3.3-V, 9-kHz, Zero-Drift, Nanopower OP Amps

Features

- Supply Voltage: 1.7 V to 3.6 V
- Low Power: Typical 650 nA at 25°C
- Low Offset Voltage: ±30 μV Maximum at 25°C
- Zero Drift: ±0.025 μV/°C
- Rail-to-Rail Input and Output
- Gain Bandwidth Product: 9 kHz
- Slew Rate: 3 V/ms

Applications

- Gas Detection
- Battery Current Sensing
- Portable Medical Equipment
- Portable Glucose Monitors
- Portable RFID Readers and Tags

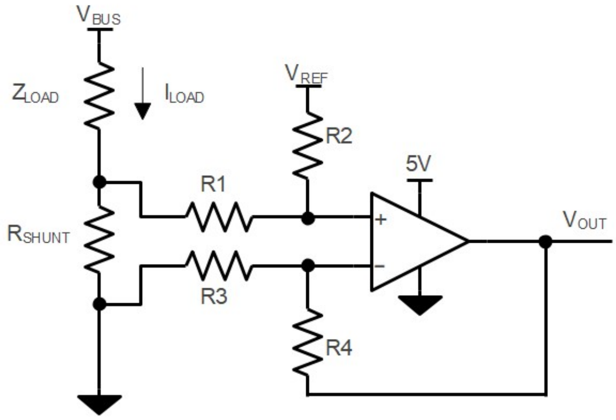
Description

The TPA551x is the nano-power, zero-drift amplifier with a maximum 30-μV low-offset voltage and stable frequency response for the high-precision sensing application that also requires low standby power.

The TPA551x devices provide rail-to-rail input and output. The devices have excellent AC performance with 9-kHz bandwidth, 3-V/ms slew rate while only drawing 650-nA quiescent current per amplifier.

The TPA5511 and TPA5511U (1-ch version) are offered in the SOT23-5 and SC70-5 packages. The TPA5512 (2-ch version) is available in the SOP-8, TSSOP-8, MSOP-8, and DFN-8 packages. All versions can be operated over the industrial temperature range of −40°C to +125°C.

Typical Application Circuit



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

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

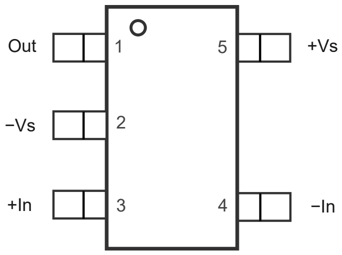
Table of Contents

Revision History

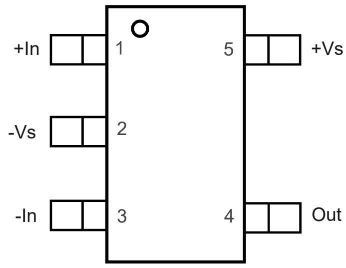
Date	Revision	Notes
2022-12-22	Rev.A.0	Initial version.
2024-01-21	Rev.A.1	Modified the maximum value of IQ at 25 ℃ from 1500 nA to 800 nA. Modified the maximum value of IQ at −40 to 125 ℃ from 1500 nA to 1100 nA. Modified the mean value of IQ at 25 ℃ from 650 nA to 600 nA.
2024-02-06	Rev.A.2	Modified the pin configuration of SOP8. The physical object has not changed, just a correction of handwriting errors.
2024-04-28	Rev.A.3	Removed the label of TPA5511U-S5TR indicating future products in the order information.

Pin Configuration and Functions

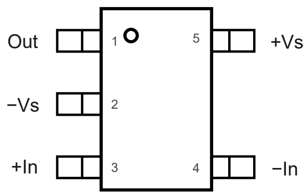
TPA5511
SOT23-5 Package
Top View



TPA5511U
SOT23-5 Package
Top View



TPA5511
SOT353-5(SC70) Package
Top View



TPA5511U
SOT353-5(SC70) Package
Top View

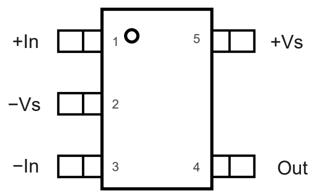


Table 1. Pin Functions: TPA5511, TPA5511U

Pin No.		Name	I/O	Description
TPA5511	TPA5511U			
1	4	Out	O	Output
2	2	$-V_S$	-	Negative power supply
3	1	+In	I	Noninverting input
4	3	−In	I	Inverting input
5	5	$+V_S$	-	Positive power supply

TPA5511
DFN1X1.4-4 Package
Top View

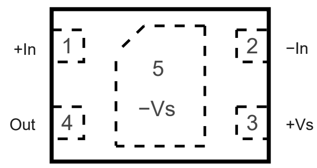
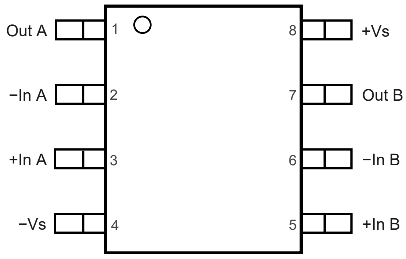


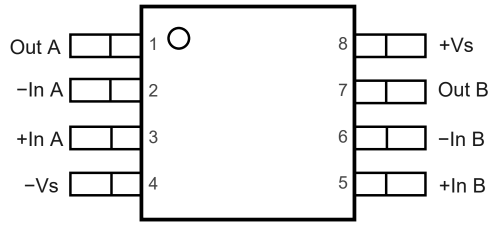
Table 2. Pin Functions: TPA5511

Pin No. TPA5511	Name	I/O	Description
4	Out	O	Output
5	$-V_S$	-	Negative power supply
1	+In	I	Noninverting input
2	−In	I	Inverting input
3	$+V_S$	-	Positive power supply

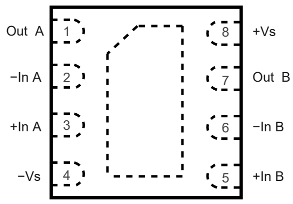
TPA5512
SOP8 Package
Top View



TPA5512
MSOP8 Package
Top View



TPA5512
DFN2X2-8 Package
Top View



TPA5512
TSSOP8 Package
Top View

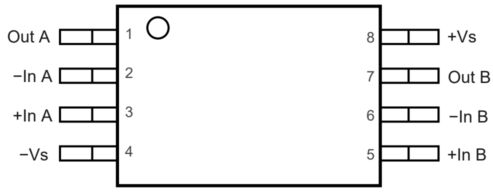


Table 3. Pin Functions: TPA5512

Pin No.	Name	I/O	Description
1	Out A	O	Output
2	−In A	I	Inverting input
3	+In A	I	Noninverting input
4	$-V_S$	-	Negative power supply
5	+In B	I	Noninverting input
6	−In B	I	Inverting input
7	Out B	O	Output
8	$+V_S$		Positive power supply

Specifications

Absolute Maximum Ratings (1)

Over operating ambient temperature, unless otherwise noted.

Parameter	Min	Max	Unit
Supply Voltage, $(+V_S) – (–V_S)$		4	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: +IN, –IN (2)	−10	10	mA
Output Voltage	$(−V_S) − 0.3$	$(+V_S) + 0.3$	V
Output Short-Circuit Duration (3)		Infinite	
Maximum Operating Junction Temperature		150	°C
Operating Temperature Range	−40	125	°C
Storage Temperature Range	−65	150	°C
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 300 mV beyond the negative 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)	3	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)	1.7		3.6	V
T_A	Operating Temperature Range	−40		125	°C

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
TSSOP8	191	44	°C/W
DFN1.5X1.5-8	200	100	°C/W
DFN2X2-8	100	60	°C/W

Electrical Characteristics

All test conditions: V_S = 3.3 V, T_A = 25°C, R_L = 10 kΩ, C_L = 100 pF, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power Supply						
V_S	Supply Voltage Range		1.7		3.6	V
I_Q	Quiescent Current per Amplifier	V_S = 3.3 V, V_{CM} = 1.65 V		600	800	nA
		V_S = 3.3 V, V_{CM} = 1.65 V, T_A = −40°C to 125°C			1100	nA
PSRR	Power Supply Rejection Ratio	V_S = 1.7 V to 3.6 V, V_{CM} = 0 V	100	122		dB
		V_S = 1.7 V to 3.6 V, V_{CM} = 0 V, T_A = −40°C to 125°C	100			dB
Input Characteristics						
V_{OS}	Input Offset Voltage	V_S = 1.7 to 3.6 V, V_{CM} = 1 / V_S	−30	1.5	30	μV
		V_S = 1.7 to 3.6 V, V_{CM} = 1 / V_S, T_A = −40°C to 125°C	−30		30	μV
V_{OS} TC	Input Offset Voltage Drift	T_A = −40°C to 125°C		0.025		μV/°C
I_B	Input Bias Current			20		pA
		T_A = −40°C to 125°C	−1100	200	1100	pA
I_{OS}	Input Offset Current			16		pA
		T_A = −40°C to 125°C	−1300	250	1300	pA
R_{IN}				10^{10}		Ω
C_{IN}	Input Capacitance	Differential Mode		5		pF
		Common Mode		5		pF
Av	Open−loop Voltage Gain	V_O = 0.1 V to 3.2 V	100	130		dB
		V_O = 0.1 V to 3.2 V, T_A = −40°C to 125°C	100			dB
V_{CMR}	Common−mode Input Voltage Range	T_A = −40°C to 125°C	$-V_S$		$+V_S$	V
CMRR	Common-Mode Rejection Ratio	V_{CM} = 0 V to 3.3V	95	125		dB
		V_{CM} = 0 V to 3.3V, T = −40°C to 125°C	90			dB
Output Characteristics						
	Output Voltage Swing from Positive Rail or Negative Rail	R_{LOAD} = 100 kΩ to V_S/2		1.5	15	mV
		R_{LOAD} = 100 kΩ to V_S/2, T_A = −40°C to 125°C			15	mV
I_{SC}	Output Short−Circuit Current	Sink or Source	10	15		mA
		Sink or Source, T_A= −40°C to 125°C	10			mA
AC Specifications						

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
GBW	Gain−Bandwidth Product			9		kHz
SR	Slew Rate	G = 1, 2 V step		3		V/ms
PM	Phase Margin	R_L = 10 kΩ, C_L = 100 pF		60		°
GM	Gain Margin	R_L = 10 kΩ, C_L = 100 pF		9.3		dB
	Channel Separation	f = 1 kHz		120		dB
Noise Performance						
E_N	Input Voltage Noise	f = 0.1 Hz to 10 Hz		5		μV_{PP}
e_N	Input Voltage Noise Density	f = 100Hz		354		nV/√Hz
i_N	Input Current Noise	f = 100Hz		1		fA/√Hz

Typical Performance Characteristics

All test conditions: V_S = 3.3 V, T_A = 25°C, unless otherwise noted.

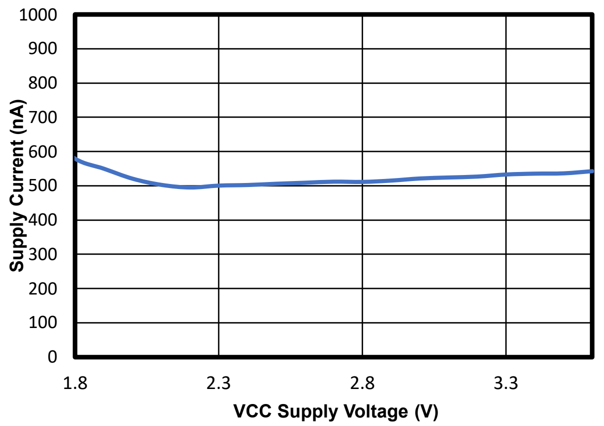


Figure 1. Supply Current vs Supply Voltage, 1ch

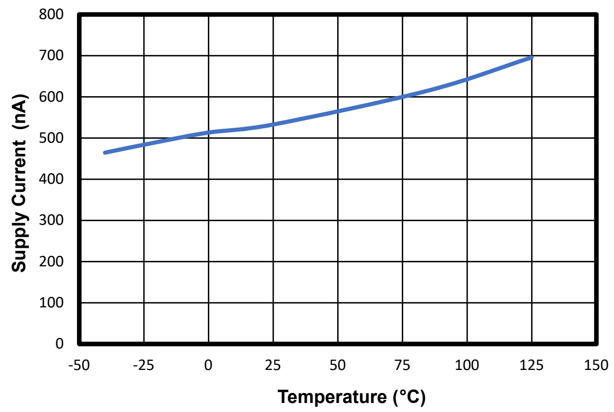


Figure 2. Supply Current vs Temperature, 1ch

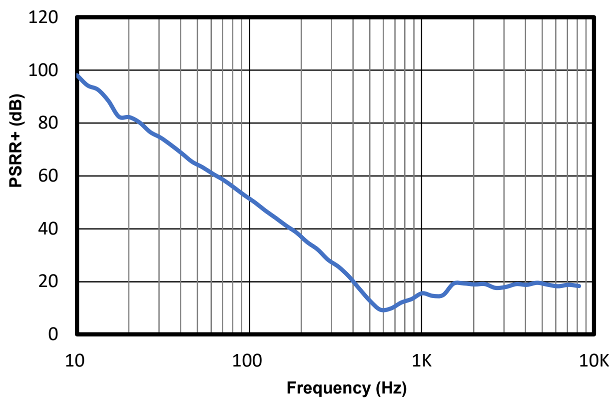


Figure 3. PSRR+ vs Frequency

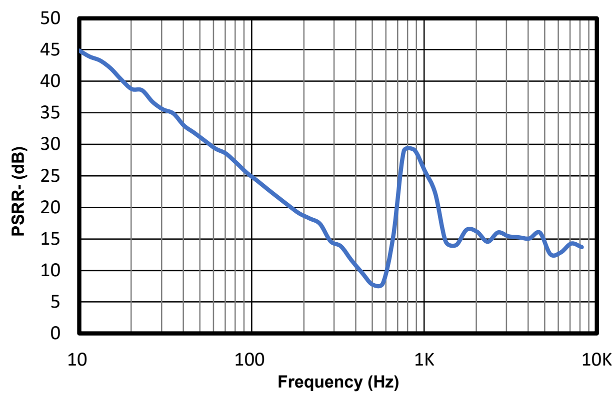


Figure 4. PSRR− vs Frequency

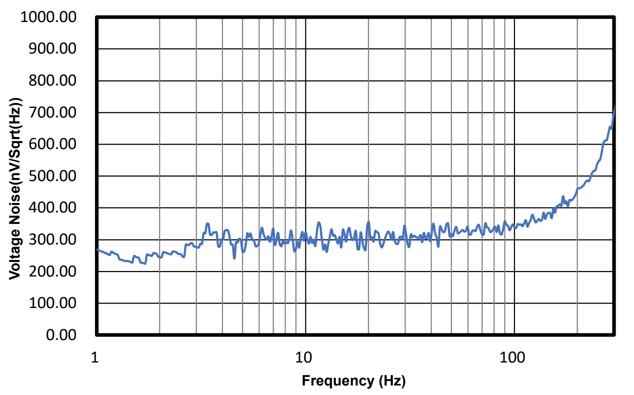


Figure 5. Voltage Noise Spectral Density vs Frequency

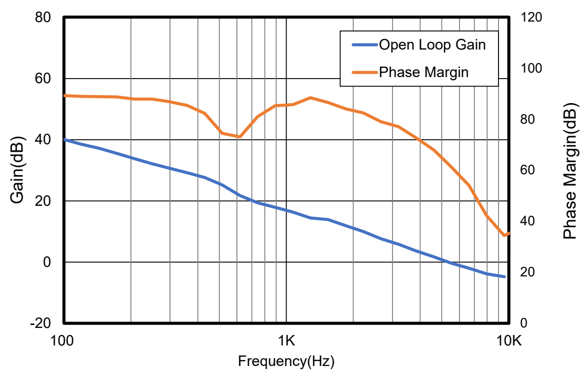


Figure 6. Open Loop Gain and Phase Margin vs Frequency, RL = 10 kΩ, C_L= 100 pF

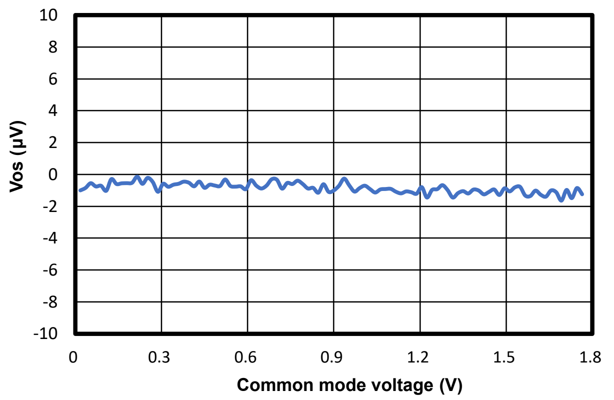


Figure 7. V_{OS} vs V_{CM}, V_S = 1.8 V

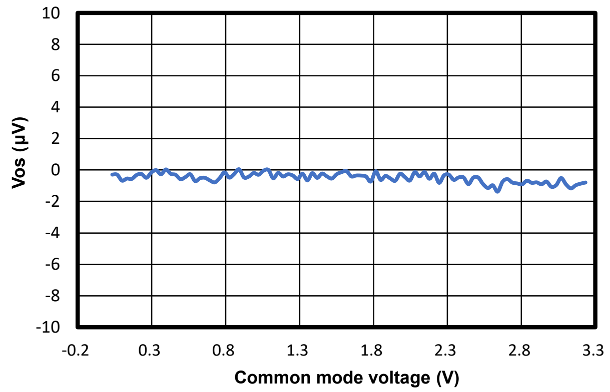


Figure 8. V_{OS} vs V_{CM}, V_S = 3.3 V

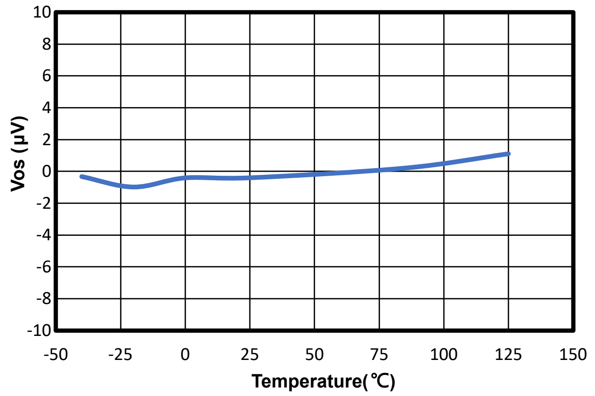


Figure 9. V_{OS} vs Temperature

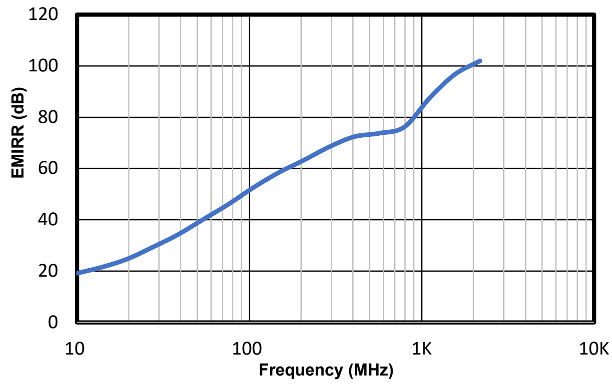


Figure 10. EMIRR vs Frequency

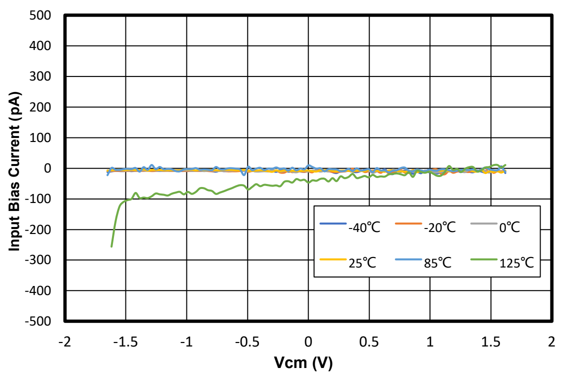


Figure 11. I_B vs Common-Mode Voltage

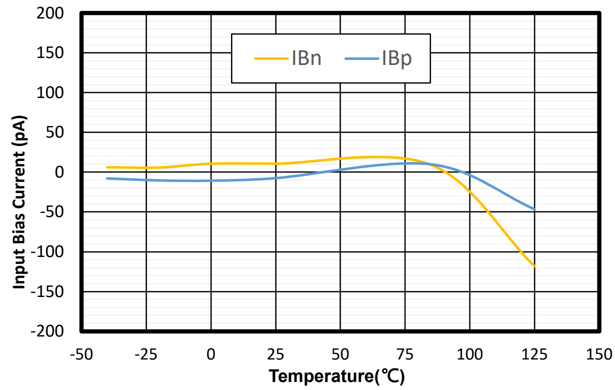


Figure 12. I_B vs Temperature

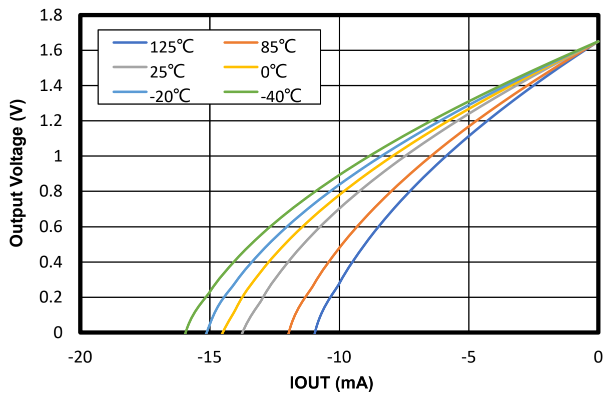


Figure 13. Output Voltage vs Output Current

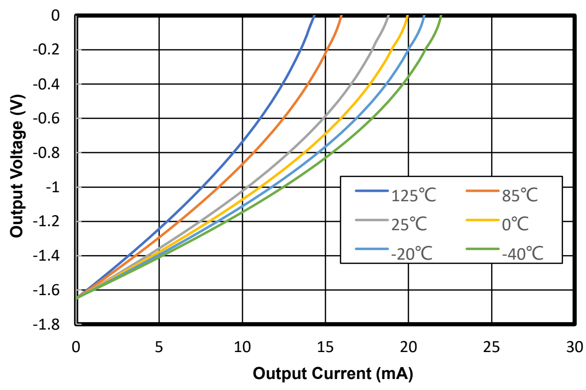


Figure 14. Output Voltage vs Output Current

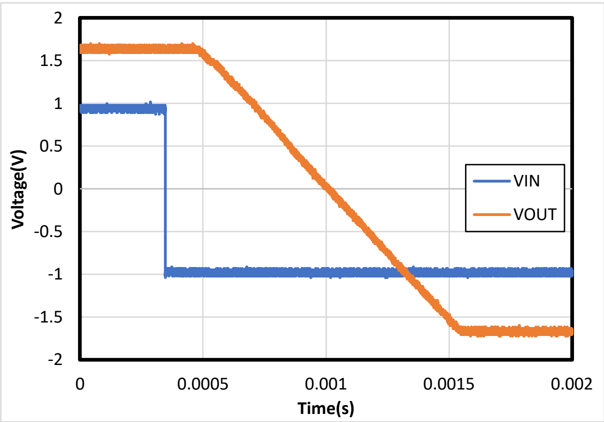


Figure 15. Overload Recovery at Negative Rail

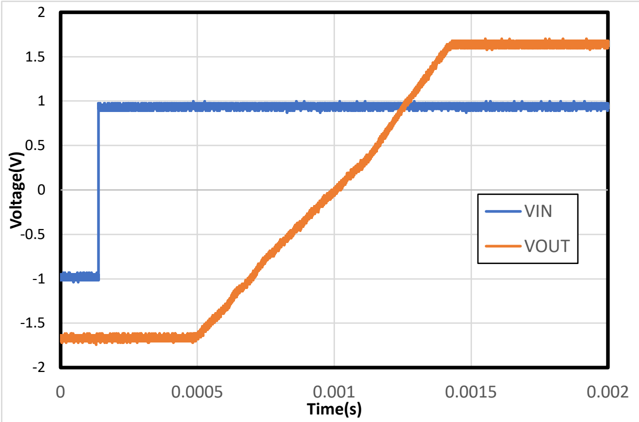


Figure 16. Overload Recovery at Positive Rail

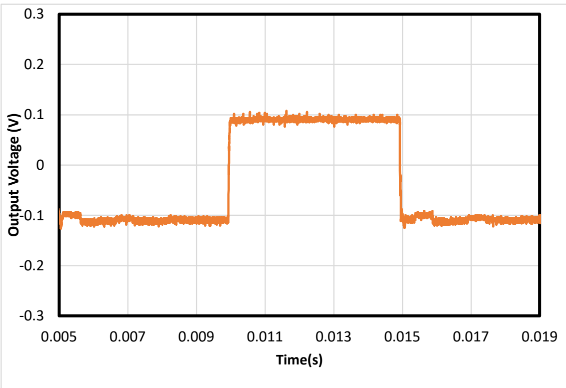


Figure 17. 100-mV Small Signal Step Response Voltage: 100 mV/div, Time: 20 ms/div

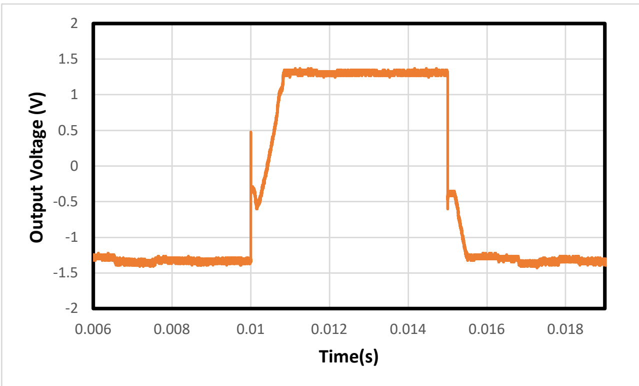


Figure 18. 1-V Large Signal Step Response Voltage: 500 mV/div, Time: 20 ms/div

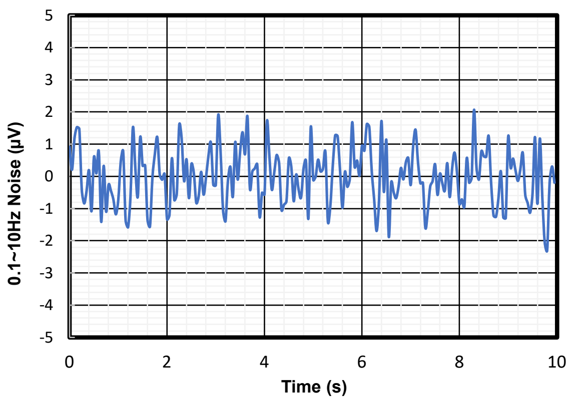


Figure 19. 0.1 to 10 Hz Voltage Noise

Detailed Description

Overview

The TPA551x family of zero-drift amplifiers can operate on a single-supply voltage (1.7 V to 3.6 V), or a split-supply voltage. With the 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 TPA551x also include 9-kHz bandwidth, no 1/f noise, and only 650-nA quiescent current, making the TPA551x suitable for many precision, low power, and temperature-sensitive applications. Parameters that can exhibit variance with regard to operating voltage or temperature are presented in Typical Performance Characteristics.

Functional Block Diagram

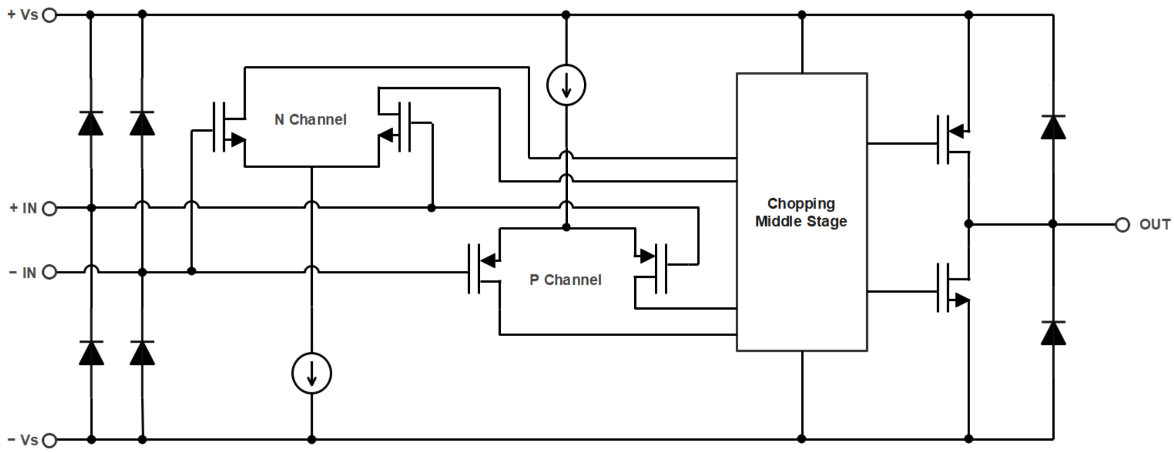


Figure 20. Functional Block Diagram

Feature Description

Operating Voltage

The devices are designed for single supply operation from 1.7 V to 3.6 V or dual supply operation from ±0.85 V to ±1.8 V.

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

The devices provide 30-μV 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, as known as 1/f noise, is inherent in semiconductor devices and increases as the 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 the standard amplifier.

Residual Voltage Ripple

The chopping technique can be used in the 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 1 kHz. If the frequency of input signal is close to the chopping frequency, the signal may be interfered 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 to 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.

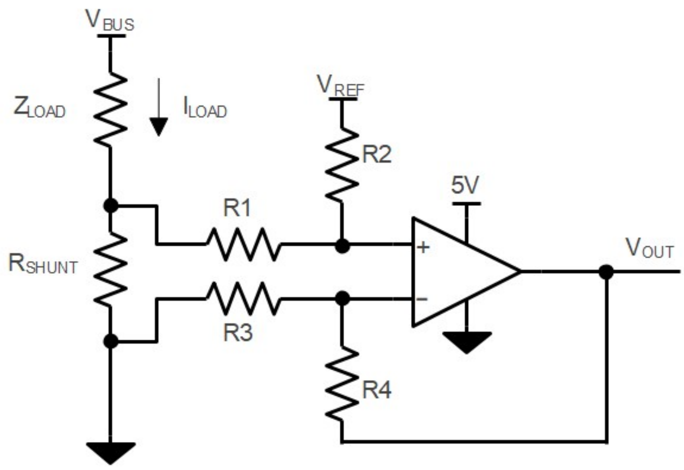
Application and Implementation

> 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 21 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. The 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.



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

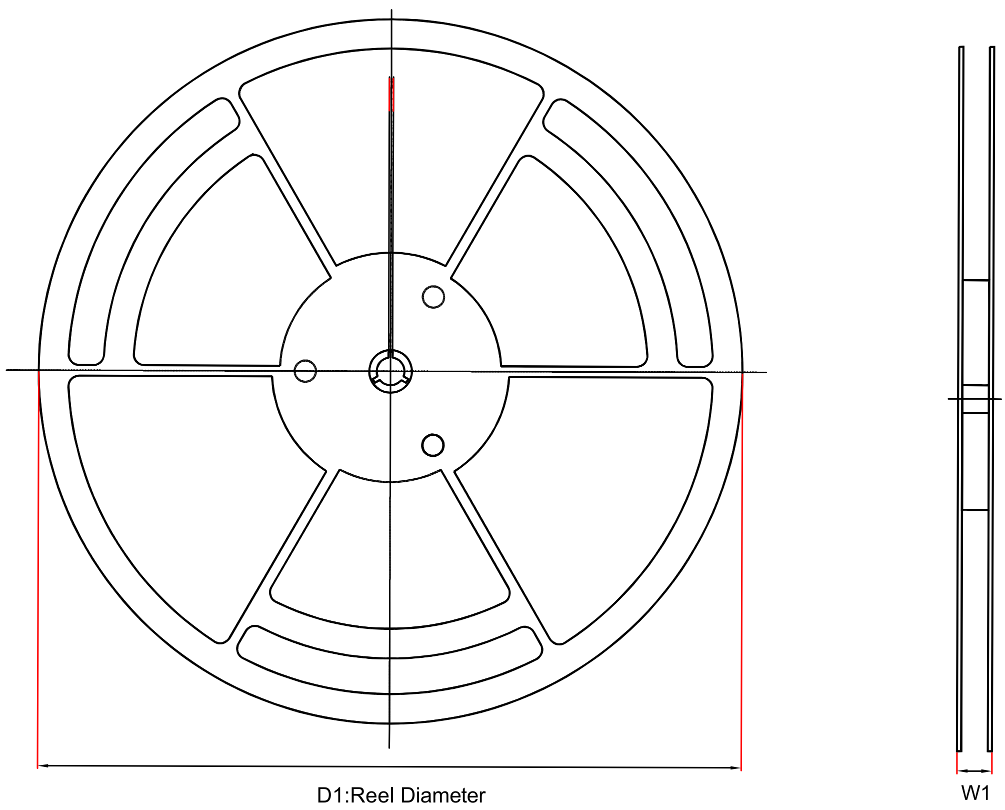
When $R3 = R1$, $R2 = R4$, $R_{SHUNT} << R1$

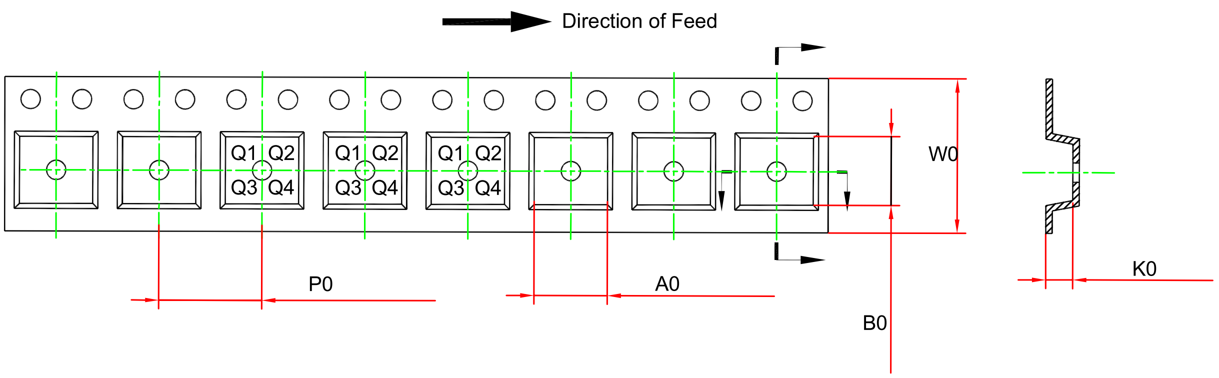
Figure 21. Low-Side Current Sensing Application

Power Supply Recommendations

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

Tape and Reel Information





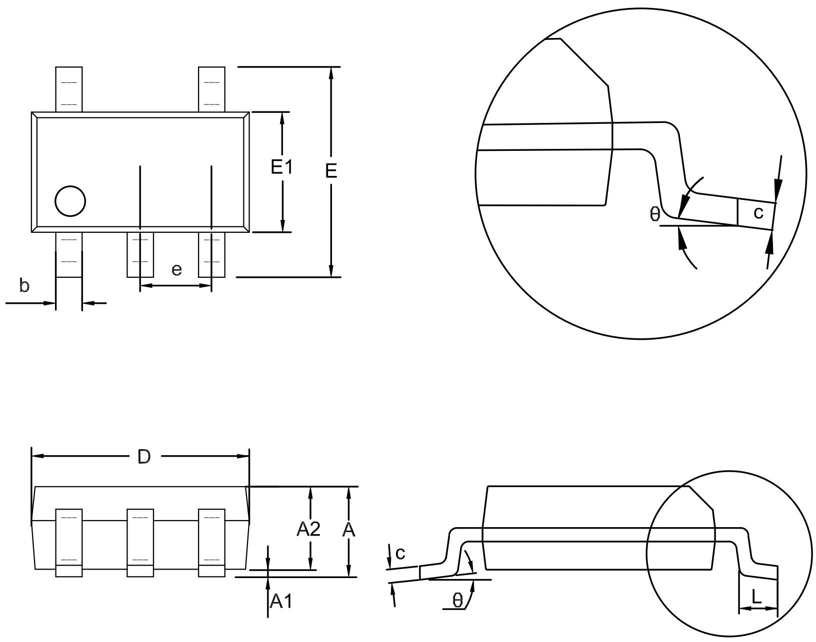
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPA5511-SC5R	SOT353 (SC70-5)	178.0	12.3	2.4	2.5	1.2	4.0	8.0	Q3
TPA5511U-SC5R	SOT353 (SC70-5)	178.0	12.3	2.4	2.5	1.2	4.0	8.0	Q3
TPA5511-S5TR	SOT23-5	180.0	13.1	3.2	3.2	1.4	4.0	8.0	Q3
TPA5511-DFPR	DFN1.4X1-4	180.0	10.0	1.15	1.6	0.5	4.0	8.1	Q1
TPA5511U-S5TR	SOT23-5	180.0	13.1	3.2	3.2	1.4	4.0	8.0	Q3
TPA5512-SO1R	SOP8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1

Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPA5512-DFGR	DFN2X2-8	180.0	13.1	2.3	2.3	1.1	4.0	8.0	Q1
TPA5512-DFSR	DFN1.5X1.5-8	180.0	12.3	1.7	1.7	0.75	4.0	8.0	Q2
TPA5512-TS1R	TSSOP8	330.0	17.6	6.8	3.3	1.2	8.0	12.0	Q1
TPA5512-VS1R	MSOP8	330.0	17.6	5.4	3.3	1.5	8.0	12.0	Q1

Package Outline Dimensions

SOT23-5

Package Outline Dimensions S5T(SOT23-5-A)



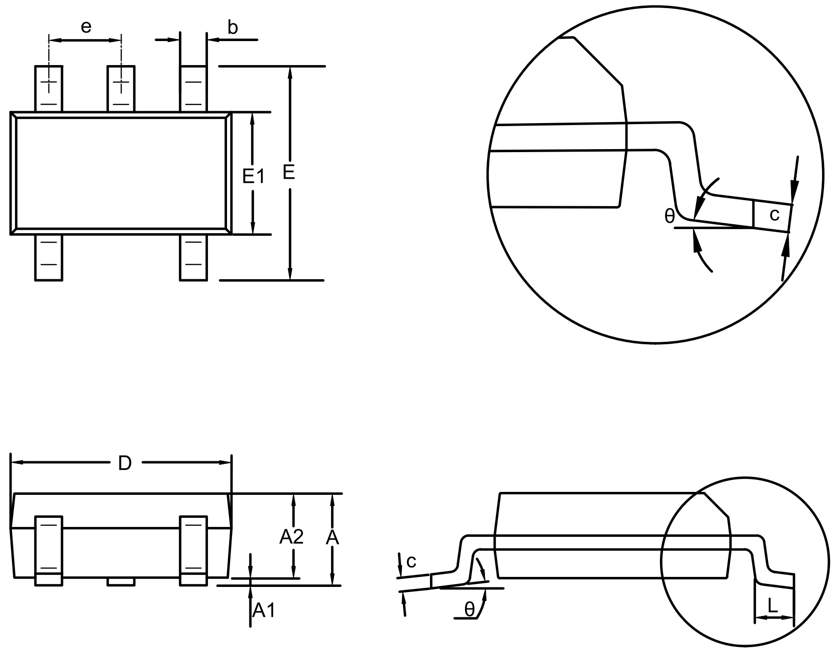
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.150	0.000	0.006
A2	1.000	1.200	0.039	0.047
b	0.280	0.500	0.011	0.020
c	0.100	0.230	0.004	0.009
D	2.820	3.020	0.111	0.119
E	2.600	3.000	0.102	0.118
E1	1.500	1.720	0.059	0.068
e	0.950 BSC		0.037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

SOT353-5

Package Outline Dimensions SC5(SOT353-5-A)



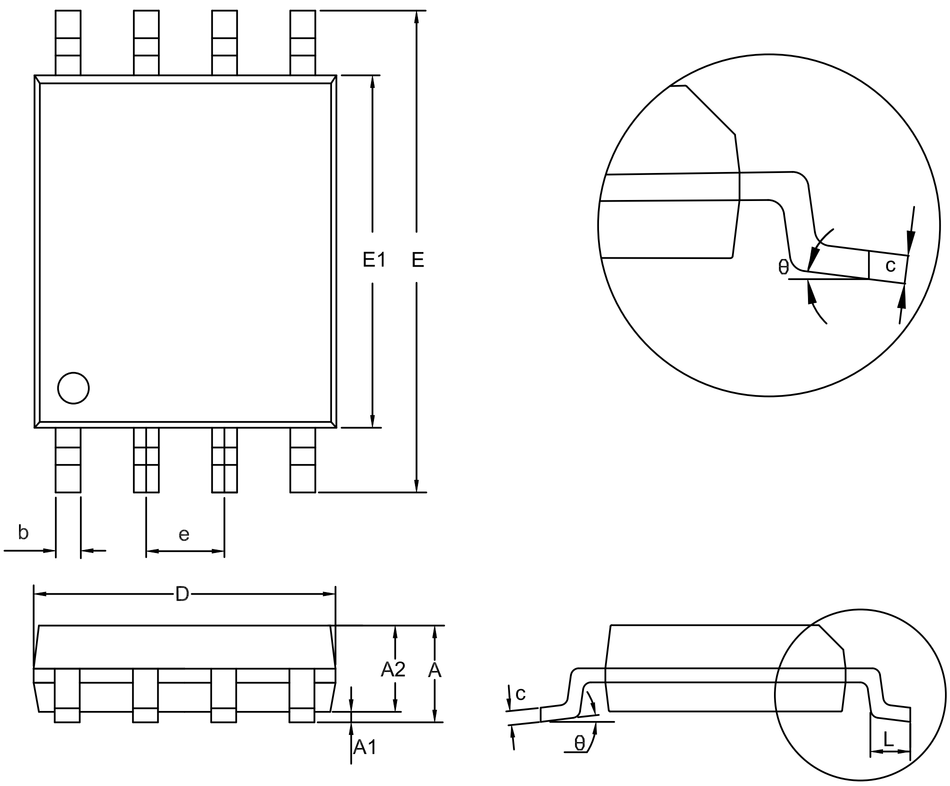
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.850	1.100	0.033	0.043
A1	0.000	0.100	0.000	0.004
A2	0.800	1.000	0.031	0.039
b	0.150	0.350	0.006	0.014
c	0.110	0.230	0.004	0.009
D	2.000	2.200	0.079	0.087
E	2.150	2.450	0.085	0.096
E1	1.150	1.350	0.045	0.053
e	0.650 BSC		0.026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

TSSOP8

Package Outline Dimensions TS1(TSSOP-8-A)



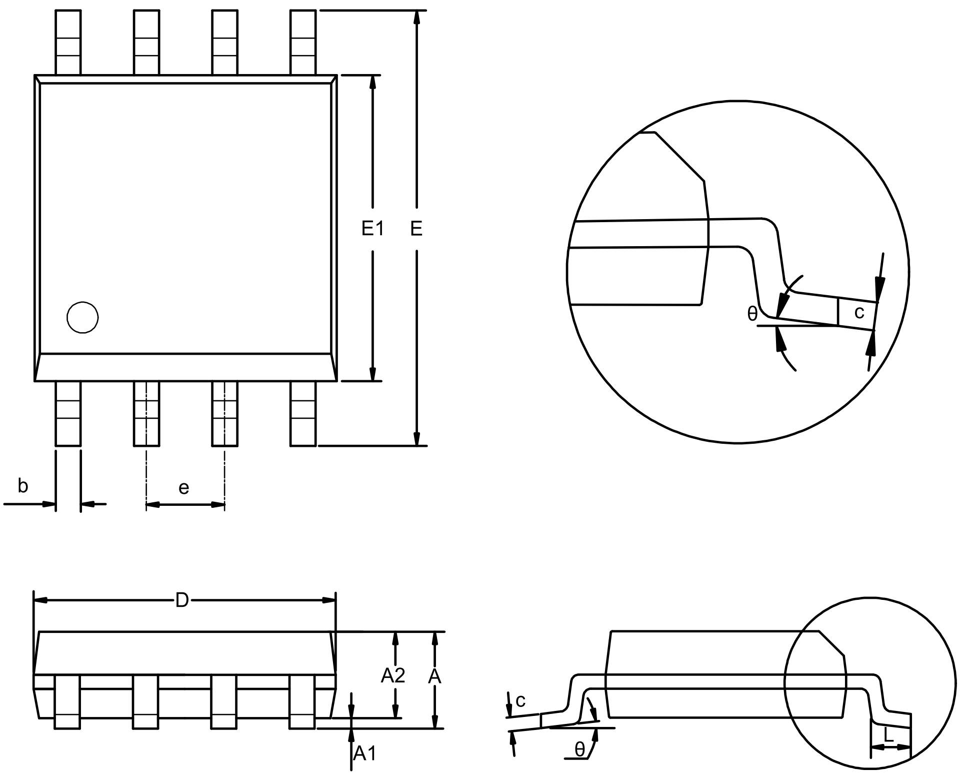
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.200	0.035	0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	2.900	3.100	0.114	0.122
E	6.200	6.600	0.244	0.260
E1	4.300	4.500	0.169	0.177
e	0.650 BSC		0.026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



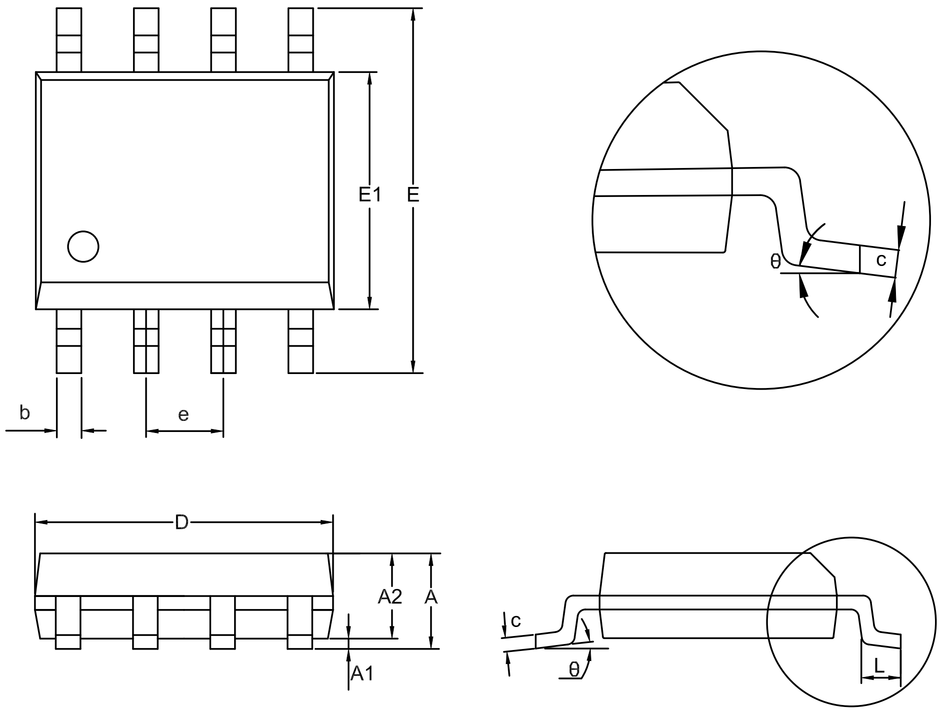
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	4.700	5.100	0.185	0.201
E1	2.900	3.100	0.114	0.122
e	0.650 BSC		0.026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

SOP8

Package Outline Dimensions SO1(SOP-8-A)



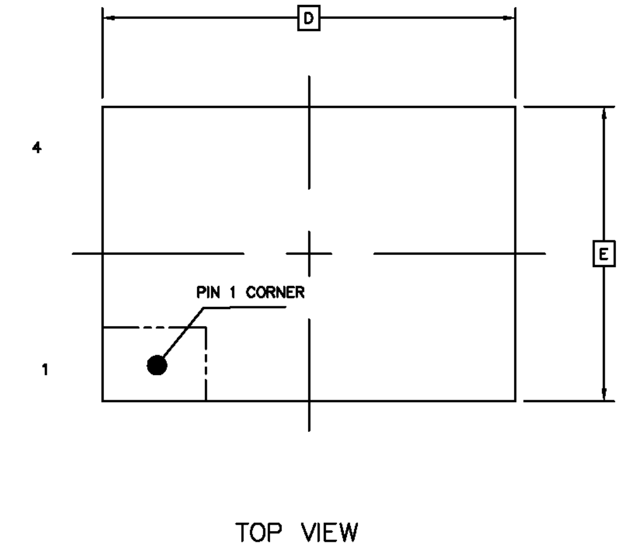
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050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

NOTES

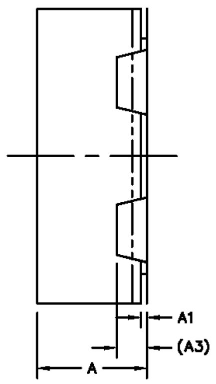
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

DFN1X1.4-4

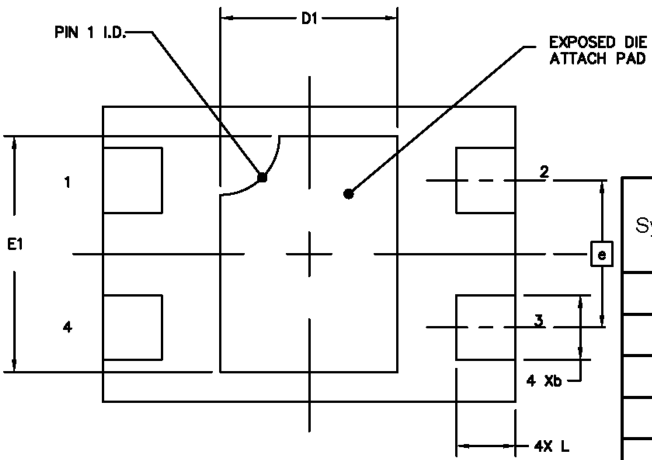
Package Outline Dimensions DFA(DFN1X1.4-4-A)



TOP VIEW



SIDE VIEW



BOTTOM VIEW

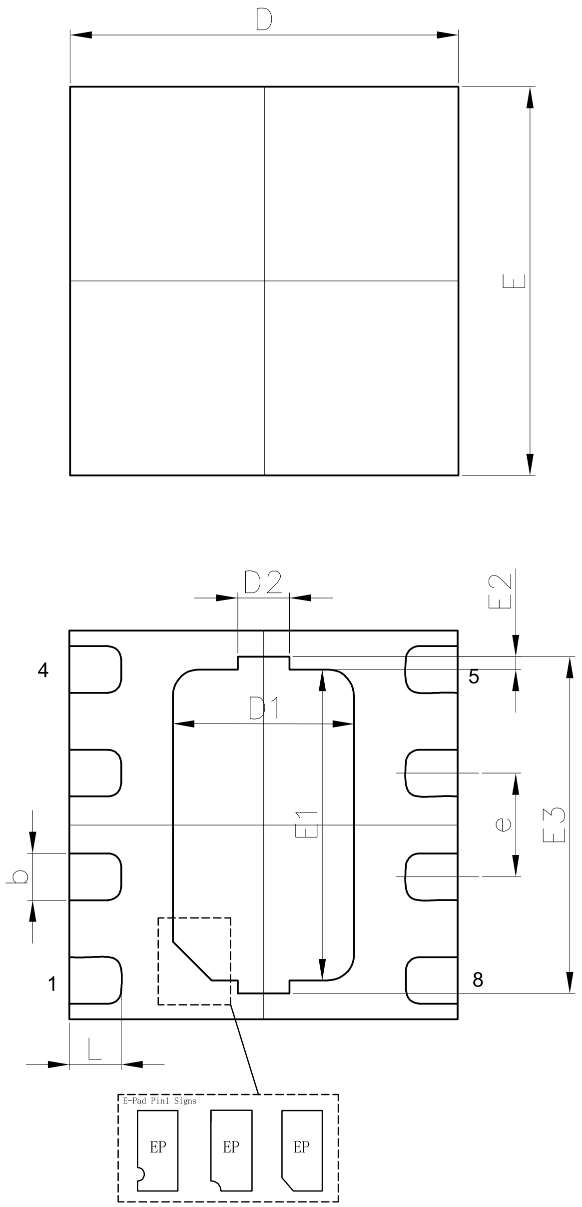
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.320	0.400	0.013	0.016
A1	0.000	0.050	0.000	0.002
b	0.170	0.270	0.007	0.011
A3	0.102REF		0.004 REF	
D	1.300	1.500	0.051	0.059
E	0.900	1.100	0.035	0.043
D1	0.500	0.700	0.020	0.028
E1	0.700	0.900	0.028	0.035
e	0.500 BSC		0.020 BSC	
L	0.150	0.250	0.006	0.010

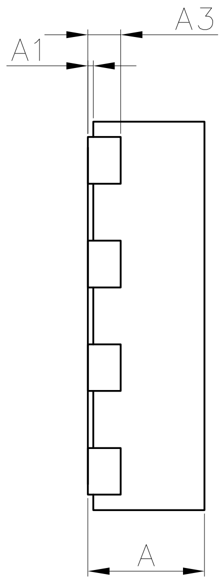
NOTES

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

DFN1.5X1.5-8

Package Outline Dimensions DFS(DFN1.5X1.5-8-A)





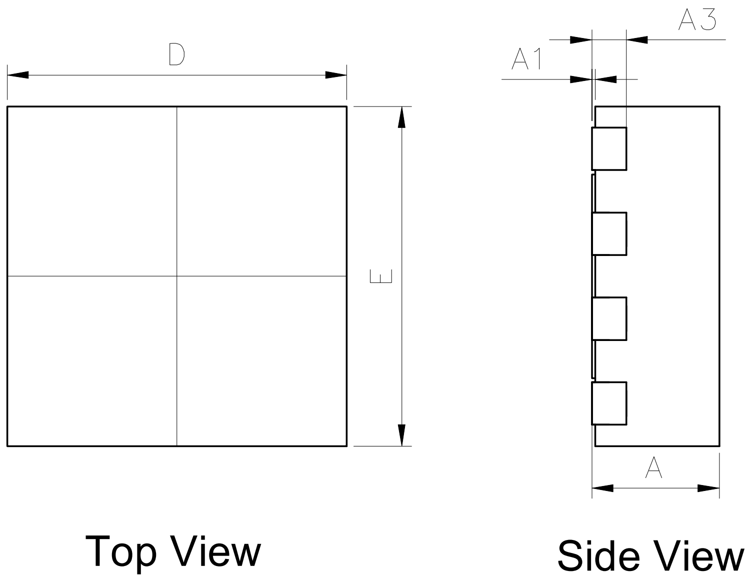
NOTES

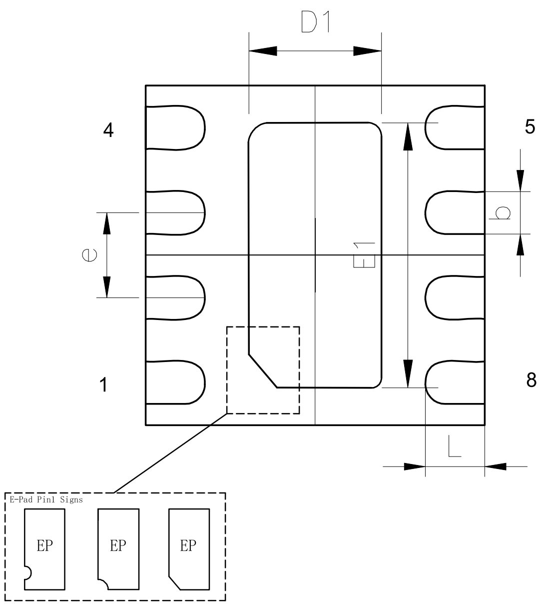
1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.
3. The many types of E-pad Pin1 signs may appear in the product.

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.400	0.500	0.016	0.020
A1	0.000	0.050	0.000	0.002
b	0.150	0.250	0.006	0.010
A3	0.127 REF		0.005 REF	
D	1.450	1.550	0.057	0.061
D1	0.600	0.800	0.024	0.031
D2	0.200 REF		0.008 REF	
E	1.450	1.550	0.057	0.061
E1	1.100	1.300	0.043	0.051
E2	0.050 REF		0.002 REF	
E3	1.200	1.400	0.047	0.055
e	0.400 BSC		0.016 BSC	
L	0.150	0.250	0.006	0.010

DFN2X2-8

Package Outline Dimensions DFG(DFN2X2-8-E)





Bottom View

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.
3. The many types of E-pad Pin1 signs may appear in the product.

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.500	0.600	0.020	0.024
A1	0.000	0.050	0.000	0.002
b	0.150	0.300	0.006	0.012
A3	0.100	0.200	0.004	0.008
D	1.900	2.100	0.075	0.083
D1	0.800	1.000	0.031	0.039
E	1.900	2.100	0.075	0.083
E1	1.600	1.800	0.063	0.071
e	0.500 BSC		0.020BSC	
L	0.224	0.376	0.009	0.015

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPA5511-DFPR	−40 to 125°C	DFN1.4X1-4	51	3	Tape and Reel, 4000	Green
TPA5511-SC5R (1)	−40 to 125°C	SOT353 (SC70-5)	511	3	Tape and Reel, 3000	Green
TPA5511U-SC5R (1)	−40 to 125°C	SOT353 (SC70-5)	51U	3	Tape and Reel, 3000	Green
TPA5511-S5TR	−40 to 125°C	SOT23-5	511	3	Tape and Reel, 3000	Green
TPA5511U-S5TR	−40 to 125°C	SOT23-5	51U	3	Tape and Reel, 3000	Green
TPA5512-DFSR (1)	−40 to 125°C	DFN1.5X1.5-8	51	3	Tape and Reel, 4000	Green
TPA5512-SO1R	−40 to 125°C	SOP8	A5512	3	Tape and Reel, 4000	Green
TPA5512-DFGR	−40 to 125°C	DFN2X2-8	551	3	Tape and Reel, 3000	Green
TPA5512-TS1R (1)	−40 to 125°C	TSSOP8	A5512	3	Tape and Reel, 3000	Green
TPA5512-VS1R	−40 to 125°C	MSOP8	A5512	3	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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