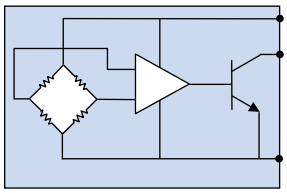
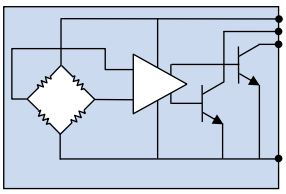
ADA-Series Advanced Magnetic Switch Sensors

Simplified Block Diagrams

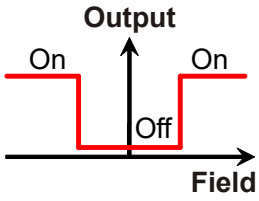


ADA021

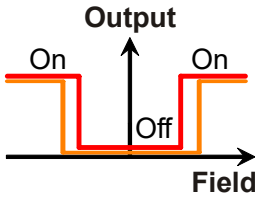


ADA32124

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 tune ultraprecise switching thresholds or to detect speed and direction.

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.

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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[1]		2000	Volts
Applied magnetic field		Unlimited	Tesla[2]

Operating Specifications

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

1. Human Body Model (HBM) per JESD22-A114.
2. 1 millitesla (mT) = 10^6 nanotesla (nT) = 10 Gauss (G) = 10 Oersted (Oe) in air.
3. See temperature derating curve in Typical Performance Graph.
4. $H_{DIF} = H_{OP} – H_{REL}$ = differential (also called switching hysteresis), which is the difference between the operate and release points.

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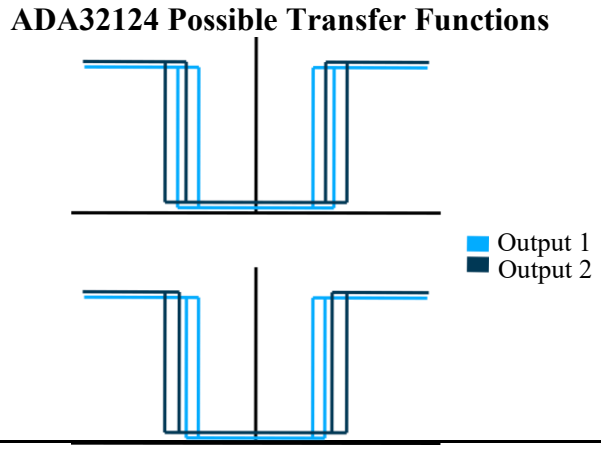
Dual-Output Operate/Release Sequence

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:



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:

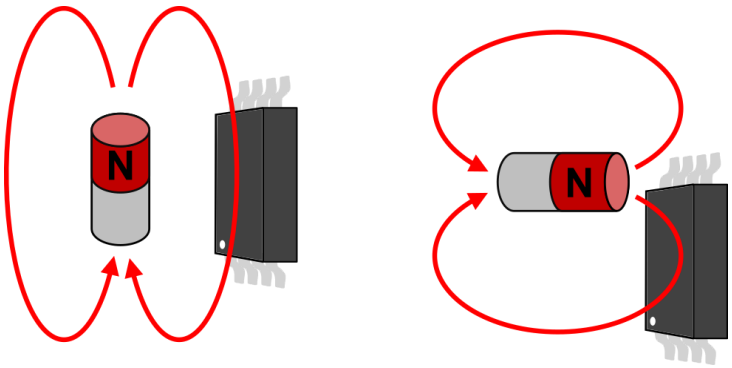
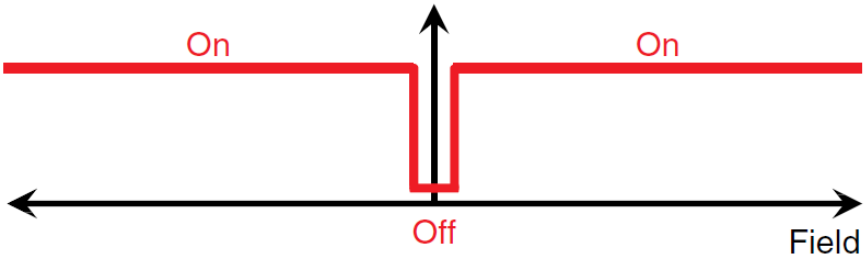


Figure 1. Direction of magnetic sensitivity.

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.

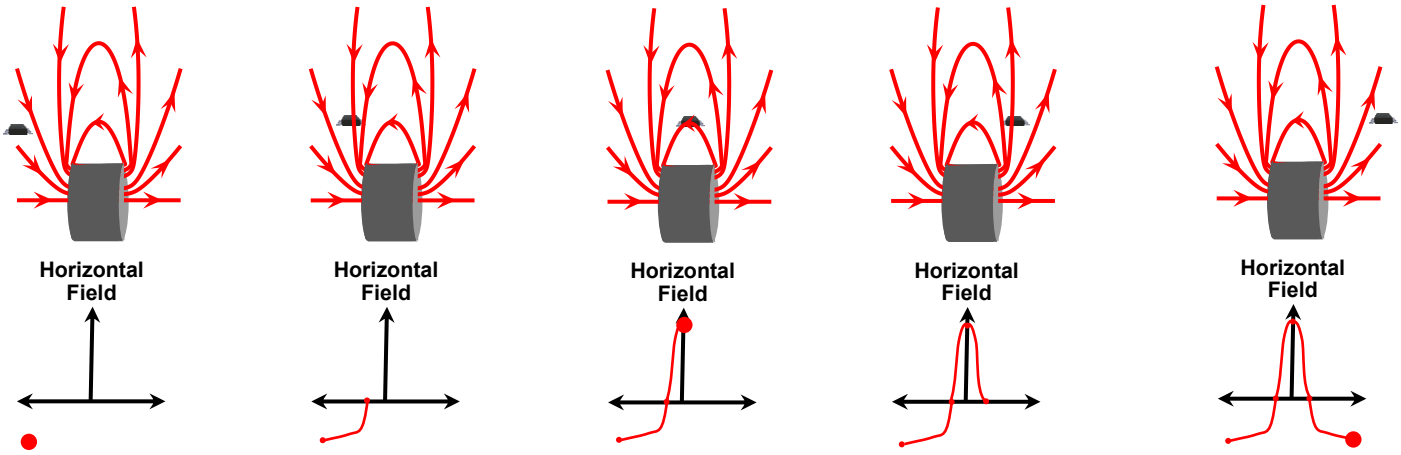


Figure 2. Ordinary sensors can double-switch because they detect only one axis of the magnetic field.

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.

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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.

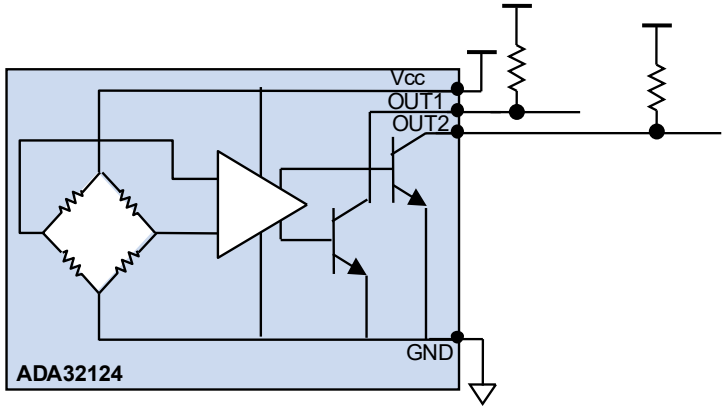
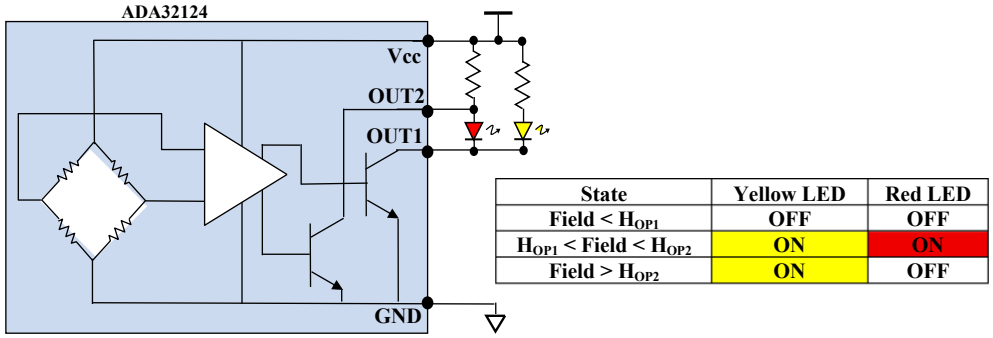


Figure 3. Typical minimum connections for normal operation. Pullup resistors should be used. The outputs can each sink at least 20 mA.

Precision Window Comparator

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



State	Yellow LED	Red LED
Field < H_{OP1}	OFF	OFF
H_{OP1} < Field < H_{OP2}	ON	ON
Field > H_{OP2}	ON	OFF

Figure 4a. The red LED will turn on when Out1 is on but Out2 is off, providing a precise window comparator function.

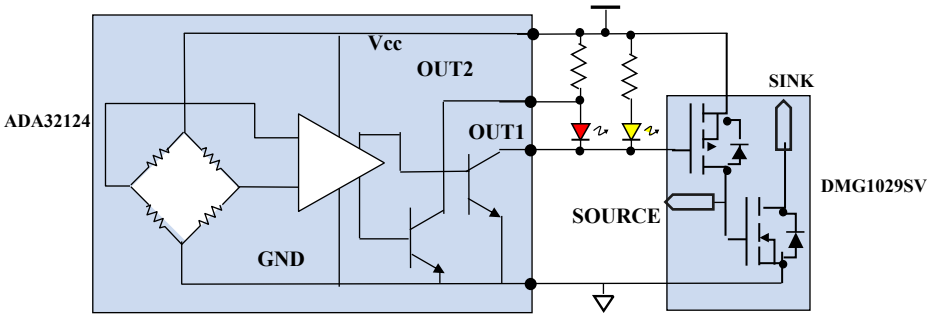


Figure 4b. Be mindful of current draw when connecting external drivers. MOSFET gates will draw minimal current, keeping the LED outputs correct. BJT bases can draw enough current to disrupt the LED outputs when Vcc is large.

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Typical Performance Graphs

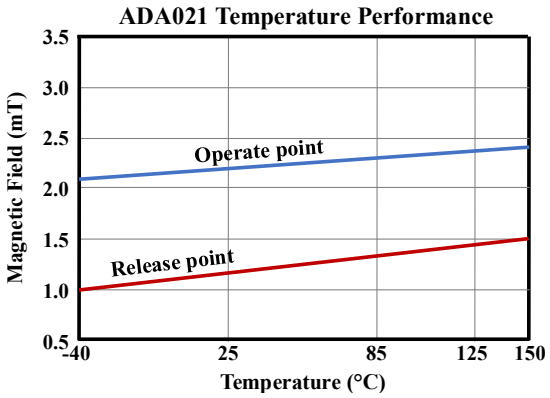

Figure 5. Typical temperature performance for ADA021 sensors. The performance is uniform across specifications.

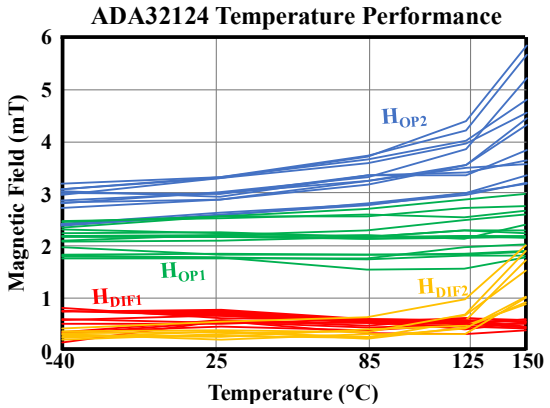

Figure 6. Typical temperature performance for ADA32124 sensors. Data from nine unique parts from three different lots is shown.

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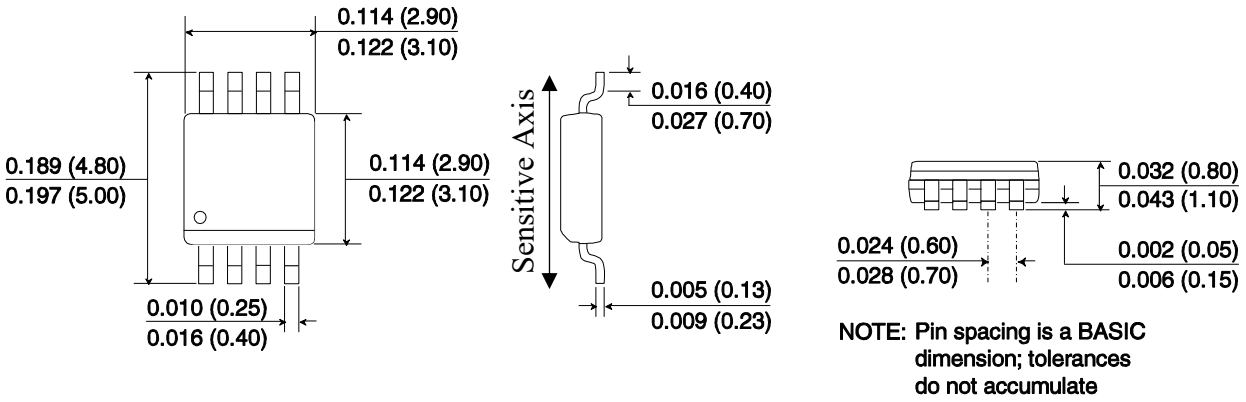
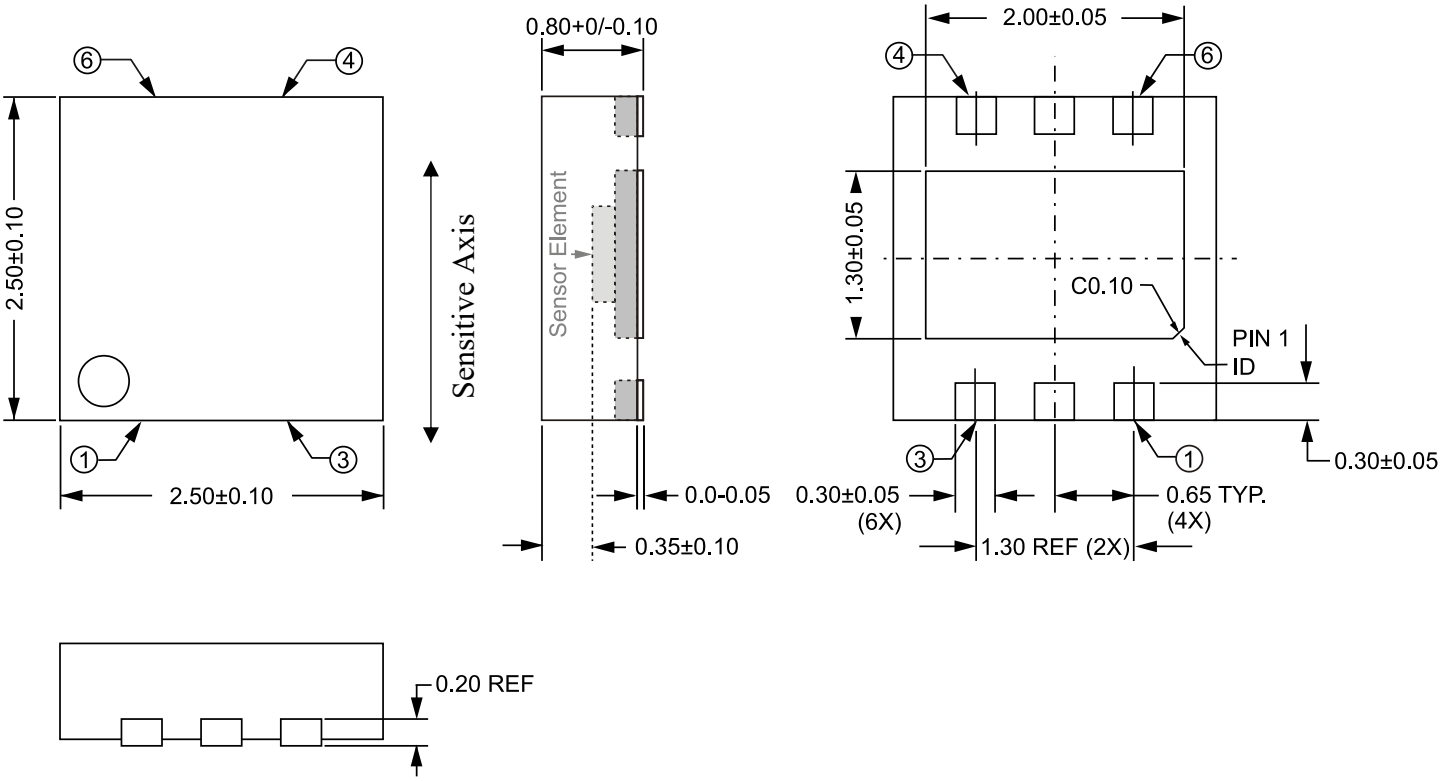
3 mm x 3 mm MSOP8 Package (-00E suffix)



NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

RoHS COMPLIANT

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

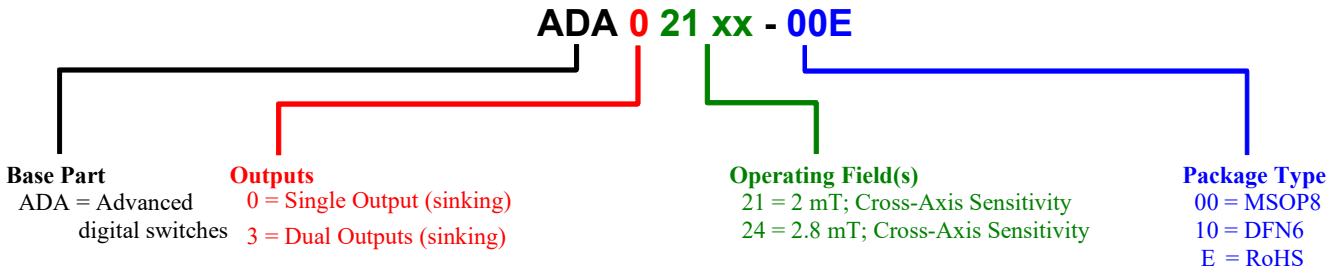


Notes:

- 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

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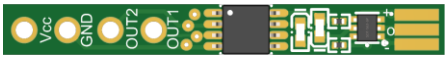
Evaluation Board

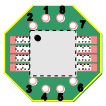
An evaluation board allows easy testing an ADA32124-00E two-threshold sensor. The board includes the sensor and LEDs to indicate the state of the two outputs. Circuitry similar to Figure 4 creates a window switching output. The board can be powered with a 4.5 to 30-volt supply:



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

SB-00-043 July 2025	**Change** • Updated application circuits • Added ADA32124-00E-EVB02
SB-00-043 February 2025	**Change** • Initial release.

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