

Features

- Supply Voltage: 2.7 V to 5.5 V
- Offset Voltage: $\pm 10 \mu\text{V}$ Maximum within Temperature Range from -40°C to 125°C
- Offset Voltage Drift: $0.027 \mu\text{V}/^\circ\text{C}$
- Rail-to-Rail Input and Output
- Decompensated, Stable when Noise Gain ≥ 10
- Bandwidth: 80 MHz
- Slew Rate: $50 \text{ V}/\mu\text{s}$
- Low Noise: $12 \text{ nV}/\sqrt{\text{Hz}}$ at 1 kHz

Applications

- Current Sensing
- Power System
- High-Accuracy and High-Speed Signal Condition

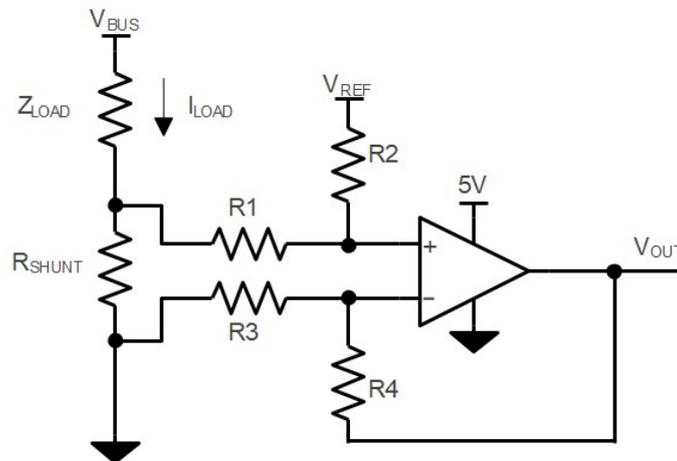
Description

The devices are single and dual-operational amplifiers. The devices have very low offset voltage within the operating temperature range by the zero-drift technology. The offset voltage of the device is $\pm 10 \mu\text{V}$ maximum within the temperature range from -40°C to 125°C .

The devices provide rail-to-rail input and output. The devices have excellent AC performance with 80-MHz bandwidth and $50\text{-V}/\mu\text{s}$ slew rate while drawing 1.6-mA quiescent current per amplifier.

The devices can be used in high-accuracy and high-speed signal conditions.

Typical Application Circuit OPA



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

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

Table of Contents

Features	1
Applications	1
Description	1
Typical Application Circuit OPA	1
Revision History	3
Pin Configuration and Functions	4
Specifications	6
Absolute Maximum Ratings ⁽¹⁾	6
ESD, Electrostatic Discharge Protection.....	6
Recommended Operating Conditions.....	6
Thermal Information.....	7
Electrical Characteristics.....	8
Electrical Characteristics (Continued).....	9
Typical Performance Characteristics.....	10
Detailed Description	13
Overview.....	13
Functional Block Diagram.....	13
Feature Description.....	13
Application and Implementation	15
Application Information	15
Tape and Reel Information	16
Package Outline Dimensions	17
SOT23-5.....	17
SOT353 (SC70-5).....	18
MSOP8.....	19
SOP8.....	20
Order Information	21
IMPORTANT NOTICE AND DISCLAIMER	22

Revision History

Date	Revision	Notes
2024-07-20	Rev.A.0	Initial version.
2024-12-10	Rev.A.1	Corrected handwriting errors. The physical object has not changed.

Pin Configuration and Functions

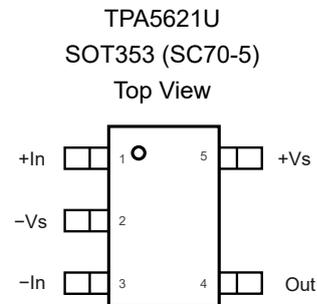
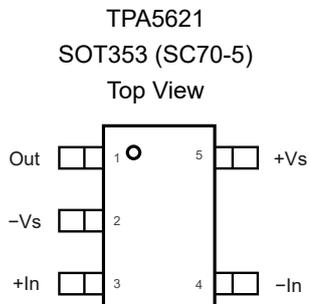
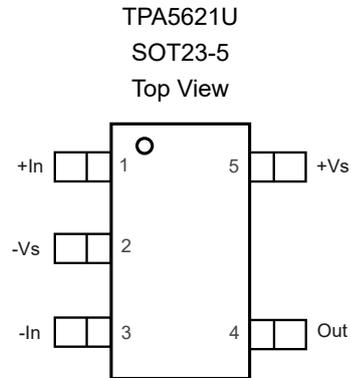
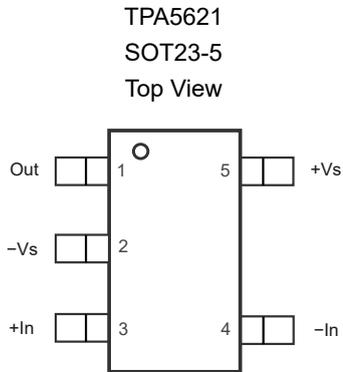
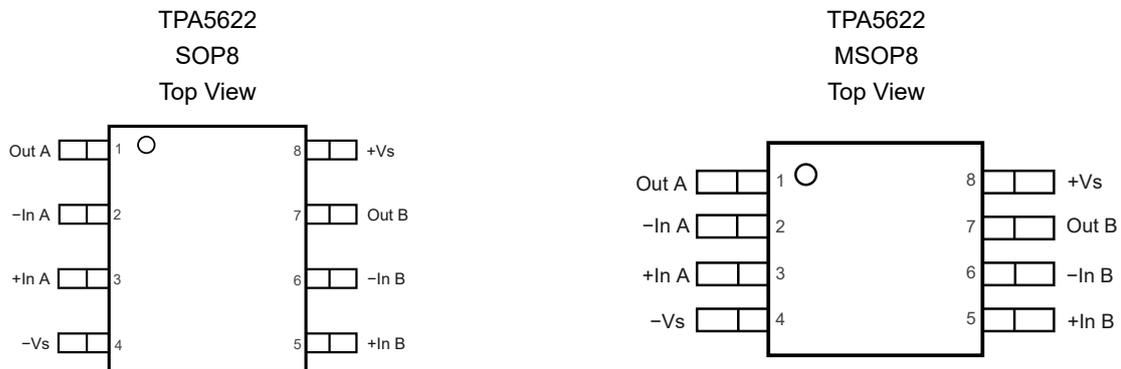


Table 1. Pin Functions: TPA5621, TPA5621U

Pin No.		Name	I/O	Description
TPA5621	TPA5621U			
1	4	Out	O	Output
2	2	-Vs	-	Negative power supply
3	1	+In	I	Non-inverting input
4	3	-In	I	Inverting input
5	5	+Vs	-	Positive power supply

5-V, 80-MHz GBW, $G \geq 10$ Stable, Zero-Drift Operational Amplifiers

Table 2. Pin Functions: TPA5622

Pin No.	Name	I/O	Description
1	Out A	O	Output
2	-In A	I	Inverting input
3	+In A	I	Non-inverting input
4	-Vs	-	Negative power supply
5	+In B	I	Non-inverting 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, $(+V_S) - (-V_S)$		6.5	V
	Input Voltage	$(-V_S) - 0.3$	$(+V_S) + 0.3$	V
	Differential Input Voltage	$(-V_S) - (+V_S)$	$(+V_S) - (-V_S)$	V
	Input Current: $+I_{IN}$, $-I_{IN}$ ⁽²⁾	-10	+10	mA
	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 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 rating. This depends on the power dissipation of the application. Thermal resistance varies with the amount of PC board metal connected to the package.

ESD, Electrostatic Discharge Protection

Parameter		Condition	Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	4	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 (± 1.35)		5.5 (± 2.75)	V
T_A	Operating Temperature Range	-40		125	°C

5-V, 80-MHz GBW, $G \geq 10$ Stable, Zero-Drift Operational Amplifiers**Thermal Information**

Package Type	θ_{JA}	θ_{JC}	Unit
SOT353 (SC70-5)	400	150	°C/W
SOT23-5	250	81	°C/W
SOP8	158	43	°C/W
MSOP8	210	45	°C/W

5-V, 80-MHz GBW, $G \geq 10$ Stable, Zero-Drift Operational Amplifiers
Electrical Characteristics

 All test conditions: $V_S = 5\text{ V}$, $T_A = 25^\circ\text{C}$, $R_L = 10\text{ k}\Omega$, $C_L = 100\text{ pF}$, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power Supply						
V_S	Supply Voltage Range		2.7		5.5	V
I_Q	Quiescent Current per Amplifier			1.6	2.3	mA
		$T_A = -40^\circ\text{C}$ to 125°C			3	mA
PSRR	Power Supply Rejection Ratio	$V_S = 2.5\text{ V}$ to 5.5 V	107	148		dB
		$V_S = 2.5\text{ V}$ to 5.5 V , $T_A = -40^\circ\text{C}$ to 125°C	105			dB
Input Characteristics						
V_{OS}	Input Offset Voltage	$V_S = 5\text{ V}$, $V_{CM} = 2.5\text{ V}$	-6	1	6	μV
		$V_S = 5\text{ V}$, $V_{CM} = 2.5\text{ V}$, $T_A = -40^\circ\text{C}$ to 125°C	-10		10	μV
		$V_S = 3.3\text{ V}$, $V_{CM} = 1.65\text{ V}$	-6	1	6	μV
		$V_S = 3.3\text{ V}$, $V_{CM} = 1.65\text{ V}$, $T_A = -40^\circ\text{C}$ to 125°C	-10		10	μV
V_{OSTC}	Input Offset Voltage Drift	$T_A = -40^\circ\text{C}$ to 125°C		0.027		$\mu\text{V}/^\circ\text{C}$
I_B	Input Bias Current ⁽¹⁾	$V_{CM} = 2.5\text{ V}$	-800	30	800	pA
		$V_{CM} = 2.5\text{ V}$, $T_A = -40^\circ\text{C}$ to 125°C	-5000		5000	pA
I_{OS}	Input Offset Current ⁽¹⁾	$V_{CM} = 2.5\text{ V}$	-800	30	800	pA
		$V_{CM} = 2.5\text{ V}$, $T_A = -40^\circ\text{C}$ to 125°C	-5000		5000	pA
R_{IN}	Input Resistance			10^{10}		Ω
C_{IN}	Input Capacitance ⁽²⁾	Differential mode		3.5		pF
		Common mode		1		pF
A_V	Open-Loop Voltage Gain	$V_O = 0.1\text{ V}$ to 4.9 V	110	130		dB
		$V_O = 0.1\text{ V}$ to 4.9 V , $T_A = -40^\circ\text{C}$ to 125°C	107			dB
V_{CMR}	Common-Mode Input Voltage Range ⁽²⁾	$T_A = -40^\circ\text{C}$ to 125°C	$(-V_S)$ -0.1		$(+V_S)$ +0.1	V
CMRR	Common-Mode Rejection Ratio	$V_{CM} = 0\text{ V}$ to 5 V	107	137		dB
		$V_{CM} = 0\text{ V}$ to 5 V , $T_A = -40^\circ\text{C}$ to 125°C	104			dB

(1) Provided by bench tests and design simulation.

(2) Provided by design simulation.

5-V, 80-MHz GBW, $G \geq 10$ Stable, Zero-Drift Operational Amplifiers
Electrical Characteristics (Continued)

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Output Characteristics						
	Output Voltage Swing from Positive Rail or Negative Rail	$R_{LOAD} = 10\text{ k}\Omega$ to $V_S / 2$		3	6	mV
		$R_{LOAD} = 10\text{ k}\Omega$ to $V_S / 2$, $T_A = -40^\circ\text{C}$ to 125°C			10	mV
		$R_{LOAD} = 2\text{ k}\Omega$ to $V_S / 2$		13	23	mV
		$R_{LOAD} = 2\text{ k}\Omega$ to $V_S / 2$, $T_A = -40^\circ\text{C}$ to 125°C			30	mV
I _{sc}	Output Short-Circuit Current	Sink or source	85	115		mA
		Sink or source, $T_A = -40^\circ\text{C}$ to 125°C	60			mA
AC Specifications						
GBW	Gain-Bandwidth Product			80		MHz
SR	Slew Rate	$G = 1$, 2-V step		50		V/ μs
t _{OR}	Overload Recovery			80		ns
t _s	Settling Time, 0.1% ⁽²⁾	$G = 1$, 2-V step		100		ns
Noise Performance						
\bar{E}_N	Input Voltage Noise	$f = 0.1\text{ Hz}$ to 10 Hz		1		μV_{PP}
e _N	Input Voltage Noise Density	$f = 1\text{ kHz}$		12		nV/ $\sqrt{\text{Hz}}$
i _N	Input Current Noise Density ⁽²⁾	$f = 1\text{ kHz}$		100		fA/ $\sqrt{\text{Hz}}$

(1) Provided by bench tests and design simulation.

(2) Provided by design simulation.

Typical Performance Characteristics

All test conditions: $V_s = 5\text{ V}$, $R_L = 10\text{ k}\Omega$, unless otherwise noted.

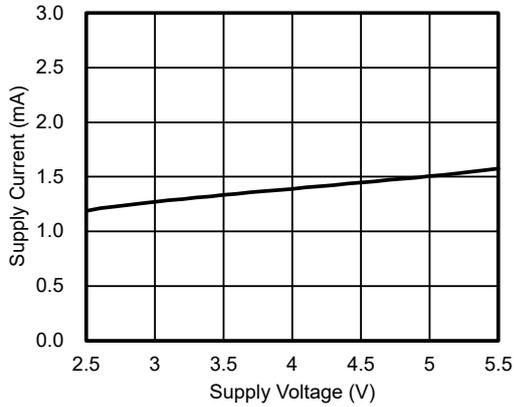


Figure 1. Supply Current vs. Supply Voltage

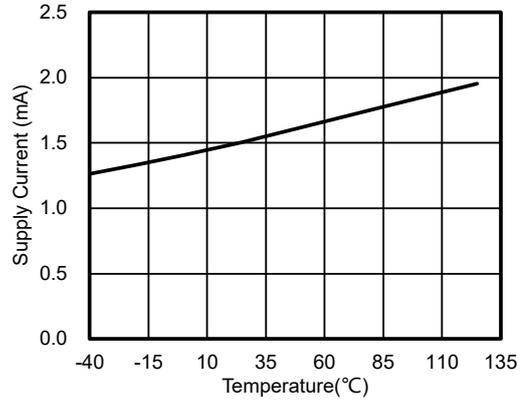


Figure 2. Supply Current vs. Temperature

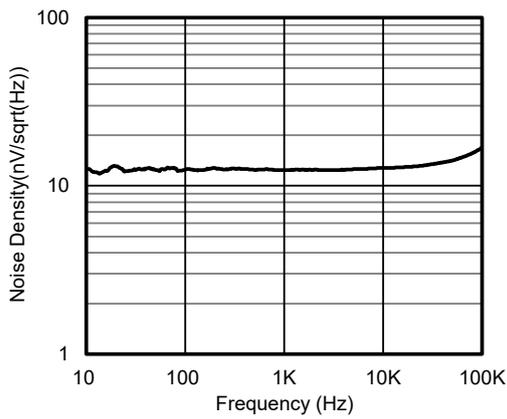


Figure 3. Voltage Noise Spectral Density vs. Frequency

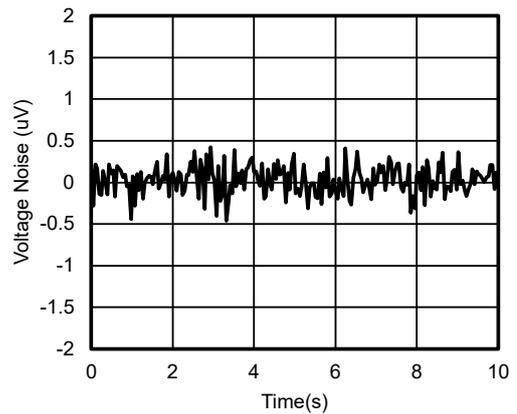


Figure 4. 0.1-Hz to 10-Hz Voltage Noise

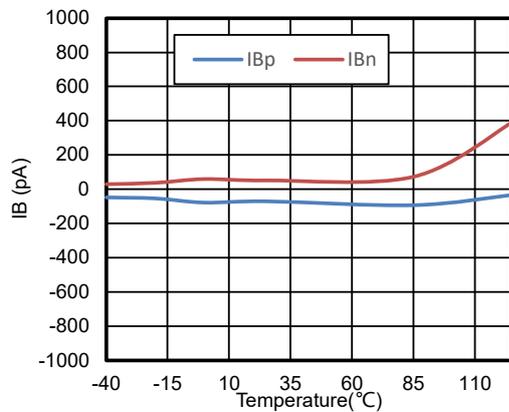


Figure 5. I_B vs. Temperature

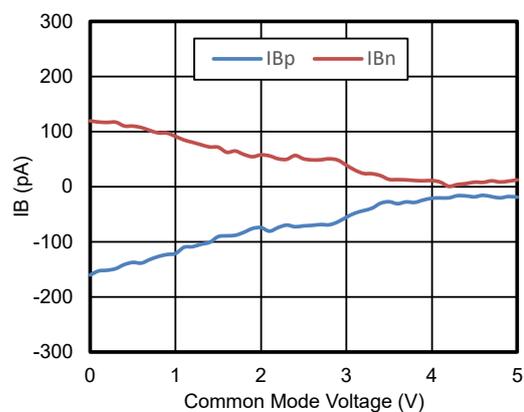


Figure 6. I_B vs. V_{CM}

5-V, 80-MHz GBW, $G \geq 10$ Stable, Zero-Drift Operational Amplifiers

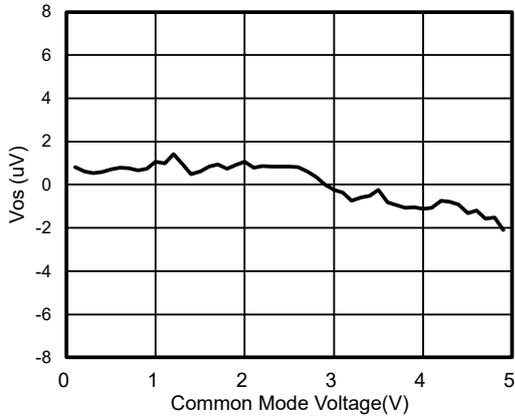


Figure 7. V_{os} vs. V_{CM}

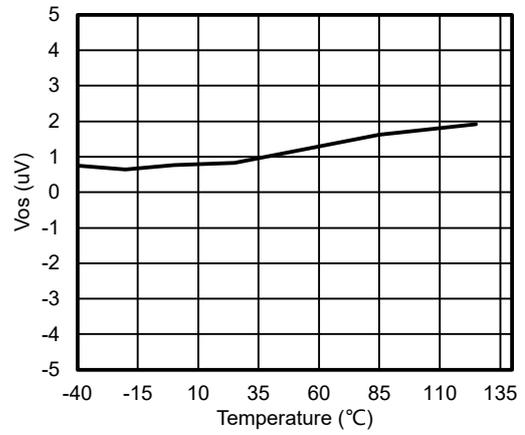


Figure 8. V_{os} vs. Temperature

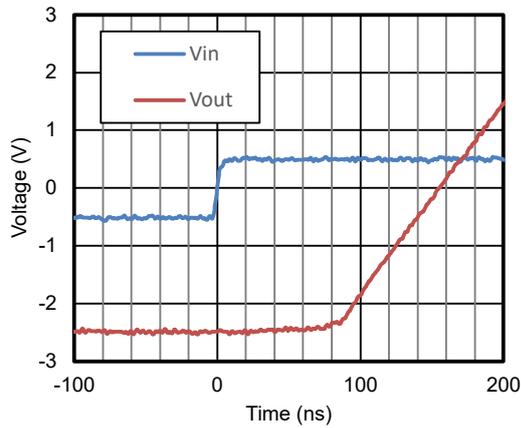


Figure 9. Overload Recovery at Negative Rail

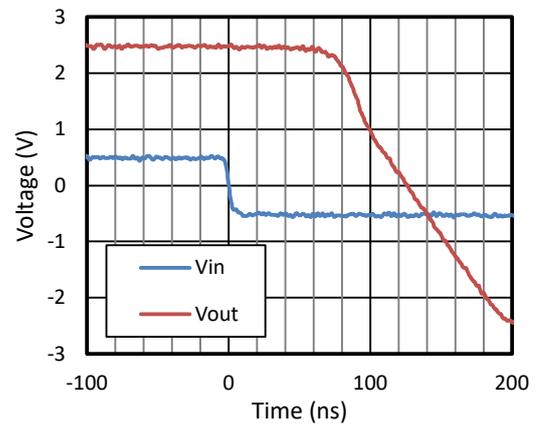


Figure 10. Overload Recovery at Positive Rail

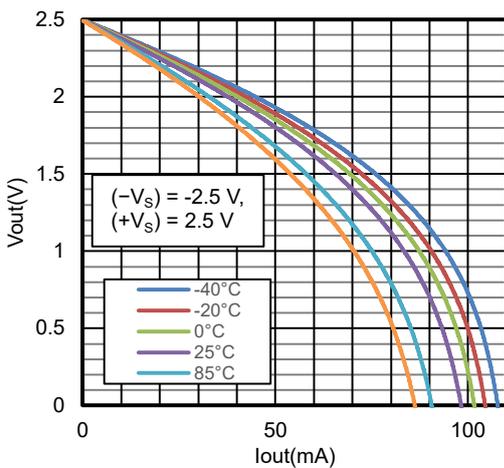


Figure 11. V_{OUT} vs. I_{OUT} , Source

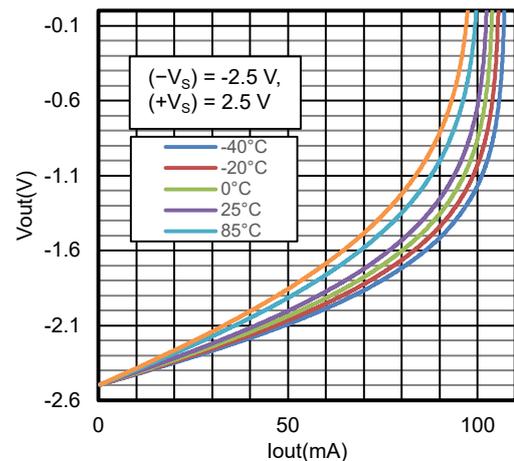


Figure 12. V_{OUT} vs. I_{OUT} , Sink

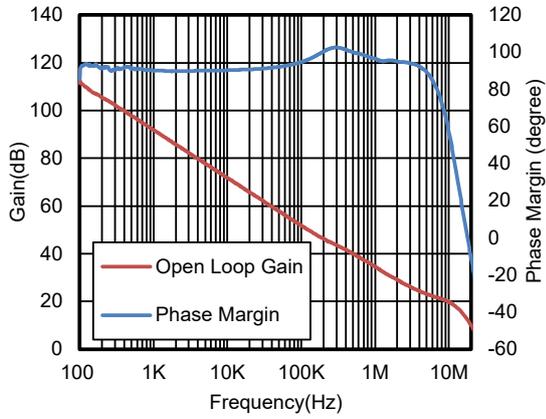
5-V, 80-MHz GBW, $G \geq 10$ Stable, Zero-Drift Operational Amplifiers


Figure 13. Open-Loop Gain and Phase Margin vs. Frequency, $R_L = 10\text{ k}\Omega$

Detailed Description

Overview

The TPA562x op amps can operate on a single-supply voltage (2.7 V to 5.5 V), or a split-supply voltage (± 1.35 V to ± 2.75 V), making them highly versatile and easy to use. With a precision auto-calibration technique, these amplifiers achieve low input offset voltage and input offset voltage drift which can achieve outstanding input and output dynamic linearity. The strengths of the devices also include 80-MHz bandwidth, no $1/f$ noise, 12-nV/ $\sqrt{\text{Hz}}$ noise spectral density, and 1.6-mA quiescent current, making the devices suitable for precision and temperature-sensitive applications. Parameters that can exhibit variance with regard to operating voltage or temperature are presented in Typical Performance Characteristics. The power-supply pins have local bypass ceramic capacitors (typically 0.01 μF to 0.1 μF). These amplifiers are fully specified from 2.7 V to 5.5 V and over the extended temperature range from -40°C to $+125^\circ\text{C}$.

Functional Block Diagram

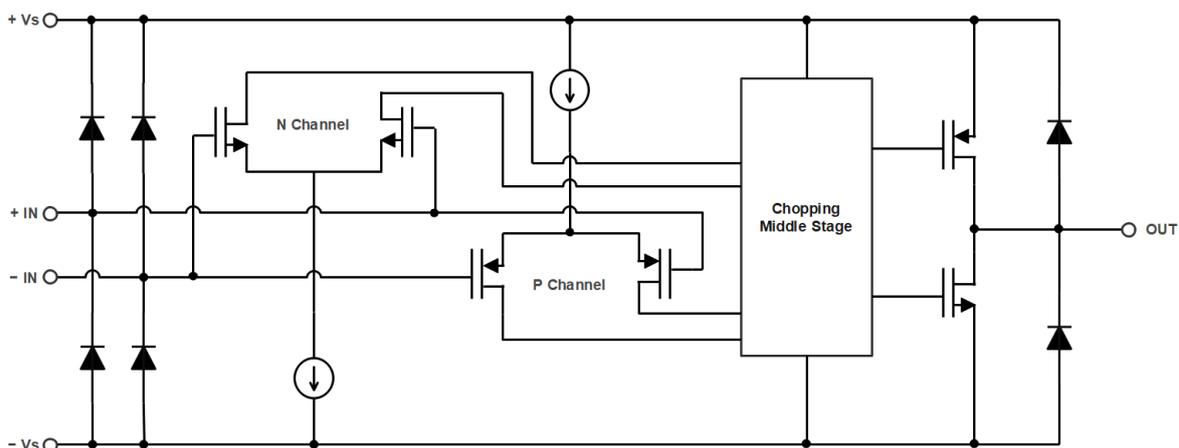


Figure 14. Functional Block Diagram

Feature Description

Operating Voltage

The devices are designed for single-supply operation from 2.7 V to 5.5 V, or dual-supply operation from ± 1.35 V to ± 2.75 V.

Ultra-Low Offset Voltage and Offset Voltage Drift in Operating Temperature Range

The devices provide low offset voltage within the temperature range from -40°C to 125°C , which is achieved through the chopper stabilized technology. This unique topology allows the devices to maintain their low-offset voltage over a wide temperature range and over their operating lifetime.

Low $1/f$ Noise

Flicker noise, also known as $1/f$ noise, is inherent in semiconductor devices and increases as frequency decreases. The flicker noise provides higher degrees of error for low-frequency applications. The devices use the chopper stabilized technology to reduce flicker noise. This reduction in $1/f$ noise allows the devices to have lower noise at DC and low-frequency range compared to standard amplifiers.

5-V, 80-MHz GBW, $G \geq 10$ Stable, Zero-Drift Operational Amplifiers**Residual Voltage Ripple**

The chopping technique can be used in amplifier design due to the internal notch filter. Although the chopping-related voltage ripple is suppressed, a higher noise spectrum exists at the chopping frequency and its harmonics due to residual ripple.

The devices set the chopping frequency to 560 kHz. If the frequency of the input signal is close to the chopping frequency, the signal may be interfered with by the residue ripple. To suppress the noise at the chopping frequency, it is recommended that a post filter be placed at the output of the amplifier.

Rail-to-Rail Input

The input common-mode voltage range of the devices extends 100 mV beyond the supply rails. This performance is achieved with a complementary input stage: a PMOS input differential pair in parallel with an NMOS input differential pair.

Rail-to-Rail Output

The devices deliver rail-to-rail output swing capability with a class-AB output stage. Different load conditions change the ability of the amplifier to swing close to the rails.

Decompensated Architecture with Wide Gain-Bandwidth Product

The decompensated architecture typically allows for higher GBW and slew rate, compared to a unity-gain stable amplifier with similar quiescent current. The devices are stable in a noise gain of 10 V/V or higher in circuits.

Application and Implementation

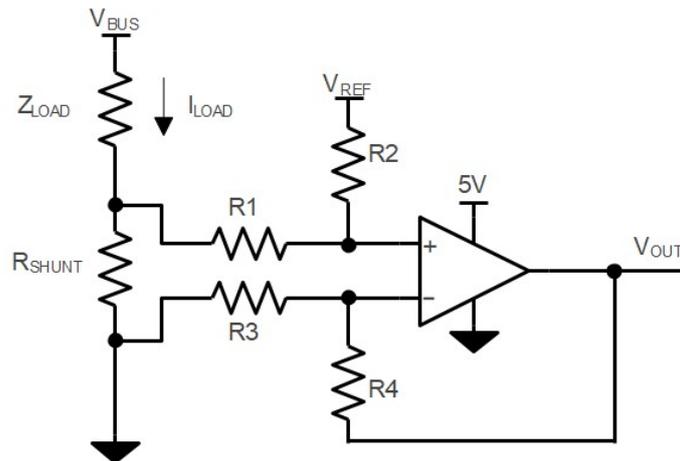
Note

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.

Application Information

Low-Side Current-Sensing Application

Figure 15 shows the device configured in a low-side current sensing application. The low-side current sensing method consists of placing a sense resistor between the load and the circuit ground. The voltage dropping across the resistor is amplified by different amplifier circuits with the device. V_{REF} can be used to add bias voltage to the output voltage. Particular attention must be paid to the matching and precision of R1, R2, R3, and R4, to maximize the accuracy of the measurement.



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

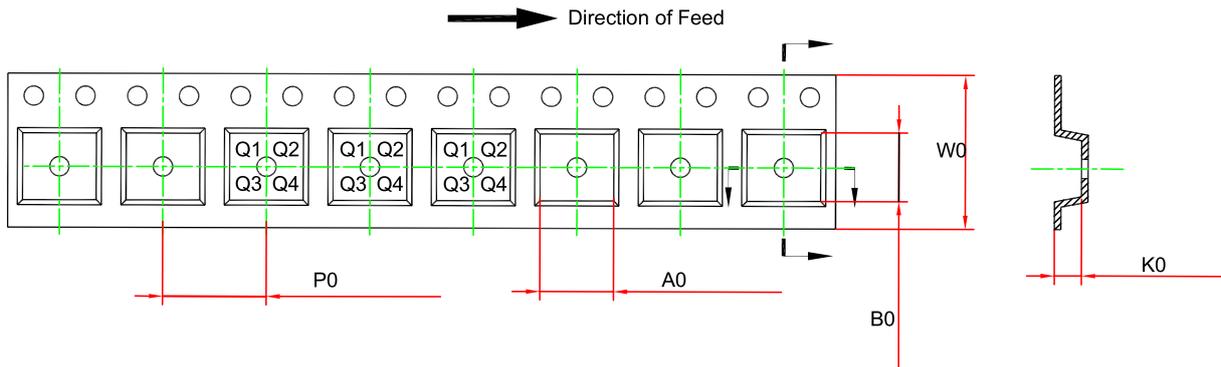
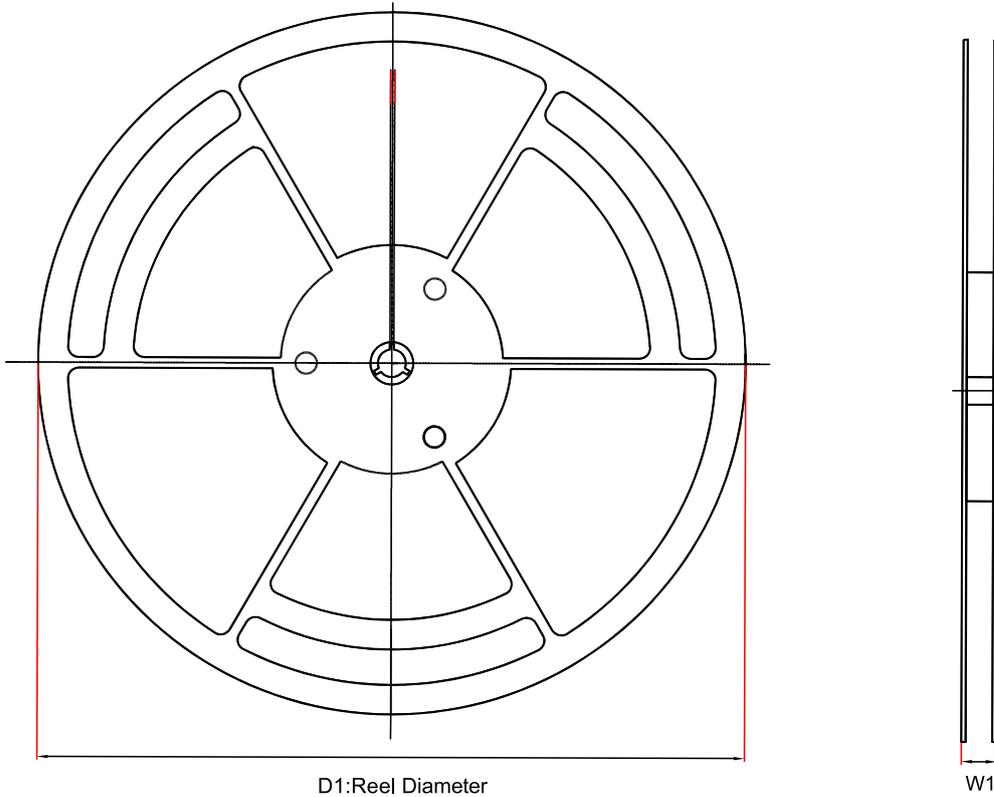
$$\text{When } R3 = R1, R2 = R4, R_{SHUNT} \ll R1$$

Figure 15. Low-Side Current-Sensing Application

Power Supply Recommendations

Place 0.1- μ F bypass capacitors close to the power supply pins to reduce coupling errors from the noise or high-impedance power supplies.

Tape and Reel Information

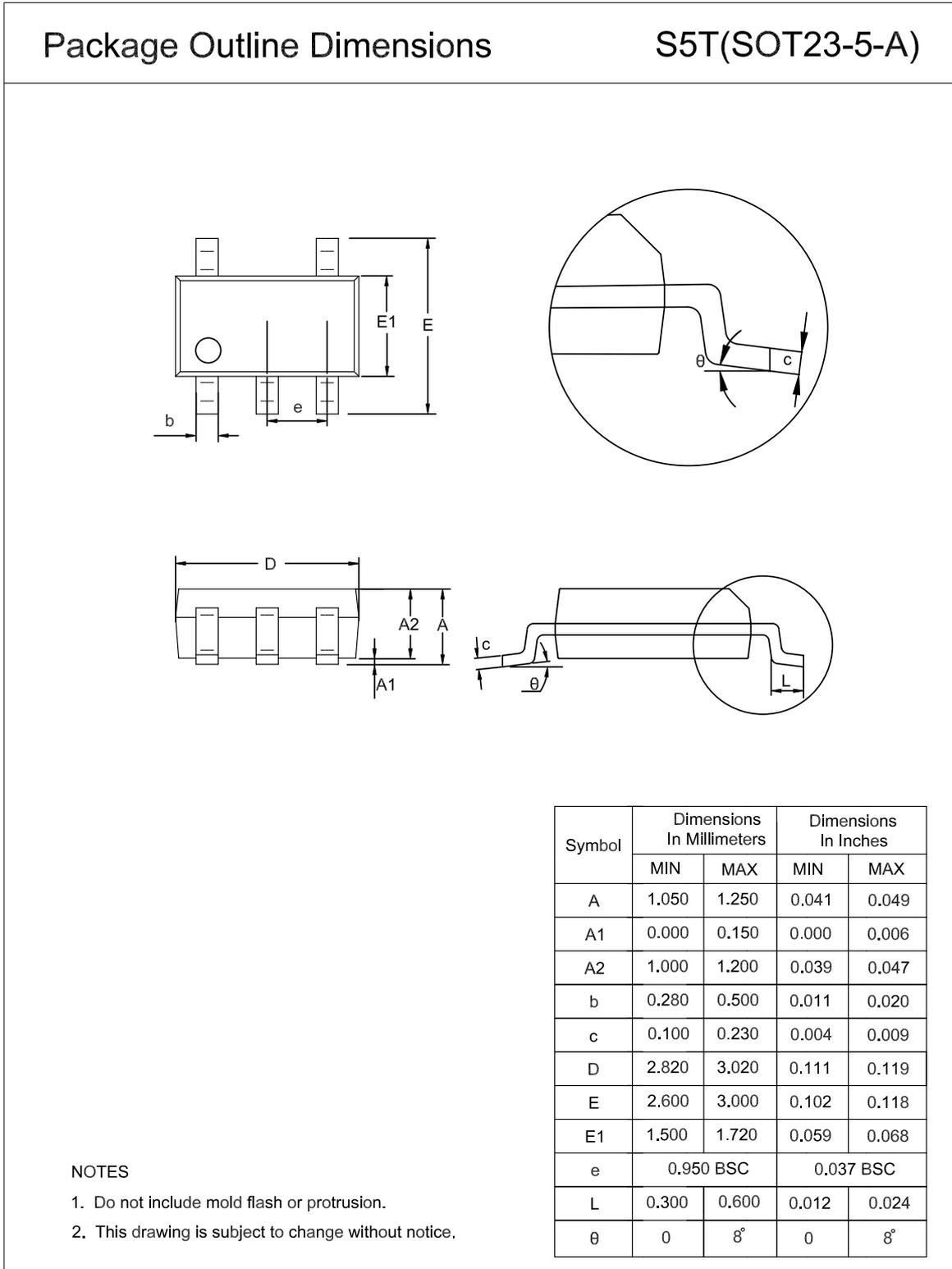


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) ⁽¹⁾	B0 (mm) ⁽¹⁾	K0 (mm) ⁽¹⁾	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPA5621-S5TR	SOT23-5	180	12	3.3	3.25	1.4	4	8	Q3

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

Package Outline Dimensions

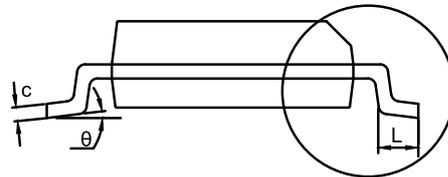
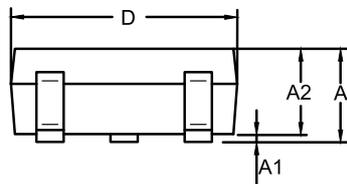
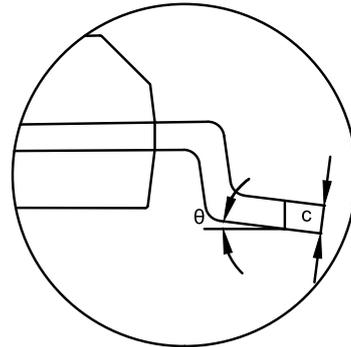
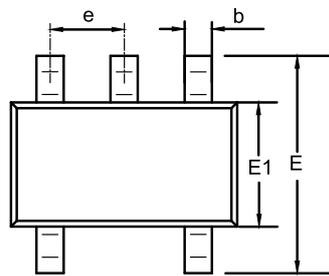
SOT23-5



SOT353 (SC70-5)

Package Outline Dimensions

SC5(SOT353-5-A)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.850	1.100	0.033	0.043
A1	0.000	0.100	0.000	0.004
A2	0.800	1.000	0.031	0.039
b	0.150	0.350	0.006	0.014
c	0.110	0.230	0.004	0.009
D	2.000	2.200	0.079	0.087
E	2.150	2.450	0.085	0.096
E1	1.150	1.350	0.045	0.053
e	0.650 BSC		0.026 BSC	
L	0.260	0.460	0.010	0.018
θ	0	8°	0	8°

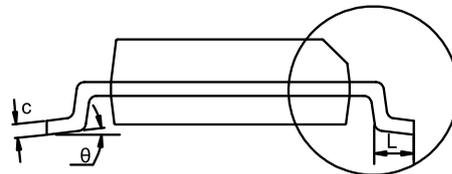
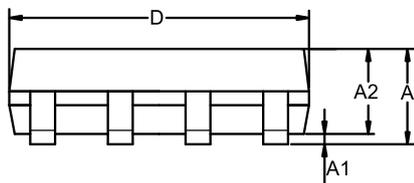
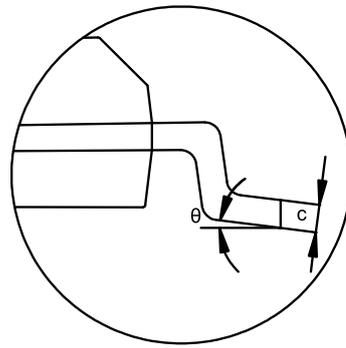
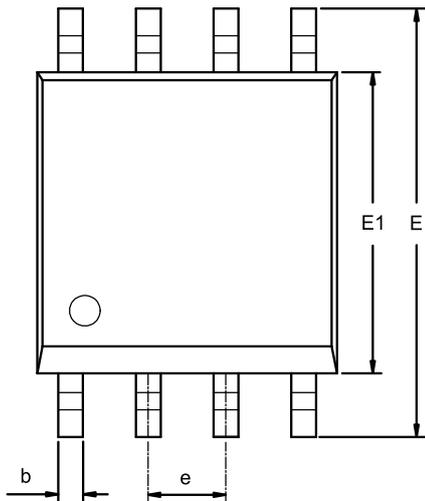
NOTES

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°

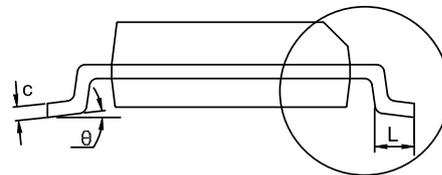
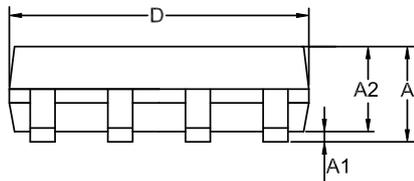
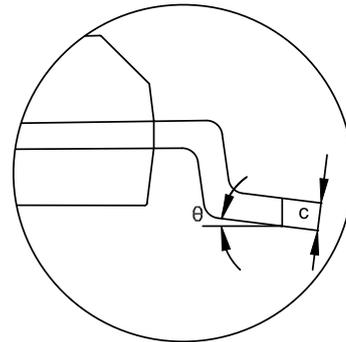
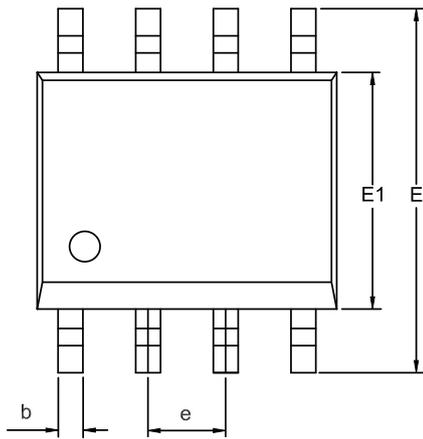
NOTES

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

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.

5-V, 80-MHz GBW, $G \geq 10$ Stable, Zero-Drift Operational Amplifiers**Order Information**

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPA5621-SC5R ⁽¹⁾	-40 to 125°C	SOT353 (SC70-5)	A05	1	Tape and Reel, 3000	Green
TPA5621-S5TR	-40 to 125°C	SOT23-5	A05	1	Tape and Reel, 3000	Green
TPA5621U-SC5R ⁽¹⁾	-40 to 125°C	SOT353 (SC70-5)			Tape and Reel, 3000	Green
TPA5621U-S5TR ⁽¹⁾	-40 to 125°C	SOT23-5			Tape and Reel, 3000	Green
TPA5622-SO1R ⁽¹⁾	-40 to 125°C	SOP8			Tape and Reel, 4000	Green
TPA5622-VS1R ⁽¹⁾	-40 to 125°C	MSOP8			Tape and Reel, 3000	Green

(1) For future products, contact the 3PEAK factory for more information and samples.

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

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