

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 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
- -40°C to 125°C Operation Temperature Range

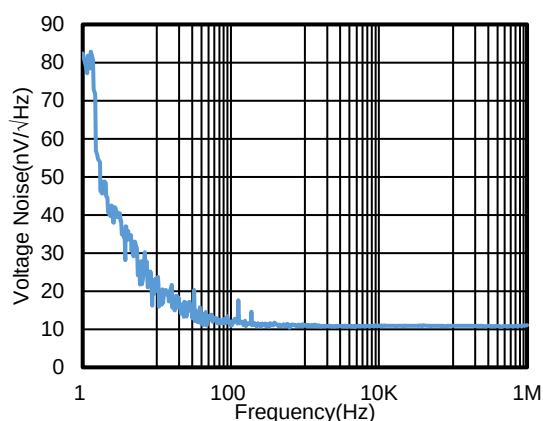
Applications

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

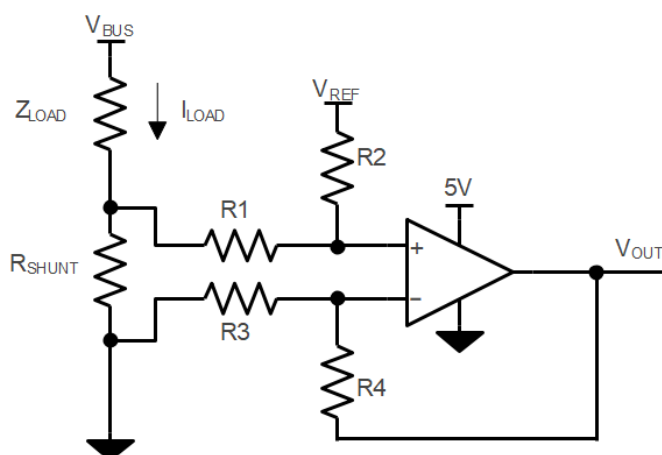
Description

The TPA268X series amplifiers are the newest high-supply voltage amplifiers with low noise and high-frequency response. They incorporate 3PEAK's proprietary and patented design techniques to achieve very good AC performance with 20MHz bandwidth, 10 V/ μ s slew rate, and low distortion while drawing only 6mA of quiescent current per amplifier.

The combination of features makes the TPA268X an ideal choice for industrial control, motor control and audio amplification, sound ports, and other consumer audio.



Typical Application Circuit



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

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

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Revision History

Date	Revision	Notes
2021/5/20	Rev.A.0	Initial-Release Version
2021/7/7	Rev.A.1	Updated maximum rating: Input voltage: $(-V_S) - 0.3$ to $(+V_S) + 0.3 \rightarrow (-V_S) - 0.3$ to 40 V
2022/4/29	Rev.A.2	Updated order information
2022/8/9	Rev.A.3	Added part number: TPA2682-TS1R

Pin Configuration and Functions

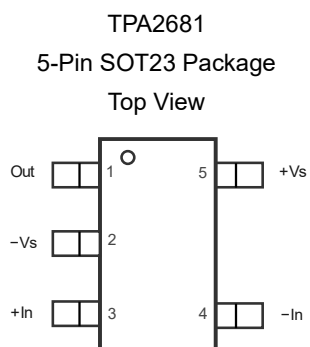
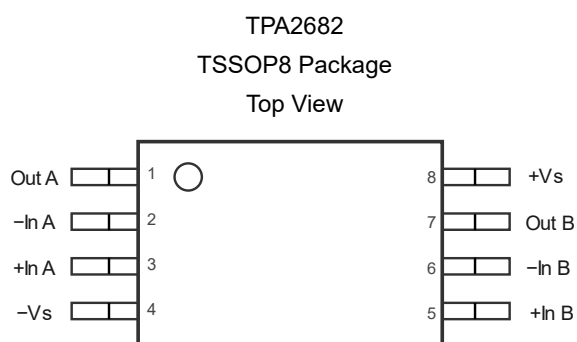
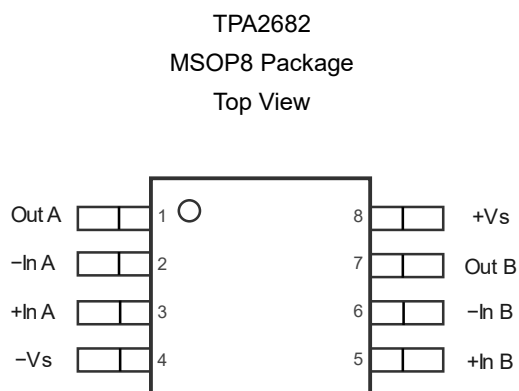
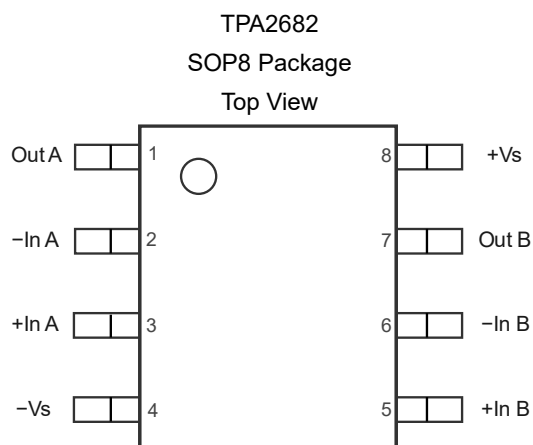


Table 6-1. Pin Functions: TPA2681

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


Table 6-2. Pin Functions: TPA2682

Pin	Name	I/O	Description
1	Out A	Output	Output
2	-In A	Input	Inverting input
3	+In A	Input	Noninverting input
4	-Vs		Negative power supply
5	+In B	Input	Noninverting input
6	-In B	Input	Inverting input
7	Out B	Output	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: +IN, –IN ⁽²⁾	–10	+10	mA
	Output Voltage	(–V _S) – 0.3	(+V _S) + 0.3	V
	Output Short-Circuit Duration ⁽³⁾		Infinite	
T _J	Maximum Junction Temperature		150	°C
T _A	Operating Temperature Range	–40	125	°C
T _{STG}	Storage Temperature Range	–65	150	°C
T _L	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 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 comparators are shorted. 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

All test condition is $V_S = 36\text{ V}$, $T_A = 25^\circ\text{C}$, $R_L = 10\text{ k}\Omega$, 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-)+2		(V+)-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

Electrical Characteristics (Continued)

Symbol	Parameter	Conditions	T _A	Min	Typ	Max	Unit
	Output Swing from Negative Rail	I _{LOAD} = 50 μA to V _S /2			0.75	1	V
			-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				10		V/μs
		-40°C to 125°C			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 K, C _L =50 pF			55		°
GM	Gain Margin	R _L =10 K, 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} = 1V _{RMS}			0.0005		%

$V_S = \pm 15\text{ V}$, $V_{CM} = 0\text{ V}$, $R_L = 10\text{ k}\Omega$, unless otherwise specified.

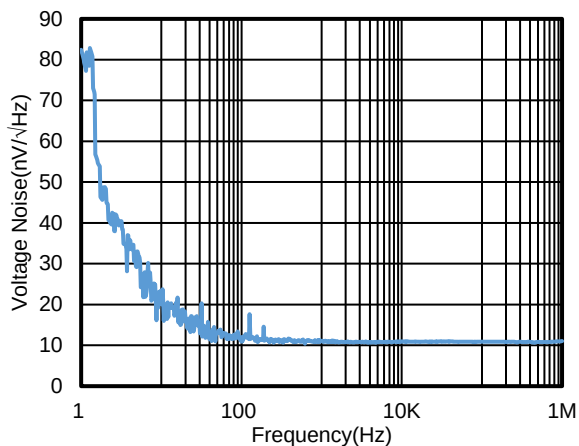


Figure 1. Voltage Noise Density vs. Frequency

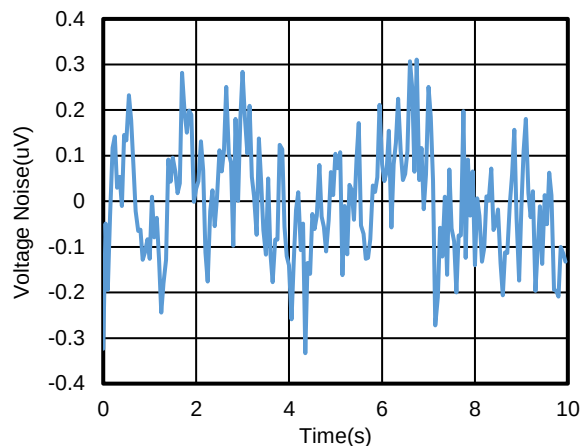


Figure 2. 0.1 to 10 Hz Voltage Noise

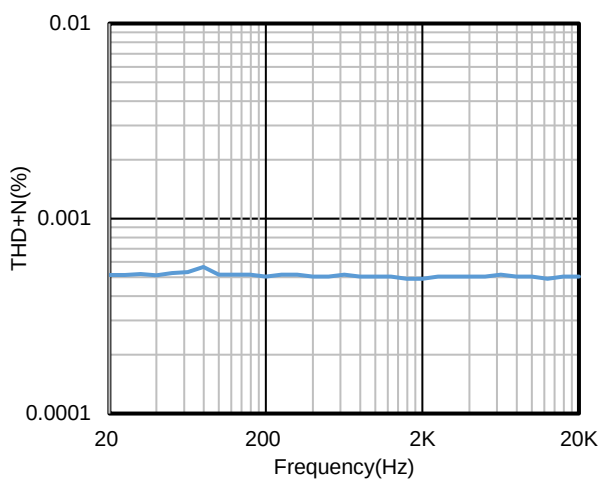


Figure 3. THD+N = 0.0005%, $G = 1$, $V_S = 30\text{ V}$

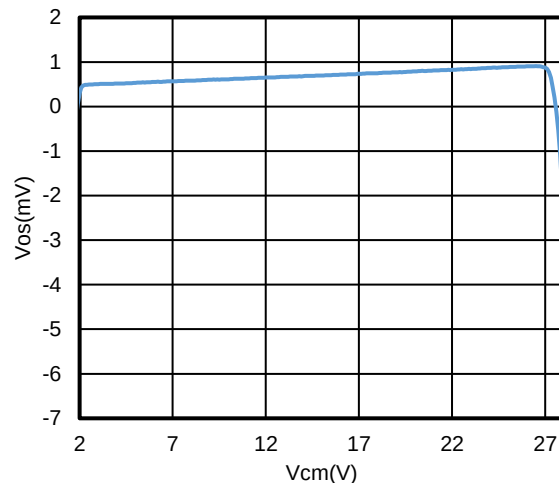


Figure 4. V_{OS} vs. Common-Mode Voltage, $V_S = 30\text{ V}$

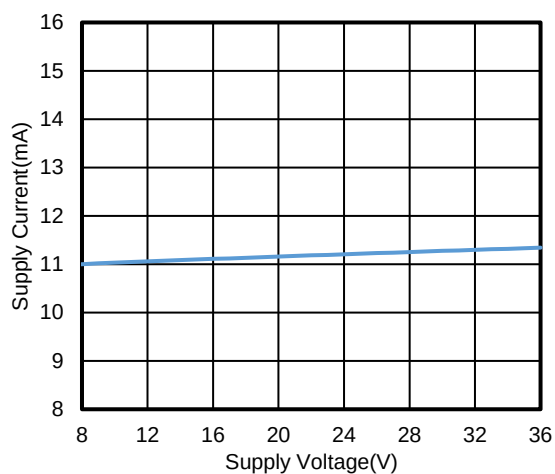


Figure 5. I_q vs. Supply Voltage

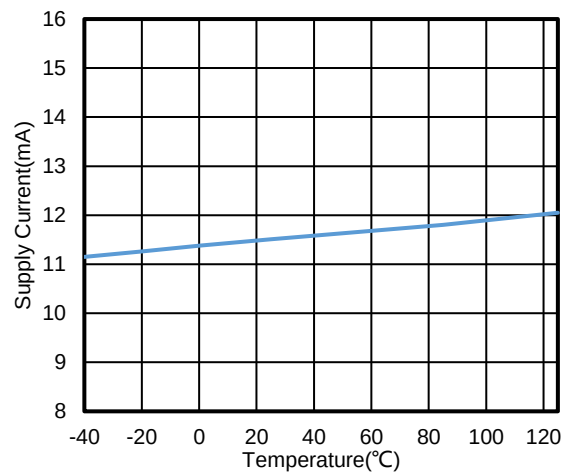


Figure 6. I_q vs. Temperature, $\pm 15\text{ V}$ Supply, TPA2682

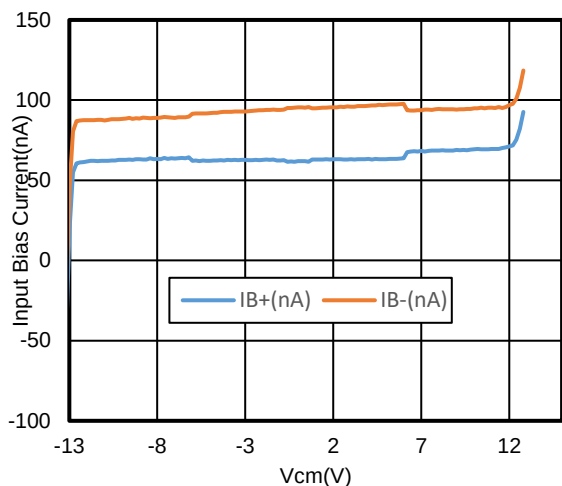


Figure 7. I_B vs. Common-Mode Voltage, $V_S = +15\text{ V}$, -15 V

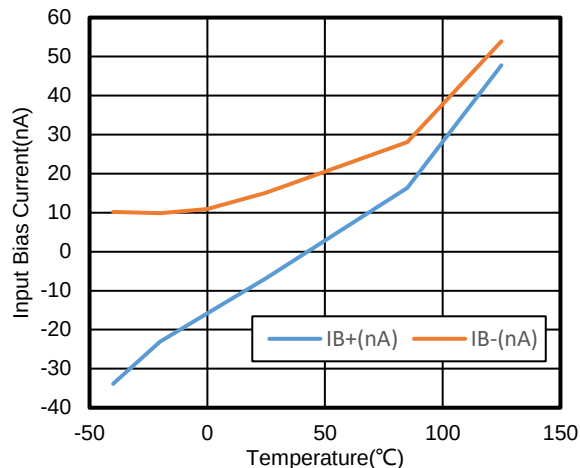


Figure 8. I_B and I_{OS} vs. Temperature

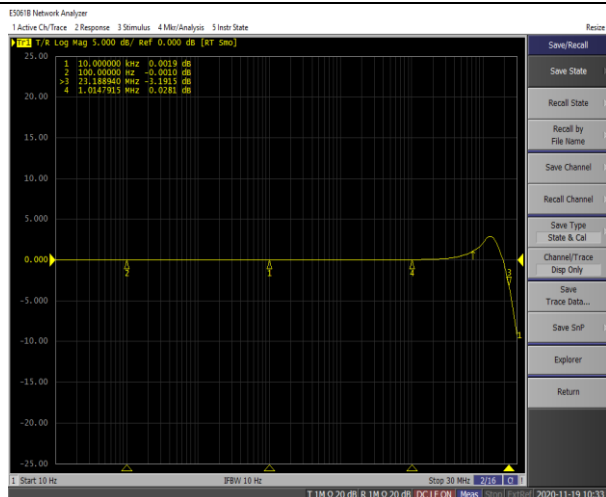


Figure 9. -3 dB Bandwidth, $G = 1$, $V_S = 30\text{ V}$

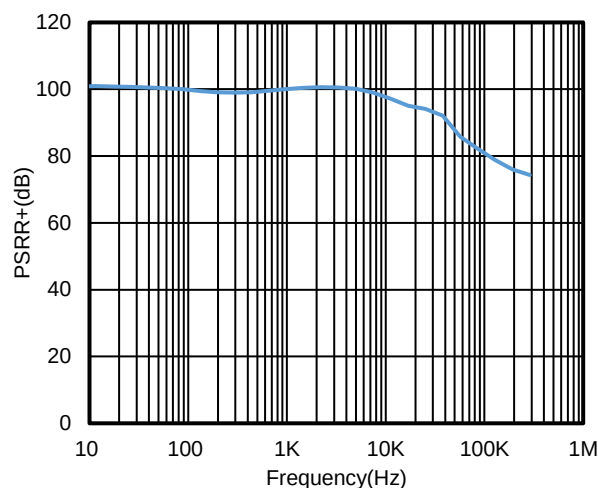


Figure 10. PSRR+ vs. Frequency

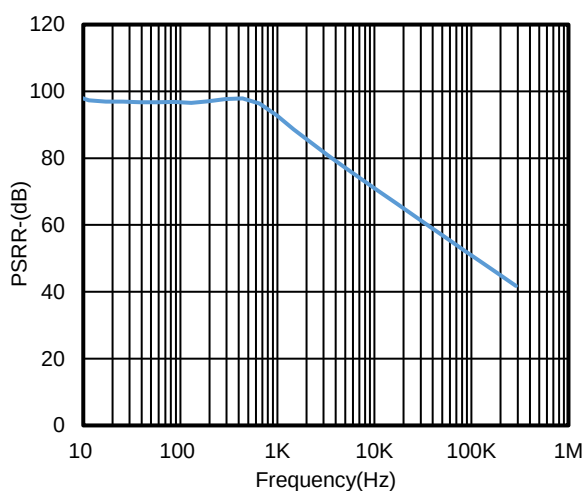


Figure 11. PSRR- vs. Frequency

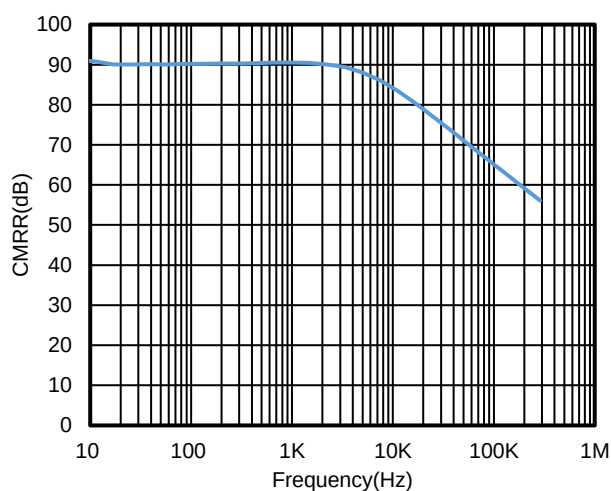


Figure 12. CMRR vs. Frequency



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

Figure 13. Positive Overload Recovery



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

Figure 14. Negative Overload Recovery

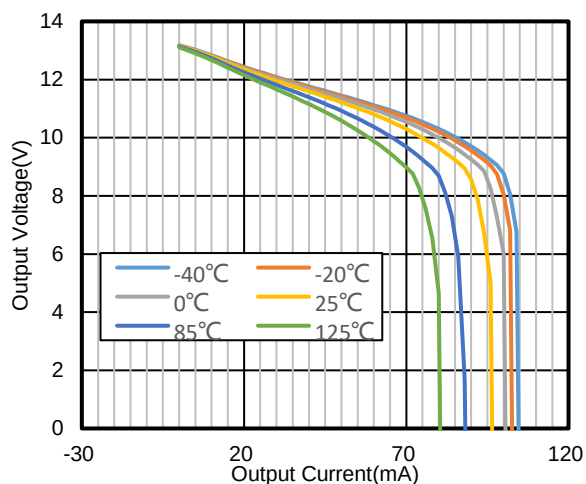


Figure 15. V_{OUT} vs. I_{OUT} , Source

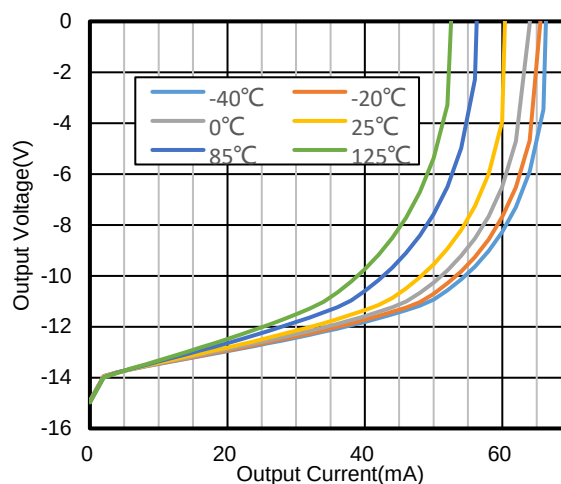


Figure 16. V_{OUT} vs. I_{OUT} , Sink

Power On and Off Behavior, 36 V Single Supply, $G = 1$, Input = $V_s / 2$, Yellow: Output, Green: V_s



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 series is a new family of high voltage op amplifiers. These devices operate from 8 V to 36 V, are unity-gain stable, and are designed for a wide range of general-purpose applications.

Functional Block Diagram

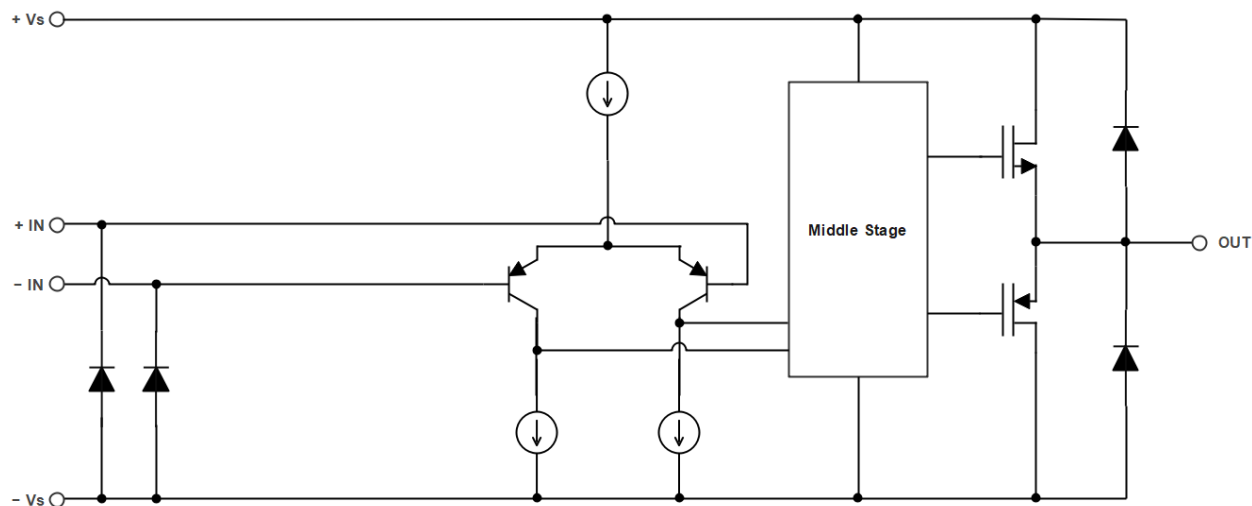
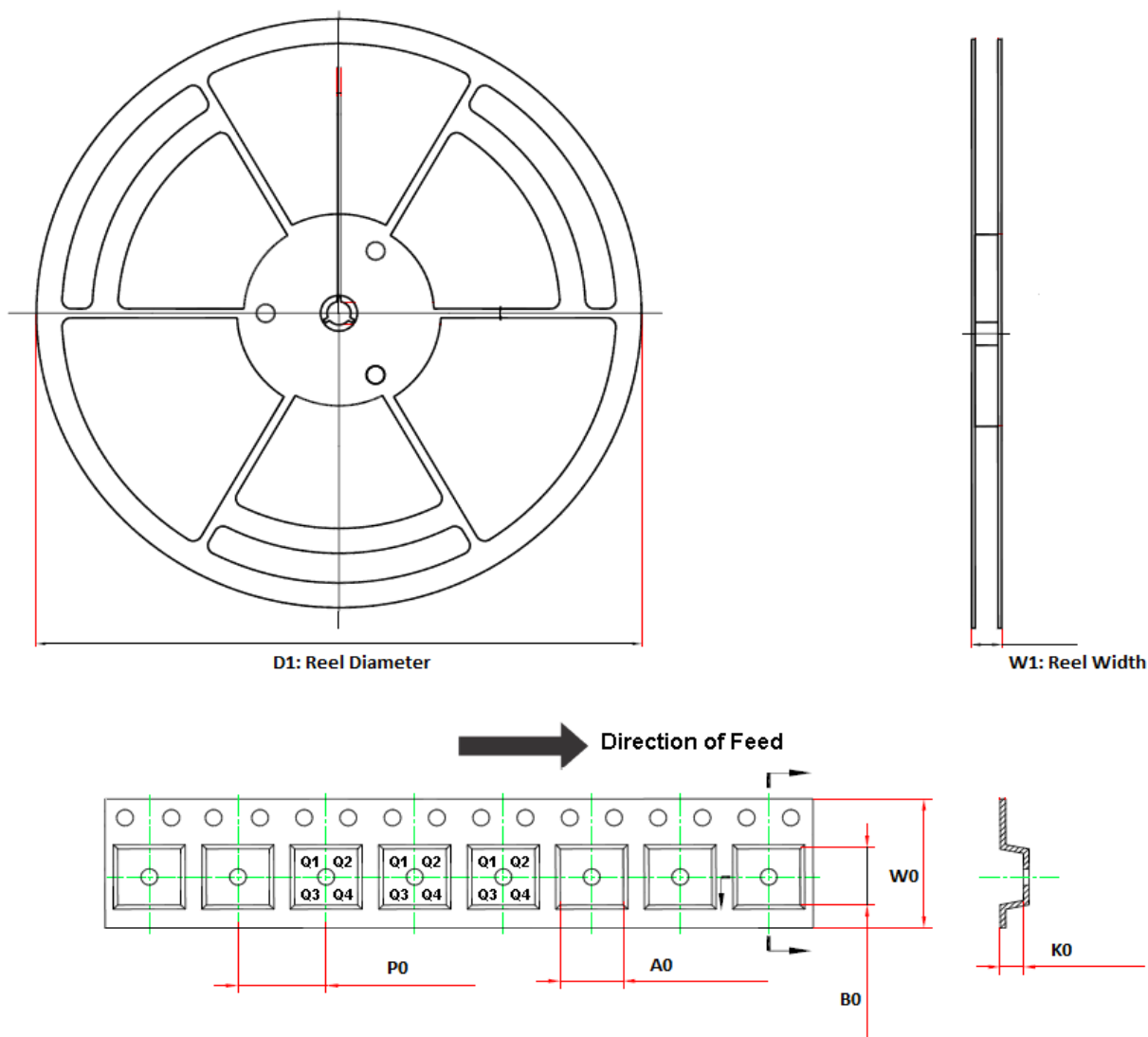
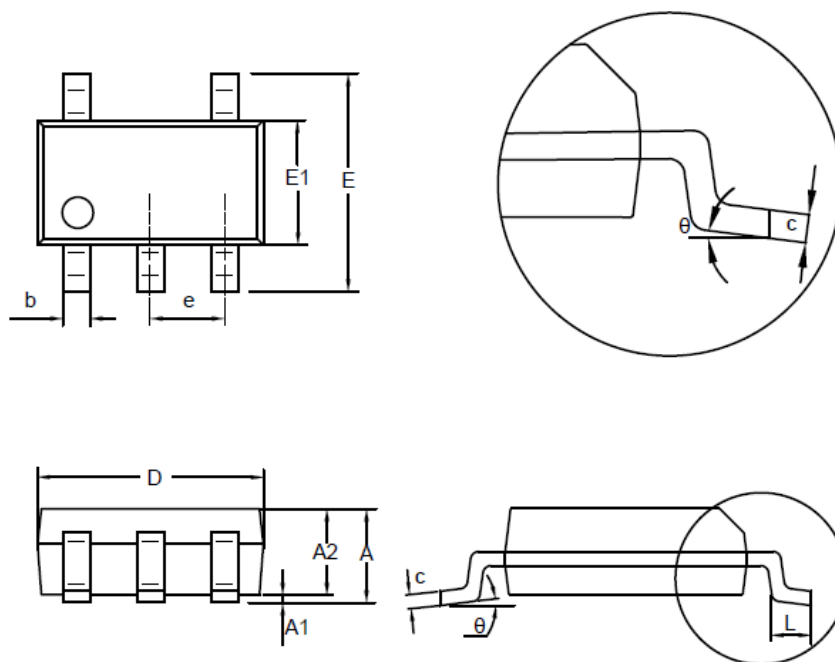


Figure 23. Functional Block Diagram

Tape and Reel Information



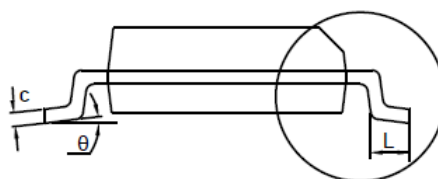
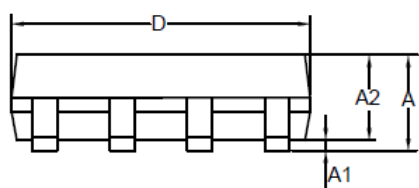
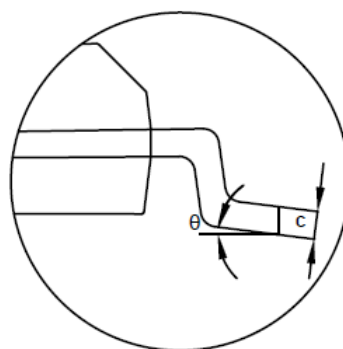
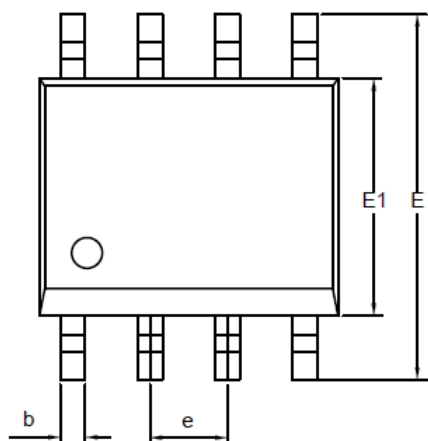
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPA2681-S5TR	SOT23-5	180.0	13.1	3.2	3.2	1.4	4.0	8.0	Q3
TPA2682-SO1R	SOP8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1
TPA2682-VS1R	MSOP8	330.0	17.6	5.2	3.3	1.5	8.0	12.0	Q1
TPA2682-TS1R	TSSOP8	330.0	17.6	6.8	3.3	1.2	8.0	12.0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

Package Outline Dimensions
SOT23-5
Package Outline Dimensions
S5T(SOT23-5-A)


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.150	0.000	0.006
A2	1.000	1.200	0.039	0.047
b	0.280	0.500	0.011	0.020
c	0.100	0.230	0.004	0.009
D	2.820	3.020	0.111	0.119
E	2.600	3.000	0.102	0.118
E1	1.500	1.720	0.059	0.068
e	0.950 BSC		0.037 BSC	
L	0.300	0.600	0.012	0.024
θ	0	8°	0	8°

NOTES

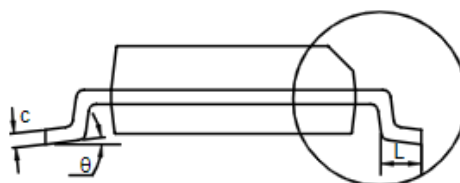
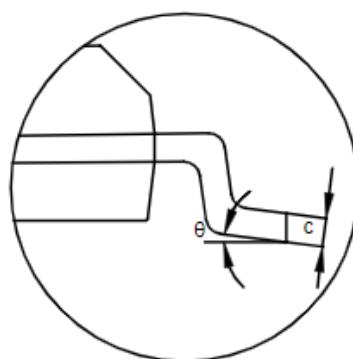
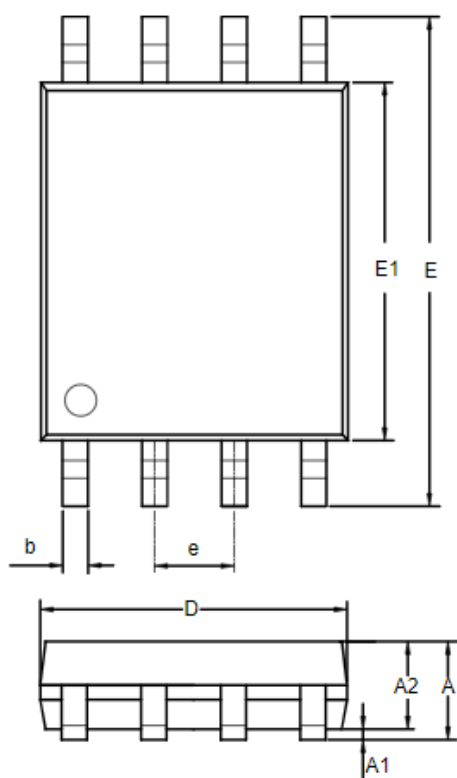
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

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

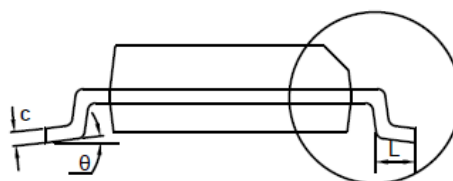
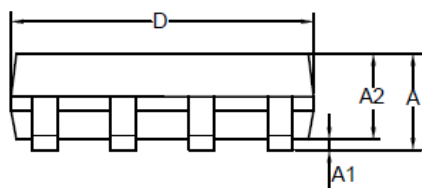
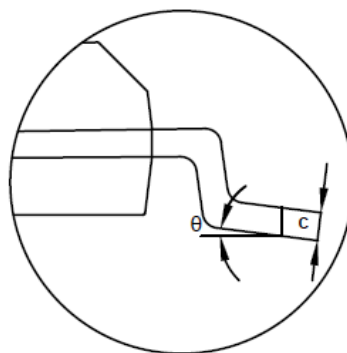
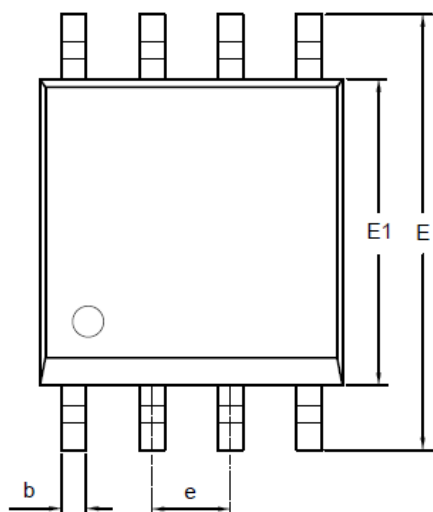
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

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	0.050	0.150	0.002	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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