPC/JEDEC J-STD-020E.
4. Temperature tolerance: +0 °C, as measured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



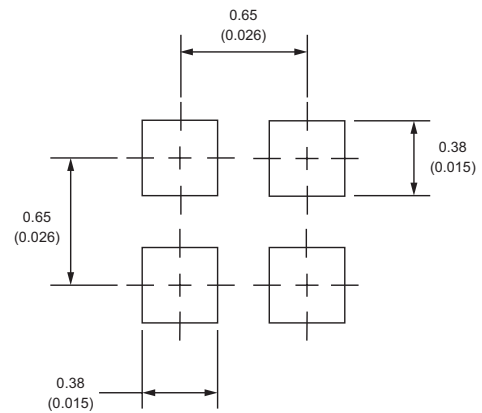
## 26 Suggested Solder Pad Layout

Dimensions in mm (inches)

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



### 26.2 LGA-4 Solder Pad Layout



### 26.3 Leaded LGA-4 Solder Pad Layout

