

Features

- Supply Voltage: 8 V to 36 V
- Offset Voltage: ± 3 mV
- Differential Input Voltage Range to Supply Rail, can Work as Comparator
- Bandwidth: 20 MHz, Slew Rate: 10 V/ μ s
- Low Noise:
 - Voltage Noise Density: 10 nV/ $\sqrt{\text{Hz}}$ at 100 Hz
 - 0.1-Hz to 10-Hz Voltage Noise: 0.8 μ V_{PP}
- Input Rail to $-V_S$, No Internal ESD Diode to $+V_S$
- High PSRR+: 80 dB at 100 kHz
- Operation Temperature Range: -40°C to 125°C

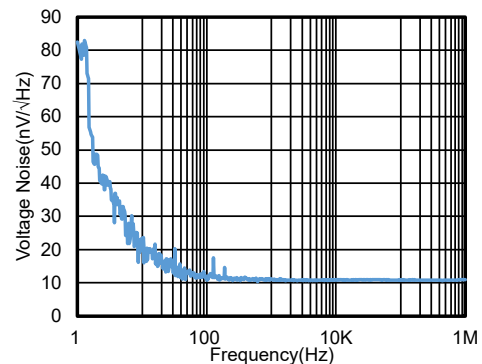
Applications

- Instrumentation
- Active Filters, ASIC Input or Output Amplifiers
- Sensor Interface
- Industrial Control
- Audio Application

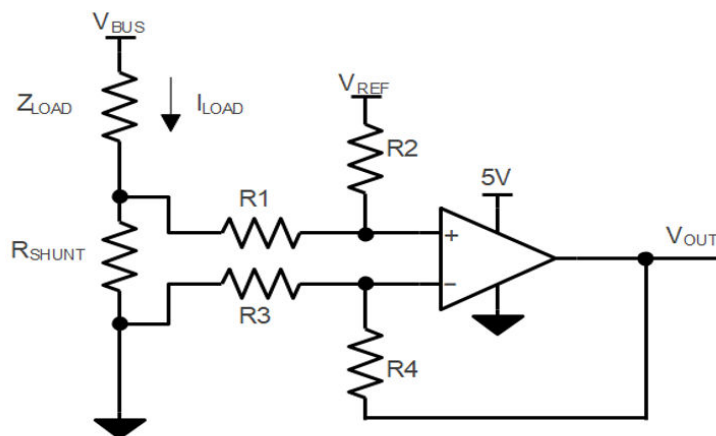
Description

The TPA268x is a series of the newest high-supply voltage amplifiers with low noise and high-frequency response. It incorporates 3PEAK's proprietary and patented design techniques to achieve excellent AC performance with a 20-MHz bandwidth, a 10-V/ μ s slew rate, and low distortion while drawing a quiescent current of only 6 mA per amplifier.

The combination of features makes the TPA268x series an ideal choice for industrial control, motor control and audio amplification, sound ports, and other consumer audio.



Typical Application Circuit



$$V_{OUT} = (I_{LOAD} \times R_{SHUNT}) \times (R_2 / R_1) + V_{REF}$$

$$\text{When } R_3 = R_1, R_2 = R_4, R_{SHUNT} \ll R_1$$

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Revision History

Date	Revision	Notes
2021-05-20	Rev.A.0	Initial version.
2021-07-07	Rev.A.1	Updated the Absolute Maximum Ratings: • Updated the minimum value of Input Voltage from $(-V_S) - 0.3$ to $(-V_S)$. • Updated the maximum value of Input Voltage from $(+V_S) + 0.3$ to 40 V.
2022-04-29	Rev.A.2	Updated the Order Information.
2022-08-09	Rev.A.3	Added a new part number: TPA2682-TS1R.
2024-12-18	Rev.A.4	The following updates are all about the new datasheet formats or typos, and the actual product remains unchanged. Updated to a new datasheet format. Updated to a new format of Package Outline Dimensions. Updated the Tape and Reel Information.

Pin Configuration and Functions

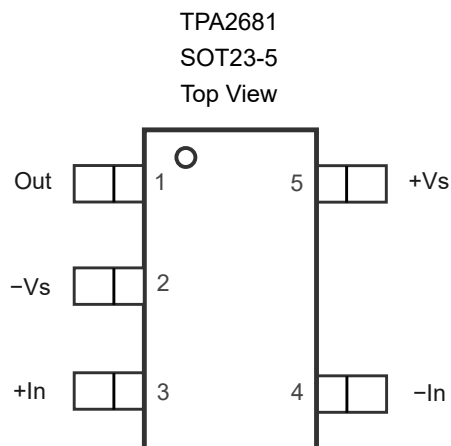
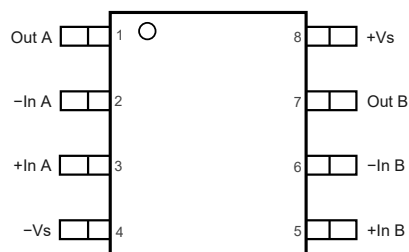


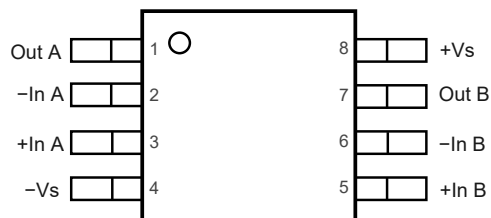
Table 1. Pin Functions: TPA2681

Pin	Name	I/O	Description
1	Out	O	Output
2	-V _S		Negative power supply
3	+In	I	Noninverting input
4	-In	I	Inverting input
5	+V _S		Positive power supply

TPA2682
SOP8
Top View



TPA2682
MSOP8
Top View



TPA2682
TSSOP8
Top View

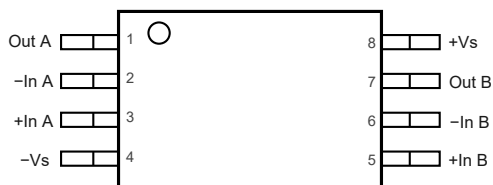


Table 2. Pin Functions: TPA2682

Pin	Name	I/O	Description
1	Out A	O	Output
2	-In A	I	Inverting input
3	+In A	I	Noninverting input
4	-Vs		Negative power supply
5	+In B	I	Noninverting input
6	-In B	I	Inverting input
7	Out B	O	Output
8	+Vs		Positive power supply

Specifications

Absolute Maximum Ratings ⁽¹⁾

Parameter	Min	Max	Unit
Supply Voltage, (+V _S) – (–V _S)		40	V
Input Voltage	(–V _S) – 0.3	40	V
Differential Input Voltage	(–V _S) – (+V _S)	(+V _S) – (–V _S)	V
Input Current: +I _N , –I _N ⁽²⁾	–10	+10	mA
Output Voltage	(–V _S) – 0.3	(+V _S) + 0.3	V
Output Short-Circuit Duration ⁽³⁾		Infinite	
T _J		150	°C
T _A	–40	125	°C
T _{STG}	–65	150	°C
T _L		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 the negative power supply. If the input extends more than 500 mV beyond the negative power supply, the current should be limited to less than 10 mA.

(3) A heat sink may be required to keep the junction temperature below the absolute maximum. This depends on the power supply voltage and how many amplifiers are shorted. The thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	2	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 ⁽²⁾	1	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	θ _{JA}	θ _{Jc}	Unit
SOT23-5	250	81	°C/W
SOP8	158	43	°C/W
MSOP8	210	45	°C/W
TSSOP8	191	50	°C/W

36-V Low-Noise Operational Amplifier
Electrical Characteristics

All test conditions: $V_S = 36\text{ V}$, $T_A = 25^\circ\text{C}$, $R_L = 10\text{ k}\Omega$, unless otherwise noted.

Symbol	Parameter	Conditions	T _A	Min	Typ	Max	Unit
Power Supply							
V _S	Supply Voltage Range			8		36	V
I _Q	Quiescent Current per Amplifier	V _S = 36 V			6	8	mA
			−40°C to 125°C			9	mA
PSRR	Power Supply Rejection Ratio	V _S = 8 V to 36 V		85	100		dB
			−40°C to 125°C	80			dB
Input Characteristics							
V _{OS}	Input Offset Voltage	V _S = 36 V, V _{CM} = 2 V to 34 V		−3	0.5	3	mV
			−40°C to 125°C	−5		5	mV
		V _S = 8 V, V _{CM} = 2 V to 6 V		−3	0.5	3	mV
			−40°C to 125°C	−5		5	mV
V _{OS} TC	Input Offset Voltage Drift		−40°C to 125°C		2		μV/°C
I _B	Input Bias Current			−500	100	500	nA
			−40°C to 125°C	−800		800	nA
I _{OS}	Input Offset Current			−500	100	500	nA
			−40°C to 125°C	−800		800	nA
I _{IN}	Different Input Current	V _S = 36 V, V _{ID} = 36 V			10		μA
			−40°C to 125°C		100		μA
C _{IN}	Input Capacitance	Differential Mode			5		pF
		Common Mode			5		pF
A _V	Open-Loop Voltage Gain	R _{LOAD} = 10 kΩ, V _{OUT} = 4 V to 32 V		95	105		dB
			−40°C to 125°C	90			dB
V _{CMR}	Common-Mode Input Voltage Range			(−V _S) + 2		(+V _S) − 2	V
CMRR	Common-Mode Rejection Ratio	V _{CM} = 2 V to 34 V		100	120		dB
			−40°C to 125°C	95			dB
Output Characteristics							
	Output Swing from Positive Rail	I _{LOAD} = 50 μA to V _S / 2			1.8	2	V
			−40°C to 125°C			2.1	V
		I _{LOAD} = 1 mA to V _S / 2			1.8	2.1	V
			−40°C to 125°C			2.2	V
		I _{LOAD} = 5 mA to V _S / 2			2	2.2	V
			−40°C to 125°C			2.35	V
	Output Swing from Negative Rail	I _{LOAD} = 50 μA to V _S / 2			0.75	1	V

36-V Low-Noise Operational Amplifier

Symbol	Parameter	Conditions	T _A	Min	Typ	Max	Unit
			−40°C to 125°C			1.15	V
		I _{LOAD} = 1 mA to V _S / 2			1	1.2	V
			−40°C to 125°C			1.3	V
		I _{LOAD} = 5 mA to V _S / 2			1.3	1.5	V
			−40°C to 125°C			1.6	V
I _{SC}	Output Short-Circuit Current	Source			100		mA
			−40°C to 85°C				mA
			−40°C to 125°C				mA
		Sink			60		mA
			−40°C to 85°C				mA
			−40°C to 125°C				mA
AC Specifications							
GBW	Gain-Bandwidth Product				20		MHz
SR	Slew Rate			8	10		V/μs
		−40°C to 125°C	7	8		V/μs	
t _{OR}	Overload Recovery				350		ns
t _s	Settling Time, 0.1%	G = 1, 10-V step			1		μs
	Settling Time, 0.01%				1.1		μs
PM	Phase Margin	R _L = 10 kΩ, C _L = 50 pF			55		°
GM	Gain Margin	R _L = 10 kΩ, C _L = 50 pF			11		dB
Noise Performance							
E _N	Input Voltage Noise	f = 0.1 Hz to 10 Hz			0.8		μV _{PP}
e _N	Input Voltage Noise Density	f = 1 Hz			80		nV/√Hz
		f = 1 kHz			10		nV/√Hz
		f = 10 kHz			10		nV/√Hz
		f = 100 kHz			10		nV/√Hz
i _N	Input Current Noise	f = 10 kHz			2		pA/√Hz
THD+N	Total Harmonic Distortion and Noise	f = 1 kHz, G = 1, R _L = 10 kΩ, V _{OUT} = 1 V _{RMS}			0.0005		%

Typical Performance Characteristics

All test conditions: $V_S = \pm 15\text{ V}$, $V_{CM} = 0\text{ V}$, $R_L = 10\text{ k}\Omega$, unless otherwise noted.

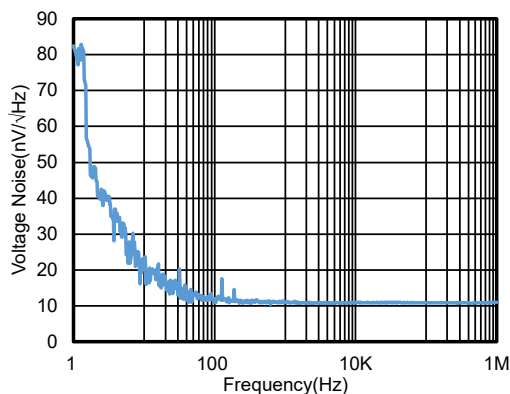


Figure 1. Voltage Noise Density vs. Frequency

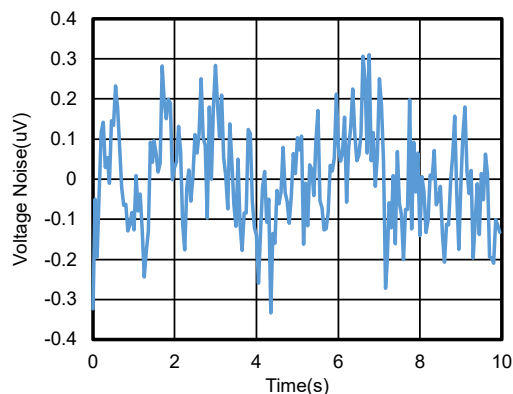


Figure 2. 0.1-Hz to 10-Hz Voltage Noise

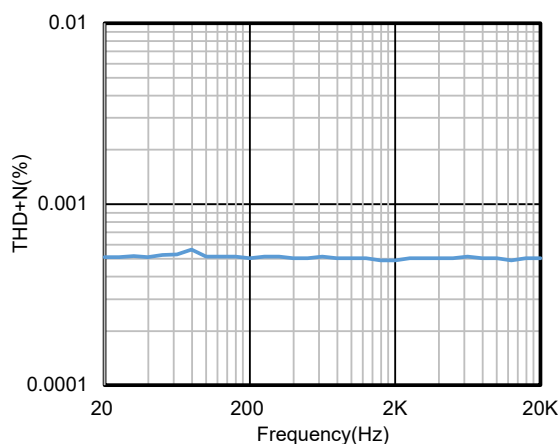


Figure 3. THD + N = 0.0005%, $G = 1$, $V_S = 30\text{ V}$

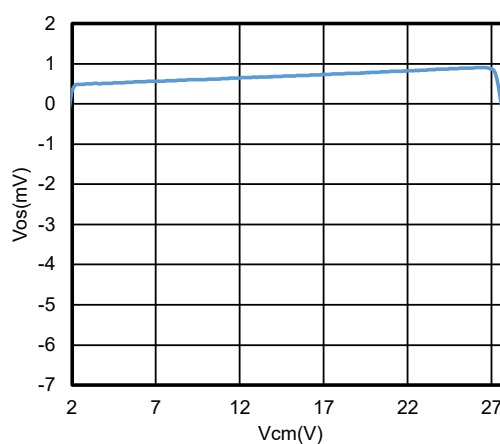


Figure 4. V_{OS} vs. Common-Mode Voltage, $V_S = 30\text{ V}$

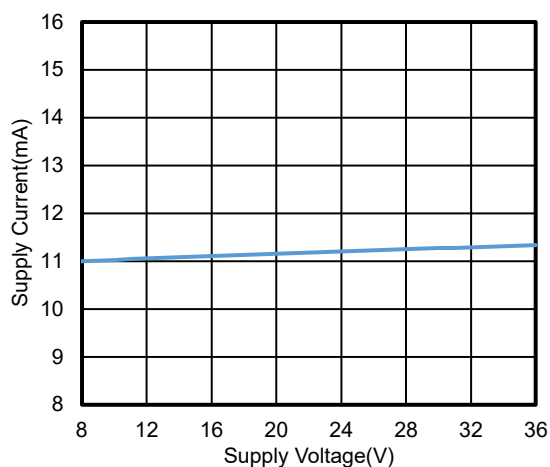


Figure 5. I_Q vs. Supply Voltage

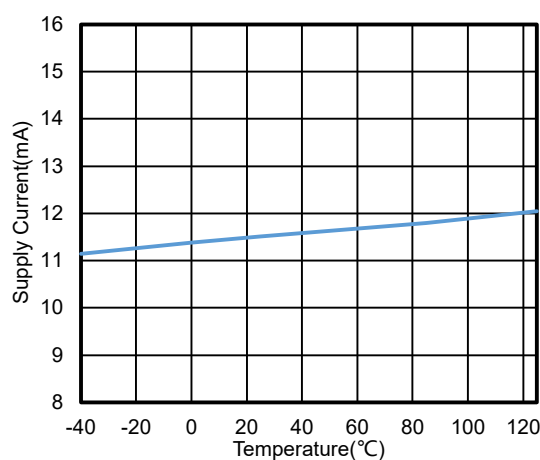
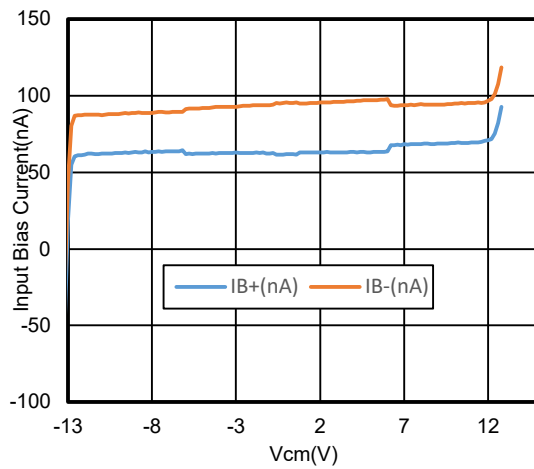
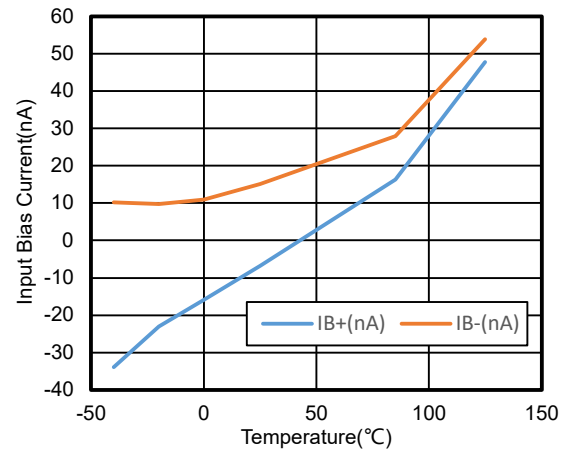
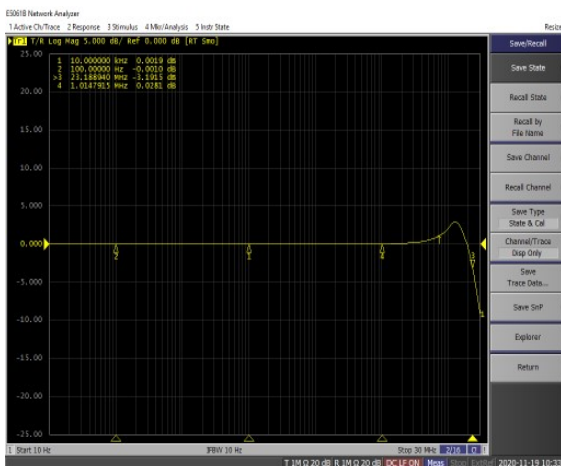
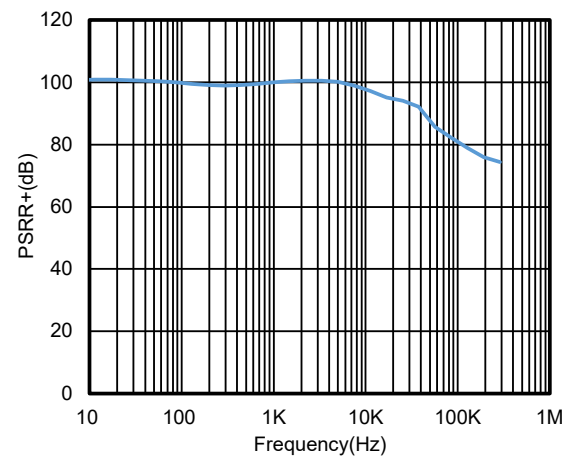
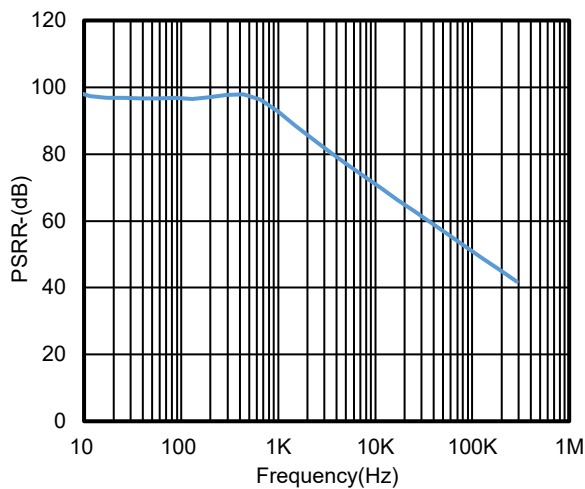
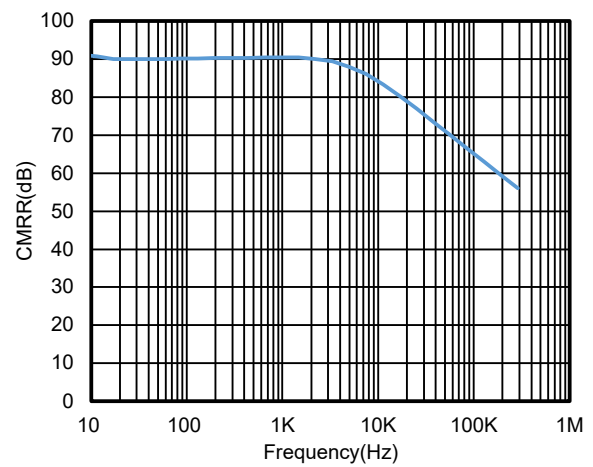


Figure 6. I_Q vs. Temperature, $\pm 15\text{-V}$ Supply, TPA2682


Figure 7. I_B vs. Common-Mode Voltage, $V_S = \pm 15\text{ V}$

Figure 8. I_B and I_{OS} vs. Temperature

Figure 9. -3-dB Bandwidth, $G = 1$, $V_S = 30\text{ V}$

Figure 10. PSRR+ vs. Frequency

Figure 11. PSRR- vs. Frequency

Figure 12. CMRR vs. Frequency

36-V Low-Noise Operational Amplifier



Time: 1 μ s/div, Measure Time: 310 ns, G = 10

Figure 13. Positive Overload Recovery



Time: 1 μ s/div, Measure Time: 350 ns, G = 10

Figure 14. 10-V Signal Step Response

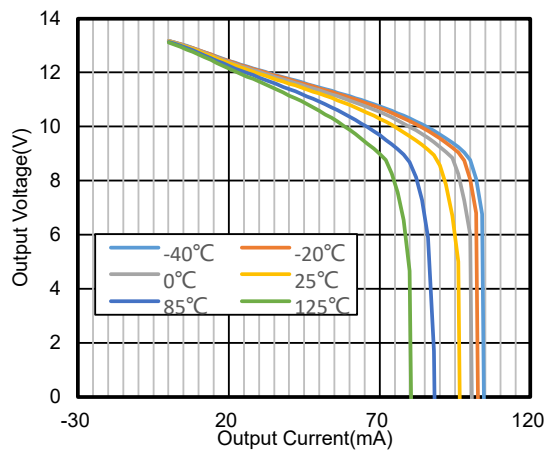


Figure 15. V_{OUT} vs. I_{OUT} , Source

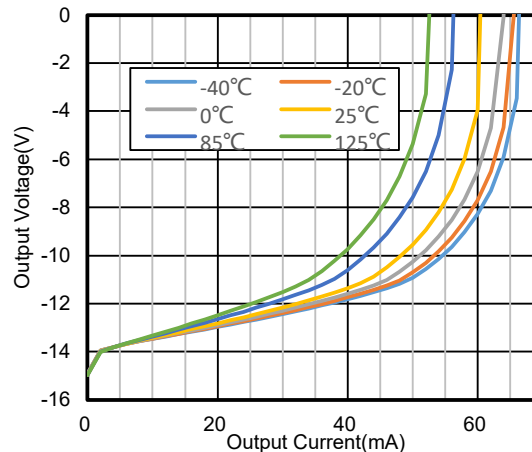


Figure 16. V_{OUT} vs. I_{OUT} , Sink

Typical Performance Characteristics (Continued)

All test conditions: $V_S = \pm 15\text{ V}$, $V_{CM} = 0\text{ V}$, $R_L = 10\text{ k}\Omega$, Power On and Off Behavior, 36-V Single Supply, $G = 1$, Input = $V_S / 2$, Yellow: Output, Green: V_S , unless otherwise noted.



Figure 17. 1-ms, 0-V to 36-V Power on and off Time



Figure 18. 1-ms, 3-V to 36-V Power on and off Time



Figure 19. 10-ms, 0-V to 36-V Power on and off Time



Figure 20. 10-ms, 3-V to 36-V Power on and off Time



Figure 21. 100-ms, 0-V to 36-V Power on and off Time



Figure 22. 100-ms, 3-V to 36-V Power on and off Time

Detailed Description

Overview

The TPA268x is a series of high-voltage operational amplifiers. The device operates from 8 V to 36 V. It is unity-gain stable and designed for a wide range of general-purpose applications.

Functional Block Diagram

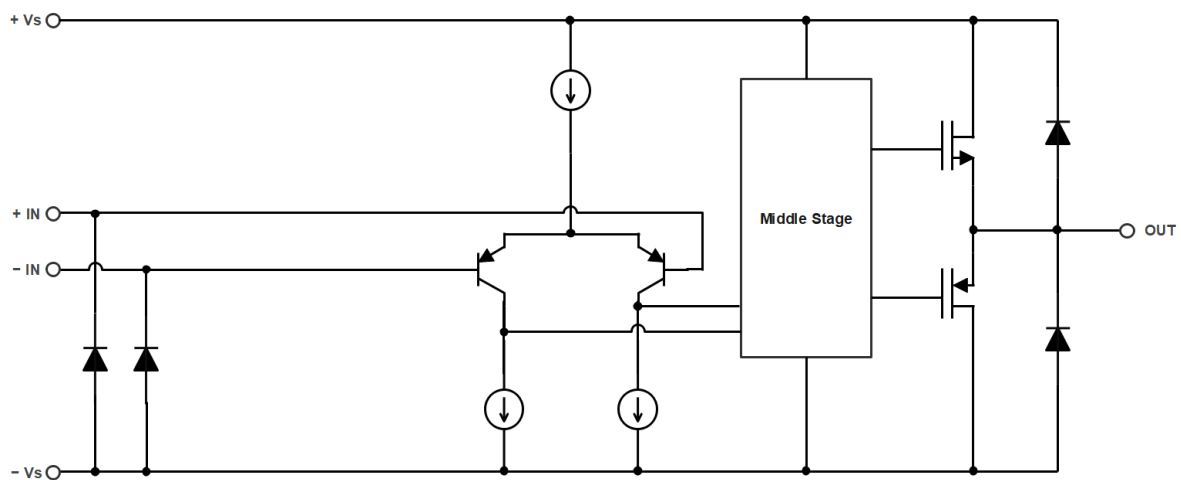


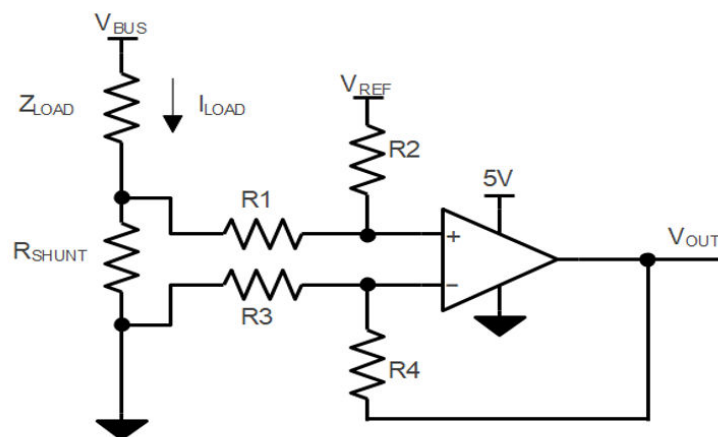
Figure 23. Functional Block Diagram

Application and Implementation

Note

Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Typical Application

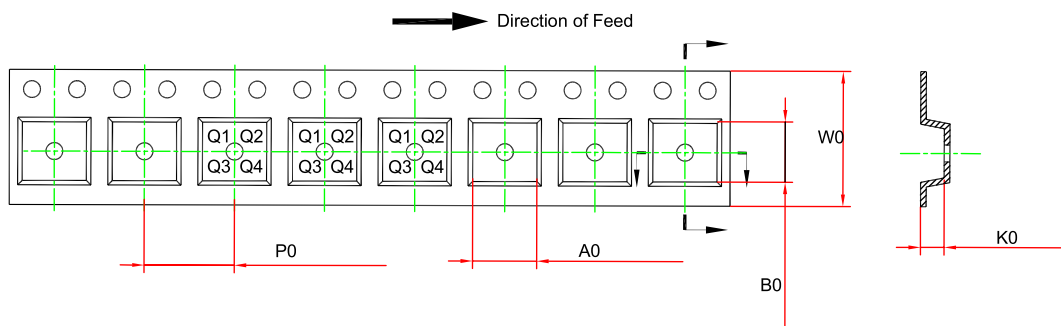
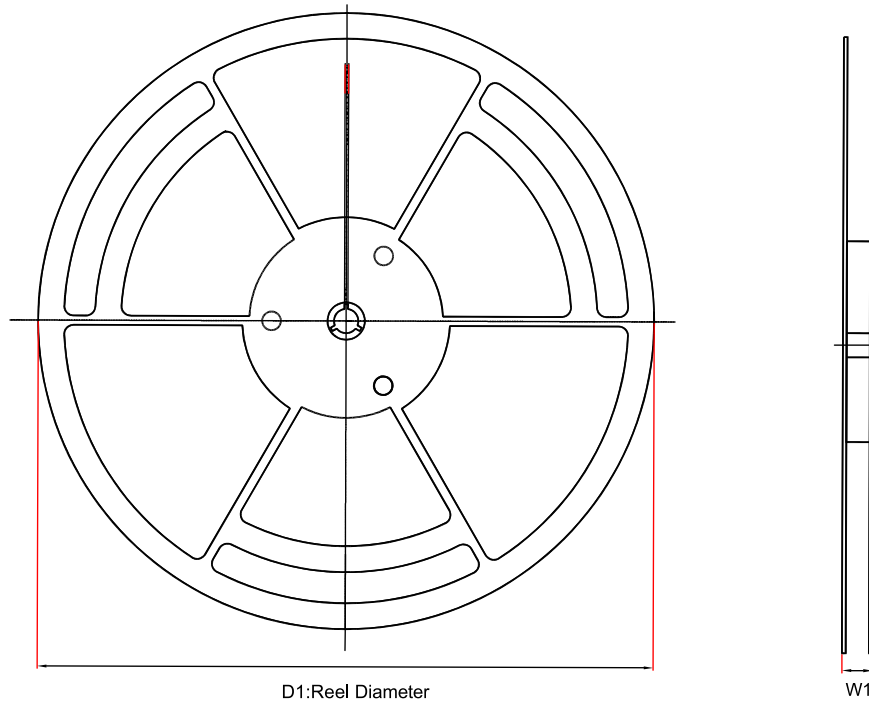


$$V_{OUT} = (I_{LOAD} \times R_{SHUNT}) \times (R2 / R1) + V_{REF}$$

When $R3 = R1$, $R2 = R4$, $R_{SHUNT} \ll R1$

Figure 24. Typical Application Circuit

Tape and Reel Information

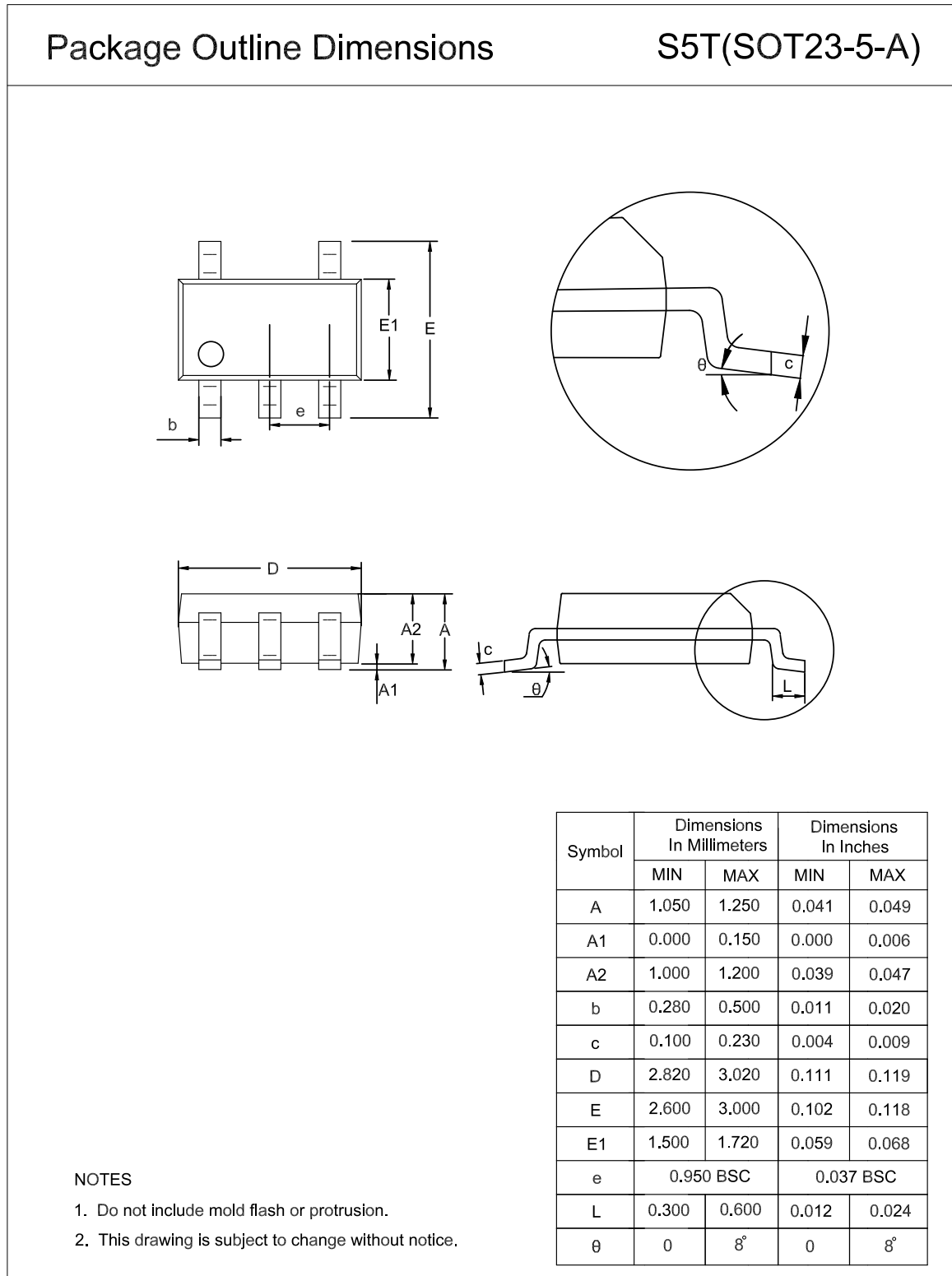


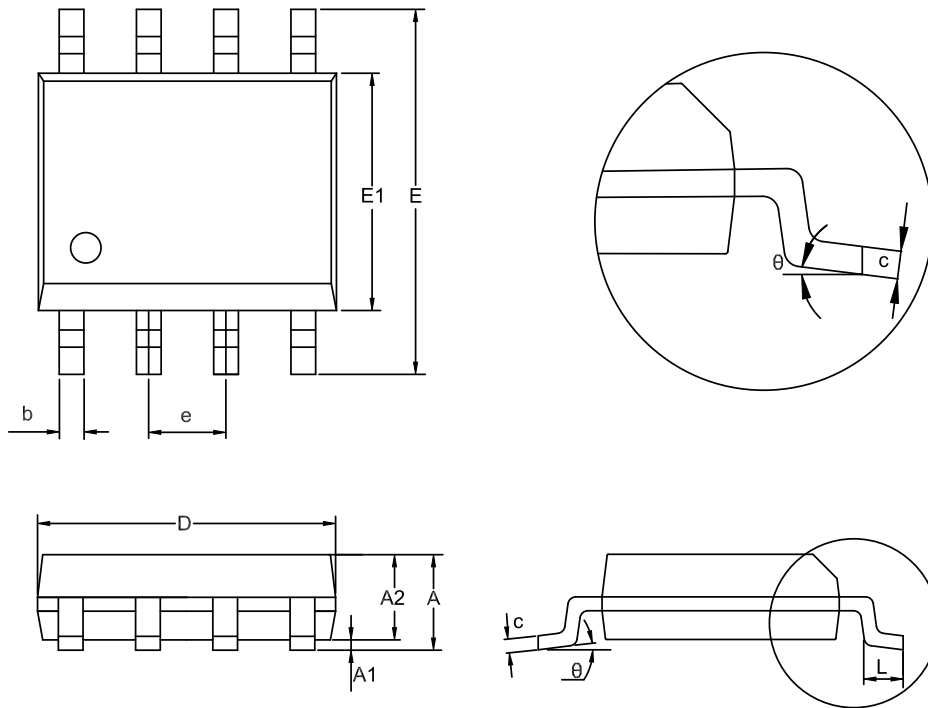
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) ⁽¹⁾	B0 (mm) ⁽¹⁾	K0 (mm) ⁽¹⁾	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPA2681-S5TR	SOT23-5	180.0	13.1	3.2	3.2	1.4	4.0	8.0	Q3
TPA2682-SO1R	SOP8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1
TPA2682-VS1R	MSOP8	330.0	17.6	5.2	3.3	1.5	8.0	12.0	Q1
TPA2682-TS1R	TSSOP8	330.0	17.6	6.8	3.3	1.2	8.0	12.0	Q1

(1) The value is for reference only. Contact the 3PEAK factory for more information.

Package Outline Dimensions

SOT23-5

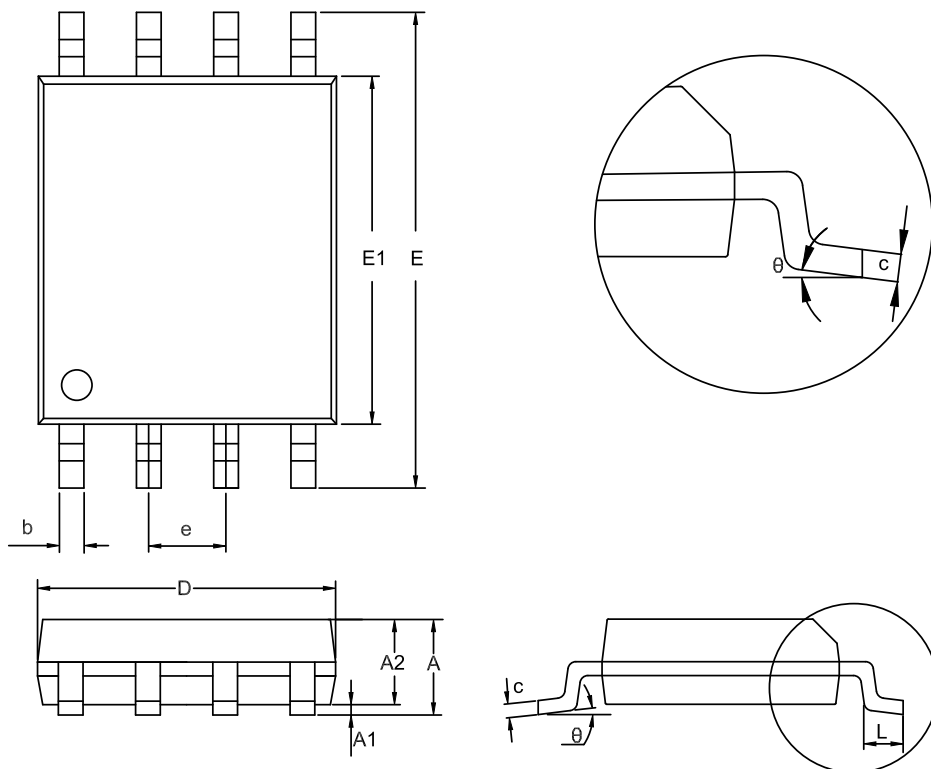


SOP8
Package Outline Dimensions
SO1(SOP-8-A)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.000	0.016	0.039
θ	0	8°	0	8°

NOTES

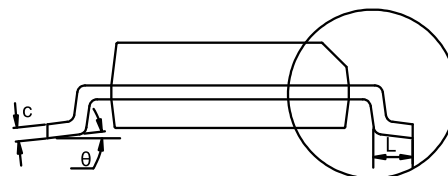
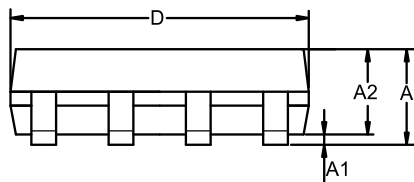
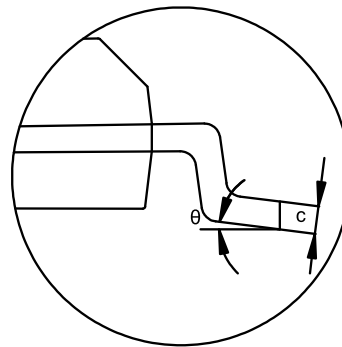
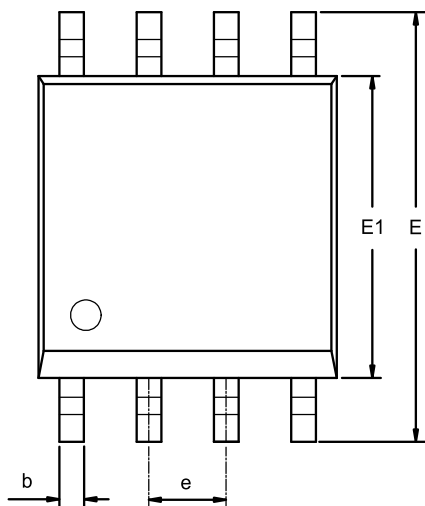
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

TSSOP8
Package Outline Dimensions
TS1(TSSOP-8-A)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.200	0.035	0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	2.900	3.100	0.114	0.122
E	6.200	6.600	0.244	0.260
E1	4.300	4.500	0.169	0.177
e	0.650 BSC		0.026 BSC	
L	0.450	0.750	0.018	0.030
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

MSOP8
Package Outline Dimensions
VS1(MSOP-8-A)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	4.700	5.100	0.185	0.201
E1	2.900	3.100	0.114	0.122
e	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPA2681-S5TR	-40 to 125°C	SOT23-5	268	3	Tape and Reel, 3,000	Green
TPA2682-SO1R	-40 to 125°C	SOP8	A2682	3	Tape and Reel, 4,000	Green
TPA2682-VS1R	-40 to 125°C	MSOP8	A2682	3	Tape and Reel, 3,000	Green
TPA2682-TS1R	-40 to 125°C	TSSOP8	A2682	3	Tape and Reel, 3,000	Green

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

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