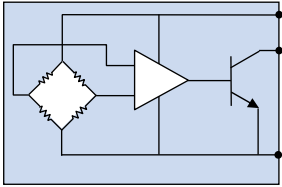
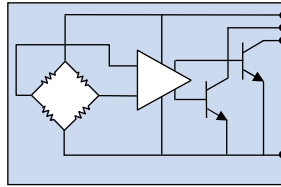


# ADA-Series Advanced Magnetic Switch Sensors

## Simplified Block Diagrams

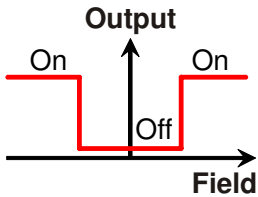


ADA021

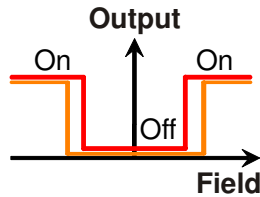


ADA32124

## Magnetic Responses



ADA021



ADA32124

## Features

- Ideal for cylinder position sensor applications
- Immune to double-switching
- Normal operation up to 1400 mT magnetic field
- Single- and dual-comparator open-drain switch outputs
- Cannot be damaged by large magnetic fields
- Ultraminiature 2.5 x 2.5 DFN6 or 3 x 3 mm MSOP8
- High-temperature operation up to 150 °C

## Applications

- Pneumatic cylinder position sensing
- Proximity sensing
- Speed sensing
- Rotation sensing

## Description

Using advanced sensing elements, ADA-Series magnetic switch sensors provide best-in-class performance and ruggedness.

The technology eliminates double switching artifacts in applications such as cylinder position sensing. Two-threshold versions can be used to detect speed and direction, regulate end-of-travel speed, or tune ultraprecise switching thresholds.

The robust parts have an extended -40 to 150 °C temperature range for harsh industrial environments and operate from 4.5 to 30-volt power supplies. The sensor elements can withstand magnetic fields up to 1400 mT without their operation being disturbed, making them immune to the effects of high external currents or strong motor magnets.

MSOP8 (-00E suffix) and DFN6 (-10E suffix) packages are available.

**Absolute Maximum Ratings**

| Parameter                 | Min. | Max.      | Units                |
|---------------------------|------|-----------|----------------------|
| Supply voltage            | -33  | 33        | Volts                |
| Output voltage            | -0.5 | 33        | Volts                |
| Continuous output current |      | 20        | mA                   |
| Storage temperature       | -65  | 150       | °C                   |
| ESD <sup>(1)</sup>        |      | 2000      | Volts                |
| Applied magnetic field    |      | Unlimited | Tesla <sup>(2)</sup> |

**Operating Specifications**

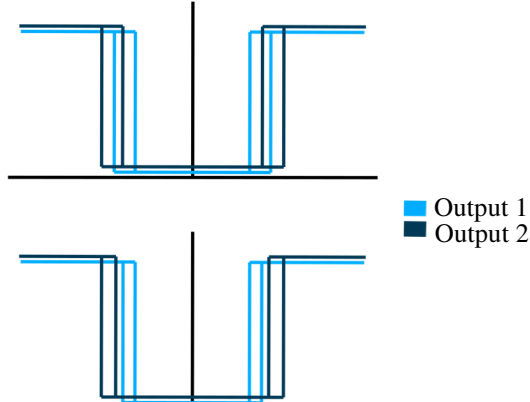
| Parameter                                                               | Symbol                                | Min.                          | Typ.       | Max.                          | Units | Test Condition                                                    |
|-------------------------------------------------------------------------|---------------------------------------|-------------------------------|------------|-------------------------------|-------|-------------------------------------------------------------------|
| Supply voltage                                                          | V <sub>DD</sub>                       | 4.5                           |            | 30                            | Volts |                                                                   |
| Operating temperature                                                   | T <sub>MIN</sub> ; T <sub>MAX</sub>   | -40                           |            | 150                           | °C    |                                                                   |
| Out1 output operate point<br>• ADA021<br>• ADA32124                     | H <sub>OP1</sub>                      | 1.8<br>H <sub>OP2</sub> - 1.3 | 2.0<br>2.0 | 2.5<br>H <sub>OP2</sub> - 0.6 | mT    | V <sub>DD</sub> = 10V;<br>T <sub>max</sub> <sup>(3)</sup> = 85 °C |
| Out2 output operate point<br>ADA32124                                   | H <sub>OP2</sub>                      | 2.1                           | 2.8        | 3.3                           |       |                                                                   |
| Out1 output release point                                               | H <sub>REL1</sub>                     | 0.5                           | 1.0        | See note <sup>(3)</sup>       |       |                                                                   |
| Out2 output release point                                               | H <sub>REL2</sub>                     | 0.5                           | 2.2        |                               |       |                                                                   |
| Output hysteresis differential <sup>(4)</sup><br>• ADA021<br>• ADA32124 | H <sub>DIF1</sub> , H <sub>DIF2</sub> | 0.1<br>0.1                    |            | 1.3<br>1.0                    |       |                                                                   |
| Output release point                                                    |                                       |                               |            |                               |       |                                                                   |
| Quiescent current<br>• ADA021<br>• ADA32124                             | I <sub>DDQ</sub>                      | 2.5<br>2.5                    |            | 5<br>10                       | mA    | V <sub>DD</sub> = 10V;<br>outputs off                             |
| Maximum output drive current                                            | I <sub>OL-ON</sub>                    | 20                            |            |                               | mA    | Per channel                                                       |
| Output low voltage                                                      | V <sub>OL</sub>                       |                               |            | 0.4                           | V     | V <sub>DD</sub> = 10V;<br>I <sub>OL-ON</sub> = 20 mA              |
| Output leakage current                                                  | I <sub>OL-OFF</sub>                   |                               |            | 40                            | µA    | V <sub>DD</sub> = 10V                                             |
| Frequency response                                                      |                                       |                               | 100        |                               | kHz   |                                                                   |

- Human Body Model (HBM) per JESD22-A114.
- 1 millitesla (mT) = 10<sup>6</sup> nanotesla (nT) = 10 Gauss (G) = 10 Oersted (Oe) in air.
- See temperature derating curve in Typical Performance Graph.
- H<sub>DIF</sub> = H<sub>OP</sub> - H<sub>REL</sub> = differential (also called switching hysteresis), which is the difference between the operate and release points.

**Dual-Output Operate/Release Sequence**

The switching order of the two ADA32124 outputs is 100% tested and guaranteed. Output 2 always switches at a higher field magnitude than Output 1. There are two possibilities:

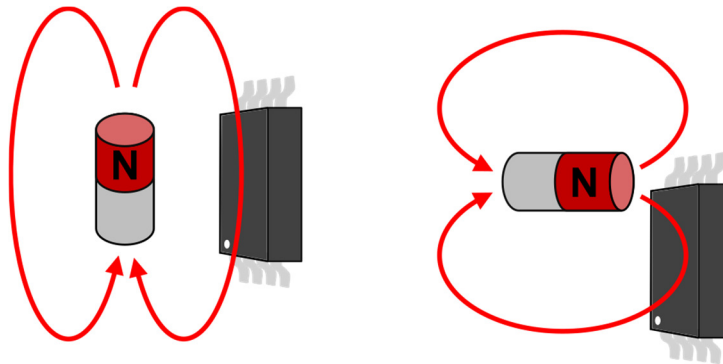
**ADA32124 Possible Transfer Functions**



**Operation**

**Direction of Magnetic Sensitivity**

As an applied magnetic field varies in intensity, the digital outputs will turn on and off. Unlike Hall effect or other sensors, the direction of sensitivity is in the plane of the package. The diagrams below show two permanent magnet orientations that will activate the sensor in the direction of sensitivity:

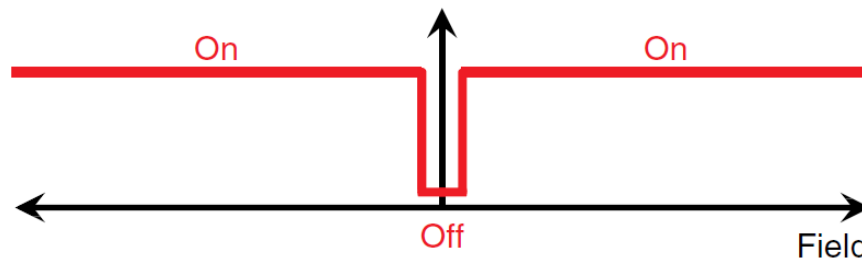


**Figure 1. Direction of magnetic sensitivity.**

ADA-Series sensors are “omnipolar,” meaning the outputs turn ON when a magnetic field of either magnetic polarity is applied.

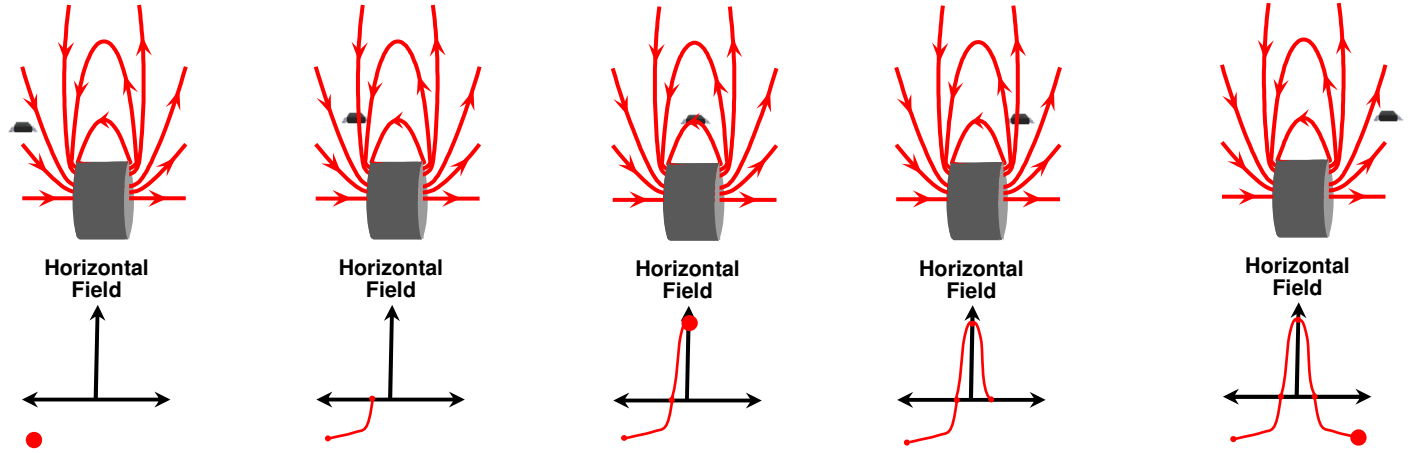
**Normal Operation in Large Magnetic Field**

Unlike lower-performance sensors, ADA-Series sensors cannot be disturbed by large magnetic fields. The parts operate normally with correct output states even in the presence of magnetic fields up to 1400 mT (1114 kA/m).



**Double-Switch-Proof Magnetic Field Detection**

Ordinary sensors detect just one axis of the field. In the figure below, the sensor is in a location where the horizontal field component is zero. Therefore as the sensor travels from left to right, the magnitude of horizontal field component will increase and decrease, potentially switching multiple times. This can be a problem in applications such as cylinder position sensing.



**Figure 2. Ordinary sensors can double-switch because they detect only one axis of the magnetic field.**

The ADA-Series sensor elements use a unique omnidirectional technology that makes them immune to double-switching. The sensors detect the vertical and horizontal field components, so the detected field increases monotonically the closer the magnet is to the center of the magnet. Therefore, ADA-Series sensors detect the magnet's arrival and departure with only a single on/off cycle.

**Application Information**

**External Pull-Up Resistors**

Outputs are logic low when the sensor is activated. The outputs are open-collector and should have external pull-up resistors. For microcontroller interfaces, the microcontroller's input pull-up resistors can be activated.

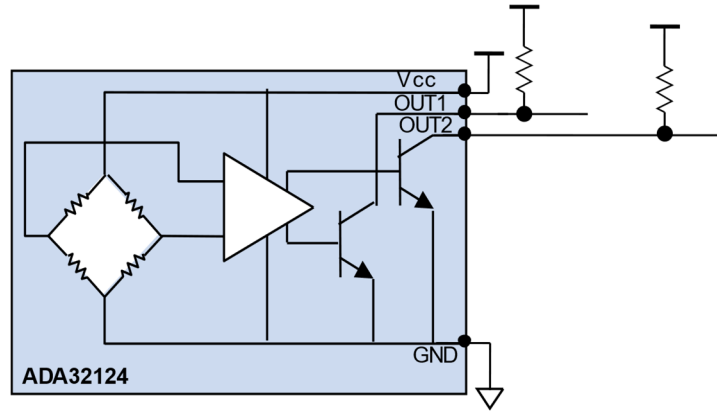


Figure 3. Typical minimum connections for normal operation. Pullup resistors should be used. The outputs can each sink at least 20 mA.

**Precision Window Comparator**

This simple circuit illustrates how transistor logic can be used to indicate a magnetic field between the two switching points:

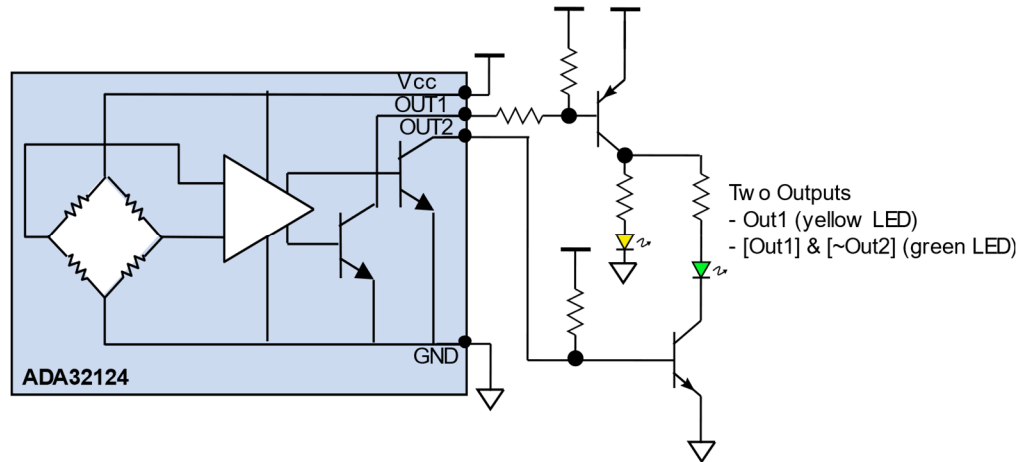


Figure 4. External BJTs or FETs can be used to create a window switching output. The green LED will turn on when Out1 is on but Out2 is off.

Typical Performance Graphs

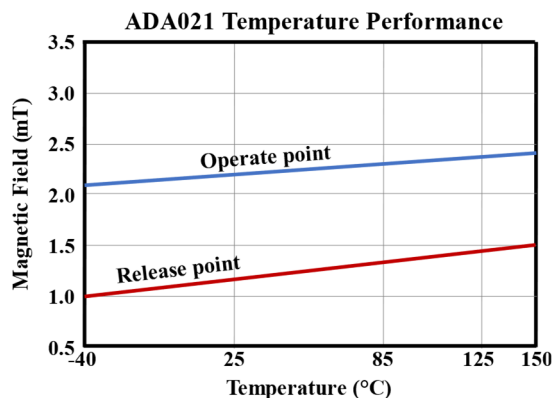


Figure 5. Typical temperature performance for ADA021 sensors. The performance is uniform across specifications.

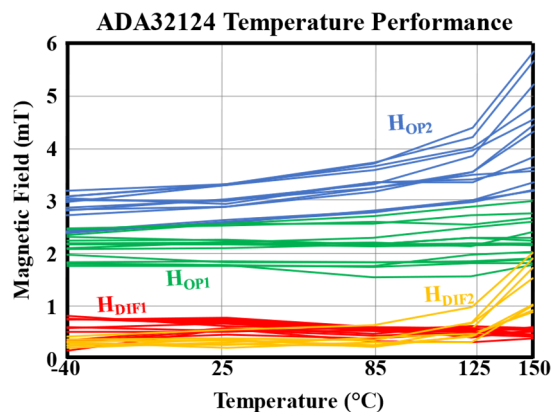
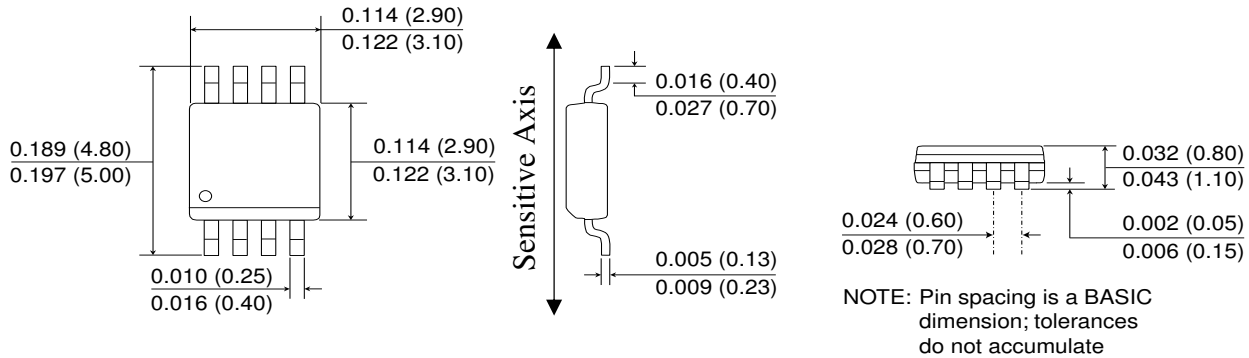


Figure 6. Typical temperature performance for ADA32124 sensors. Data from nine unique parts from three different lots is shown.

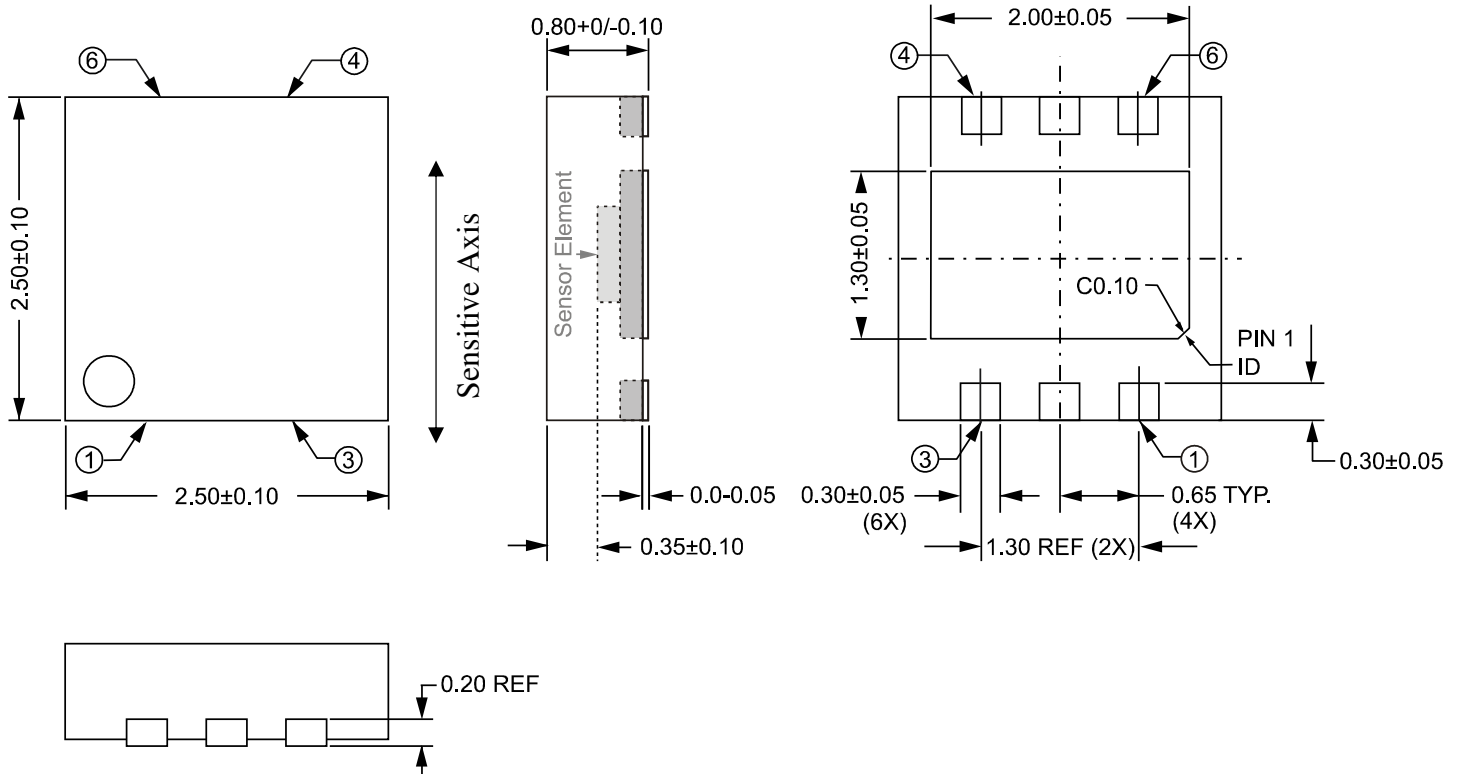
**3 mm x 3 mm MSOP8 Package (-00E suffix)**

Dimensions in inches (mm); scale = approx. 5X



RoHS  
COMPLIANT

**2.5 mm x 2.5 mm DFN6 Package (-10 suffix)**

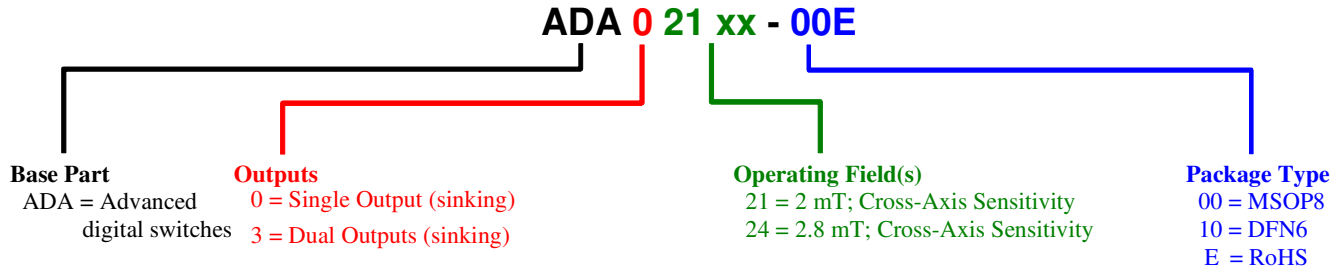


**Notes:**

- Dimensions in millimeters.
- Soldering profile per JEDEC J-STD-020C, MSL 1.

RoHS  
COMPLIANT

Part Numbering



Available Parts

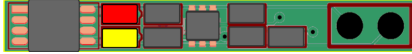
| Part Number  | Outputs | Operate Point (typ.) | Release Point (typ.) | Package |
|--------------|---------|----------------------|----------------------|---------|
| ADA021-00E   | 1       | 2 mT                 | 1 mT                 | MSOP8   |
| ADA021-10E   |         |                      |                      | DFN6    |
| ADA32124-00E | 2       | 2 mT; 2.8 mT         | 1 mT; 2.2 mT         | MSOP8   |

| Pinout | ADA021-00E | ADA021-10E | ADA32124-00E |
|--------|------------|------------|--------------|
| Pin 1  | Vcc        | Vcc        | Vcc          |
| Pin 2  | NC         | NC         | NC           |
| Pin 3  | NC         | NC         | NC           |
| Pin 4  | NC         | GND        | NC           |
| Pin 5  | GND        | NC         | GND          |
| Pin 6  | NC         | Out        | NC           |
| Pin 7  | NC         | -          | Out 1        |
| Pin 8  | Out        | -          | Out 2        |



**Evaluation Board**

An evaluation board allows easy testing an ADA32124-00E two-threshold sensor. The board includes the sensor and LEDs to indicate the state of the two outputs. Circuitry similar to Figure 4 creates a window switching output. The board can be powered with a 4.5 to 30-volt supply:

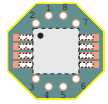


**ADA32124-00E-EVB02**

1" x 0.12" (25 mm x 3 mm)

**Bare Circuit Boards**

NVE offers several bare circuit boards for easy connections to surface-mount sensors. Popular PCBs are shown below (images are two times actual size):



**AG915-06:**

0.25" (6 mm) octagonal  
for MSOP8



**AG918-06** (standard) / **AG919-06** (cross-axis):  
2" x 0.25" (50 mm x 6 mm) for MSOP8



**AG035-06:**  
1.57" x 0.25" (40 mm x 6 mm) for DFN6

**Revision History**

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**SB-00-043**

February 2025

**Change**

- Initial release.

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