

Features

- Supply Voltage: 2.5 V to 5.5 V
- No Oscillation when Driving Large Capacitor Loads: Up to 10 μF
- Offset Voltage: ± 3 mV Maximum
- Bandwidth: 6 MHz, Slew Rate: 5 V/ μs
- Low Power: 0.8 mA per Channel
- Rail-to-Rail Input and Output
- Low 1/f Noise: 25 nV/ $\sqrt{\text{Hz}}$ at 1 kHz
- -40°C to 125°C Operation Temperature Range

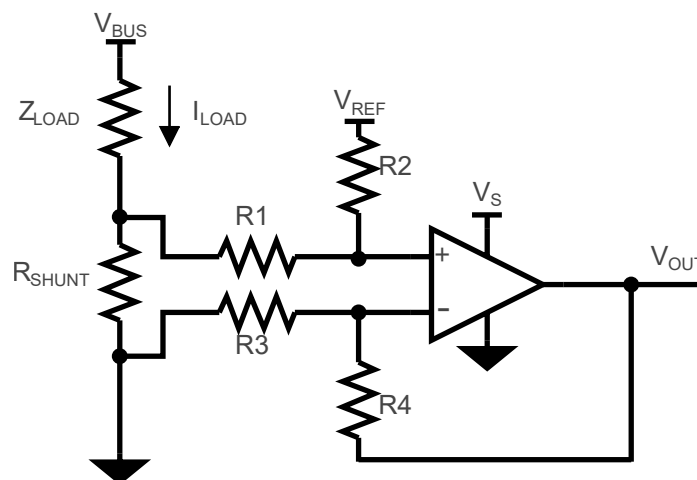
Description

The devices are CMOS RRIO op-amps with low offset, low power, and stable high-frequency response. They incorporate proprietary and patented design techniques to achieve high-performance AC with 6-MHz bandwidth, 5-V/ μs slew rate, and low distortion while drawing only 0.8 mA of quiescent current per amplifier. The devices are suitable for audio and motor control applications.

Applications

- Instrumentation
- Motor Control
- Industrial Control

Typical Application Circuit



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

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

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Revision History

Date	Revision	Notes
2024-11-20	Rev.A.0	Initial release.
2025-08-15	Rev.A.1	The following updates are all about new formats or typo corrections. The actual product remains unchanged. Updated the order information of TPA6061-S5TR, TPA6064-SO2R, and TPA6064- TS2R.

Pin Configuration and Functions

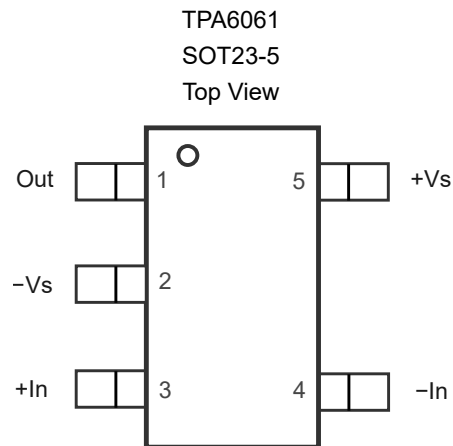
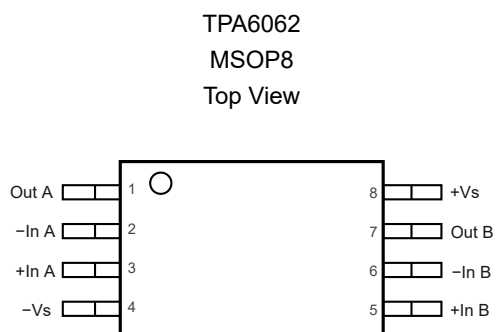
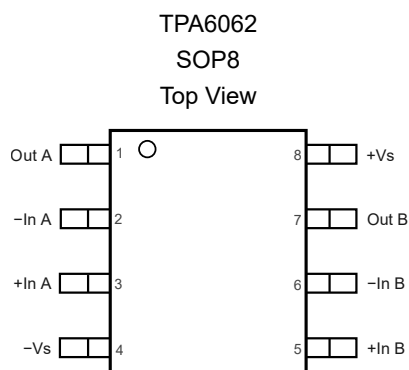
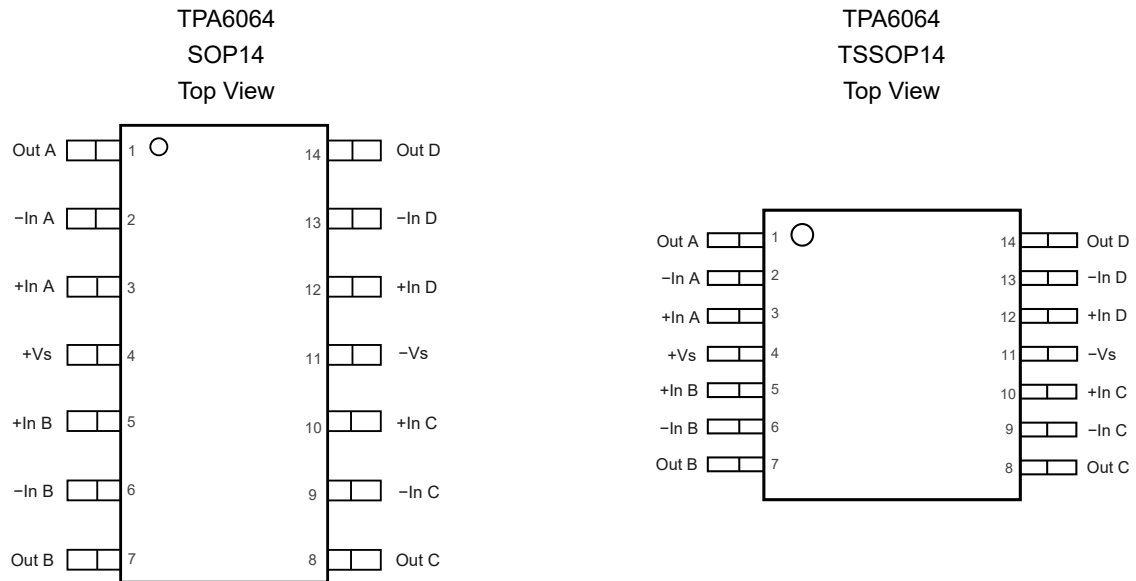


Table 1. Pin Functions: TPA6061

Pin No. SOT23-5	Name	I/O	Description
1	Out	O	Output
2	-Vs		Negative power supply
3	+In	I	Non-inverting input
4	-In	I	Inverting input
5	+Vs		Positive power supply


Table 2. Pin Functions: TPA6062

Pin No.		Name	I/O	Description
SOP8	MSOP8			
1	1	Out A	O	Output
2	2	-In A	I	Inverting input
3	3	+In A	I	Non-inverting input
4	4	-Vs		Negative power supply
5	5	+In B	I	Non-inverting input
6	6	-In B	I	Inverting input
7	7	Out B	O	Output
8	8	+Vs		Positive power supply


Table 3. Pin Functions: TPA6064

Pin No.		Name	I/O	Description
SOP14	TSSOP14			
1	1	Out A	O	Output
2	2	-In A	I	Inverting input
3	3	+In A	I	Non-inverting input
4	4	+Vs		Positive power supply
5	5	+In B	I	Non-inverting input
6	6	-In B	I	Inverting input
7	7	Out B	O	Output
8	8	Out C	O	Output
9	9	-In C	I	Inverting input
10	10	+In C	I	Non-inverting input
11	11	-Vs		Negative power supply
12	12	+In D	I	Non-inverting input
13	13	-In D	I	Inverting input
14	14	Out D	O	Output

Specifications

Absolute Maximum Ratings

Over operating ambient temperature (unless otherwise noted) ⁽¹⁾

Parameter		Min	Max	Unit
	Supply Voltage, (+V _S) – (–V _S)		6.5	V
	Input Voltage	(–V _S) – 0.3	(+V _S) + 0.5	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 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.

(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. 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

Parameter		Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	6	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 ⁽²⁾	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.

Recommended Operating Conditions

Parameter		Min	Typ	Max	Unit
V _S	Supply Voltage, (+V _S) – (–V _S)	2.5		5.5	V
T _A	Operating Temperature Range	–40		125	°C

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
SOP14	120	36	°C/W
TSSOP14	180	35	°C/W

Electrical Characteristics

All test conditions: $V_S = 5\text{ V}$, $T_A = 25^\circ\text{C}$, $R_L = 10\text{ k}\Omega$, unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
Power Supply						
V _S	Supply Voltage Range		2.5		5.5	V
I _Q	Quiescent Current per Amplifier			0.8	1	mA
		T _A = −40°C to 125°C			1.2	mA
PSRR	Power Supply Rejection Ratio	V _S = 2.5 V to 5.5 V, V _{CM} = 1 V	72	94		dB
		V _S = 2.5 V to 5.5 V, V _{CM} = 1 V , T _A = −40°C to 125°C	60			dB
Input Characteristics						
V _{OS}	Input Offset Voltage	V _{CM} = 0 V to 2.5 V	−3	1.5	3	mV
		V _{CM} = 0 V to 2.5 V, T _A = −40°C to 125°C	−3.5		3.5	mV
		V _{CM} = 3.5 V to 5 V	−6.8	1.8	6.8	mV
		V _{CM} = 3.5 V to 5 V, T _A = −40°C to 125°C	−11		11	mV
V _{OS} TC	Input Offset Voltage Drift	V _{CM} = 0 V to 2.5 V, T _A = −40°C to 125°C		1		μV/°C
		V _{CM} = 3.5 V to 5 V, T _A = −40°C to 125°C		2		μV/°C
I _B	Input Bias Current ⁽¹⁾	V _{CM} = 2.5 V	−300	10	300	pA
		V _{CM} = 2.5 V, T _A = −40°C to 125°C	−5		5	nA
I _{OS}	Input Offset Current ⁽¹⁾	V _{CM} = 2.5 V	−300	10	300	pA
		V _{CM} = 2.5 V, T _A = −40°C to 125°C	−5		5	nA
C _{IN}	Input Capacitance ⁽²⁾	Differential Mode		6		pF
		Common Mode		8		pF
A _V	Open-loop Voltage Gain	V _O = 1 V to 4 V	85	100		dB
		V _O = 1 V to 4 V, T _A = −40°C to 125°C	80			dB
V _{CMR}	Common-mode Input Voltage Range	T _A = −40°C to 125°C	(−V _S)−0.1		(+V _S) + 0.1	V
CMRR	Common-mode Rejection Ratio	V _{CM} = 0 V to 3 V	80	105		dB
		V _{CM} = 0 V to 3 V, T _A = −40°C to 125°C	75			dB
		V _{CM} = 0 V to 5 V	60	80		dB
		V _{CM} = 0 V to 5 V, T _A = −40°C to 125°C	55			dB
Output Characteristics						
	Output Voltage Swing from Positive Rail or Negative Rail	R _L = 10 kΩ to V _S /2		10	15	mV
		R _L = 10 kΩ to V _S /2, T _A = −40°C to 125°C			20	mV

All test conditions: $V_S = 5\text{ V}$, $T_A = 25^\circ\text{C}$, $R_L = 10\text{ k}\Omega$, unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
I _{SC}	Output Short-Circuit Current	Sink or Source	70	90		mA
		Sink or Source, T _A = −40°C to 125°C	50			mA
AC Specifications						
GBW	Gain-Bandwidth Product			6		MHz
SR	Slew Rate	G = 1, 2 V step, T _A = −40°C to 125°C	3	5		V/μs
t _{OR}	Overload Recovery			200		ns
t _s	Settling Time, 0.1%	G = 1, 2 V step		900		ns
	Settling Time, 0.01%	G = 1, 2 V step		1200		ns
PM	Phase Margin	R _L = 10 kΩ, C _L = 100 pF		70		°
GM	Gain Margin	R _L = 10 kΩ, C _L = 100 pF		10		dB
	Channel Separation	f = 100 kHz		120		dB
Noise Performance						
E _N	Input Voltage Noise	f = 0.1 Hz to 10 Hz,		2.1		μV _{RMS}
e _N	Input Voltage Noise Density	f = 1 kHz		25		nV/√Hz
i _N	Input Current Noise	f = 1 kHz		20		fA/√Hz
THD+N	Total Harmonic Distortion and Noise	f = 1 kHz, G = 1, R _L = 10 kΩ, V _{OUT} = 1 V _{RMS}		0.002		%

(1) Provided by bench test and design simulation.

(2) Provided by design simulation.

Typical Performance Characteristics

All test conditions: $V_S = 5\text{ V}$, $V_{CM} = 2.5\text{ V}$, unless otherwise noted.

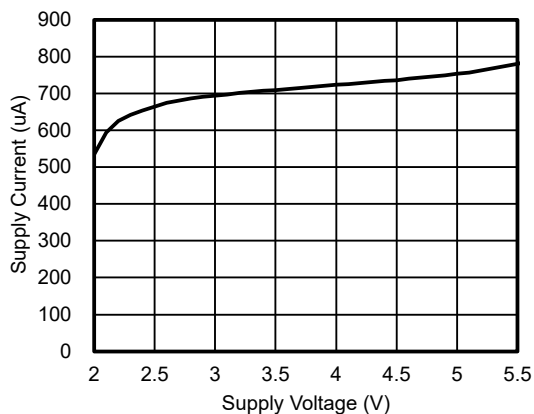


Figure 1. Supply Current vs. Supply Voltage

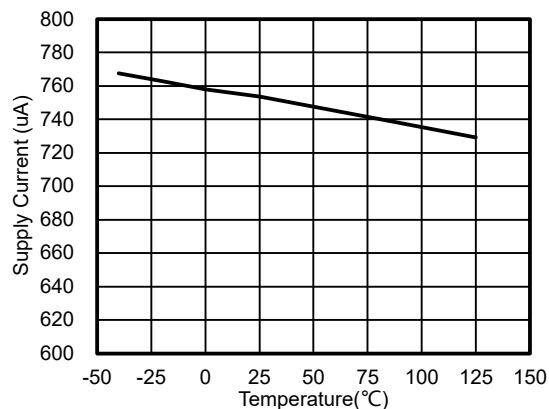


Figure 2. Supply Current vs. Temperature

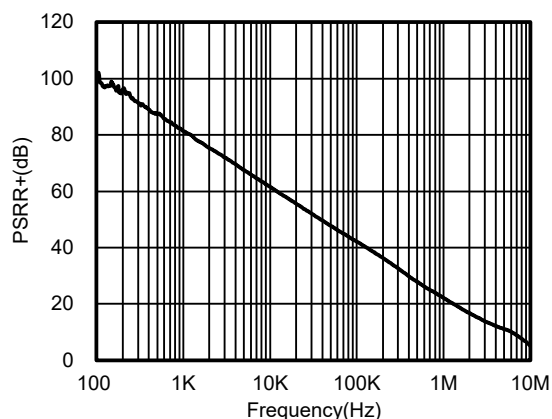


Figure 3. PSRR+ vs. Frequency

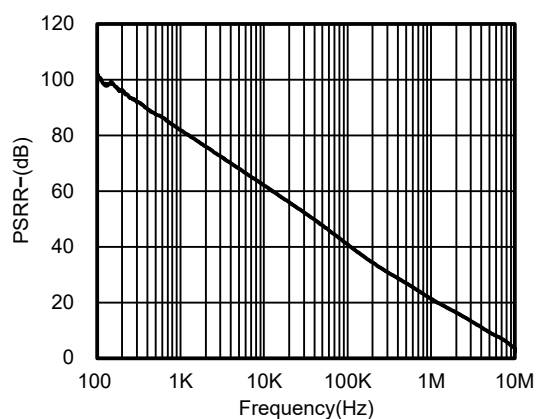


Figure 4. PSRR- vs. Frequency

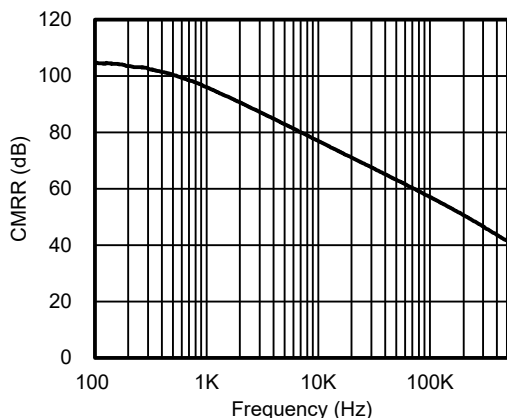


Figure 5. CMRR vs. Frequency

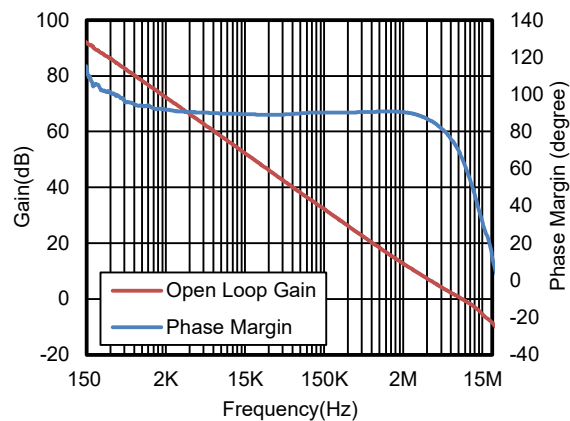
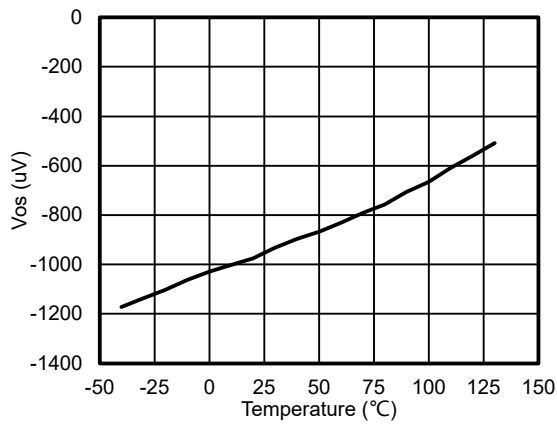
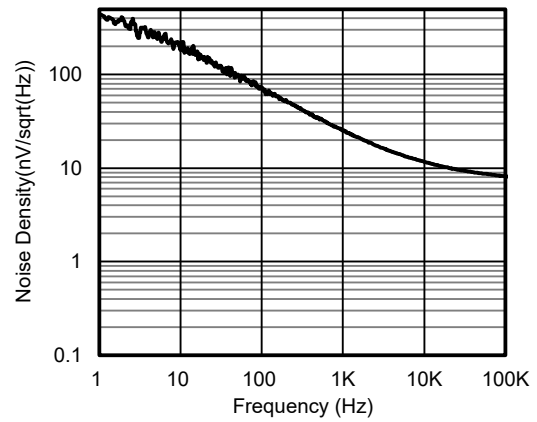
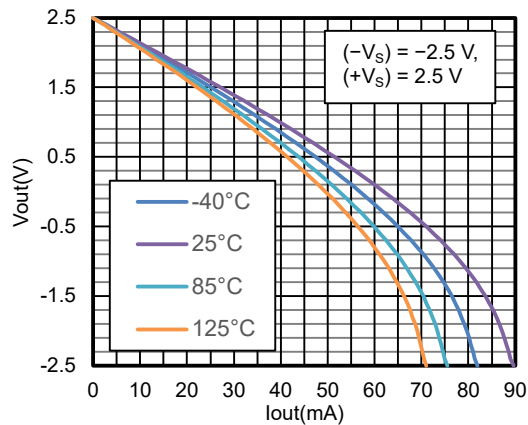
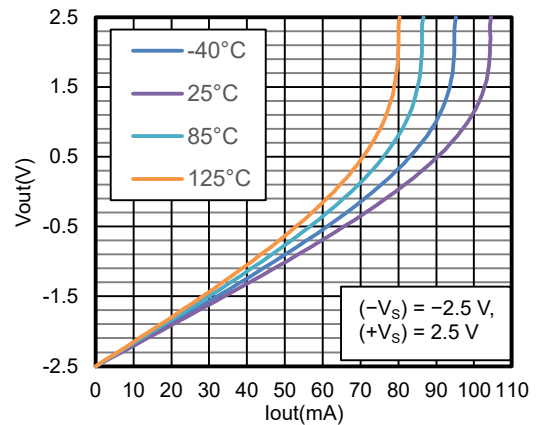
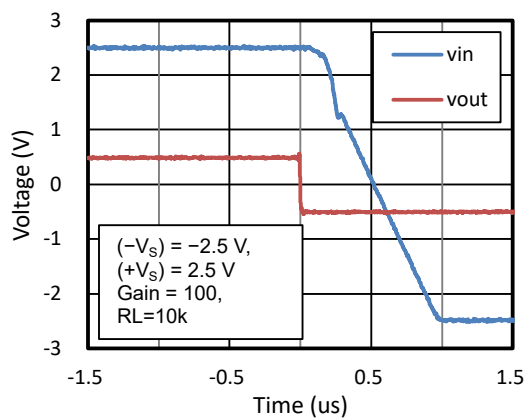
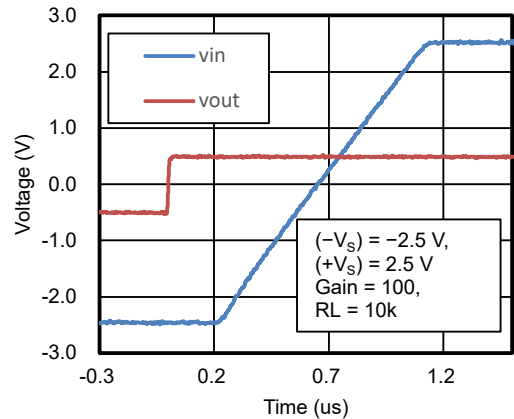


Figure 6. Open Loop Gain and Phase Margin vs. Frequency, $R_L = 10\text{ k}\Omega$


Figure 7. V_{OS} vs. Temperature

Figure 8. Voltage Noise Spectral Density vs. Frequency

Figure 9. Output Voltage vs. Output Current

Figure 10. Output Voltage vs. Output Current

Figure 11. Overload Recovery at Negative Rail

Figure 12. Overload Recovery at Positive Rail

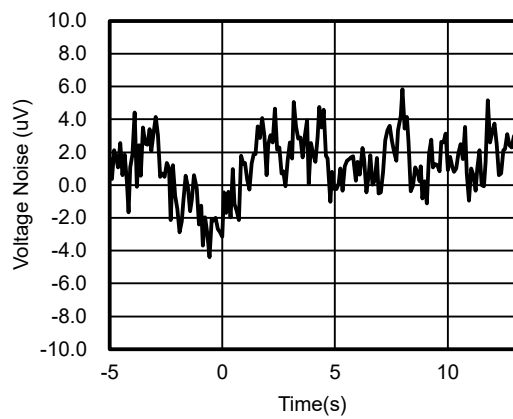


Figure 13. 0.1 to 10 Hz Voltage Noise

Detailed Description

Overview

The devices are a family of low-power, rail-to-rail output operational amplifiers. These devices operate from 2.5 V to 5.5 V, and are designed for a wide range of general-purpose applications.

Functional Block Diagram

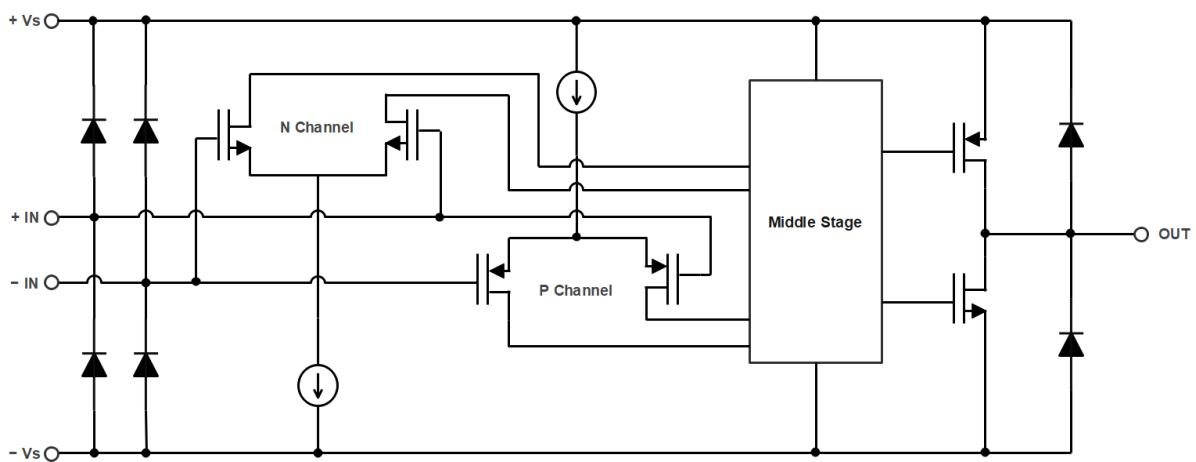


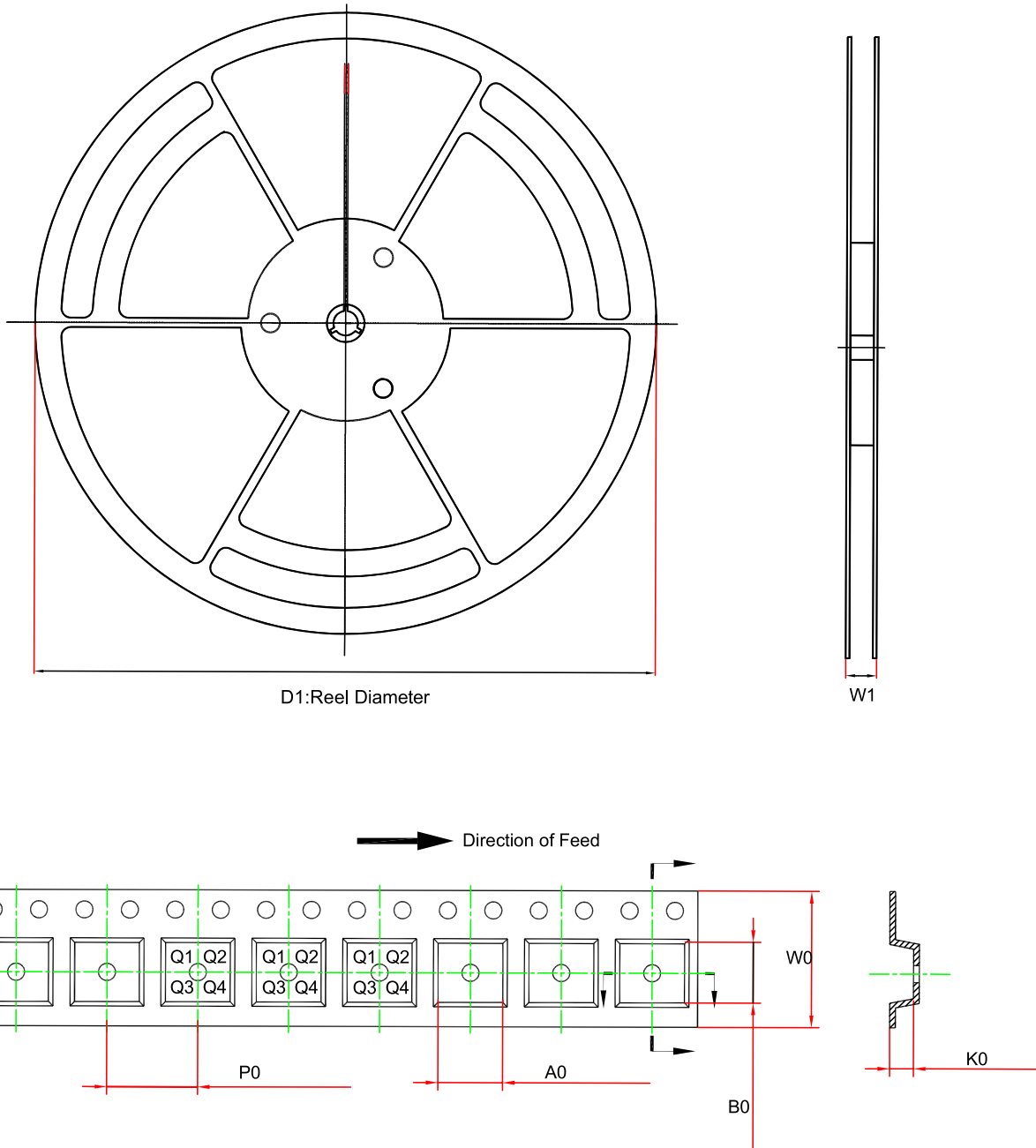
Figure 14. Functional Block Diagram

Feature Description

Drive Large Capacitive Loads

Driving capacitive loads has always been a difficult part of the amplifier circuit design, and the devices are designed with a special architecture that prevents it from sustaining oscillations when the output is driving large capacitive loads up to 10 μ F.

Tape and Reel Information



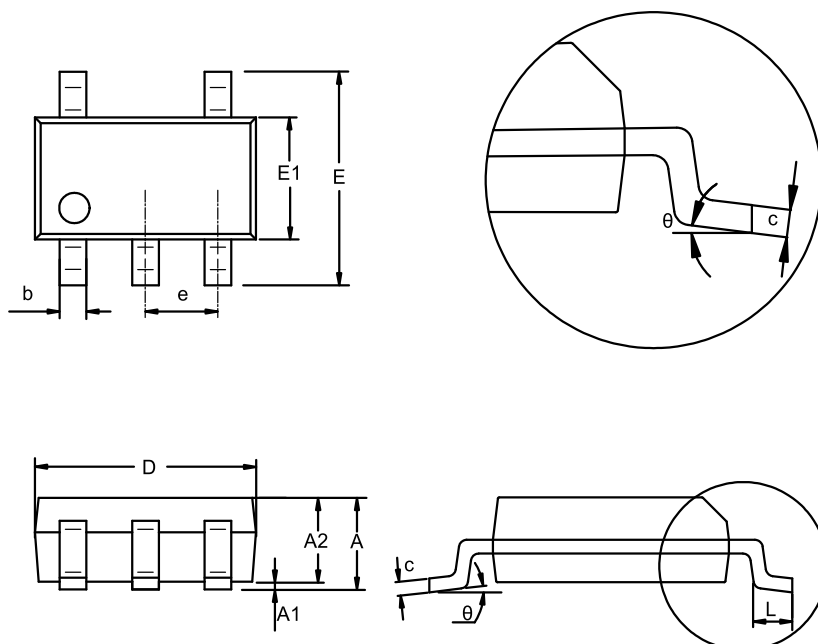
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPA6061-S5TR	SOT23-5	180.0	12	3.3	3.25	1.4	4.0	8.0	Q3
TPA6062-SO1R	SOP8	330.0	17.6	6.5	5.4	2.0	8.0	12.0	Q1
TPA6062-VS1R	MSOP8	330.0	17.6	5.3	3.4	1.3	8.0	12.0	Q1
TPA6064-SO2R	SOP14	330.0	21.6	6.5	9.15	1.8	8.0	16.0	Q1
TPA6064-TS2R	TSSOP14	330.0	17.6	6.8	5.5	1.3	8.0	12.0	Q1

Package Outline Dimensions

SOT23-5

Package Outline Dimensions

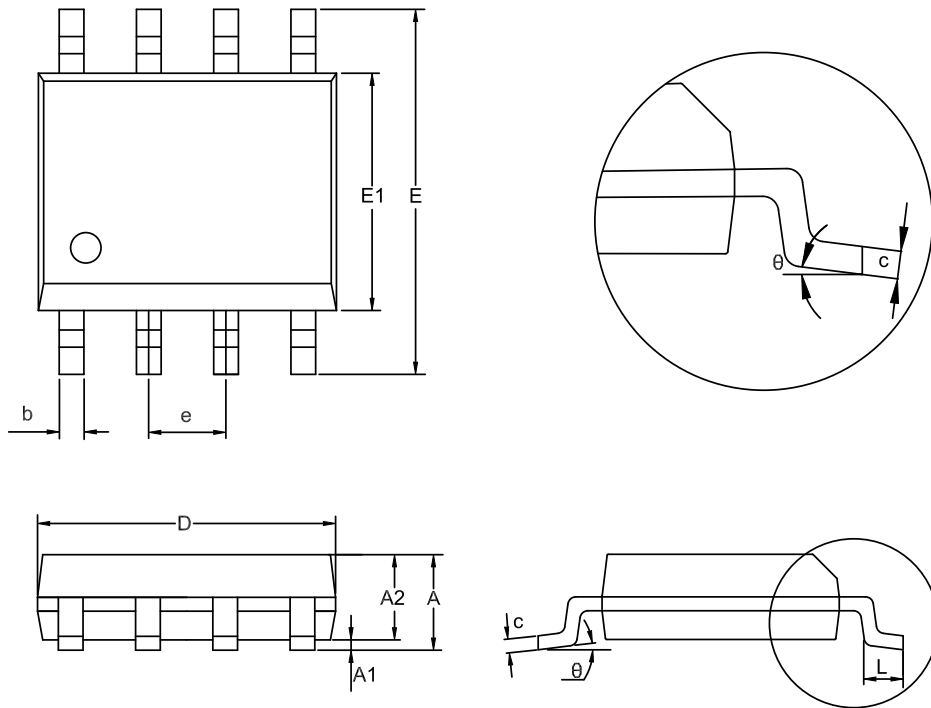
S5T(SOT23-5-B)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.000	1.200	0.039	0.047
b	0.330	0.410	0.013	0.016
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

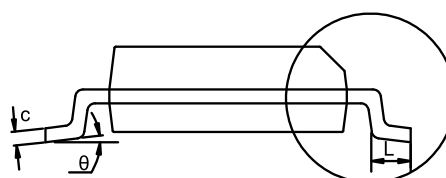
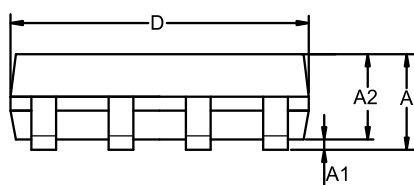
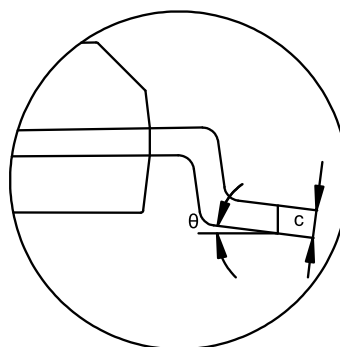
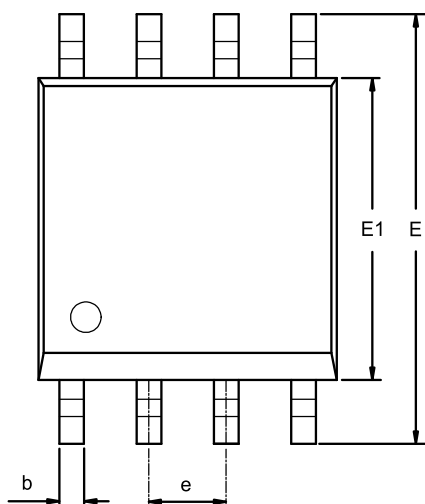
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

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

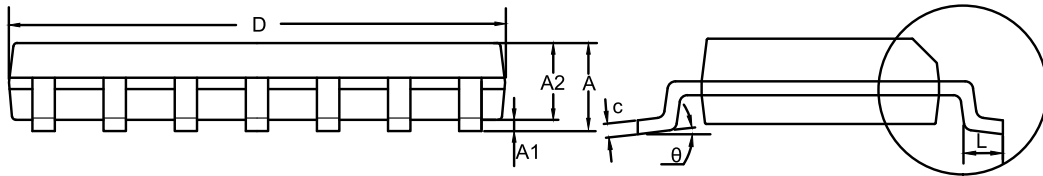
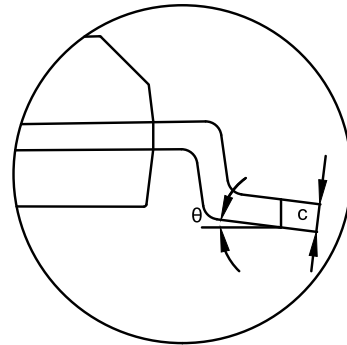
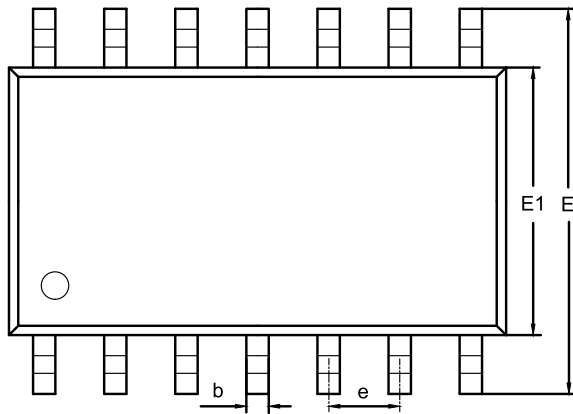
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

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

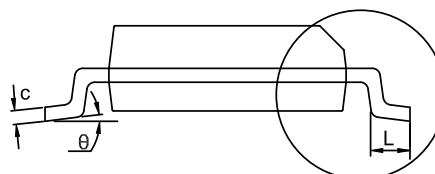
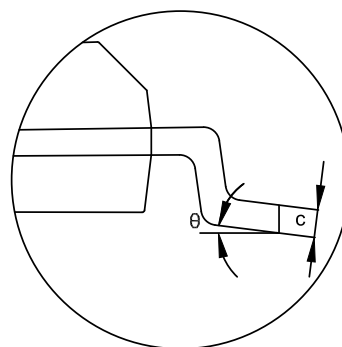
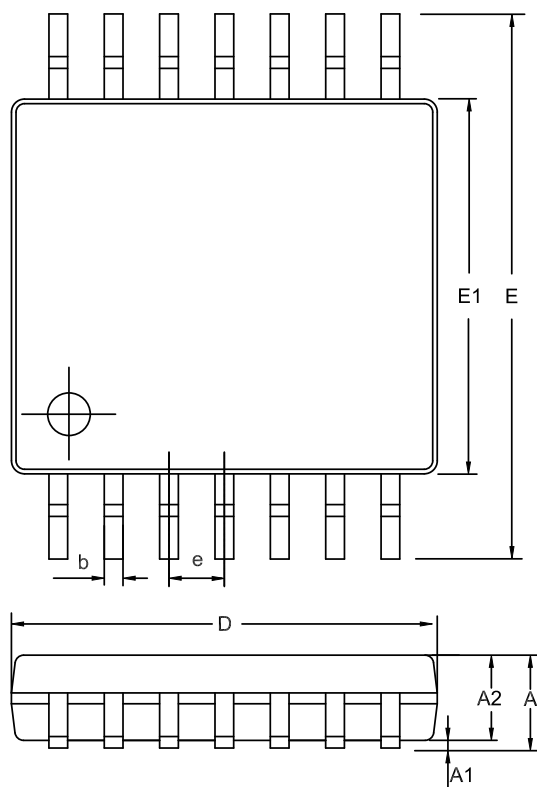
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

SOP14
Package Outline Dimensions
SO2(SOP-14-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	1.650	0.049	0.065
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
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	1.270	0.016	0.050
θ	0	8°	0	8°

NOTES

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

TSSOP14
Package Outline Dimensions
TS2(TSSOP-14-A)

NOTES

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

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	4.900	5.100	0.193	0.201
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°

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPA6061-S5TR	–40 to 125°C	SOT23-5	AA0	1	Tape and Reel, 3000	Green
TPA6062-SO1R	–40 to 125°C	SOP8	A6062	3	Tape and Reel, 4000	Green
TPA6062-VS1R	–40 to 125°C	MSOP8	A6062	2	Tape and Reel, 3000	Green
TPA6064-SO2R	–40 to 125°C	SOP14	A6064	3	Tape and Reel, 2500	Green
TPA6064-TS2R	–40 to 125°C	TSSOP14	A6064	3	Tape and Reel, 3000	Green

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

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