

## 1 Description

The RedRock® RR112-1D92-532 and RR112-1D93-532 are analog magnetic sensors with proportional linear voltage output ideal for use in medical, industrial, automotive, and consumer applications. Based on patented Tunneling Magnetoresistance (TMR) technology with seamless CMOS integration, the RR112 offers multiple configurations of several parameters to enable applications such as proximity sensing, rotary sensing, and level detection.

The RR112 series features a magnetic field range from -20 to +20 G (-2 mT to +2 mT) with a typical sensitivity of 20mV/V/G (200 mV/V/mT). Because it is rated to operate across a wide temperature range (-40°C up to 125°C) and it offers a wide supply voltage range (1.7 up to 5.5 V), the RR112 series is ideal for applications ranging from small battery-powered electronics to industrial machinery.

## 2 Features

- ▶ Operate Sensitivity Range from -20 G to +20 G
- ▶ Low Average Current < 50  $\mu$ A
- ▶ Wide Supply Voltage Range of 1.7V to 5.5V
- ▶ Linear Analog Voltage Response
- ▶ Sampling Frequency of 10 kHz
- ▶ Temperature Rated up to 125°C
- ▶ Critical Performance Specs 100% Production Tested Throughout Complete Temperature Range
- ▶ RoHS & REACH Compliant

## 3 Applications

- ▶ Proximity Detection
- ▶ Rotary Sensing
- ▶ Fluid Level Detection
- ▶ Door & Lid Closure Detection
- ▶ Utility Meters
- ▶ Portable Medical Devices
- ▶ Consumer Electronics
- ▶ IoT Devices

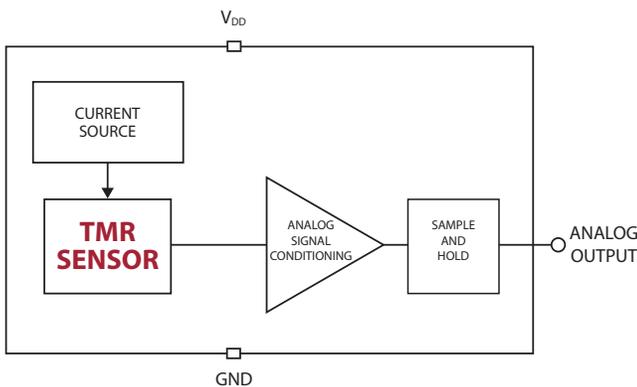
## Device Information

Part Series	Package	Body Size (mm)	Temp Rating °C
<b>RR112-1D92-532</b>	LGA-4	1.45 x 1.45 x 0.44	-40 to +85
<b>RR112-1D93-532</b>	LGA-4	1.45 x 1.45 x 0.44	-40 to +125



## Device Packages

### Functional Block Diagram for Analog Output



## Device Nomenclature

### Ordering Information

RR112-1 D 9 X-5 3 2	
<b>Series</b>	RR112-1 D 9 X-5 3 2
<b>Magnetic Polarity Response</b>	1 = Omnipolar
<b>Magnetic Sensitivity (mV/V/G)</b>	D: -20 G: -5
<b>Sampling Frequency (Hz)</b>	4: 100 9: 10,000
<b>Package</b>	2: LGA-4
<b>Output Response</b>	3: Analog
<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</sup>

Parameters	Units	Min	Typ	Max
Operating Temperature (T <sub>OP</sub> ) (RR112-1D92-532)	°C	-40		+85
Operating Temperature (T <sub>OP</sub> ) (RR112-1D93-532)	°C	-40		+125
Input/Output Pins Maximum Voltage (V <sub>I/O</sub> )	V	-0.3		V <sub>DD</sub> + 0.3
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 (HBM) per JESD22-A114	V	±4000		
ESD Level Charged Device Model (CDM) per JESD22-C101	V	±500		
Junction-to-Ambient Thermal Resistance	°C/W		165	
Maximum Magnetic Field Exposure (B <sub>MAX</sub> )	G			±600

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

Parameters	Units	Min	Typ	Max
Supply Voltage (V <sub>DD</sub> )	V	-0.3		6.0
Input and Output Current (I <sub>IN</sub> /I <sub>OUT</sub> )	mA			±20

### 4.3 Operating Electrical Characteristics for all RR112 Series Sensors<sup>2</sup>

Parameters	Units	Min	Typ	Max
Supply Voltage (V <sub>DD</sub> )	V	1.7	3.0	5.5
OUT Voltage Range	V	0.0		V <sub>DD</sub>
Power-On Time (t <sub>ON</sub> )(V <sub>DD</sub> > 1.7V)	μs		50	75
Active Mode Time (t <sub>ACTIVE</sub> )	μs		2.6	
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	1.44	1.53	
Under Voltage Lockout Hysteresis (V <sub>UV-HYST</sub> )	mV		70	

#### 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, V<sub>DD</sub> = 1.7 V to 5.5 V, T<sub>A</sub> = -40°C to +85°C (1D92), -40°C to +125°C (1D93). Typical values are V<sub>DD</sub> = 3.0 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 RR112-1D92-532 & RR112-1D93-532<sup>1</sup>

Parameters	Units	Min	Typ	Max
Operating Temperature (T <sub>OP</sub> ) (RR112-1D92-532)	°C	-40		+85
Operating Temperature (T <sub>OP</sub> ) (RR112-1D93-532)	°C	-40		+125
Average Supply Current (I <sub>DD(AVG)</sub> ) <sup>2</sup> @ V <sub>DD</sub> = 1.7V, f <sub>S</sub> = 10 kHz	μA		50	
Average Supply Current (I <sub>DD(AVG)</sub> ) <sup>2</sup> @ V <sub>DD</sub> = 3.0V, f <sub>S</sub> = 10 kHz	μA		40	
Sampling Frequency <sup>3</sup> (f <sub>S</sub> )	kHz	6	10	14
Active Mode Time (t <sub>ACTIVE</sub> )	μs		2.6	
Idle Mode Time (t <sub>IDLE</sub> )	μs	71	100	166
Maximum Drive Capability (I <sub>DRV(MAX)</sub> ) ΔV <sub>OUT</sub> ≤ 10mV	μA	-10		10
Output Capacitive Load (C <sub>L</sub> )	pF			10
Magnetic Field Range (B <sub>ANA</sub> )	G	±15	±20	±29
Analog Output Voltage Range (V <sub>ANA</sub> )	V	0.1 x V <sub>DD</sub>		0.9 x V <sub>DD</sub>
Voltage Output Quiescent (V <sub>OQ</sub> ) <sup>2</sup>	%V <sub>DD</sub>	45	50	55
Sensitivity @ T = +25°C	mV/V/G	-17	-20	-23
Sensitivity @ Full Temperature Range (S <sub>FULL_RANGE</sub> )	mV/V/G	-14	-20	-26

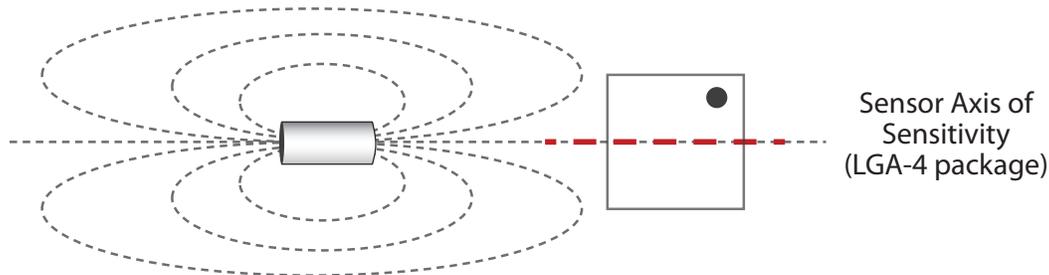
#### Notes:

1. Unless otherwise specified, V<sub>DD</sub> = 1.7 V to 5.5 V, T<sub>A</sub> = -40°C to +85°C (1D92), -40°C to +125°C (1D93). Typical values are V<sub>DD</sub> = 3.0 V and T<sub>A</sub> = +25°C.
2. Conditions: t = 10 seconds
3. The RR112-1D92-532 samples the magnetic field at 10kHz. In cases with large changes in magnetic flux density, the RR112's output could take multiple sampling cycles to reflect the proper voltage level for a given magnetic flux density value.

## 5 Magnetic Response

For more information please contact Coto Technology at [www.cotorelay.com](http://www.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. For tips on proper magnetic orientation see our Applications Note:

download PDF  
["How to Replace a Hall Effect Sensor with a TMR Sensor"](#)



watch our video:  
["Replacing Hall Effect Sensors with TMR Sensors – How and Why?"](#)

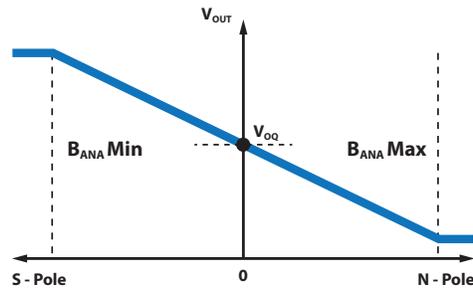


## 5 Magnetic Response (cont.)

### 5.2 Magnetic Response Table (LGA-4 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>ANALOG OUTPUT (ANA OUT)</b>	$\frac{V_{dd}}{2}$ Output is half of $V_{dd}$	$0 < V_{out} < \frac{V_{dd}}{2}$ Output is between 0V and half of $V_{dd}$	$\frac{V_{dd}}{2}$ Output is half of $V_{dd}$	$\frac{V_{dd}}{2} < V_{out} < V_{dd}$ Output is between half of $V_{dd}$ and full $V_{dd}$	$\frac{V_{dd}}{2}$ Output is half of $V_{dd}$

### 5.3 Magnetic Response Diagram

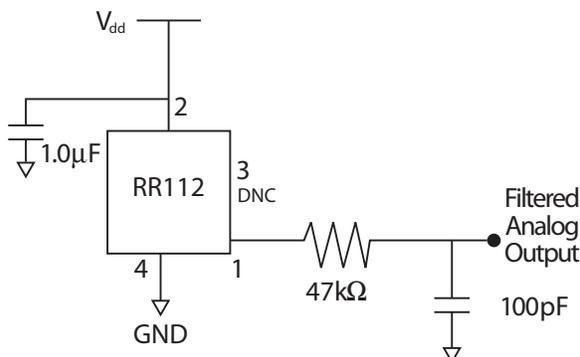


## 6 Application Information

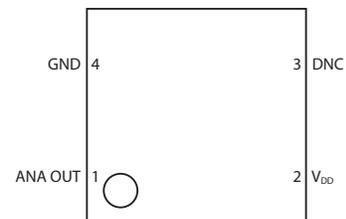
### RR112 Output Application Circuit

The output voltage can be connected to an analog 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  $\mu$ F will suffice. 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 47k $\Omega$  and a capacitor value of 100 pF should suffice.

#### 6.1 Application Circuit (LGA-4)

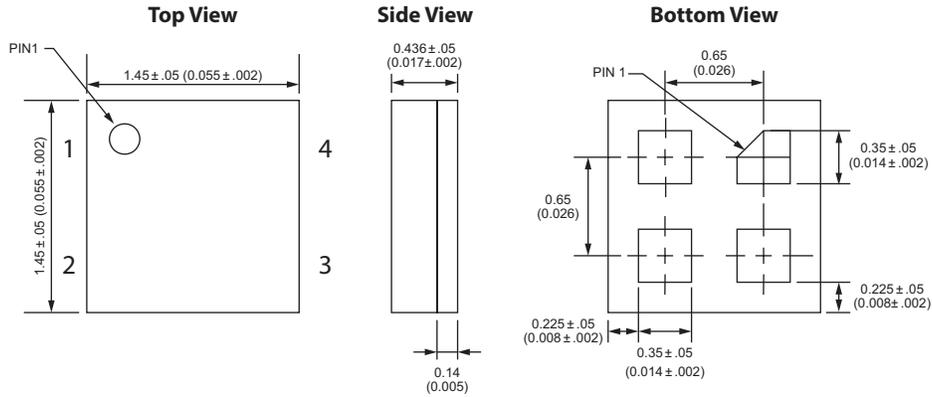


#### 6.2 Package Pinout (LGA-4)



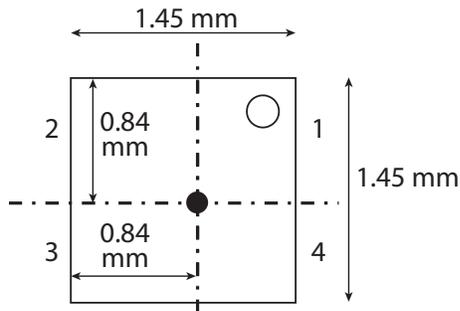
7 Dimensions Millimeters (Inches)

7.1 LGA-4 Package

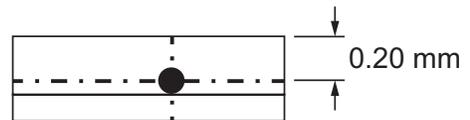


8 TMR Sensor Location

8.2 LGA-4 Package



8.2 LGA Package - Side View



## 9 TMR Sensor & Switch Packaging

### 9.1 LGA-4 Tape & Reel Packaging

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

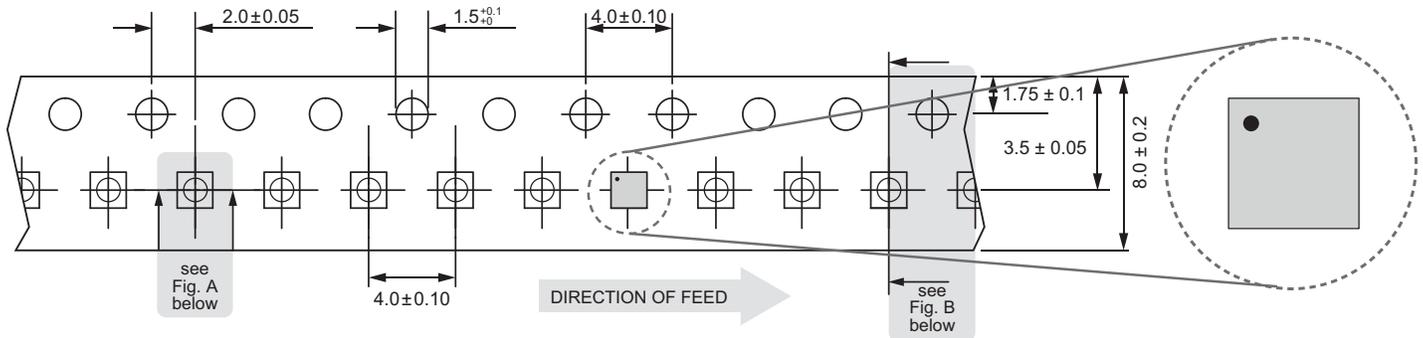


Fig. A

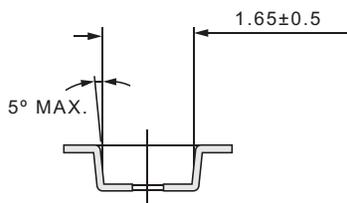
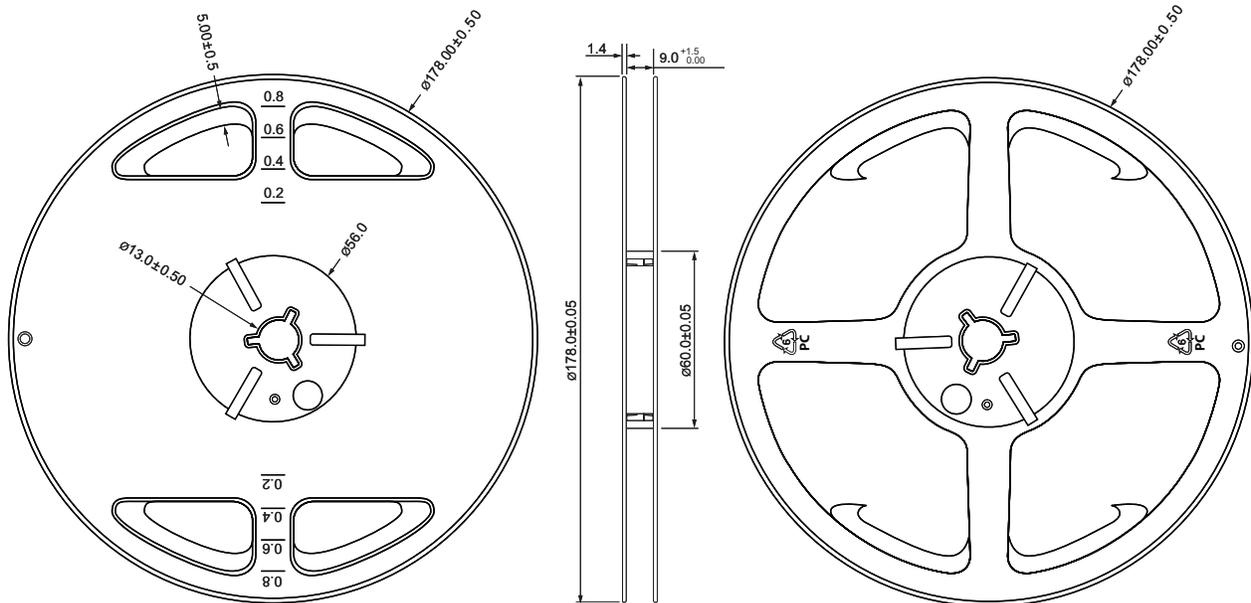
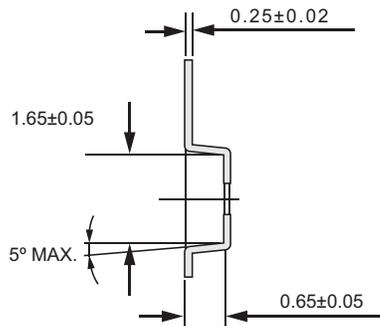


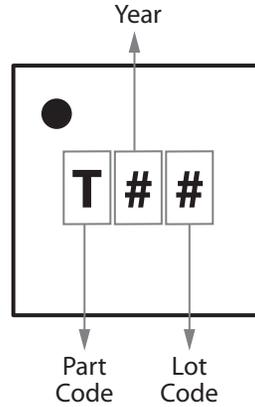
Fig. B



## 9 TMR Sensor & Switch Packaging

### 9.2 RedRock Package Codes (TBD)

RR112-1D92-532 / RR112-1D93-532 (LGA-4)



### 9.3 RedRock TMR Packaging

#### Box Dimensions – 14x10x6 inches

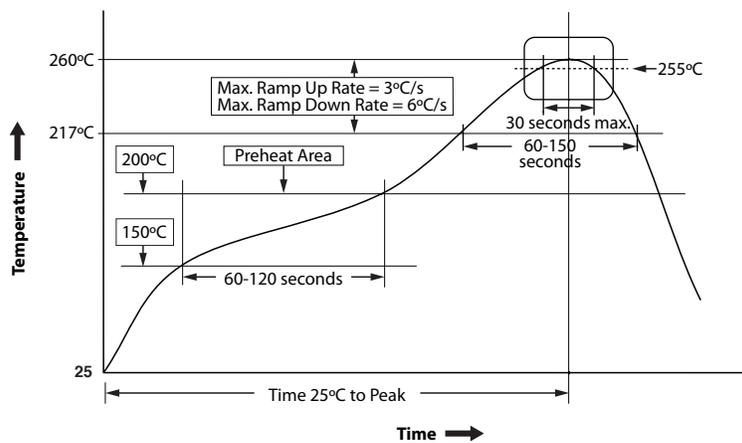
- Fits 1 to 3 reels = 3000 to 9000 pcs
- Weight for 3000 pcs = 0.90 kilos
- Weight for 9000 pcs = 1.00 kilos

#### 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

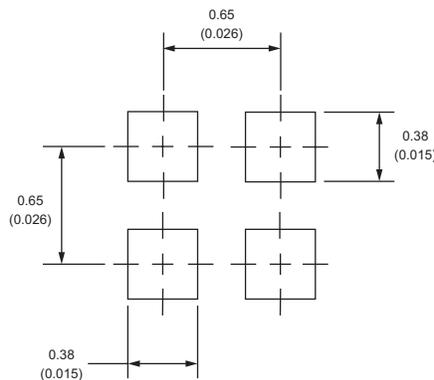
## 10 Suggested Pb-Free Reflow Profile

- Notes:**
1. Fully compatible with standard no-lead solder profile, 260 °C for 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 3 (LGA-4 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  $\pm 2$  °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.



## 11 Suggested Solder Pad Layout

### LGA-4 Solder Pad Layout



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