36-V, 7-MHz GBWP, RRO Operational Amplifiers

Features

- Gain-Bandwidth Product: 7 MHz
- High Slew Rate: 20 V/μs
- Wide Supply Range: 3.1 V to 36 V or ±2.25 V to ±18 V
- Low Offset Voltage: 0.5 mV (Max)
- Low Input Bias Current: 30 pA (Typ)
- Rail-to-Rail Output Voltage Range
- Unit-Gain Stable
- Operating Temperature Range: −40°C to 125°C

Applications

- Digital Servo Control Loops
- Machine and Motion Control Devices
- Photodiode Pre-Amp
- Industrial Process Control
- Temperature Measurements
- Strain Gage Amplifier
- Medical Instrumentation

Description

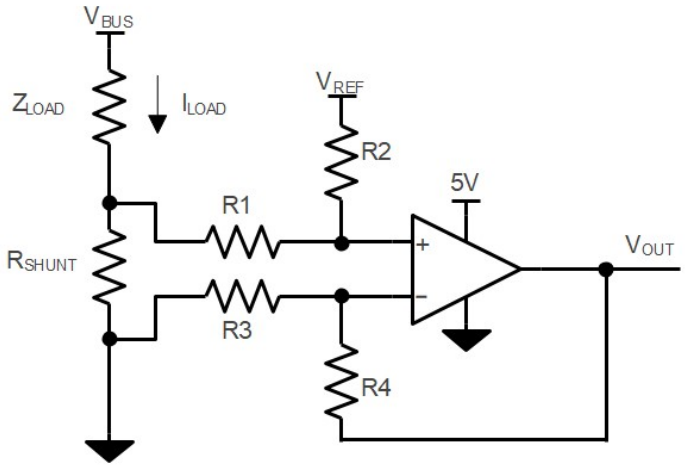
The TP2271/TP2272/TP2274 devices are EMI Hardened 36-V CMOS op amps featuring EMIRR of 84 dB at 900 MHz. The devices are unity-gain stable with 100-pF capacitive load and high speed with a wide 7-MHz bandwidth and 20-V/μs high slew rate, making the devices appropriate for I/V converters.

The rail-to-rail output swing and input range that includes $-V_S$ makes the TP227x an ideal choice for interfacing with modern, single-supply, and precision data converters.

The TP227x op amps offer lower noise, offset voltage, offset drift over temperature, and bias current. In addition, the devices have better common-mode rejection and slew rates.

The TP227x family, exhibiting high input impedance and low noise, is excellent for small-signal conditioning for high-impedance sources, such as piezoelectric transducers.

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
2023-05-23	Rev.D.1	Updated EC table and specification over the full temperature range. Added new part numbers: TP2272-SO1R, TP2272-VS1R, TP2274-SO2R, and TP2274-TS2R. The following updates are all about the new datasheet formats or typos, and the actual product remains unchanged. • Updated address of web site. • Updated Tape and Reel Information.
2024-12-18	Rev.D.2	The following updates are all about the new datasheet formats or typos, and the actual product remains unchanged. • Updated the Tape and Reel Information.

Pin Configuration and Functions

TP2271
SOT23-5
Top View

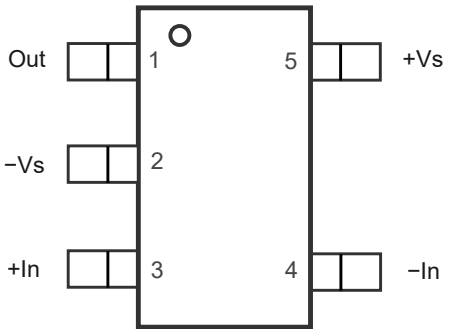
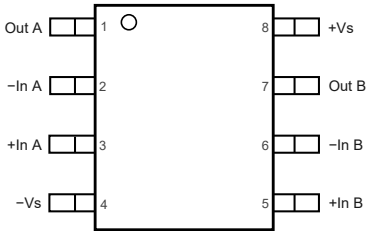


Table 1. Pin Functions: TP2271

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

TP2272
SOP8
Top View



TP2272
TSSOP8
Top View

TP2272
MSOP8
Top View

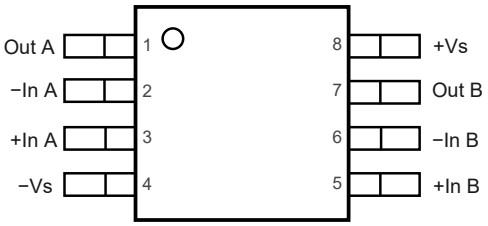
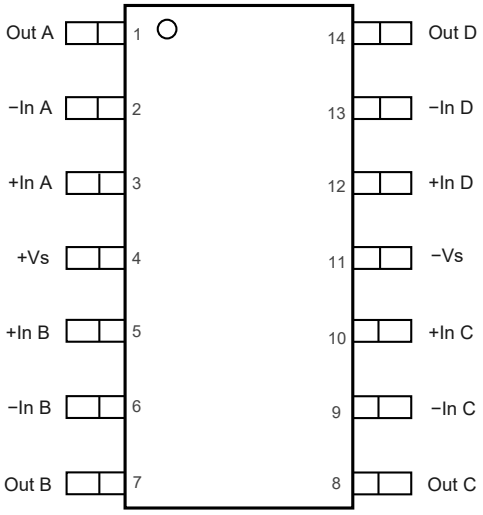


Table 2. Pin Functions: TP2272

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	$-V_S$	-	Negative power supply
5	+In B	I	Non-inverting input
6	−In B	I	Inverting input
7	Out B	O	Output
8	$+V_S$	-	Positive power supply

TP2274
SOP14
Top View



TP2274
TSSOP14
Top View

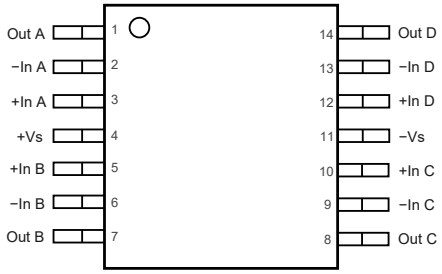


Table 3. Pin Functions: TP2274

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	$+V_S$	-	Positive power supply
5	+In B	I	Non-inverting input
6	−In B	I	Inverting input
7	Out B	O	Output
8	Out C	O	Output
9	−In C	I	Inverting input
10	+In C	I	Non-inverting input
11	$-V_S$	-	Negative power supply
12	+In D	I	Non-inverting input
13	−In D	I	Inverting input
14	Out D	O	Output

Specifications

Absolute Maximum Ratings (1)

Parameter		Min	Max	Unit
Supply Voltage, $(+V_S) - (-V_S)$ (2)			40	V
Voltage on Input and Output Pin		$(-V_S) - 0.3$	$(+V_S) + 0.3$	V
Input Current: +IN, −IN (3)		−10	10	mA
Output Short-Circuit Duration (4)			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 op amp supplies must be established simultaneously, with, or before, the application of any input signals.
(3) The inputs are protected by ESD protection diodes to each power supply. If the input extends more than 500 mV beyond the power supply, the input current should be limited to less than 10 mA.
(4) 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

Symbol	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)	2	kV

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOT23-5	250	81	°C/W
SOP8	158	43	°C/W
MSOP8	210	45	°C/W
TSSOP8	191	44	°C/W
SOP14	120	36	°C/W
TSSOP14	180	35	°C/W

Electrical Characteristics

All test conditions: V_S = 30 V, T_A = 25°C, R_L = 10 kΩ to V_S / 2, unless otherwise noted.

Symbol	Parameter	Conditions	T_A	Min	Typ	Max	Unit
Power Supply							
V_S	Supply Voltage Range			3.1		36	V
I_Q	Quiescent Current per Amplifier	V_S = 30 V, TP2271			1.5	2	mA
			−40°C to 125°C			3	mA
		V_S = 30 V, TP2272/ TP2274			1	1.6	mA
			−40°C to 125°C			2.5	mA
PSRR	Power Supply Rejection Ratio	V_S = 4.5 V to 36 V		95	130		dB
			−40°C to 125°C	90			dB
Input Characteristics							
V_{OS}	Input Offset Voltage	V_S = 30 V, V_{CM} = 15 V		−0.5	±0.2	0.5	mV
			−40°C to 125°C	−1		1	mV
		V_S = 5 V, V_{CM} = 2.5 V		−0.5	±0.2	0.5	mV
			−40°C to 125°C	−1		1	mV
V_{OS} TC	Input Offset Voltage Drift		−40°C to 125°C		2		µV/°C
I_B	Input Bias Current				30		pA
			−40°C to 85°C		250		pA
			−40°C to 125°C		7700		pA
I_{OS}	Input Offset Current				25		pA
I_{IN}	Different Input Current	V_S = 36 V, V_{ID} = 36 V			10	100	nA
			−40°C to 125°C		100	300	nA
C_{IN}	Input Capacitance	Differential Mode			4		pF
		Common Mode			2.5		pF
A_V	Open-Loop Voltage Gain	V_S = 30 V, V_{OUT} = 0.5 V to 29.5 V		95	120		dB
			−40°C to 125°C	90			dB
V_{CMR}	Common-Mode Input Voltage Range			(−V_S)		(+V_S) – 1.5	V
CMRR	Common-Mode Rejection Ratio	V_{CM} = 0.5 V to 28.5 V		95	125		dB
			−40°C to 125°C	90			dB
Output Characteristics							
V_{OH}	Output Swing from Positive Rail	R_{LOAD} = 100 kΩ to V_S / 2			5	15	mV
			−40°C to 125°C			40	mV
		R_{LOAD} = 10 kΩ to V_S / 2			50	80	mV
			−40°C to 125°C			130	mV
V_{OL}	Output Swing from Negative Rail	R_{LOAD} = 100 kΩ to V_S / 2			5	10	mV

Symbol	Parameter	Conditions	T_A	Min	Typ	Max	Unit
			−40°C to 125°C			25	mV
		R_{LOAD} = 10 kΩ to V_S / 2			40	50	mV
			−40°C to 125°C			100	mV
I_{SC}	Output Short-Circuit Current	Source Current		20	32		mA
		Sink Current		15	25		mA
AC Specifications							
GBW	Gain-Bandwidth Product				7		MHz
SR	Slew Rate	G = 1, 10-V step		13	20		V/μs
			−40°C to 125°C	10			V/μs
t_{OR}	Overload Recovery				100		ns
t_S	Settling Time, 0.1%	G = −1, 10-V step			0.5		μs
	Settling Time, 0.01%				0.8		μs
PM	Phase Margin	V_S = 36 V, R_L = 10 kΩ, C_L = 100 pF			60		°
GM	Gain Margin	V_S = 36 V, R_L = 10 kΩ, C_L = 100 pF			10		dB
Noise Performance							
E_N	Input Voltage Noise	f = 0.1 Hz to 10 Hz			2		μV_{RMS}
e_N	Input Voltage Noise Density	f = 1 kHz			25		nV/√Hz
i_N	Input Current Noise	f = 1 kHz			2		fA/√Hz
THD+N	Total Harmonic Distortion and Noise	f = 1 kHz, G = 1, R_L = 10 kΩ, V_{OUT} = 6 V_{RMS}			0.0005		%
Thermal Shutdown							
	Thermal Shutdown Temperature				170		°C
	Recover Temperature				150		°C

Typical Performance Characteristics

All test conditions: V_S = ±15 V, V_{CM} = 0 V, R_L = 10 kΩ, unless otherwise noted.

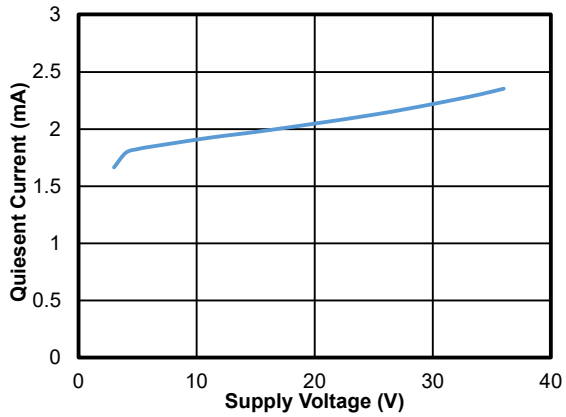


Figure 1. Quiescent Current vs. Supply Voltage, 1-Channel OPA

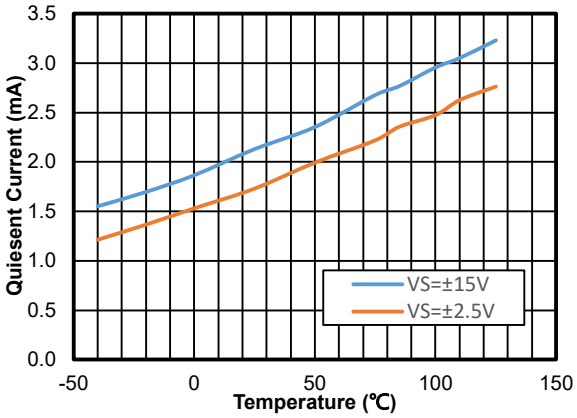


Figure 2. Quiescent Current vs. Temperature, 1-Channel OPA

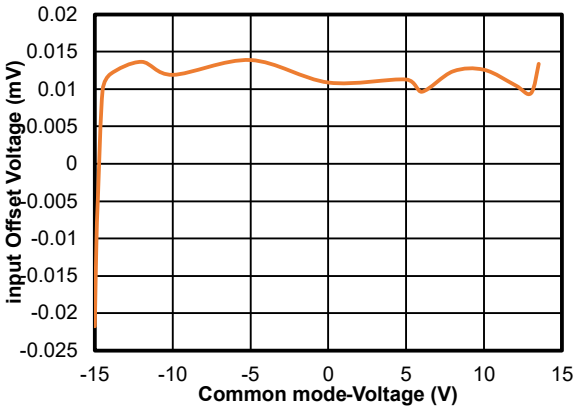


Figure 3. Offset Voltage vs. Common-Mode Voltage

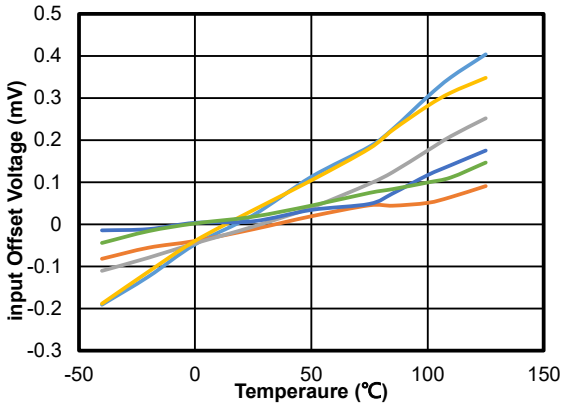


Figure 4. V_{OS} vs. Temperature

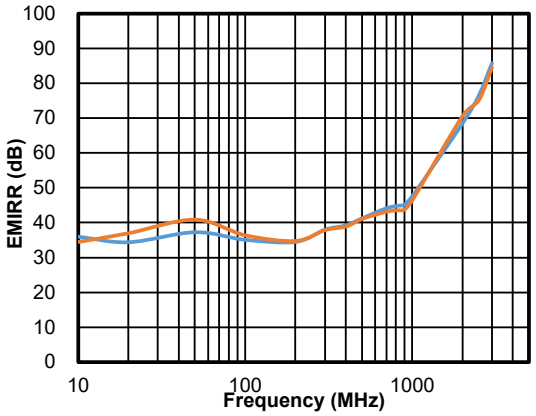


Figure 5. EMIRR vs. Frequency

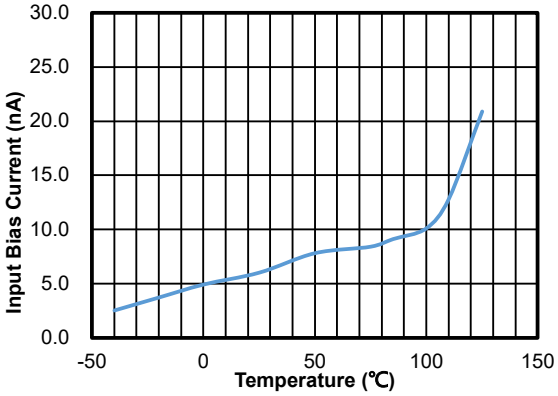


Figure 6. Input Current in Large V_{DM} vs. Temperature

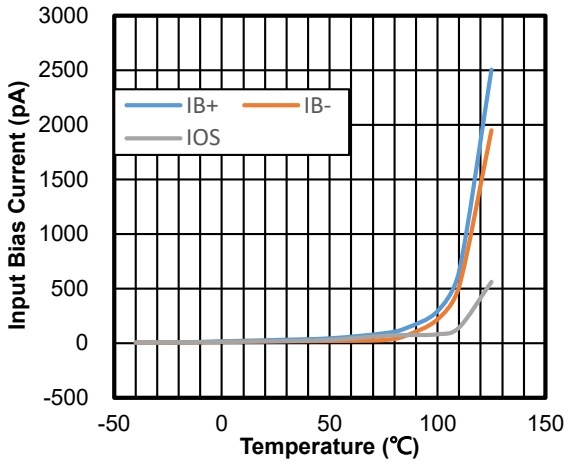


Figure 7. I_B vs. Temperature, −40 to 125°C

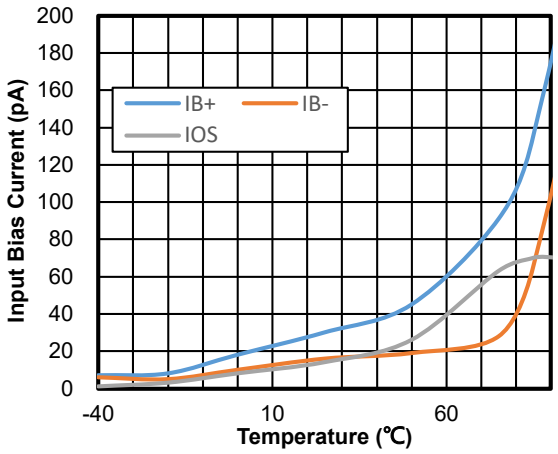


Figure 8. I_B vs. Temperature, −40 to 90°C

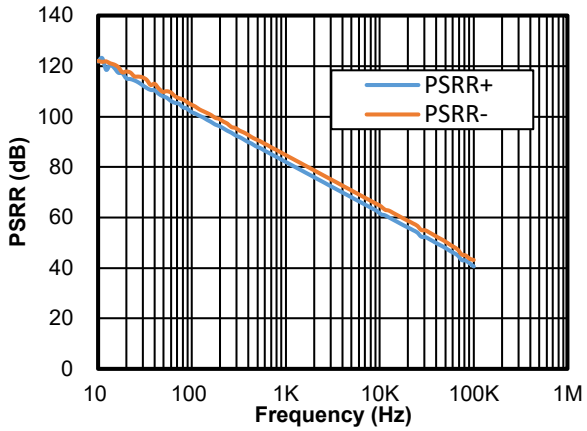


Figure 9. PSRR vs. Frequency

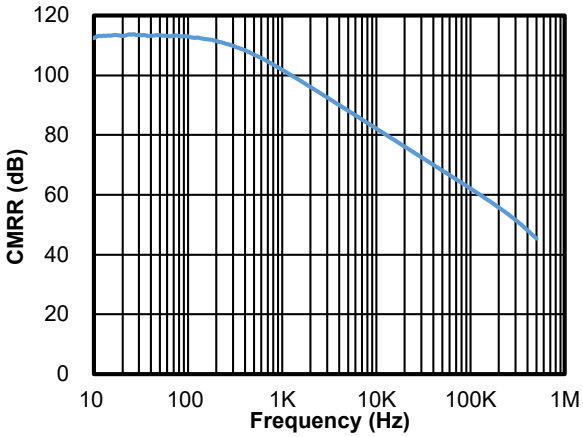


Figure 10. CMRR vs. Frequency

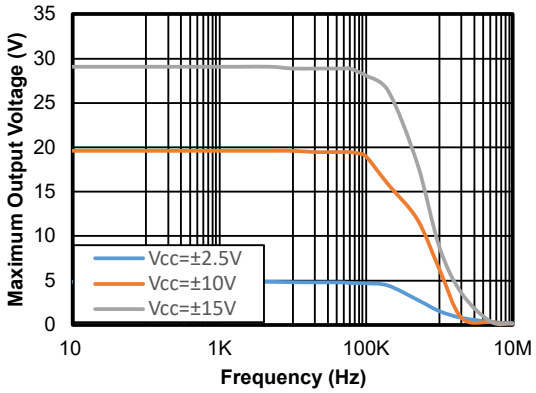


Figure 11. Maximum Output Voltage vs. Frequency

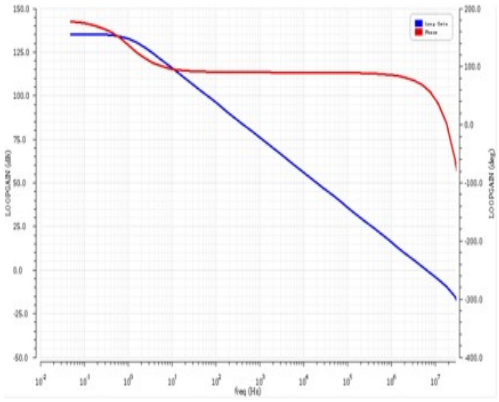


Figure 12. Open-Loop Gain and Phase vs. Frequency, R_{LOAD} = 10 kΩ, C_{LOAD} = 100 pF

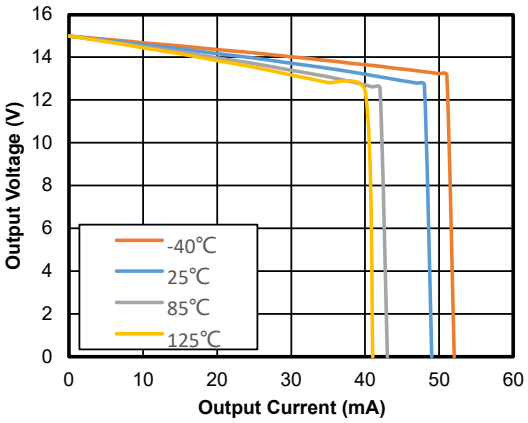


Figure 13. Positive Output Voltage vs. Output Current

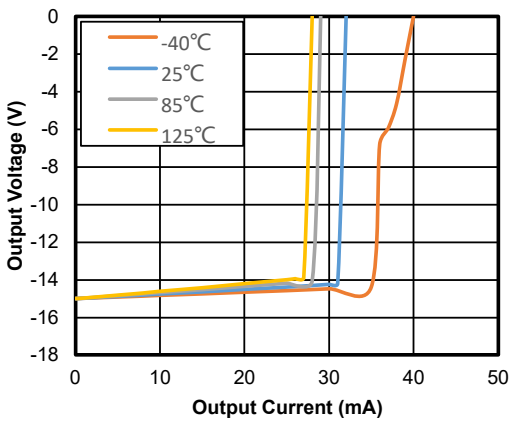


Figure 14. Negative Output Voltage vs. Output Current

Voltage: 5 V/div for Output, Time: 500 ns/div

G = −10, V_{IN} = 5 V_{PP}, R_L = 2 kΩ, C_L = 100 pF

Figure 15. Positive Overload Recovery

Voltage: 5 V/div for Output, Time: 500 ns/div

G = −10, V_{IN} = 5 V_{PP}, R_L = 2 kΩ, C_L = 100 pF

Figure 16. Negative Overload Recovery

Voltage: 50 mV/div, Time: 1 µs/div

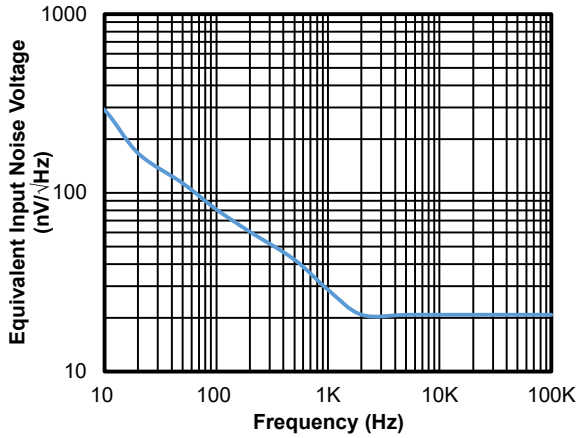
R_L = 2 kΩ, C_L = 100 pF, G = 1

Figure 17. 100-mV Signal Step Response

Voltage: 5 V/div, Time: 1 µs/div

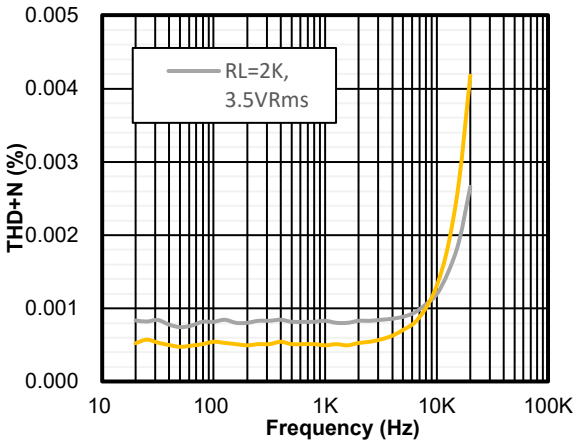
R_L = 2 kΩ, C_L = 100 pF, G = 1

Figure 18. 10-V Signal Step Response



V_S = ±15 V, V_{CM} = 0 V

Figure 19. Voltage Noise Spectral Density vs. Frequency



V_S = ±15 V, V_{CM} = 0 V, G = 1

Figure 20. THD + N vs. Frequency

Detailed Description

Functional Block Diagram

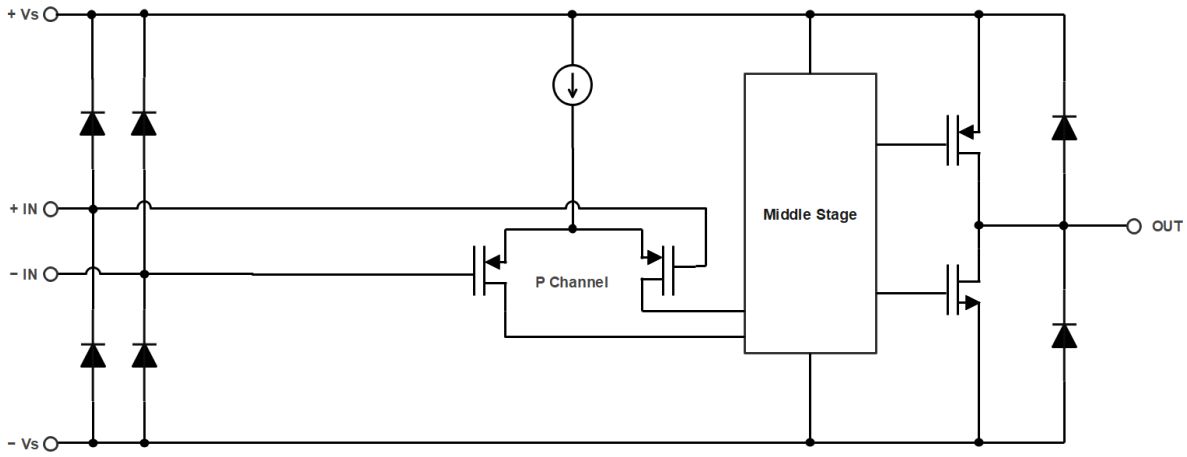


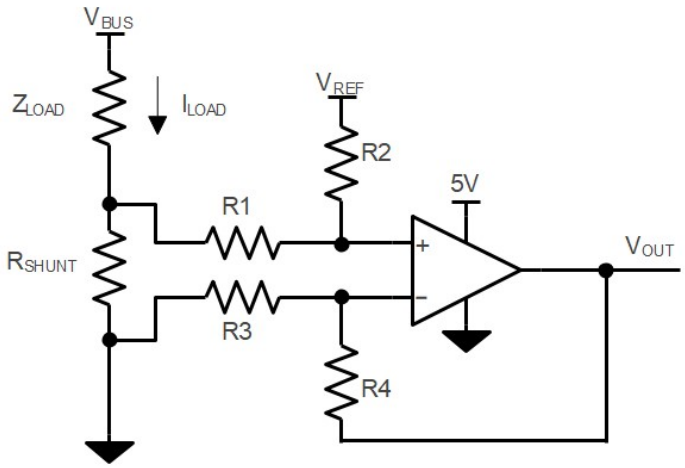
Figure 21. Functional Block Diagram

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.

Typical Application

Figure 22 shows the typical application schematic.

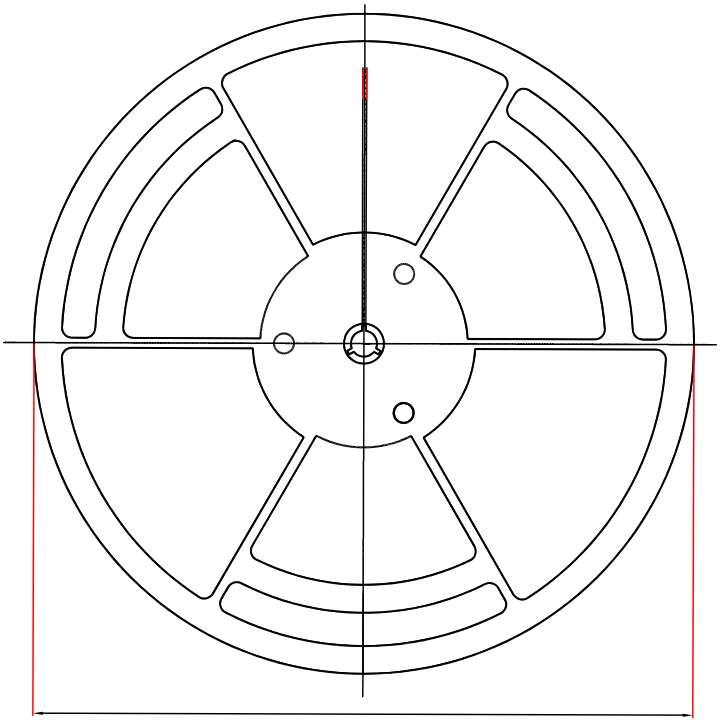


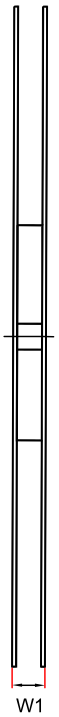
$V_{OUT} = (I_{LOAD} \times R_{SHUNT}) \times (R2 / R1) + V_{REF}$

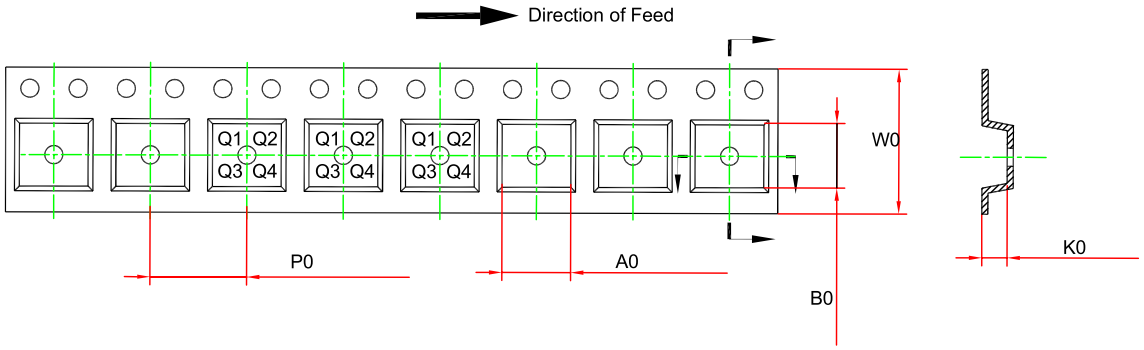
When R3 = R1, R2 = R4, $R_{SHUNT} << R1$

Figure 22. Typical Application Circuit

Tape and Reel Information







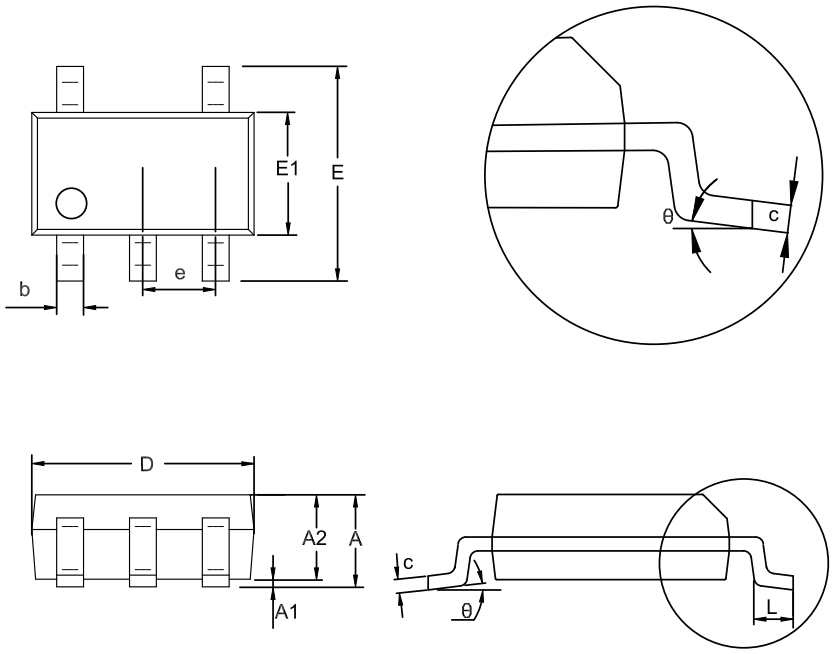
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) (1)	B0 (mm) (1)	K0 (mm) (1)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TP2271-TR	SOT23-5	180	12	3.3	3.25	1.4	4	8	Q3
TP2272-SO1R	SOP8	330	17.6	6.5	5.4	2	8	12	Q1
TP2272-TSR	TSSOP8	330	17.6	6.8	3.4	1.2	8	12	Q1
TP2272-VS1R	MSOP8	330	17.6	5.3	3.4	1.3	8	12	Q1
TP2274-SO2R	SOP14	330	21.6	6.5	9.15	2.1	8	16	Q1
TP2274-TS2R	TSSOP14	330	17.6	6.8	5.5	1.3	8	12	Q1

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

Package Outline Dimensions

SOT23-5

Package Outline Dimensions S5T(SOT23-5-A)



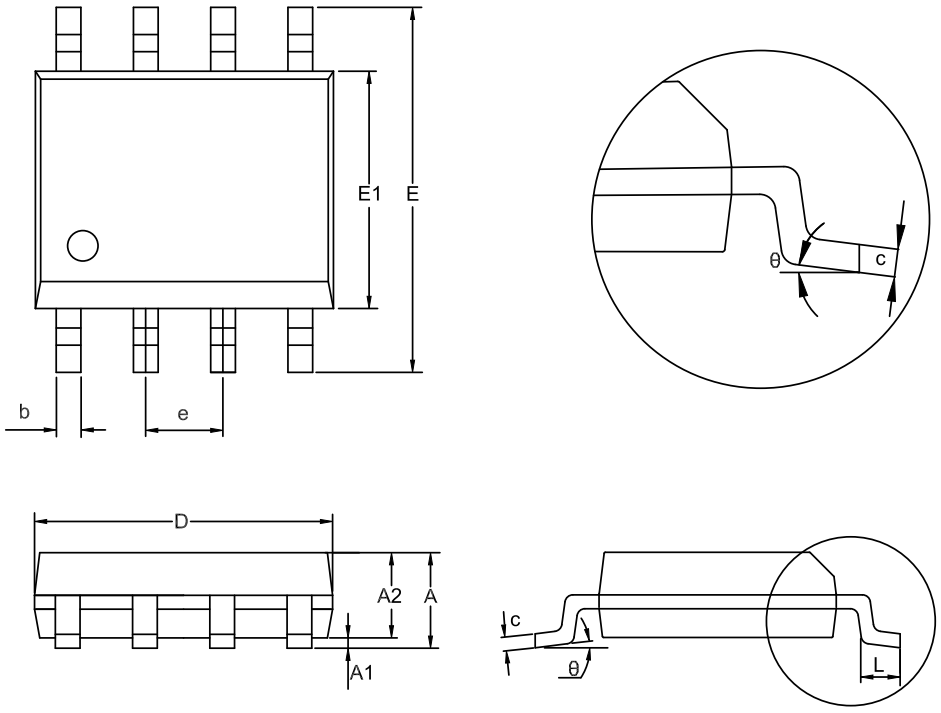
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.150	0.000	0.006
A2	1.000	1.200	0.039	0.047
b	0.280	0.500	0.011	0.020
c	0.100	0.230	0.004	0.009
D	2.820	3.020	0.111	0.119
E	2.600	3.000	0.102	0.118
E1	1.500	1.720	0.059	0.068
e	0.950 BSC		0.037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

NOTES

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

SOP8

Package Outline Dimensions SO1(SOP-8-A)



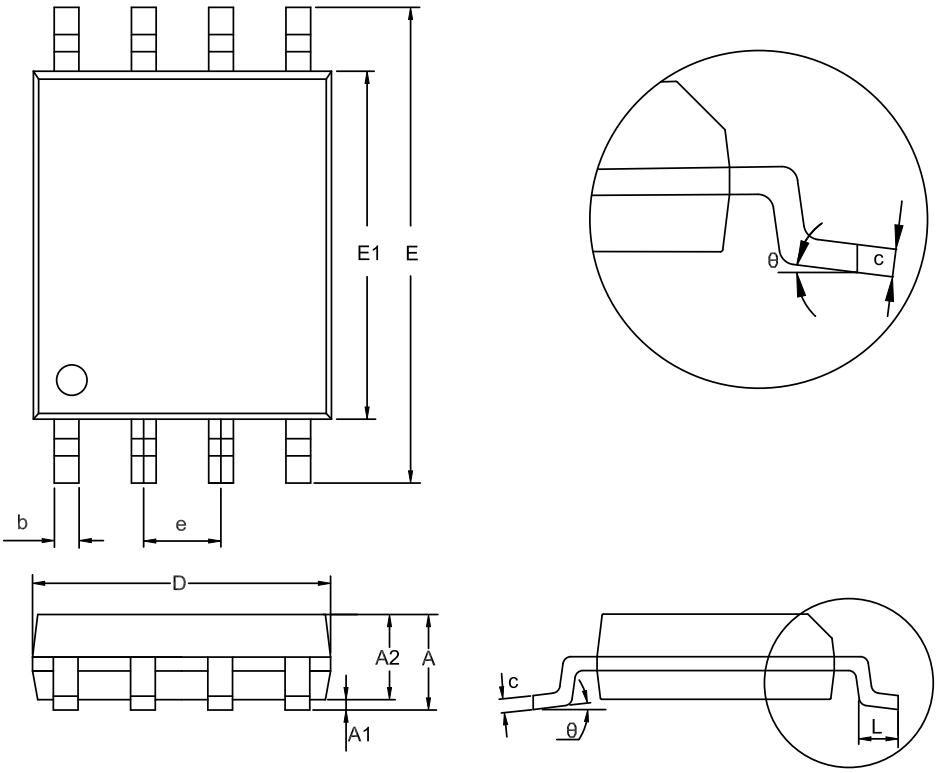
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050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

NOTES

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

TSSOP8

Package Outline Dimensions TS1(TSSOP-8-A)



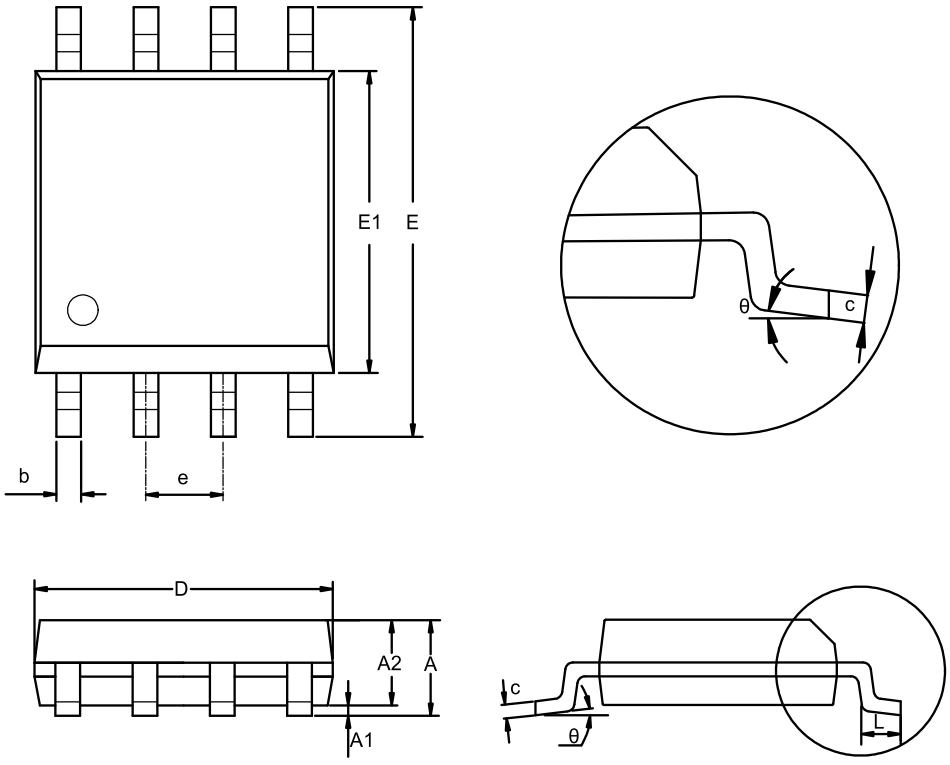
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.200	0.035	0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	2.900	3.100	0.114	0.122
E	6.200	6.600	0.244	0.260
E1	4.300	4.500	0.169	0.177
e	0.650 BSC		0.026 BSC	
L	0.450	0.750	0.018	0.030
θ	0	8°	0	8°

NOTES

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

MSOP8

Package Outline Dimensions VS1(MSOP-8-A)



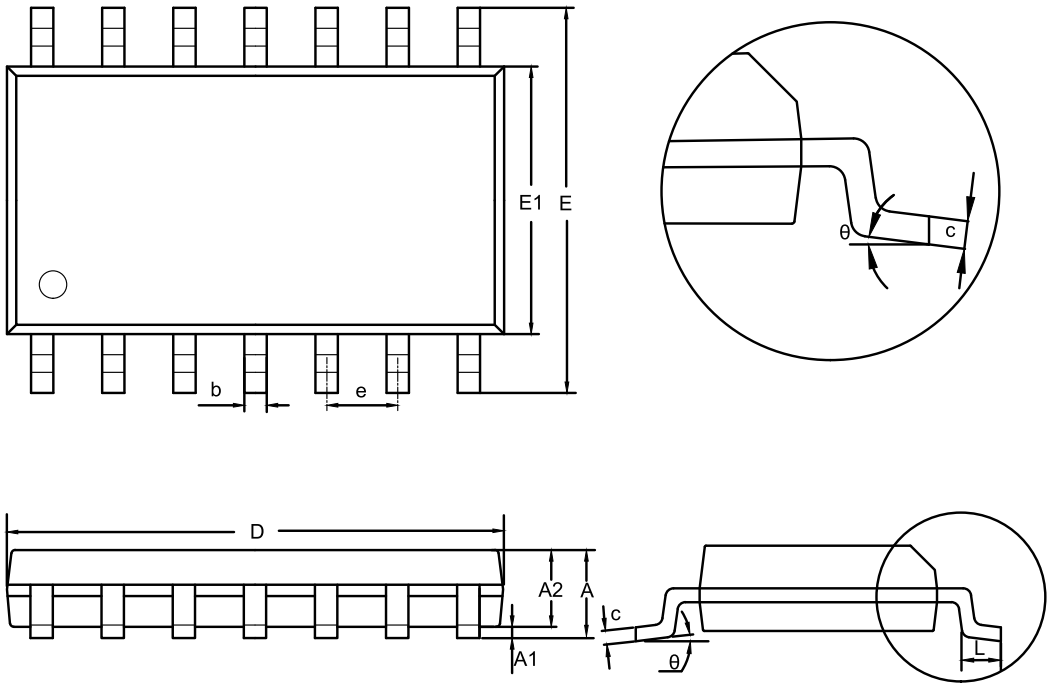
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	4.700	5.100	0.185	0.201
E1	2.900	3.100	0.114	0.122
e	0.650 BSC		0.026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



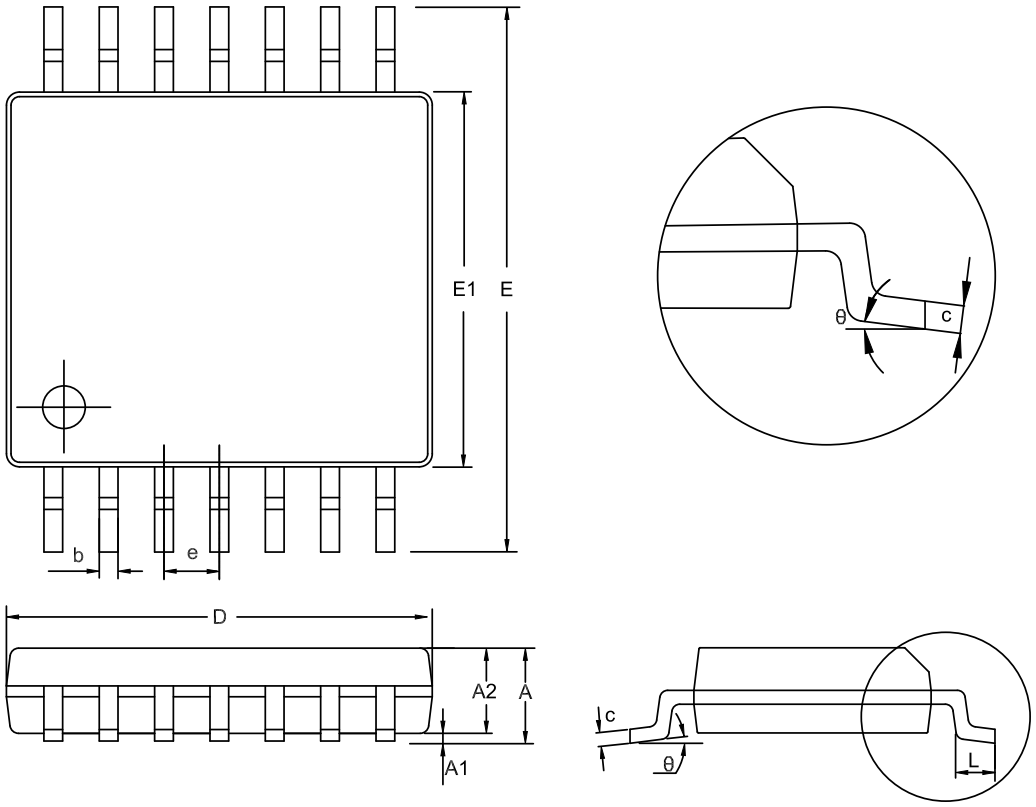
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.650	0.049	0.065
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 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)



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°

NOTES

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

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TP2271-TR	−40 to 125°C	SOT23-5	E22	3	Tape and Reel, 3,000	Green
TP2272-SO1R	−40 to 125°C	SOP8	A2272	1	Tape and Reel, 4,000	Green
TP2272-VS1R	−40 to 125°C	MSOP8	A2272	1	Tape and Reel, 3,000	Green
TP2272-TSR	−40 to 125°C	TSSOP8	TP2272	1	Tape and Reel, 3,000	Green
TP2274-SO2R	−40 to 125°C	SOP14	A2274	3	Tape and Reel, 2,500	Green
TP2274-TS2R	−40 to 125°C	TSSOP14	A2274	3	Tape and Reel, 3,000	Green

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

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