1 Description

The RedRock® RR142-1L12-542/545 and RR142-1L13-542/545 are multi-channel magnetic sensors with multiple output options ideal for use in medical, industrial, automotive, and consumer applications. Based on patented Tunneling Magnetoresistance (TMR) technology with seamless CMOS integration, the RR142 offers multiple configurations of several parameters to enable applications like proximity sensing, rotary sensing, and level detection.

The RR142-1L12-542/545 and RR142-1L13-542/545 feature both digital and analog channels. The digital channel features an operate sensitivity of 60 G (6 mT) with omnipolar magnetic field response. The analog channel offers a linear voltage output with a wide magnetic sensitivity range from -80 G to +80 G with a sensitivity of 5 mV/V/G. It offers 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. It has the world's lowest average current drain (50 nA) for an active magnetic sensor. The analog channel samples and holds at 100 Hz. The device has a wide operating temperature range of -40°C to 85°C (RR142-1L12-542/545) or -40°C to 125°C (RR142-1L13-532/545).

The RR142 offers an innovative new option to meet the needs of next generation applications. For "wake-up" applications, the analog output functionally is kept inactive until the sensor detects the removal of a nearby magnetic field < Brp). Once awakened, the analog circuitry stays on and continues to provide an output signal until sensor is reset (VDD is < $V_{UVLO-FALL}$). This is particularly ideal for battery-powered, high-precision level and proximity sensing.

2 Features

- Multi channel Outputs: Digital & Analog
- Operate sensitivity of 60 G
- Linear Analog Sensitivity Range from -80 G to +80 G
- Wide Supply Voltage range of 1.7V – 5.5V
- Lowest Average Current of 50 nA
- Omnipolar Push-Pull Response for the Digital Output
- Linear Analog Voltage Response for the Analog Output
- Digital Operating Frequency of 2 Hz
- Analog Operating Frequency of 100 Hz (Sample & Hold)
- Temperature Rated up to 125°C
- RoHS & REACH Compliant

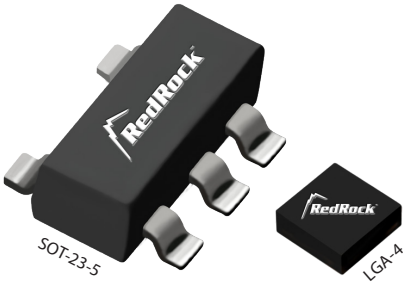
3 Applications

- Proximity Detection
- Rotary Sensing
- Fluid Level Detection
- Door & Lid Closure Detection
- Utility Meters
- Portable Medical Devices
- Motor Controllers
- Consumer Electronics
- Wake-Up µProcessor

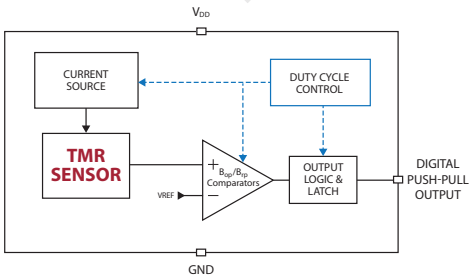
Device Information

Part Series	Package	Body Size (mm)	Temp Rating °C
RR142-1L12-542	LGA-4	1.45 x 1.45 x 0.44	-40 – +85
RR142-1L12-545	SOT-23-5	2.9 x 1.6 x 1.2	-40 – +85
RR142-1L13-542	LGA-4	1.45 x 1.45 x 0.44	-40 – +125
RR142-1L13-545	SOT-23-5	2.9 x 1.6 x 1.2	-40 – +125

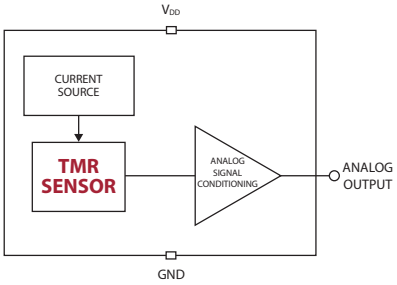
Device Packages



Functional Block Diagram for Digital Push-Pull Output



Functional Block Diagram for Analog Output



Device Nomenclature

Ordering Information

RR142-1 L 1 X-5 4 X

Series

Magnetic Polarity Response
1 = Omnipolar

Push-Pull Magnetic Sensitivity (G)
L: Op 60, Rel 40

Clock Frequency (Hz)
(Digital Only Mode)
1: 2

Package
2: LGA-4
5: SOT-23-5

Output Response
4: Active Low + Analog on "Wake Up"

Supply Voltage (V)
5: 1.7 – 5.5

Temp Rating (°C)
2: -40 – +85
3: -40 – +125

4 Specifications

4.1 Absolute Environmental Ratings[1]

Parameters	Units	Min	Typ	Max
Operating Temperature (T_{OP}) (RR122-1L12-542/545)	°C	-40		+85
Operating Temperature (T_{OP}) (RR122-1L13-542/545)	°C	-40		+125
Storage Temperature (T_{STG})	°C	-65		+150
Junction Temperature (T_J)	°C	-40		+150
Soldering Temperature (3 cycles, 1 min.) (T_{SOL})	°C			+260
ESD Level Human Body Model per JESD22-A114	V	±4000		
ESD Charged Device Model (CDM) per JESD22-C101	V	±500		
Maximum Magnetic Field Exposure (B_{MAX})	G			±2000

4.2 Absolute Electrical Ratings[1]

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 (V_{IN}/I_{OUT})	mA			±20

4.3 Operating Electrical Characteristics for all RR142 Series Sensors[2]

Parameters	Units	Min	Typ	Max
Supply Voltage (V_{DD})	V	1.7	3.0	5.5
Push-Pull Output Voltage (High)	V	90% V_{DD}		
Push-Pull Output Voltage (Low)	V			10% V_{DD}
Power-On Time (t_{ON})(V_{DD} > 1.7V)	µs		50	75
Under Voltage Lockout Threshold Rising V_{DD} ($V_{UVLO-RISE}$)	V		1.6	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	

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, V_{DD} = 1.7 V to 5.5 V, T_A = -40°C to +85°C (1L12), -40°C to +125°C (1L13). Typical values are V_{DD} = 3.0 V and T_A = +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 RR142-1L12-542/545 & RR142-1B13-542/545[1]

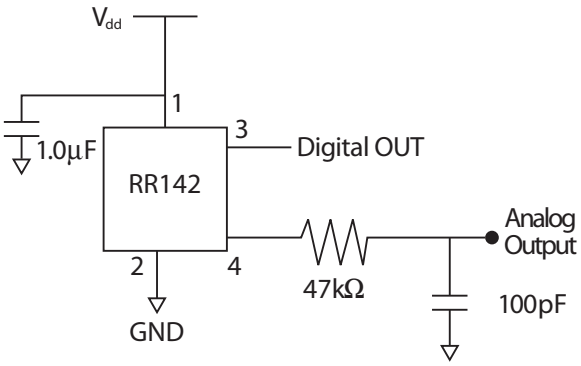
Parameters	Units	Min	Typ	Max
DIGITAL MODE (Only Digital Output is Active)				
Switching Frequency (f_{SW})	Hz	1	2	4
Idle Mode Time (t_{idle})	ms		500	
Average Supply Current @ V_{DD} = 1.7V, f_{SW} = 2 Hz ($I_{DD\ (AVG)}$)[2]	nA		50	
Average Supply Current @ V_{DD} = 3.0V, f_{SW} = 2 Hz ($I_{DD\ (AVG)}$)[2]	nA		60	
Operate Point (B_{OPN})	G	53	60	67
Operate Point (B_{OPS})	G	-67	-60	-53
Release Point (B_{RPN})	G	35	40	45
Release Point (B_{RPS})	G	-45	-40	-35
ANALOG MODE (Analog & Digital Output is Active)				
Sampling/Switching Frequency (f_{SW})	Hz		100	
Idle Mode Time (t_{idle})	ms		10	
Average Supply Current @ V_{DD} = 1.7V, f_{SW} = 100 Hz ($I_{DD\ (AVG)}$)[2]	µA		1.2	
Average Supply Current @ V_{DD} = 3.0V, f_{SW} = 100 Hz ($I_{DD\ (AVG)}$)[2]	µA		1.5	
Analog Output Magnetic Field Range (B_{ANA})	G	±54	±80	±100
Analog Output Magnetic Sensitivity @ T = +25°C (T_A = +25°C)	G	-3.5	-5.0	-6.5
Analog Output Sensitivity @ Full Temperature	G		-5	
Analog Output Voltage Range (V_{ANA})	V	0.1 x V_{DD}		0.9 x V_{DD}
Analog Output Quiescent (V_{OQ})	%V_{DD}	45	50	55
Analog Output Capacitive Load	V			10pF
Analog Output Maximum Drive Capability	V			±10

Notes:

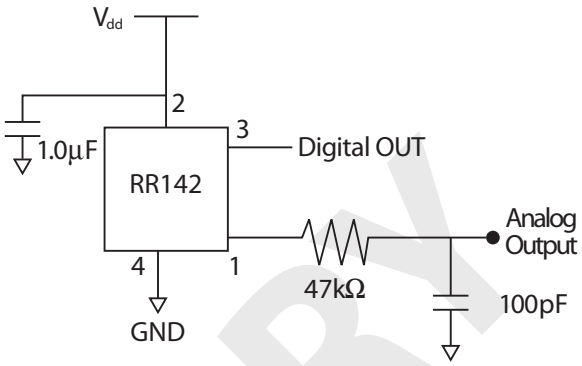
1. Unless otherwise specified, V_{DD} = 1.7 V to 5.5 V, T_A = -40°C to +85°C (1L12), -40°C to +125°C (1L13). Typical values are V_{DD} = 3.0 V and T_A = +25°C.
2. Conditions: t = 10 seconds

5 Application Information

5.1 Application Circuit (SOT-23-5)



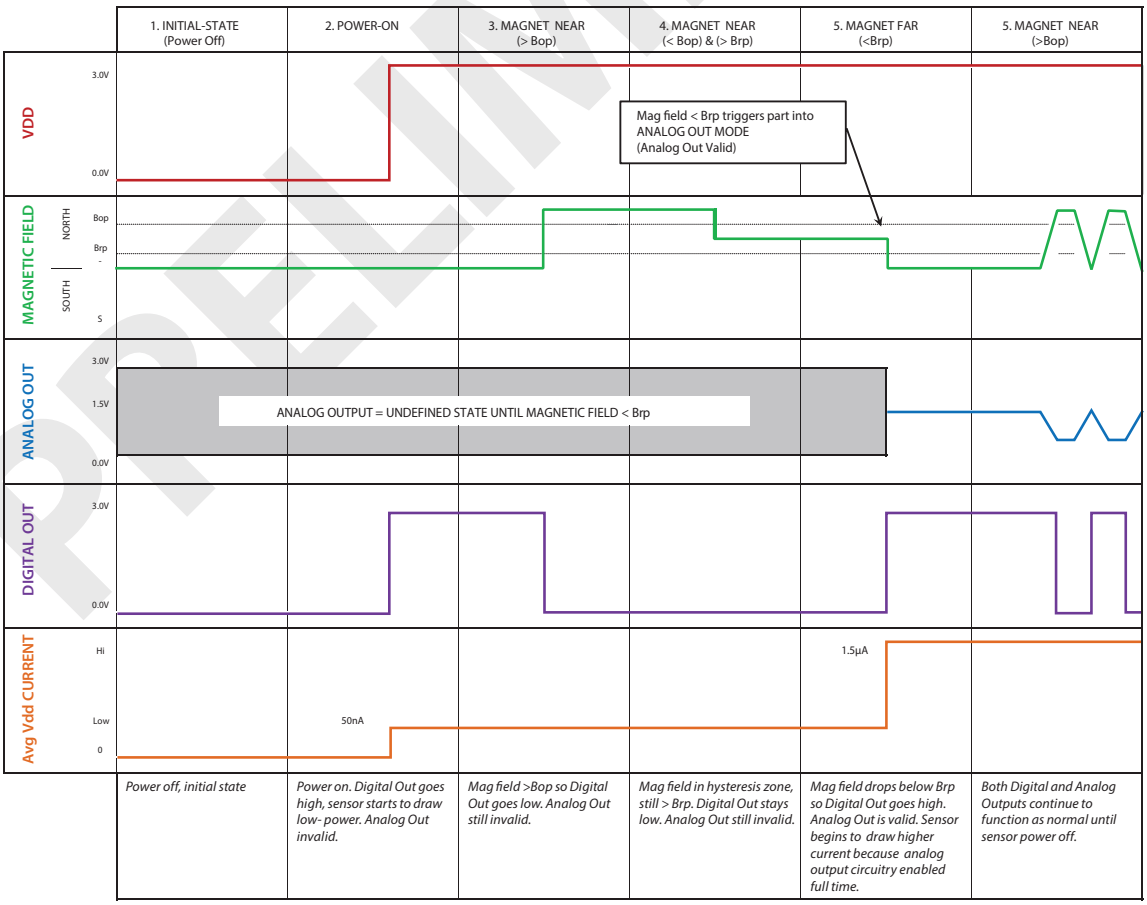
5.2 Application Circuit (LGA-4)



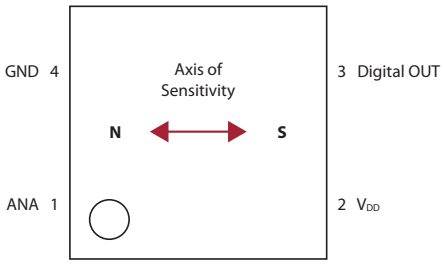
RR142 Output Application Circuit
The output voltage can be connected to an analog I/O pin on a microcontroller. The analog output voltage is proportional to the strength of an applied magnetic field. A simple RC filter is recommended at the output. A resistor value of 47kΩ and a capacitor value of 100 pF should suffice. A decoupling capacitor with a minimum value of 1.0 µF placed within 10 mm of the sensor is required.

6 RedRock RR142 Series Dual Output Behavior Diagram

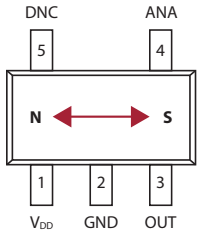
Sensor Frequency = 10Hz in Digital Mode, 100Hz in Analog Mode



8 Axis of Sensitivity *(Top View)*



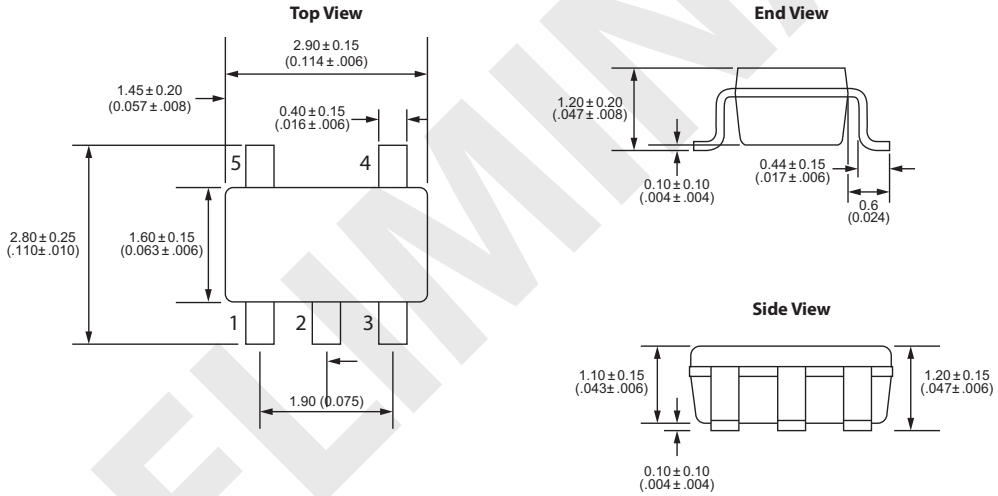
LGA-4 Package



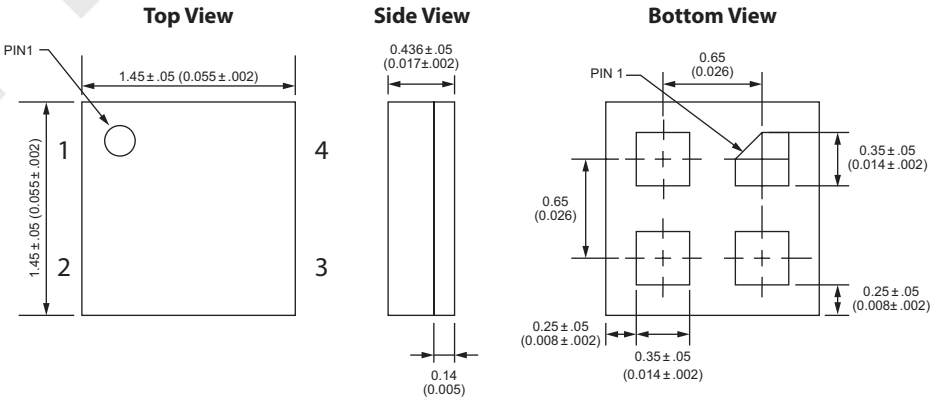
SOT-23-5 Package

9 Dimensions *Millimeters (Inches)*

9.1 SOT-23-5 Package

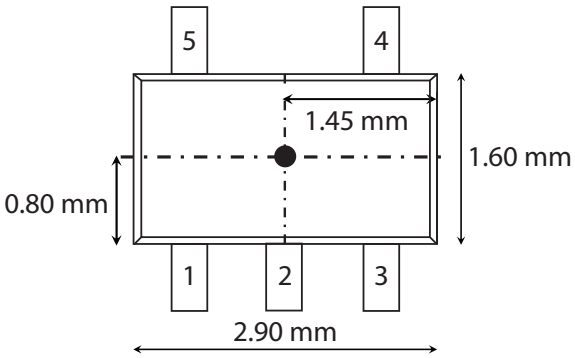


9.2 LGA-4 Package

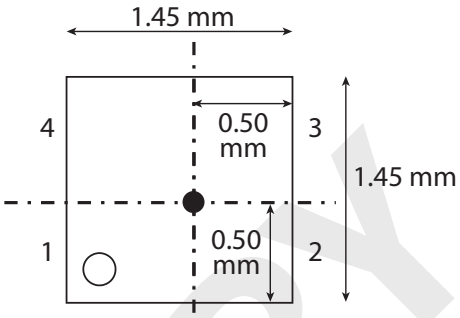


10 TMR Sensor Location

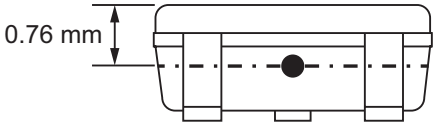
10.1 SOT-23-5 Package



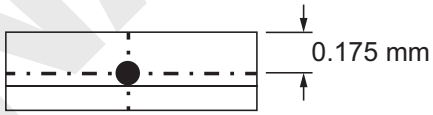
10.2 LGA-4 Package



10.3 SOT Package - Side View

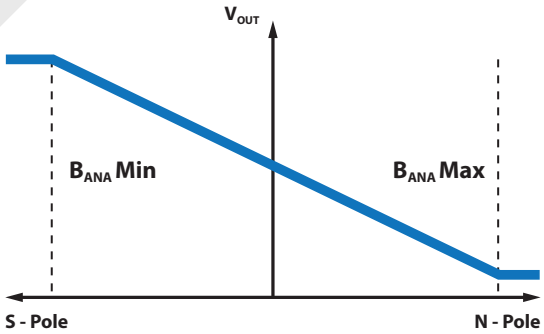


10.4 LGA Package - Side View

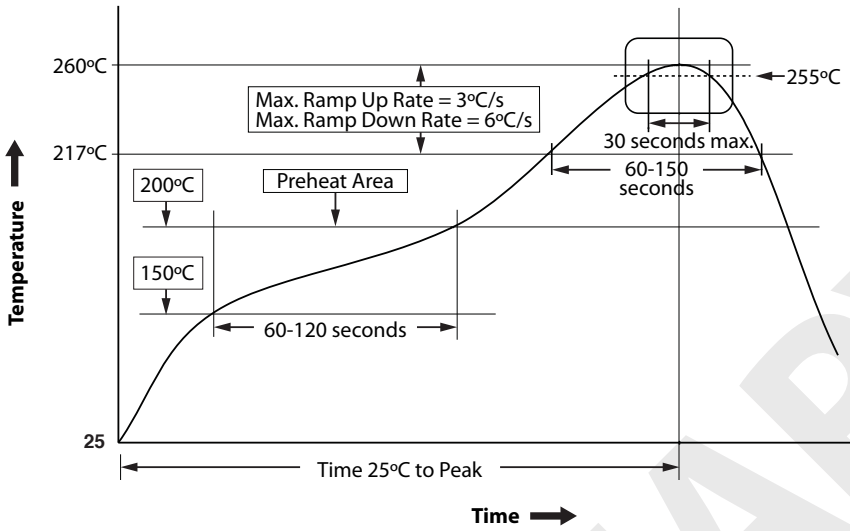


11 Magnetic Flux Response Diagram

Analog Magnetic Flux Response



12 Suggested Pb-Free Reflow Profile

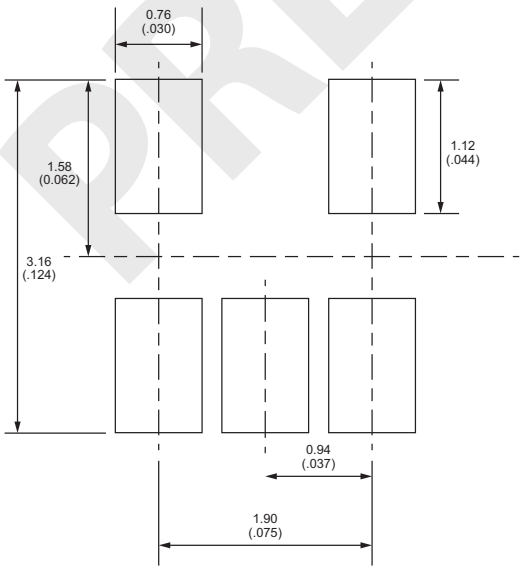


Notes:

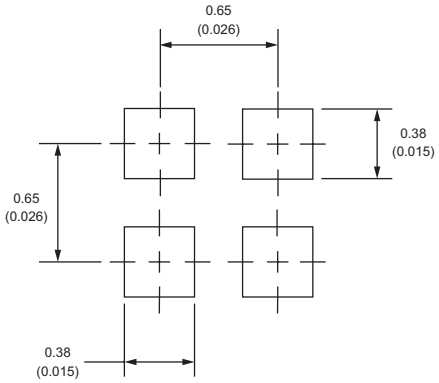
1. Fully compatible with standard no-lead solder profile, 260 °C for 1 minute max (3 cycles max).
2. Profile shown as example. Users are advised to develop their own board-level profile.
3. Suggested Pb-free reflow profile derived from IPC/JEDEC J-STD-020E.
4. Temperature tolerance: +0 °C, as measured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

13 Suggested Solder Pad Layout

13.1 SOT-23-5 Solder Pad Layout



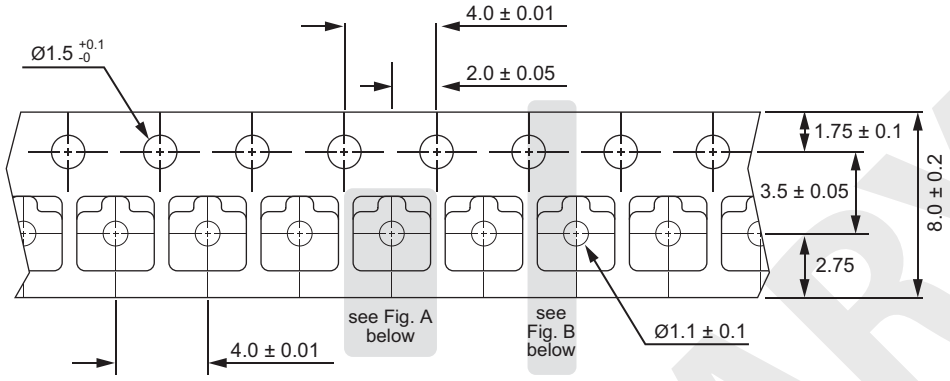
13.2 LGA-4 Solder Pad Layout



14 TMR Sensor & Switch Packaging

14.1 SOT-23-5 Tape & Reel Packaging

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



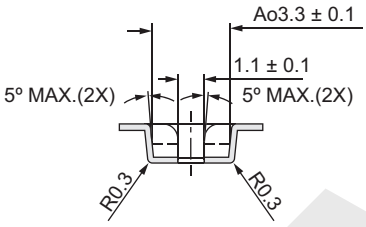


Fig. A

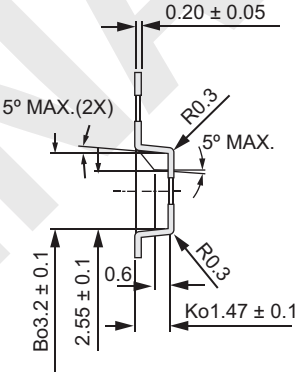
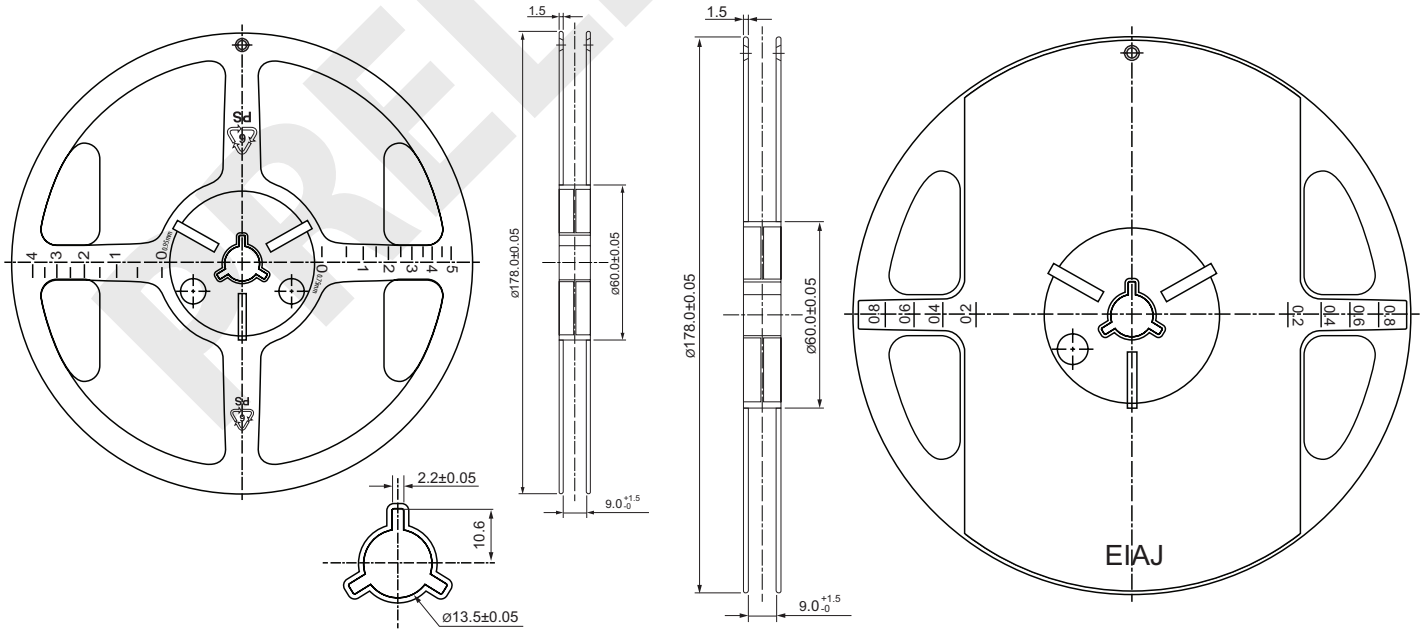


Fig. B



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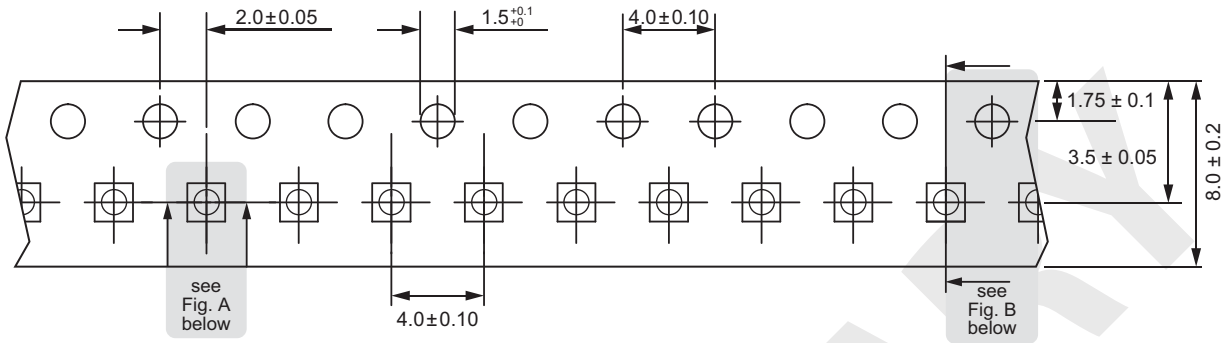
14 TMR Sensor & Switch Packaging

14.2 LGA-4 Tape & Reel Packaging

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



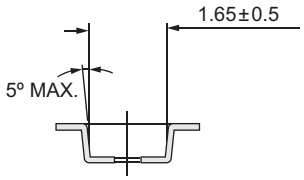


Fig. A

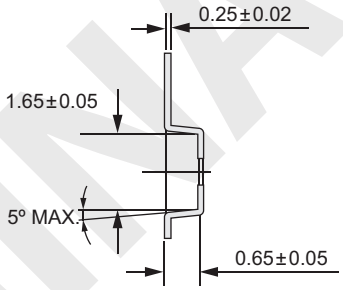
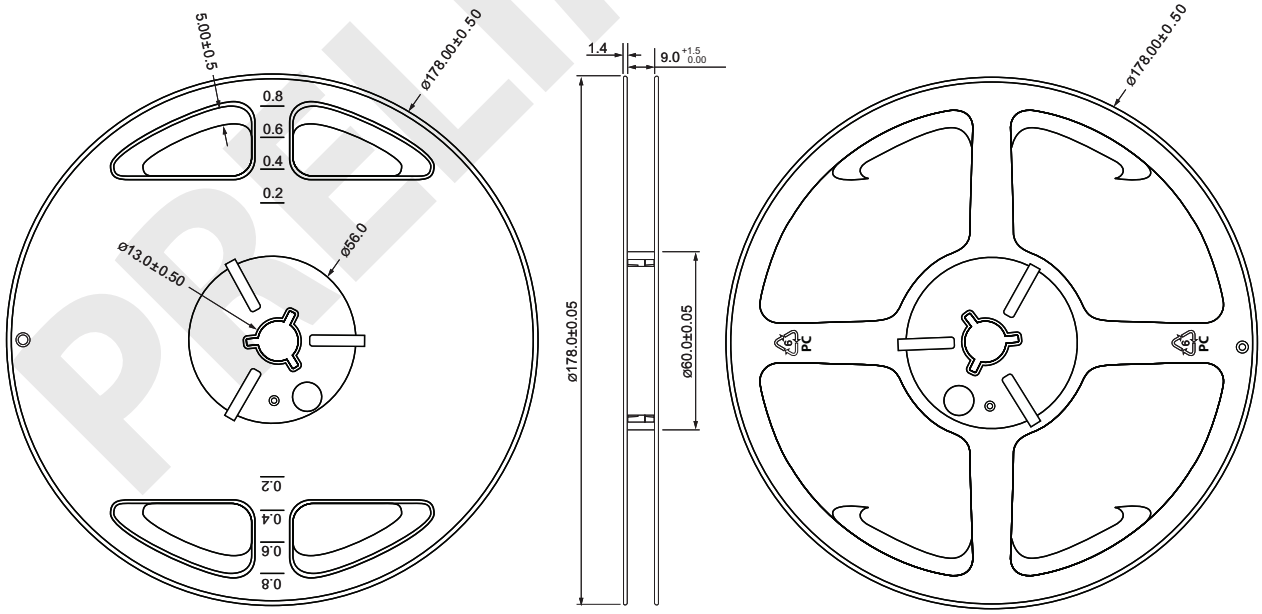


Fig. B



14 TMR Sensor & Switch Packaging

14.3 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