5-V, Zero-Drift, RRIO, 15-MHz, Presicion Op Amp

Features

- Supply Voltage: 2.7 V to 5.5 V
- Dual Supply: ±1.35 V to ±2.75 V
- Low Offset Voltage: ±20 μV Maximum
- Zero Drift: ±0.01 μV/°C
- Rail-to-Rail Input and Output
- Gain Bandwidth Product: 15 MHz
- Slew Rate: 4.9 V/μs
- Low Noise: 10 nV/√Hz at 1 kHz
- No 1/f noise: 0.2-uVPP (0.1 Hz to 10 Hz)

Applications

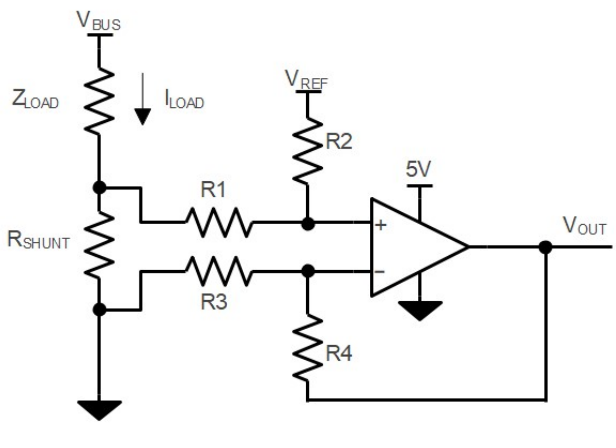
- Server PSU
- Battery Current Sensing
- Precision Signal Condition
- Power System
- Temperature Transmitter
- Medical Instrumentation

Description

The TPA558x is the newest zero-drift amplifier with maximum 20-μV low-offset voltage, low noise, and stable high-frequency response. It incorporates proprietary and patented design techniques to achieve excellent AC performance with 15-MHz bandwidth, 4.9-V/μs slew rate, and low distortion while drawing 1-mA quiescent current per amplifier. The input common-mode voltage extends to V–, and the output swings rail-to-rail. The amplifier can be used as a plug-in replacement for many commercially available op-amps to improve performance. Considering the requirement of the low standby power in some special applications, there is a shutdown function which is TPA558xN series with only 7.5-μA shutdown current.

The TPA5581 and TPA5581U (1-ch veision) are offered in the SOT23-5 and SC70-5 packages. The TPA5582 (2-ch version) is available in the SOP-8, TSSOP-8, MSOP-8, and DFN-8 packages. The TPA5581N (shutdown version) is only offered in the SOT23-5 package. 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 $R3 = R1$, $R2 = R4$, $R_{SHUNT} << R1$

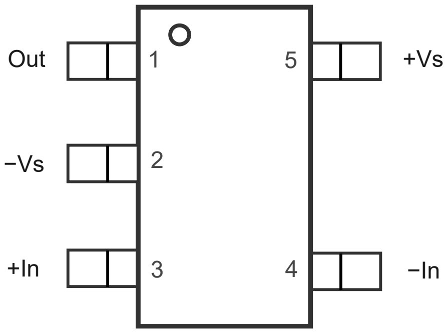
Table of Contents

Revision History

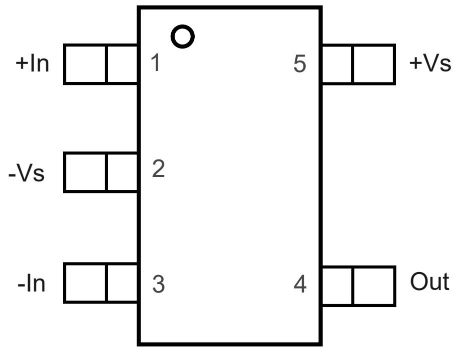
Date	Revision	Notes
2022-12-22	Rev.A.0	Initial version .
2023-07-31	Rev.A.1	Updating the curve of the Open Loop Gain and Phase Margin vs Frequency.
2023-12-22	Rev.A.2	Updating the max value of Ios under room temperature.
2024-04-28	Rev.A.3	Removed the the label of TPA5582-TS1R indicating future products in order information.

Pin Configuration and Functions

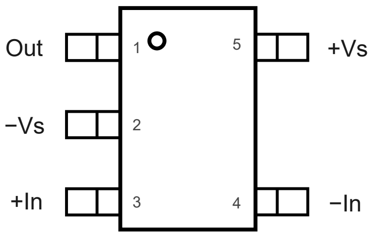
TPA5581
SOT23-5 Package
Top View



TPA5581U
SOT23-5 Package
Top View



TPA5581
SOT363-5(SC70) Package
Top View



TPA5581U
SOT363-5(SC70) Package
Top View

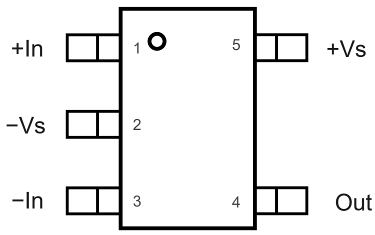


Table 1. Pin Functions: TPA5581, TPA5581U

Pin No.		Name	I/O	Description
TPA5581	TPA5581U			
1	4	Out	Output	Output
2	2	$-V_S$		Negative power supply
3	1	+In	Input	Noninverting input
4	3	−In	Input	Inverting input
5	5	$+V_S$		Positive power supply

TPA5581N
SOT23-6 Package
Top View

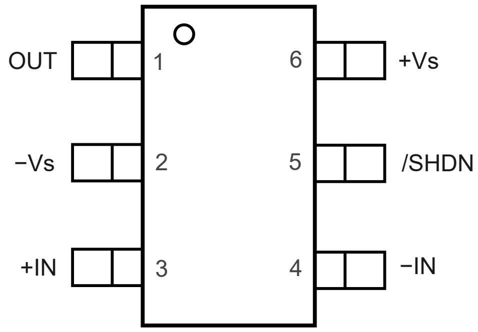
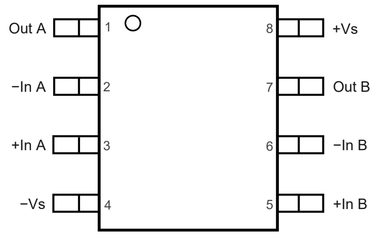


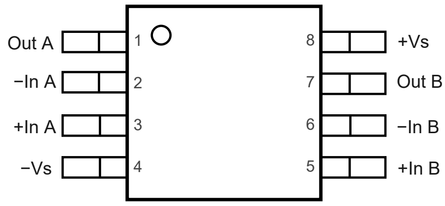
Table 2. Pin Functions: TPA5581N

Pin No.	Name	I/O	Description
1	Out	Output	Output
2	$-V_S$		Negative power supply
3	+In	Input	Noninverting input
4	−In	Input	Inverting input
5	/SHDN	Input	Shut down input.The device is shut down when the low-level input voltage is on the input; the device is active when the high-level input voltage is on the input. The device is active in default with a 10-MΩ internal pull-up resistor.
6	$+V_S$		Positive power supply

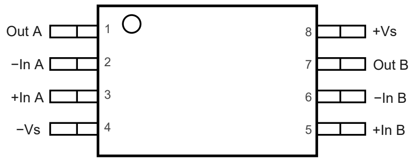
TPA5582
SOP8 Package
Top View



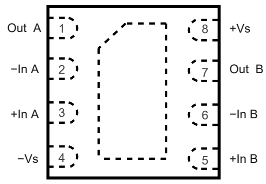
TPA5582
MSOP8 Package
Top View



TPA5582
TSSOP8
Top View



TPA5582
DFN2X2-8
Top View



TPA5582
DFN3X3-8
Top View

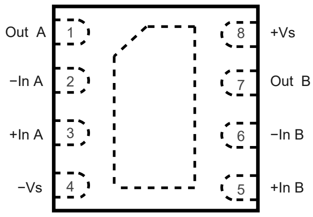


Table 3. Pin Functions: TPA5582

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

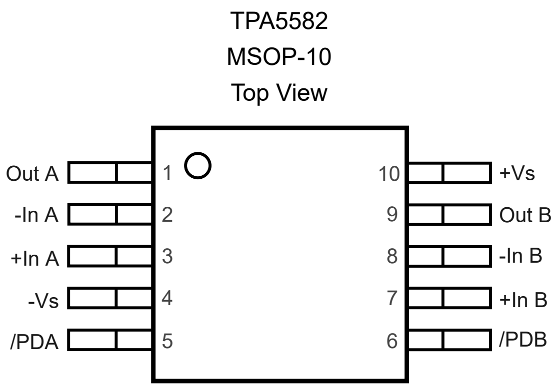


Table 4. Pin Functions: TPA5582

Pin No.	Name	I/O	Description
1	Out A	Output	Output
2	−In A	Input	Inverting input
3	+In A	Input	Noninverting input
4	$-V_S$		Negative power supply
5	/PD A	Input	Shut down input of channel A.The device is shut down when the low-level input voltage is on the input; the device is active when the high-level input voltage is on the input. The device is active in default with a 10-MΩ internal pull-up resistor.
6	/PD B	Input	Shut down input of channel B.The device is shut down when the low-level input voltage is on the input; the device is active when the high-level input voltage is on the input. The device is active in default with a 10-MΩ internal pull-up resistor.
7	+In B	Input	Noninverting input
8	−In B	Input	Inverting input
9	Out B	Output	Output
10	$+V_S$		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)		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: +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 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, $(+V_S) – (−V_S)$	2.7		5.5	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
DFN2X2-8	100	60	°C/W

Electrical Characteristics

Test condition is at V_S = 5 V, T_A = 25°C, R_L = 10 kΩ, C_L = 100 pF, unless otherwise noted

Parameter		Conditions	Min	Typ	Max	Unit
Power Supply						
V_S	Supply Voltage Range		2.7		5.5	V
I_Q	Quiescent Current per Amplifier	V_S = 2.7 V to 5.5 V		1	1.2	mA
		V_S = 2.7 V to 5.5 V, T_A = −40°C to 125°C			1.8	mA
	Shutdown Current	V_S = 2.7 to 5.5 V, /SHDN = 0 V		7.5		µA
		V_S = 2.7 to 5.5 V, /SHDN = 0 V, T_A = −40°C to 125°C			21	µA
	Input Logic High of Shutdown	T_A = −40°C to 125°C	0.7 × V_S			V
	Input Logic Low of Shutdown	T_A = −40°C to 125°C			0.3 × V_S	V
PSRR	Power Supply Rejection Ratio	V_S = 2.7 V to 5.5 V	114	124		dB
		V_S = 2.7 V to 5.5 V, T_A = −40°C to 125°C	110			dB
Input Characteristics						
V_{OS}	Input Offset Voltage	V_S = 5 V, V_{CM} = 2.5 V	−10	1.2	10	µV
		V_S = 5 V, , V_{CM} = 2.5 V, T_A = −40°C to 125°C	−20		20	µV
		V_S = 3.3 V, V_{CM} = 1.65 V	−10	1.3	10	µV
		V_S = 3.3 V, , V_{CM} = 1.65 V, T_A = −40°C to 125°C	−20		20	µV
V_{OS} TC	Input Offset Voltage Drift	T_A = −40°C to 125°C		0.01		µV/°C
I_B	Input Bias Current	V_S = 5 V, V_{CM} = 2.5 V	−800	200	800	pA
		V_S = 5 V, V_{CM} = 2.5 V, T_A = −40°C to 125°C	−1500		1500	pA
I_{OS}	Input Offset Current	V_S = 5 V, V_{CM} = 2.5 V	−800	120	800	pA
		V_S = 5 V, V_{CM} = 2.5 V, T_A = −40°C to 125°C	−1000	440	1000	pA
R_{IN}				50		GΩ
C_{IN}	Input Capacitance	Differential Mode		2		pF
		Common Mode		5		pF
Av	Open−Loop Voltage Gain	V_O = 0.5 V to 4.5 V	120	150		dB
		V_O = 0.5 V to 4.5 V, T_A = −40°C to 125°C	115			dB
V_{CMR}	Common−Mode Input Voltage Range	T_A = −40°C to 125°C	(−V_S)−0.1		(+V_S)+0.1	V

Parameter		Conditions	Min	Typ	Max	Unit
CMRR	Common-Mode Rejection Ratio	V_{CM} = 0 V to 5V	115	144		dB
		V_{CM} = 0 V to 5 V, T_A= −40°C to 125°C	110			dB
Output Characteristics						
	Output Voltage Swing from Positive Rail or Negative Rail	R_{LOAD} = 10 kΩ to V_S/2		5		mV
		R_{LOAD} = 10 kΩ to V_S/2, T_A = −40°C to 125°C			10	mV
		R_{LOAD} = 2 kΩ to V_S/2		22		mV
		R_{LOAD} = 2 kΩ to V_S/2, T_A = −40°C to 125°C			35	mV
I_{SC}	Output Short−Circuit Current	Sink or Source	140	160		mA
		Sink or Source, T_A = −40°C to 125°C	100			mA
AC Specifications						
GBW	Gain−Bandwidth Product			15		MHz
SR	Slew Rate	G = 1, 2 V step		4.9		V/μs
t_{OR}	Overload Recovery			5		μs
t_S	Settling Time, 0.1%	G = 1, 2 V step		3		us
	Settling Time, 0.01%			4		μs
PM	Phase Margin	R_L = 10 kΩ, C_L = 100 pF		45		°
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		0.2		$μV_{PP}$
e_N	Input Voltage Noise Density	f = 1 kHz		10		nV/√Hz
i_N	Input Current Noise	f = 1 kHz		200		fA/√Hz
THD+N	Total Harmonic Distortion and Noise	G = 1, f = 1 kHz, V_O = 1 V_{RMS}, R_L = 2 kΩ		0.0007		%

Typical Performance Characteristics

All test conditions: V_S = 5 V, T_A = +25°C, test device is TPA5581N-S6TR, unless otherwise noted.

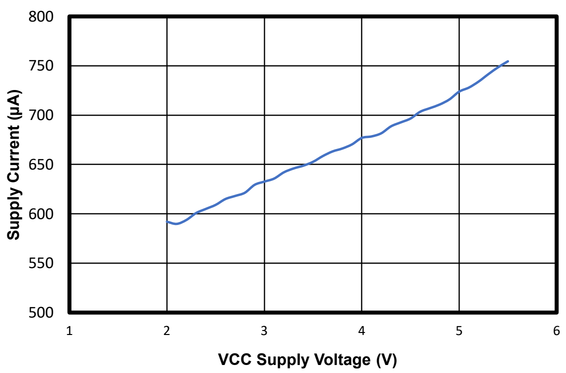


Figure 1. Supply Current vs Supply Voltage

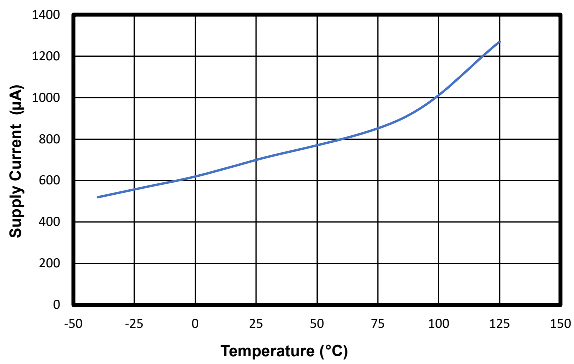


Figure 2. Supply Current vs Temperature

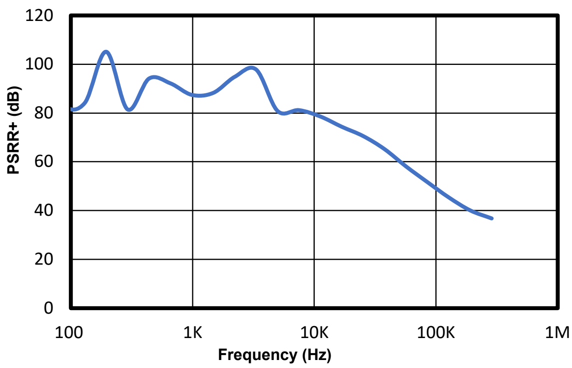


Figure 3. PSRR+ vs Frequency

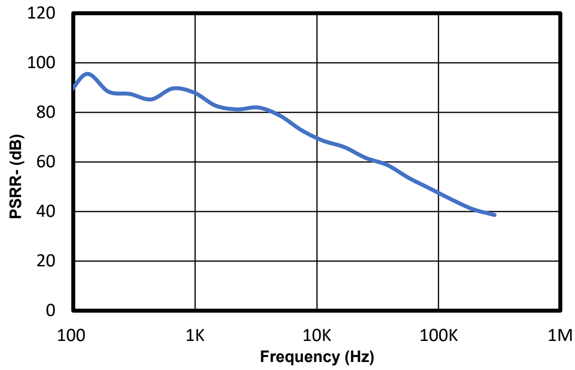


Figure 4. PSRR− vs Frequency

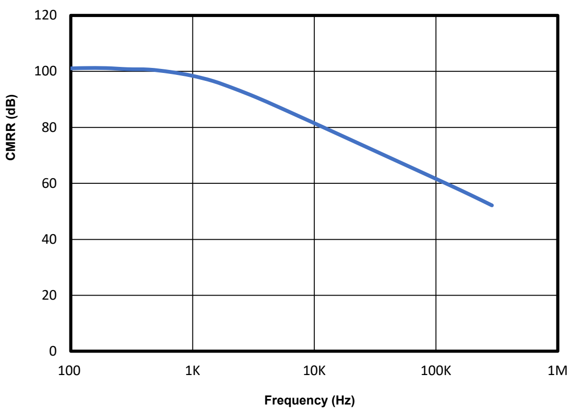


Figure 5. CMRR vs Frequency

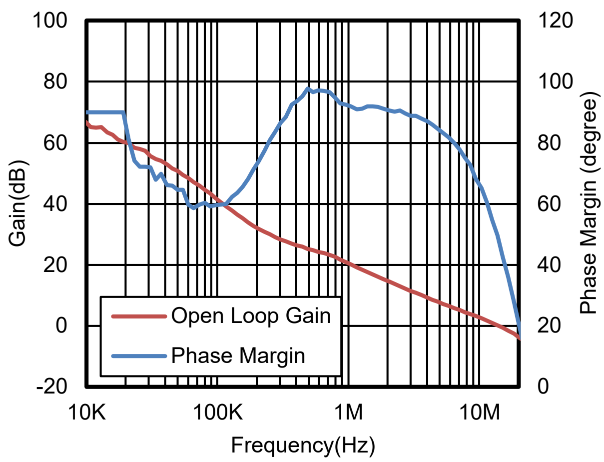


Figure 6. Open Loop Gain and Phase Margin vs Frequency, RL = 10 kΩ, CL = 100 pF

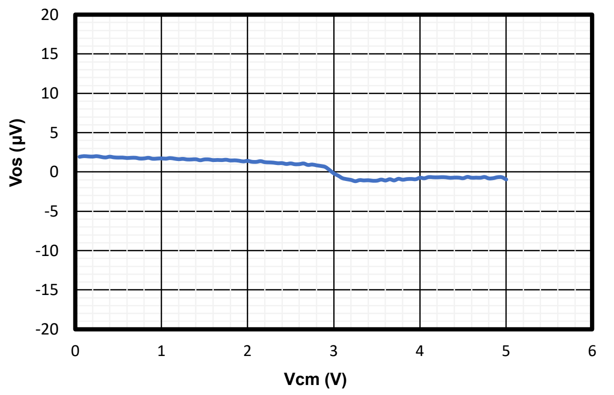


Figure 7. V_{OS} vs V_{CM}, V_S= 5 V

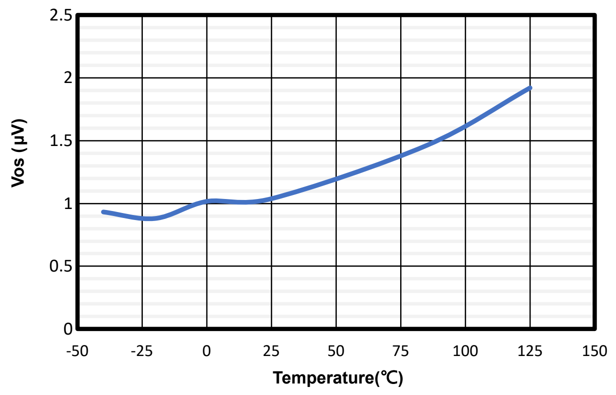


Figure 8. V_{OS} vs Temperature

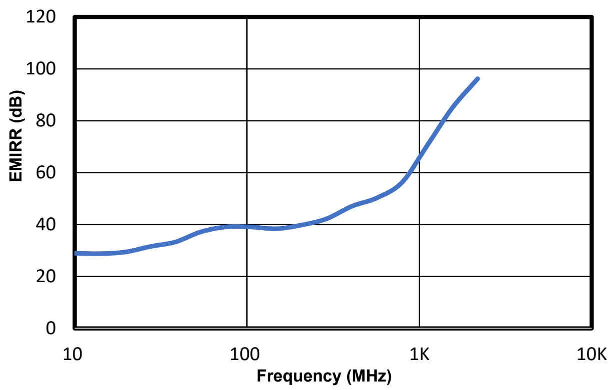


Figure 9. EMIRR vs Frequency

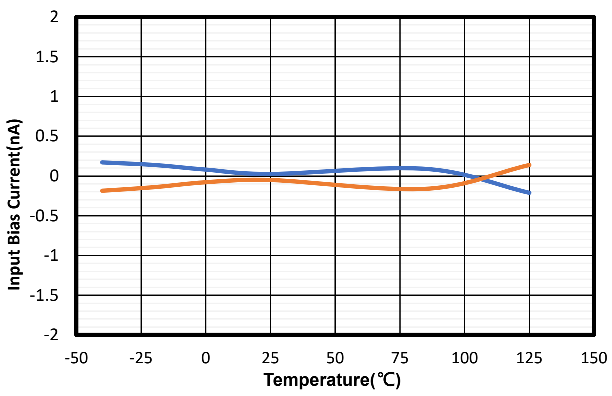


Figure 10. I_B vs Temperature

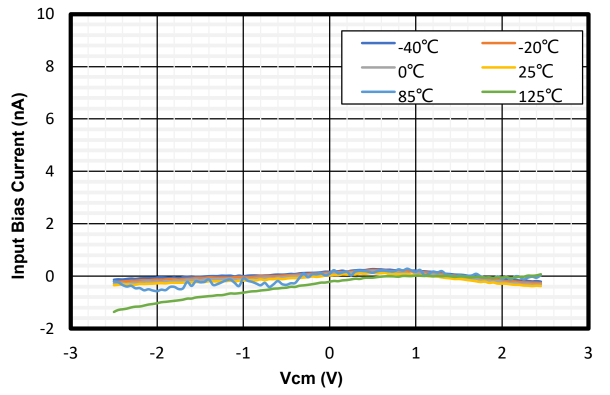


Figure 11. I_B vs Common Voltage, ($-V_S$) = −2.5 V, ($+V_S$) = 2.5 V

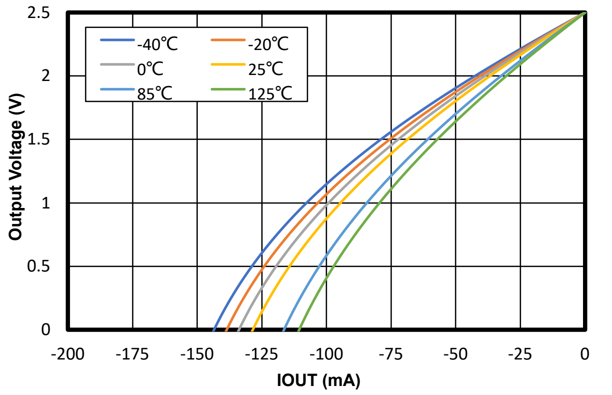


Figure 12. Output Voltage vs Output Current, (−V) = −2.5 V, (+VS) = 2.5 V

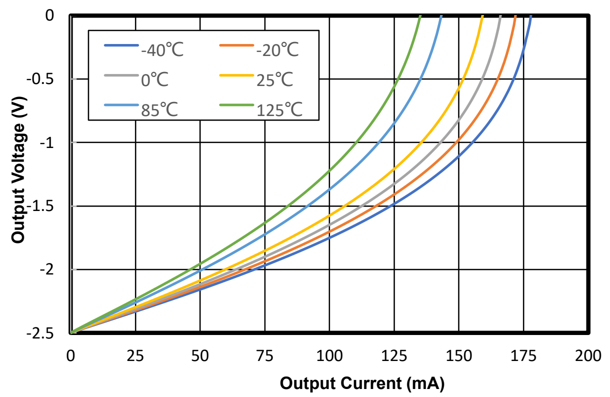


Figure 13. Output Voltage vs Output Current, (−VS) = −2.5 V, (+VS) = 2.5 V

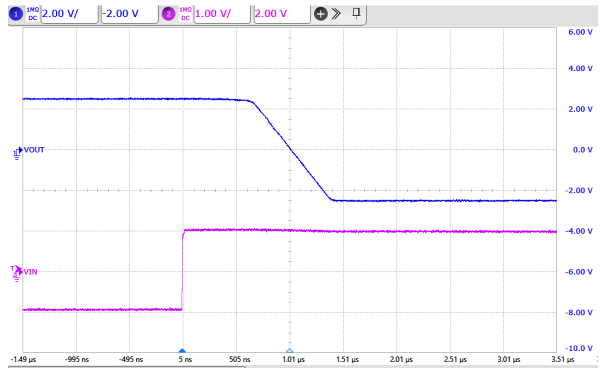


Figure 14. Overload Recovery at Negative Rail

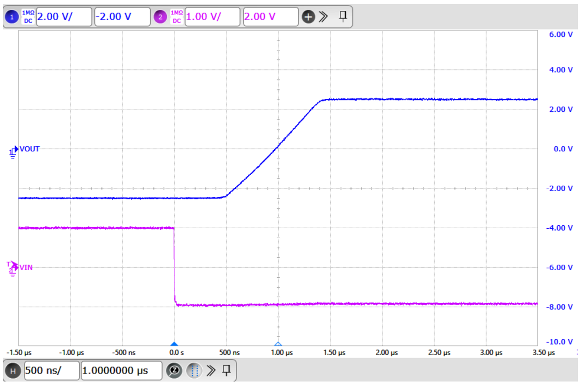


Figure 15. Overload Recovery at Positive Rail

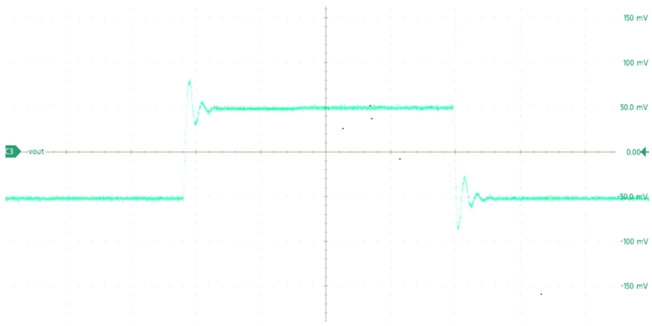


Figure 16. Small Signal Step Response: 50 mV/div, Time: 400 ns/div

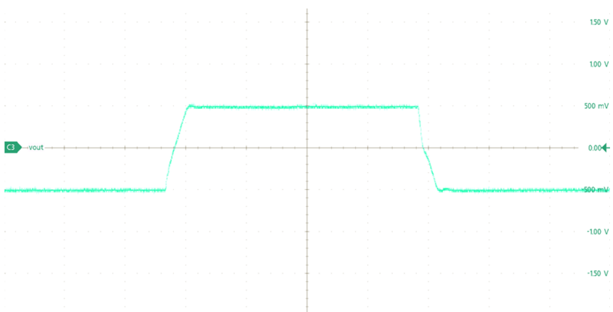


Figure 17. Large Signal Step Response: 500 mV/div, Time: 400 ns/div

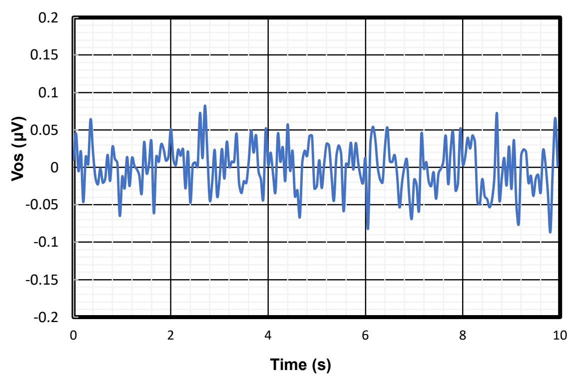


Figure 18. 0.1 to 10 Hz Voltage Noise, V_{CM} = 0 V

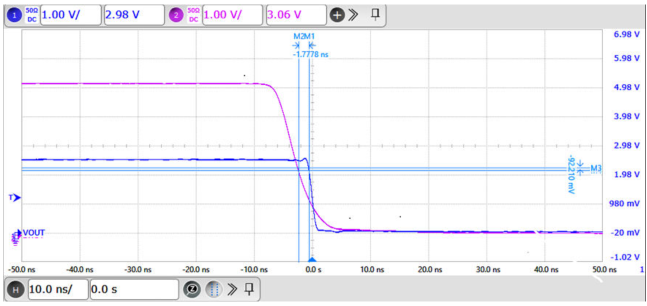


Figure 19. Turnoff Transient

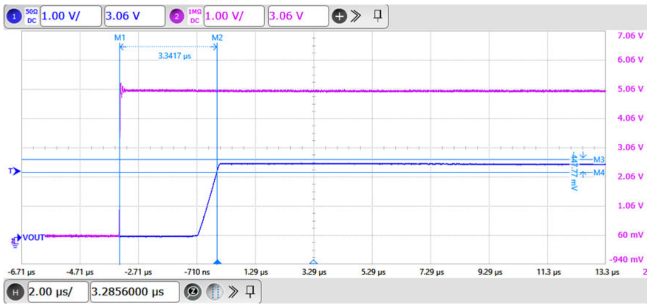


Figure 20. Turnon Transient

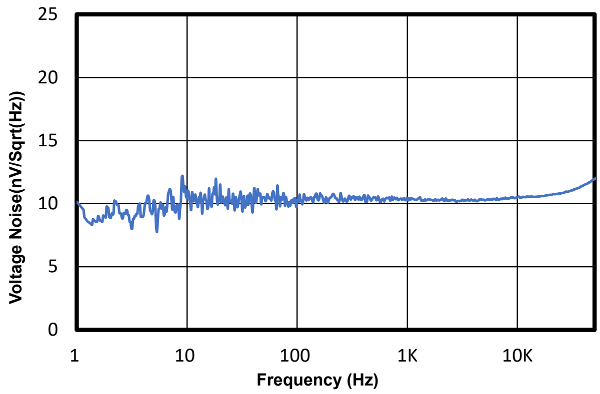


Figure 21. Voltage Noise Spectral Density vs Frequency, V_{CM} = 1 V

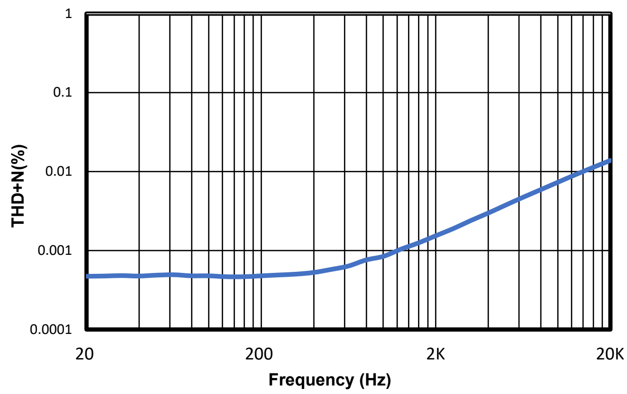


Figure 22. THD vs Frequency, G = 1, V_{IN} = 1 V_{RMS}

Detailed Description

Overview

The TPA558x family of zero-drift amplifiers can operate on a single-supply voltage (2.7 V to 5.5 V), or a split-supply voltage. 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 TPA558x also include 15-MHz bandwidth, no 1/f noise, 10-nV/√ Hz noise spectral density, and 1 mA quiescent current, making the TPA558x suitable for many precision 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

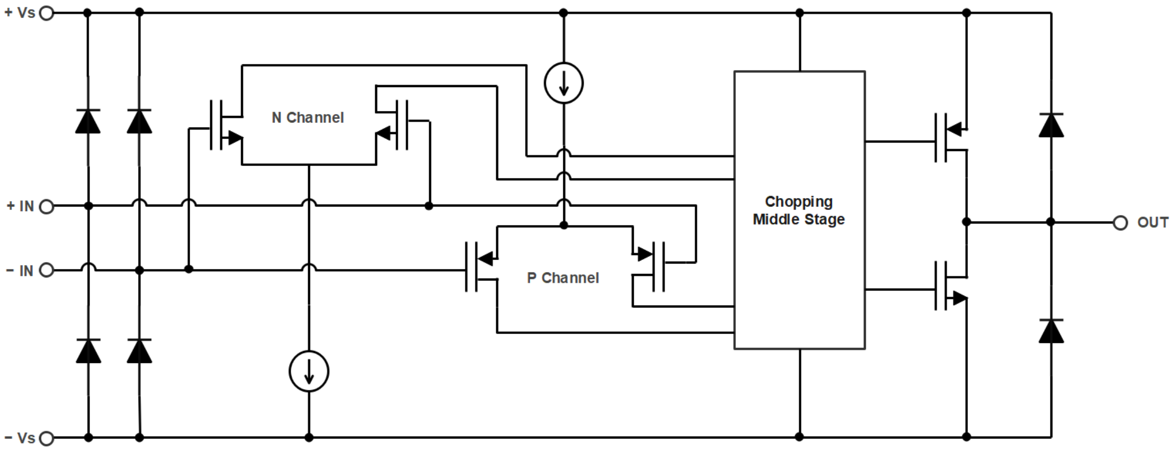


Figure 23. Functional Block Diagram

Feature Description

Operating Voltage

The TPA558x family of op amplifiers is 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.

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, higher noise spectrum exists at the chopping frequency and its harmonics due to the residual ripple.

The devices set the chopping frequency to 400 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 to be placed at the output of the amplifier.

Rail-to-Rail Input

The input common-mode voltage range of the TPA558x family extends 100 mV beyond the supply rails. This performance is achieved with a complementary input stage: a P-channel input differential pair in parallel with an N-channel differential pair. The P-channel pair is active for inputs from 100 mV below the negative supply to approximately (+VS) – 1.5 V, whereas the N-channel pair is active for input voltages close to the positive rail, typically (+VS) – 1.5 V to 100 mV above the positive supply. There is around 200-mV transition region at (+VS) – 1.5 V where both pairs are on. Within this transition region, PSRR, CMRR, offset voltage, offset drift, and THD can degrade comparing to that operating outside this region.

Rail-to-Rail Output

The TPA558x family delivers 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.

Shutdown Function

The shutdown function of the TPA558x is only available in the TPA558xN series. The voltage level of this is referenced to the supply voltage of the operaional amplifier. The operational amplifier is enabled with a valid high voltage and shutdown by a valid low voltage. When the single supply is used, a valid high level is defined as 0.7 × (+Vs) of the positive supply and a valid low level is defined as 0.3 × (+Vs) of the positive supply. For example, with +Vs at 5 V and −Vs at 0 V, a valid high level is defined as 3.5 V and a valid low level is defined as 1.5 V. If dual or split power supplies are used, make sure the valid high or valid low input signals are properly referred to the positive supply voltage. For example, with +Vs at 2.5V and −Vs at −2.5V, a valid high level is defined as 1 V and a valid low level is defined as −1 V. The pin of SHDN is internally pulled up to a vaild high level when this pin is left open state, so the amplifier is enabled initially if nothing is connected to the shutdown pin. The output state of the amplifier is assumed as high-impedance state if shut down. The specific requirement and performance about this function are provided in the Typical Performance Characteristics (see Figure 19 and Figure 20). The output state of the amplifier is assumed as high-impedance state if shut down.

Application and Implementation

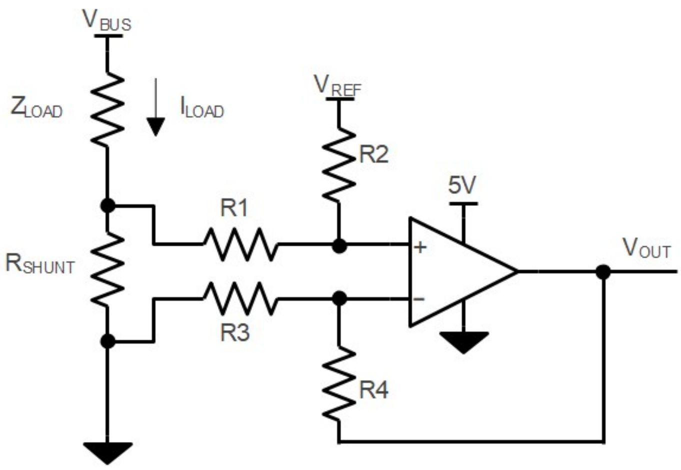
Note

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 24 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.



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

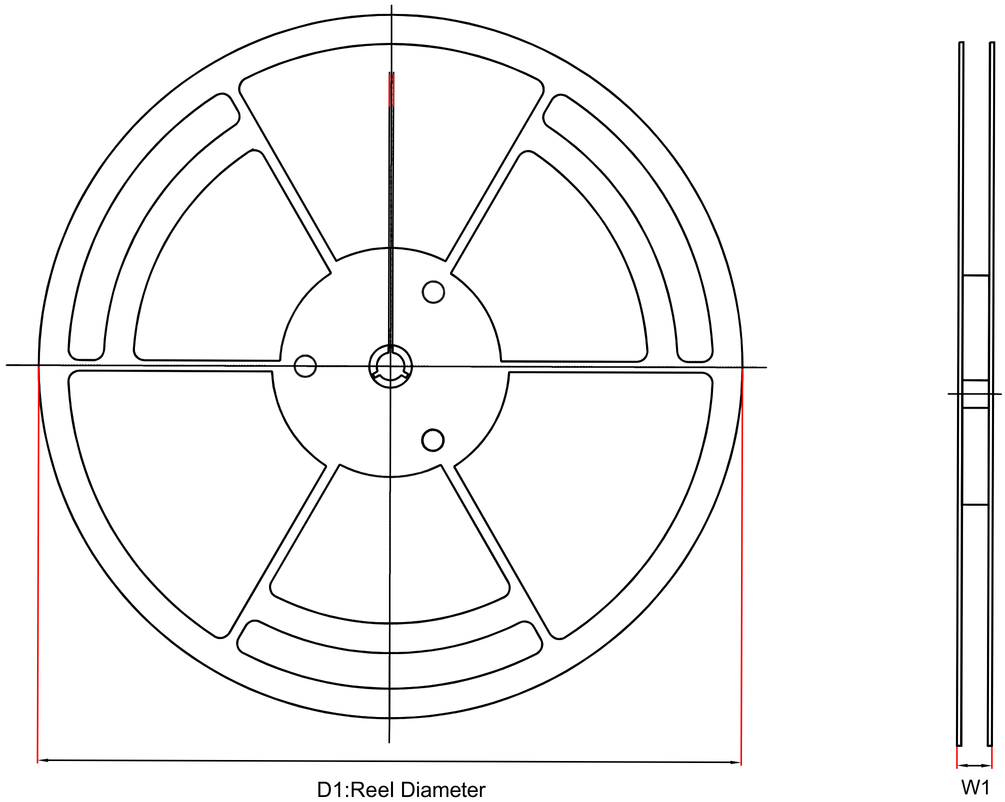
When $R3 = R1$, $R2 = R4$, $R_{SHUNT} << R1$

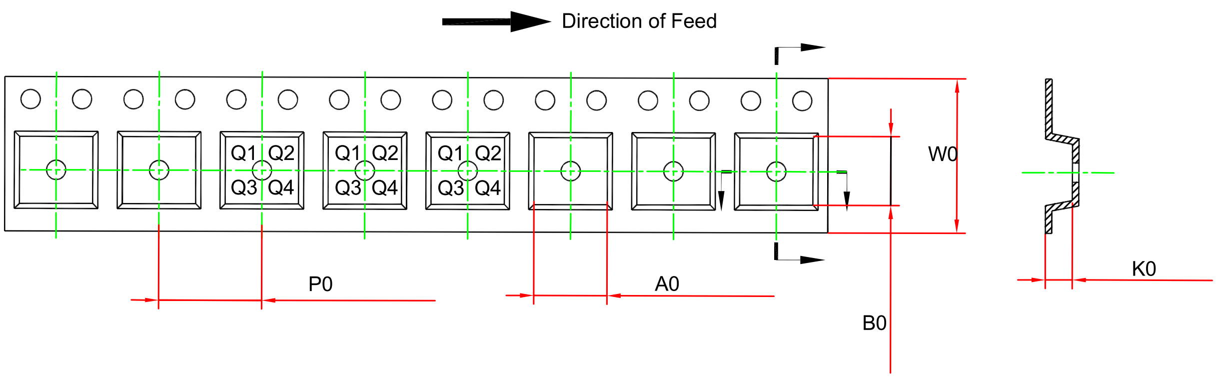
Figure 24. Low-Side Current Sensing Application

Power Supply Recommendations

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

Tape and Reel Information





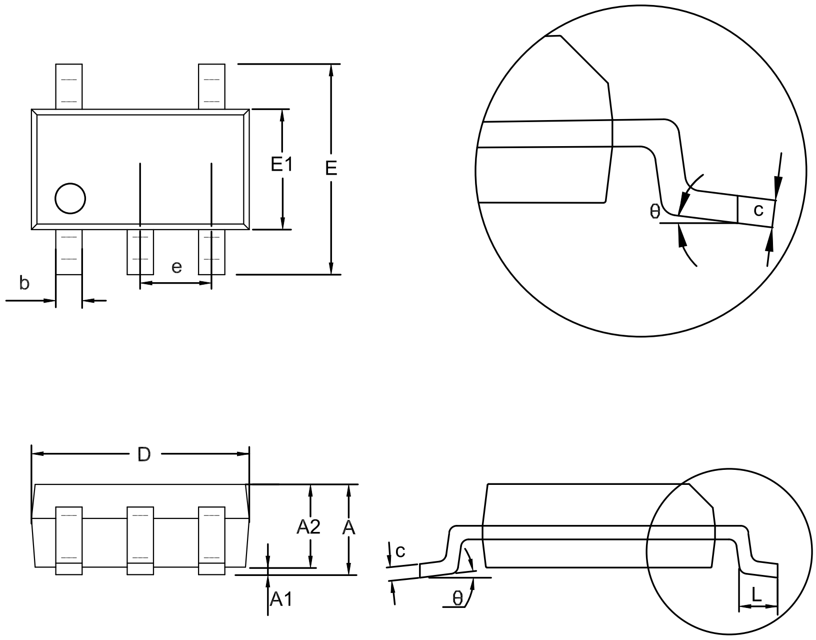
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPA5581-SC5R	SOT353 (SC70-5)	178.0	12.3	2.4	2.5	1.2	4.0	8.0	Q3
TPA5581U-SC5R	SOT353 (SC70-5)	178.0	12.3	2.4	2.5	1.2	4.0	8.0	Q3
TPA5581N-S6TR	SOT23-6	178.0	11.4	3.3	3.2	1.4	4.0	8.0	Q3
TPA5581-S5TR	SOT23-5	178.0	11.4	3.3	3.2	1.4	4.0	8.0	Q3
TPA5581U-S5TR	SOT23-5	178.0	11.4	3.3	3.2	1.4	4.0	8.0	Q3
TPA5582-SO1R	SOP8	330.0	16.8	6.6	5.5	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
TPA5582-DF7R	DFN3X3-8	330.0	17.6	3.3	3.3	1.1	8.0	12.0	Q1
TPA5582-DF4R	DFN2X2-8	180.0	13.1	2.3	2.3	1.1	4.0	8.0	Q1
TPA5582-TS1R	TSSOP8	330.0	17.6	6.8	3.3	1.2	8.0	12.0	Q1
TPA5582-VS1R	MSOP8	330.0	17.6	5.2	3.3	1.5	8.0	12.0	Q1
TPA5582N-VS2R	MSOP10	330.0	17.6	5.2	3.3	1.5	8.0	12.0	Q1

Package Outline Dimensions

SOT23-5

Package Outline Dimensions S5T(SOT23-5-A)



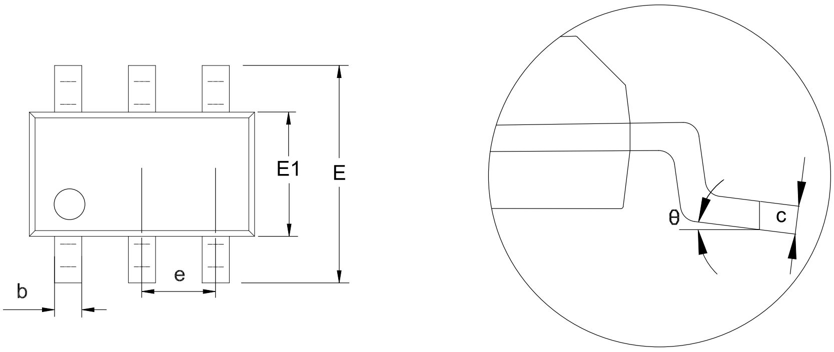
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.150	0.000	0.006
A2	1.000	1.200	0.039	0.047
b	0.280	0.500	0.011	0.020
c	0.100	0.230	0.004	0.009
D	2.820	3.020	0.111	0.119
E	2.600	3.000	0.102	0.118
E1	1.500	1.720	0.059	0.068
e	0.950 BSC		0.037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

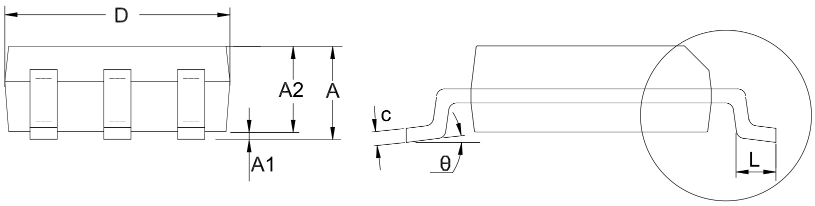
NOTES

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

SOT23-6

Package Outline Dimensions S6T(SOT23-6-A)





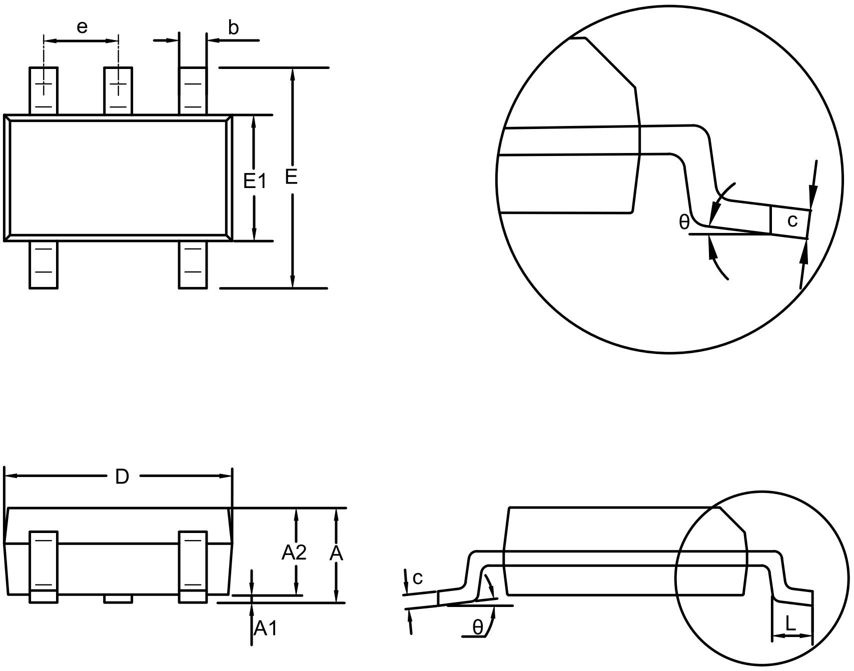
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.150	0.000	0.006
A2	1.000	1.200	0.039	0.047
b	0.280	0.500	0.011	0.020
c	0.100	0.230	0.004	0.009
D	2.820	3.020	0.111	0.119
E	2.600	3.000	0.102	0.118
E1	1.500	1.720	0.059	0.068
e	0.950 BSC		0.037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



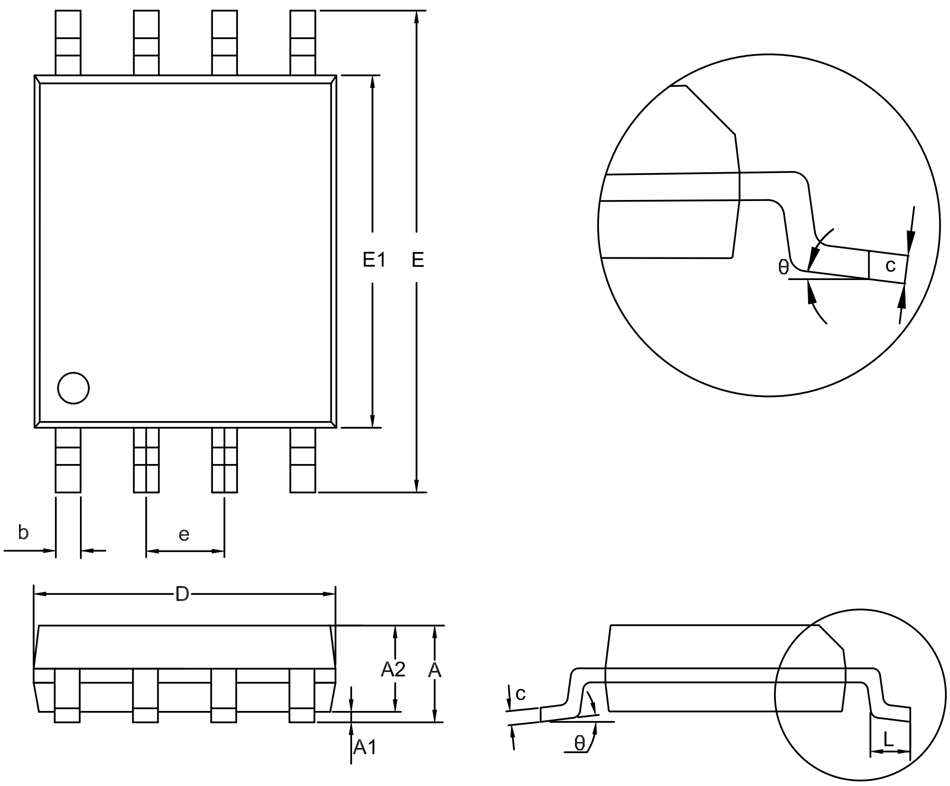
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.850	1.100	0.033	0.043
A1	0.000	0.100	0.000	0.004
A2	0.800	1.000	0.031	0.039
b	0.150	0.350	0.006	0.014
c	0.110	0.230	0.004	0.009
D	2.000	2.200	0.079	0.087
E	2.150	2.450	0.085	0.096
E1	1.150	1.350	0.045	0.053
e	0.650 BSC		0.026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



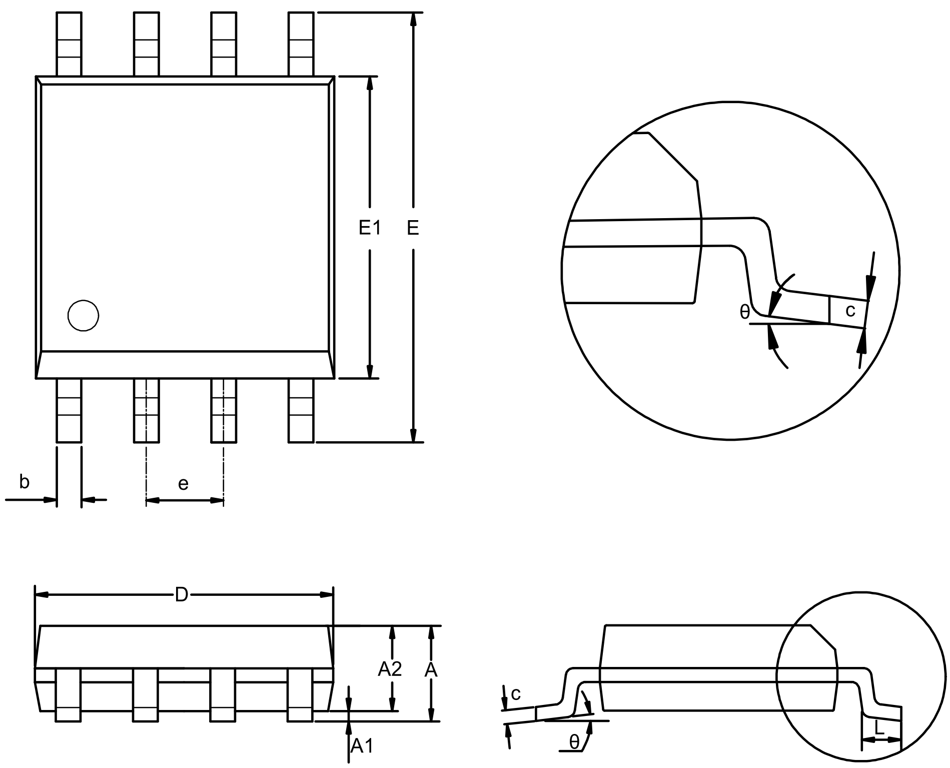
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.200	0.035	0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	2.900	3.100	0.114	0.122
E	6.200	6.600	0.244	0.260
E1	4.300	4.500	0.169	0.177
e	0.650 BSC		0.026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



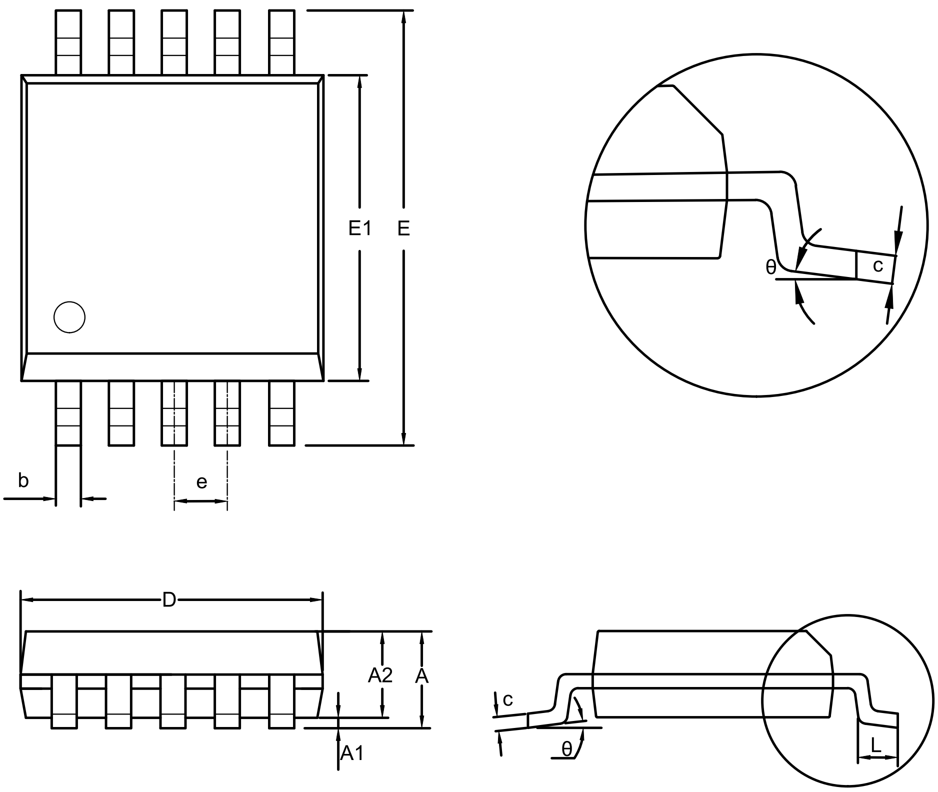
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	4.700	5.100	0.185	0.201
E1	2.900	3.100	0.114	0.122
e	0.650 BSC		0.026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

MSOP10

Package Outline Dimensions VS2(MSOP-10-A)

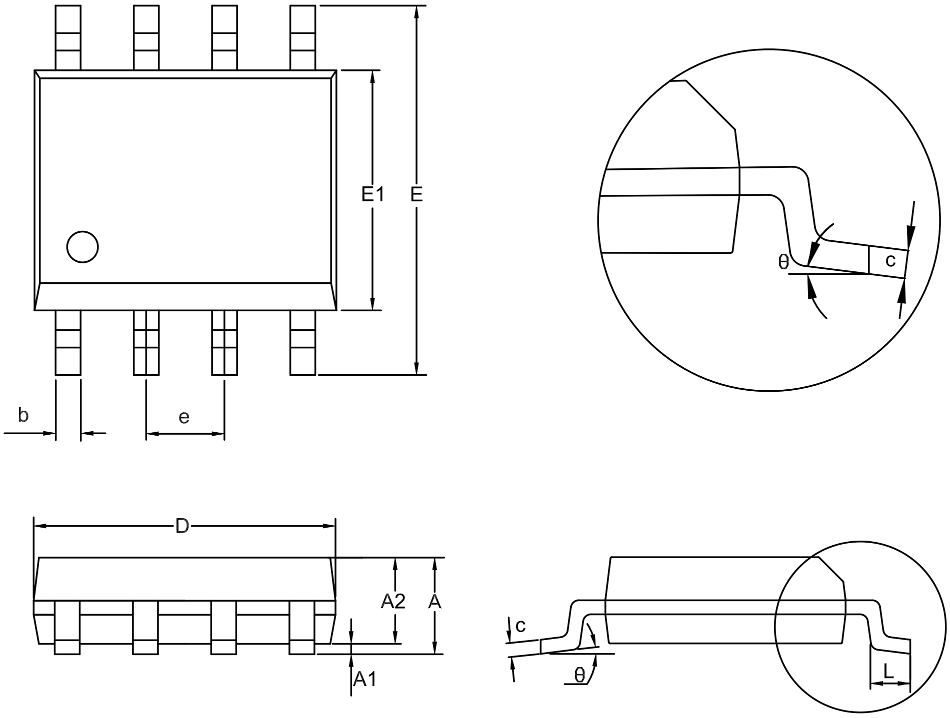


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.050	0.150	0.002	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	4.700	5.100	0.185	0.201
E1	2.900	3.100	0.114	0.122
e	0.500 BSC		0.020 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)



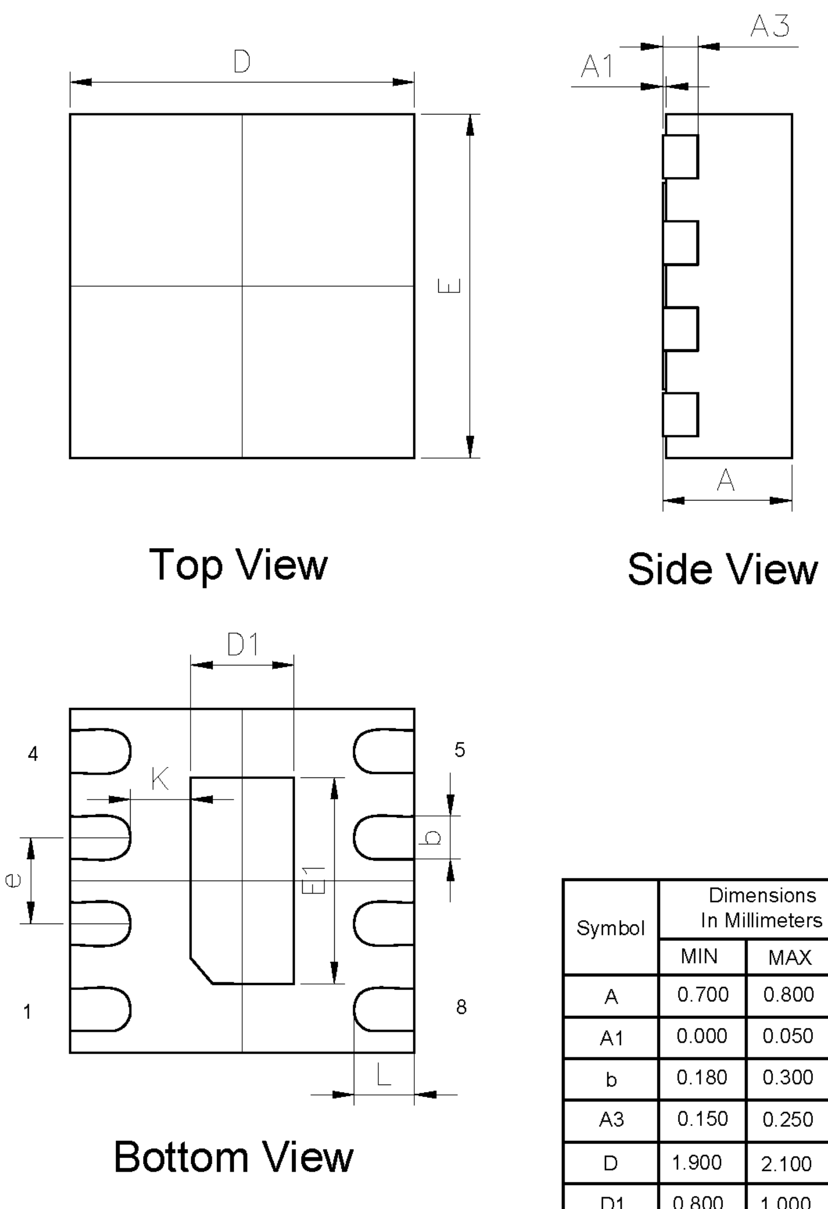
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050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

DFN2X2-8

Package Outline Dimensions DF4(DFN2X2-8-D)

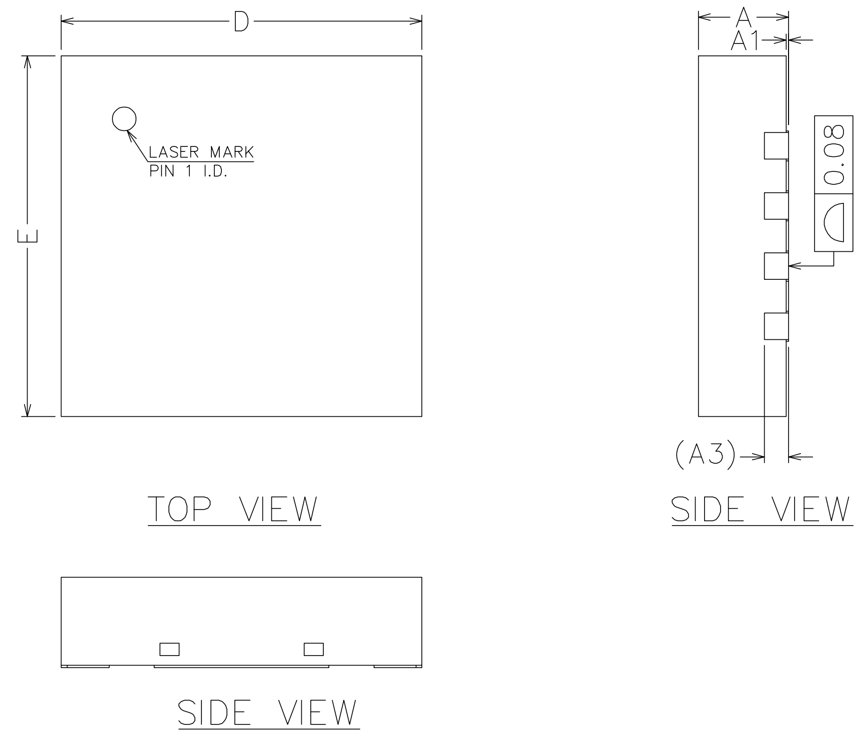


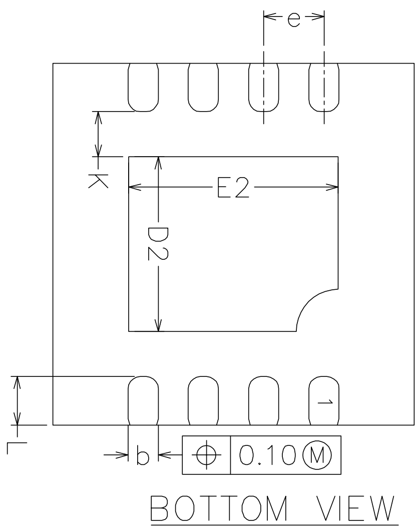
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
b	0.180	0.300	0.007	0.012
A3	0.150	0.250	0.006	0.010
D	1.900	2.100	0.075	0.083
D1	0.800	1.000	0.031	0.039
E	1.900	2.100	0.075	0.083
E1	1.500	1.700	0.059	0.067
e	0.500 BSC		0.020BSC	
L	0.250	0.350	0.010	0.014

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

DFN3X3-8

Package Outline Dimensions DF7(DFN3X3-8-G)





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	0.700	0.900	0.028	0.035
A1	0.000	0.050	0.000	0.002
b	0.200	0.300	0.008	0.012
A3	0.203REF		0.008REF	
D	2.924	3.076	0.115	0.121
D2	1.600	1.800	0.630	0.071
E	2.924	3.076	0.115	0.121
E2	2.300	2.500	0.906	0.098
e	0.500 BSC		0.020 BSC	
L	0.324	0.476	0.013	0.019

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPA5581-SC5R (1)	−40 to 125°C	SOT353 (SC70-5)	581	3	Tape and Reel, 3000	Green
TPA5581U-SC5R (1)	−40 to 125°C	SOT353 (SC70-5)	58U	3	Tape and Reel, 3000	Green
TPA5581N-S6TR	−40 to 125°C	SOT23-6	58N	3	Tape and Reel, 3000	Green
TPA5581-S5TR	−40 to 125°C	SOT23-5	581	3	Tape and Reel, 3000	Green
TPA5581U-S5TR (1)	−40 to 125°C	SOT23-5	58U	3	Tape and Reel, 3000	Green
TPA5582-SO1R	−40 to 125°C	SOP8	A5582	3	Tape and Reel, 4000	Green
TPA5582-DF4R	−40 to 125°C	DFN2X2-8	558	3	Tape and Reel, 3000	Green
TPA5582-TS1R	−40 to 125°C	TSSOP8	A5582	3	Tape and Reel, 3000	Green
TPA5582-DF7R(1)	−40 to 125°C	DFN3X3-8	558	3	Tape and Reel, 3000	Green
TPA5582N-VS2R (1)	−40 to 125°C	MSOP10	5582N	3	Tape and Reel, 3000	Green
TPA5582-VS1R	−40 to 125°C	MSOP8	A5582	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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