

### Features

- Supply Voltage: 4.5 V to 36 V,  $\pm 2.25$  V to  $\pm 18$  V
- Offset Voltage:  $\pm 300$   $\mu$ V Maximum
- Gain Error: 0.05% Maximum
- Bandwidth: 3 MHz, Slew Rate: 5 V/ $\mu$ s
- EMI Enhancement
- Over-Temperature Protection
- $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  Operation Temperature Range

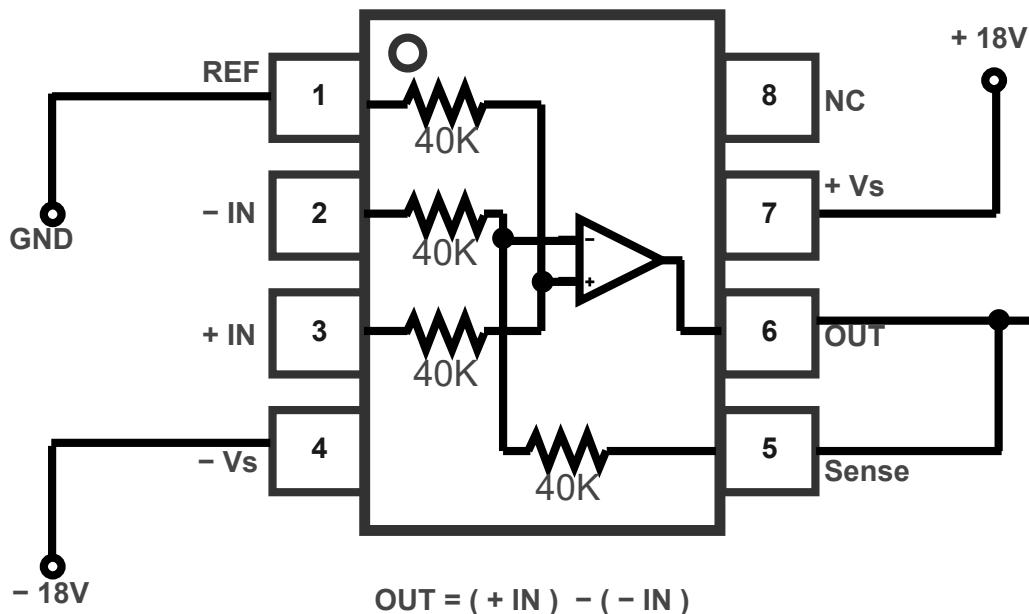
### Applications

- Instrumentation
- Industrial Control
- Audio
- Building Block for the Precision Amplifier Circuit

### Description

The TPA9361 is a general-purpose, unity-gain difference amplifier, which is intended for precision signal conditioning. The on-chip resistors are trimmed for excellent gain accuracy and high CMRR. It has extremely low-gain drift within the operating temperature range. It also provides an exceptional common-mode rejection ratio (100 dB typical) and high bandwidth while amplifying signals are well beyond the supply rails. The common-mode range of the amplifier extends to almost two times than the supply voltage, making the device ideal for single-supply applications that require a wide common-mode voltage range.

### Typical Application Circuit



## Table of Contents

<b>Features</b> .....	<b>1</b>
<b>Applications</b> .....	<b>1</b>
<b>Description</b> .....	<b>1</b>
<b>Typical Application Circuit</b> .....	<b>1</b>
<b>Revision History</b> .....	<b>3</b>
<b>Pin Configuration and Functions</b> .....	<b>4</b>
<b>Specifications</b> .....	<b>5</b>
Absolute Maximum Ratings <sup>(1)</sup> .....	5
ESD, Electrostatic Discharge Protection.....	5
Thermal Information.....	5
Electrical Characteristics.....	6
Typical Performance Characteristics.....	8
<b>Tape and Reel Information</b> .....	<b>9</b>
<b>Package Outline Dimensions</b> .....	<b>10</b>
SOP8.....	10
<b>Order Information</b> .....	<b>11</b>

**Revision History**

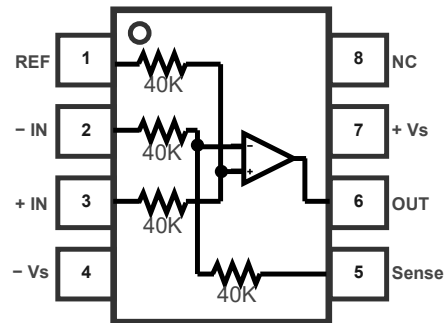
Date	Revision	Notes
2020-05-05	Rev.Pre	Pre-release Version
2020-10-10	Rev.Pre.1	Updated Spec
2021-02-09	Rev.Pre.2	Updated Feature, Application and Description
2021-03-20	Rev.A.0	Initial Version
2022-11-08	Rev.A.1	Updated document with new format. Updated HBM value: 1 kV → 500 V

## Pin Configuration and Functions

TPA9361

SOP8 Package

Top View



Pin No.	Pin Name	I/O	Description
1	REF		Reference input.
2	-In		Inverting input.
3	+In		Noninverting input
4	-Vs		Negative power supply <sup>(1)</sup>
5	Sense		Sense input.
6	VOU		Output
7	+Vs		Positive power supply <sup>(1)</sup>
8	NC		Not Connect

(1) In this document, (V+) – (V-) is referred to Vs.

## Specifications

### Absolute Maximum Ratings <sup>(1)</sup>

Parameter		Min	Max	Unit
	Supply Voltage: $V^+ - V^-$		36	V
	Input Voltage Range		2*( Supply Voltage )	V
	Input Current: +IN, -IN <sup>(2)</sup>	-10	+10	mA
T <sub>J</sub>	Maximum Junction Temperature		150	°C
T <sub>A</sub>	Operating Temperature Range	-40	125	°C
T <sub>STG</sub>	Storage Temperature Range	-65	150	°C
T <sub>L</sub>	Lead Temperature (Soldering 10 sec)		260	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

(2) The inputs are protected by ESD protection diodes to each power supply. If the input extends more than 300 mV beyond the power supply, the input current should be limited to less than 10 mA.

### ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	500	V
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 <sup>(2)</sup>	1.5	kV

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### Thermal Information

Package Type	$\theta_{JA}$	$\theta_{JC}$	Unit
SOP8	158	43	°C/W

**Electrical Characteristics**

All test condition is  $V_+ = +15\text{ V}$  and  $V_- = -15\text{ V}$ ,  $R_L = 10\text{ k}\Omega$  to ground, reference pin connected to ground, sense pin connected to  $V_{OUT}$  pin,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

Symbol	Parameter	Conditions	$T_A$	Min	Typ	Max	Unit
<b>Power Supply</b>							
$V_S$	Supply Voltage Range			$\pm 2.25$		$\pm 18$	V
$I_Q$	Quiescent Current per Amplifier	No Load			1.5	2	mA
			$-40^\circ\text{C}$ to $125^\circ\text{C}$			2.5	mA
<b>Gain</b>							
	Initial	$V_{OUT} = \pm 10\text{ V}$			1		V/V
	Gain Error	$V_{OUT} = \pm 10\text{ V}$			0.02	0.05	%FSR
			$-40^\circ\text{C}$ to $125^\circ\text{C}$			0.1	%FSR
	Gain Drift		$-40^\circ\text{C}$ to $125^\circ\text{C}$		5		PPM/ $^\circ\text{C}$
	Nonlinearity				0.0005		%FSR
<b>Offset Voltage</b>							
$V_{OS}$	Input Offset Voltage	$V_{CM} = 0\text{ V}$			150	300	$\mu\text{V}$
			$-40^\circ\text{C}$ to $125^\circ\text{C}$			800	$\mu\text{V}$
$V_{OS\ TC}$	Offset Voltage Drift		$-40^\circ\text{C}$ to $125^\circ\text{C}$		2		$\mu\text{V}/^\circ\text{C}$
PSRR	Power Supply Rejection Ratio	$V_S = \pm 2.25\text{ V}$ to $\pm 18\text{ V}$ , $V_{CM} = 0\text{ V}$		100	120		dB
			$-40^\circ\text{C}$ to $125^\circ\text{C}$	95			dB
<b>Input</b>							
	Impedance	Differential			80		k $\Omega$
		Common-mode			40		k $\Omega$
	Input Voltage Range	Differential		$-2*(V_-)$		$2*[(V_+) - 1.5]$	V
CMRR	Common-Mode Rejection	$V_{CM} = -30\text{ V}$ to $27\text{ V}$		80	100		dB
			$-40^\circ\text{C}$ to $125^\circ\text{C}$	78			dB
<b>Output</b>							
	Output Swing from Supply Rail	$R_{LOAD} = 10\text{ k}\Omega$ to $V_S/2$			50	200	mV

**Precision Difference Amplifier**

Symbol	Parameter	Conditions	T <sub>A</sub>	Min	Typ	Max	Unit
		R <sub>LOAD</sub> = 2 kΩ to V <sub>S</sub> /2			400	500	mV
I <sub>sc</sub>	Output Short-Circuit Current				100		mA
<b>AC Specifications</b>							
GBW	Gain-Bandwidth Product				3		MHz
SR	Slew Rate	10 V step			5		V/μs
t <sub>s</sub>	Settling Time, 0.1%	G = -1, 10 V step			0.8		μs
<b>Noise Performance</b>							
E <sub>N</sub>	Input Voltage Noise	f = 0.1 Hz to 10 Hz			0.2		μV <sub>RMS</sub>
e <sub>N</sub>	Input Voltage Noise Density	f = 1 kHz			30		nV/√Hz

### Typical Performance Characteristics

All test condition:  $V_s = \pm 15\text{ V}$ ,  $V_{CM} = 0\text{ V}$ ,  $R_L = 10\text{ k}\Omega$ , unless otherwise specified.

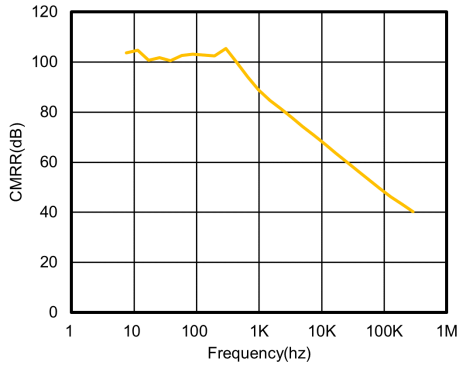


Figure 1. CMRR vs. Frequency

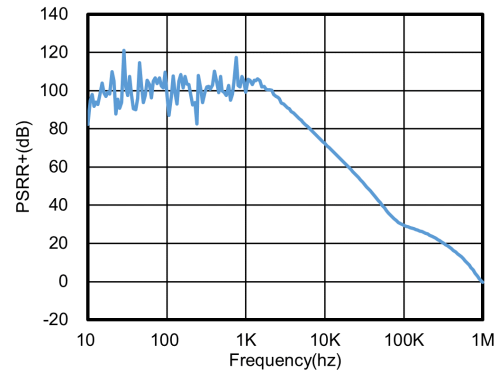


Figure 2. PSRR+ vs. Frequency

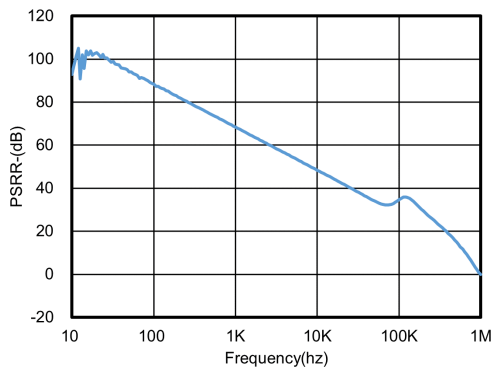


Figure 3. PSRR- vs. Frequency

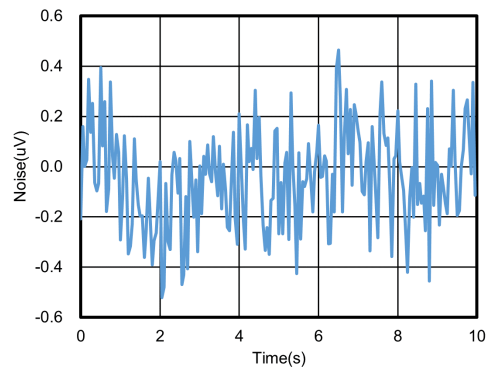
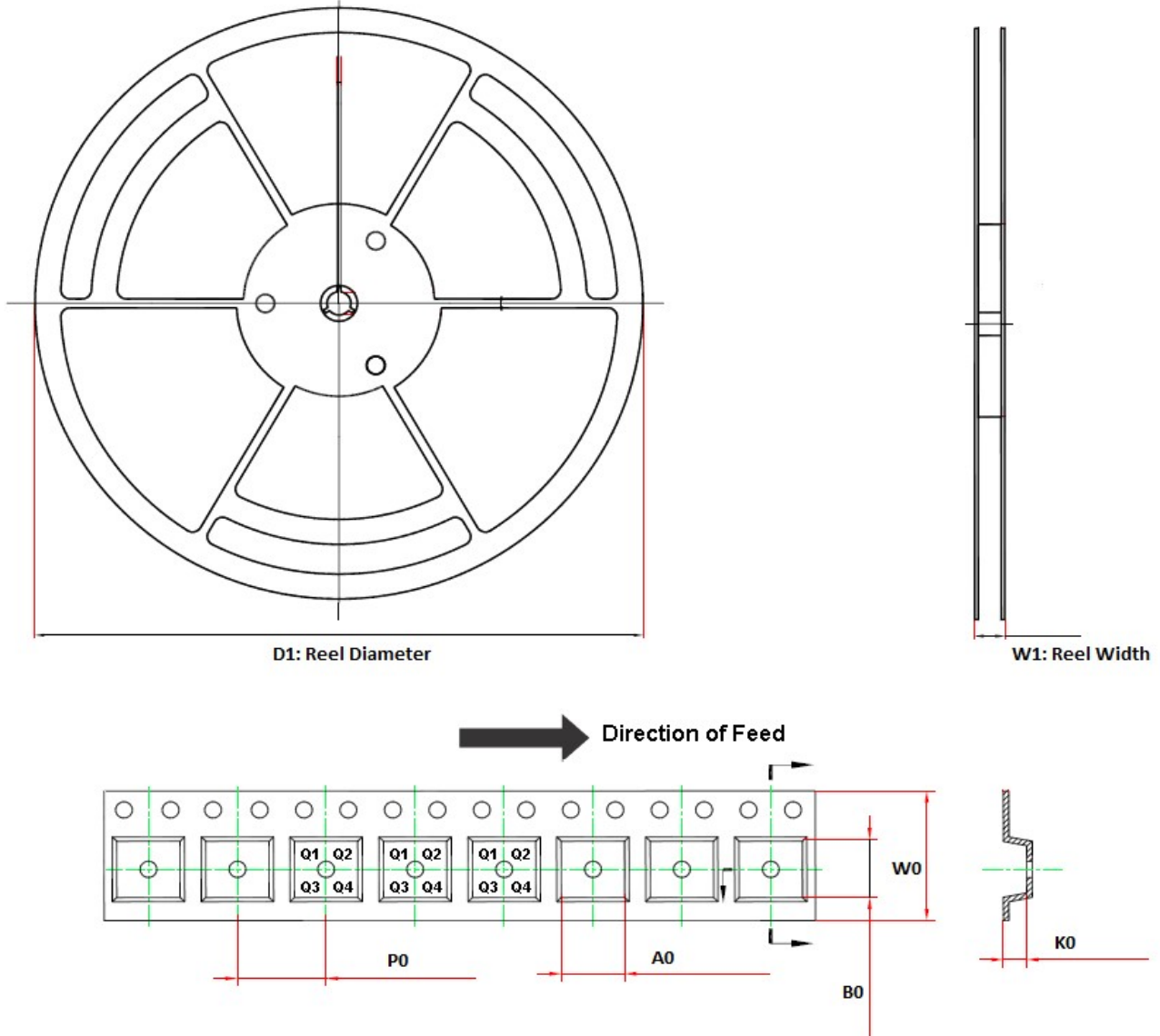


Figure 4. 0.1 to 10 Hz Voltage Noise



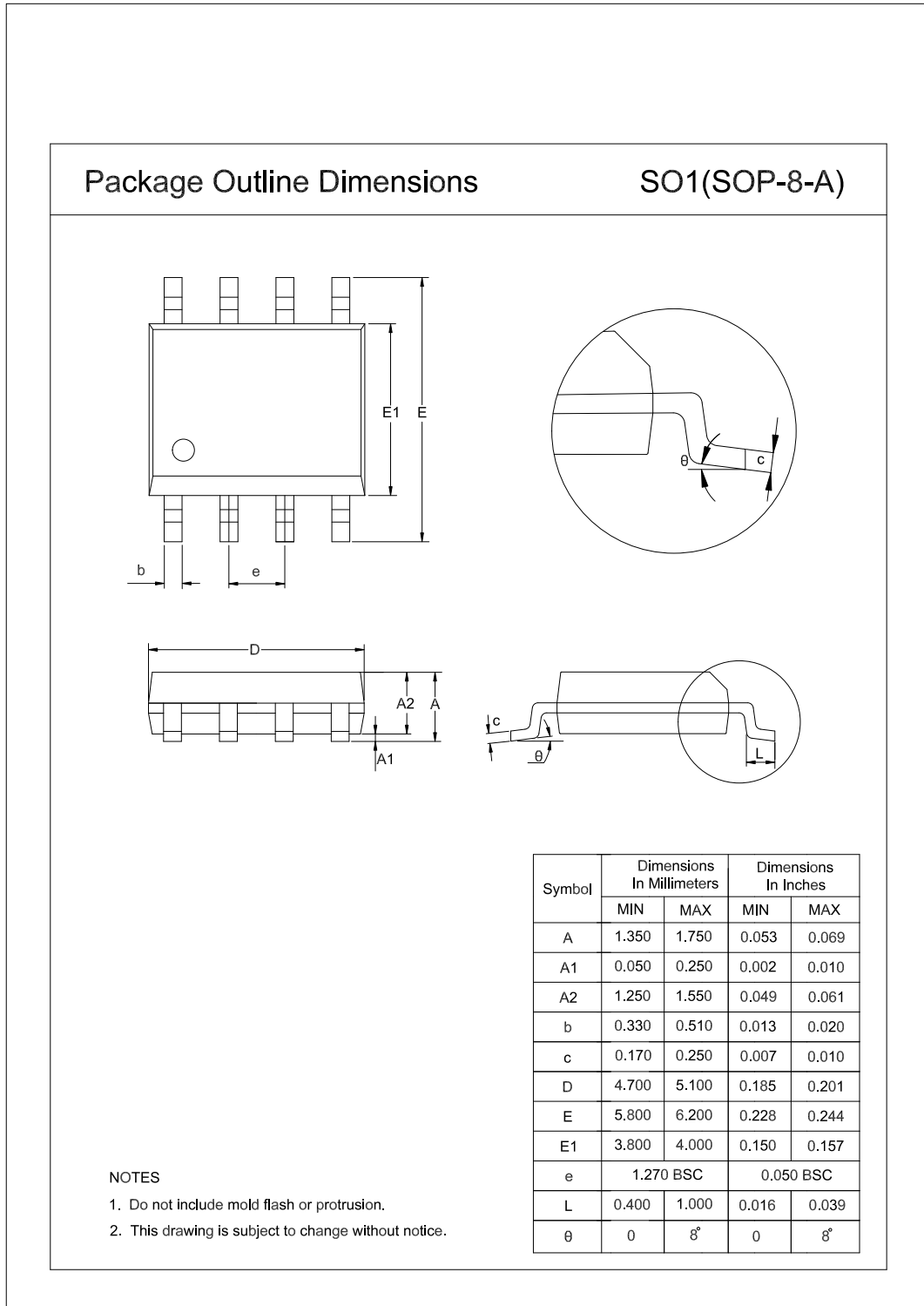
Tape and Reel Information



Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPA9361-SO1R	SOP8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1

Package Outline Dimensions

SOP8



## Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPA9361-SO1R	-40 to 125°C	SOP8	A9361	3	Tape and Reel, 4000	Green

**Green:** 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

---

**3PEAK and the 3PEAK logo are registered trademarks of 3PEAK INCORPORATED. All other trademarks are the property of their respective owners.**

---

This page intentionally left blank