80 MHz, 12 V, Rail-to-Rail
High Speed Operational Amplifiers

Features

- 80 MHz @ -3dB Bandwidth
- Single or Dual Supply Operation:
  - 3.2V ~ 12V
  - ±1.6V to ±6V
- Slew Rate: 36 V/µs
- Rail-to-Rail Output (RRO)
- Low Quiescent Current: 1.7 mA
- Unity Gain Stable
- No Phase Reversal
- Extended Temperature Ranges
  From -40°C to +125°C
- Small Packaging
  COS8031 available in SOT23-5/SOP-8
  COS8032 available in SOP-8/MSOP-8
  COS8034 available in SOP14/TSSOP14

Applications

- Coaxial cable drivers
- Active filters
- Video and Cameras
- CCD imaging systems
- Clock buffers
- Base stations
- A-to-D Drivers

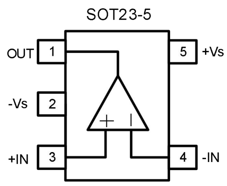
General Description

The COS8031 (single), COS8032 (dual) and COS8034 (quad) are low power voltage feedback, high speed amplifiers operated on single supply from 3.2V to 12V or dual supplies from ±1.6V to ±6V. They have bandwidth and slew rate typically found in current feedback amplifiers. The wide bandwidth and fast slew rate make these amplifiers useful in many general purpose, high speed applications.

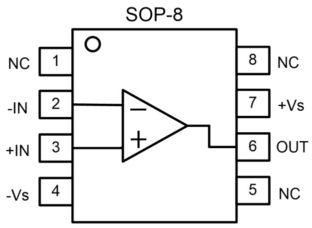
The COS8031/2/4 family provide excellent overall performance and versatility. The output voltage swing extends to within 20 mV of each rail, providing the maximum output dynamic range with excellent overdrive recovery. The features make the COS8031/2/4 family useful for video electronics, such as cameras, video switchers, or any high speed portable equipment. Low distortion and fast settling also make them ideal for active filter applications.

Rev1.0

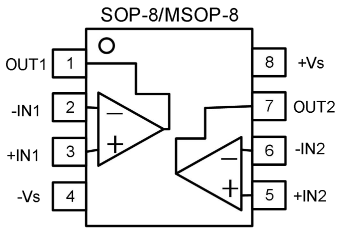
1. Pin Configuration and Functions



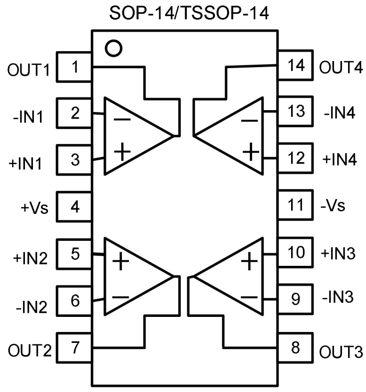
COS8031



COS8031



COS8032



COS8034

Pin Functions

Name	Description	Note
+Vs	Positive power supply	A bypass capacitor of 0.1μF as close to the part as possible should be placed between power supply pins or between supply pins and ground.
-Vs	Negative power supply or ground	If it is not connected to ground, bypass it with a capacitor of 0.1μF as close to the part as possible.
-IN	Negative input	Inverting input of the amplifier. Voltage range of this pin can go from -Vs -0.3V to +Vs + 0.3V.
+IN	Positive input	Non-inverting input of the amplifier. This pin has the same voltage range as –IN.
OUT	Output	The output voltage range extends to within millivolts of each supply rail.
NC	No connection	

2. Package and Ordering Information

Channel	Model	Package	Order Number	Package Option	Marking Information
1	COS8031	SOT23-5	COS8031AST	Tape and Reel, 3000	COS8031
		SOP-8	COS8031ARZ	Tape and Reel, 3000	COS8031
2	COS8032	SOP-8	COS8032ARZ	Tape and Reel, 3000	COS8032
		MSOP-8	COS8032AMR	Tape and Reel, 3000	COS8032
4	COS8034	SOP-14	COS8034ARZ	Tape and Reel, 4000	COS8034
		TSSOP-14	COS8034ATR	Tape and Reel, 4000	COS8034

3. Product Specification

3.1 Absolute Maximum Ratings [1]

Parameter	Rating	Units
Power Supply: +Vs to -Vs	12.6	V
Input Voltage	-Vs -0.5V to +Vs + 0.5V	V
Input Current [2]	10	mA
Storage Temperature Range	-65 to 150	°C
Junction Temperature	150	°C
Operating Temperature Range	-40 to 125	°C
ESD Susceptibility, HBM	2000	V

(1) Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.
(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 10mA or less.

3.2 Thermal Data

Parameter	Rating	Unit
Package Thermal Resistance, $R_{\theta JA}$ (Juntion-to-ambient)	190 (SOT23-5) 206 (MSOP8) 155 (SOP8) 105 (TSSOP14) 82 (SOP14)	°C/W

3.3 Recommended Operating Conditions

Parameter	Rating	Unit
DC Supply Voltage	(+3.2 ~ +12) or (±1.6 to ±6)	V
Input common-mode voltage range	-Vs ~ +Vs-1	V
Operating ambient temperature	-40 to +85	°C

3.4 Electrical Characteristics

(V_S=±5V, T_A=+25°C, R_L=2kΩ to 0V, unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Characteristics						
Input Offset Voltage	V_{OS}			±2	±10	mV
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	-40 to 125°C		±10		μV/°C
Input Bias Current	I_B			-	±1	nA
Input Offset Current	I_{OS}			-	±1	nA
Common-Mode Voltage Range	V_{CM}		-5	+4		V
Common-Mode Rejection Ratio	CMRR	V_{CM} =-5V to +3.5V	60	80		dB
Open-Loop Voltage Gain	A_{OL}	R_L=1kΩ		120		dB
Output Characteristics						
Output Voltage Swing from Rail	V_{SWR}	R_L=10kΩ		20		mV
		R_L=1kΩ		150		mV
Short-Circuit Current	I_{SR}	Sourcing		24		mA
	I_{SK}	Sinking		32		mA
Power Supply						
Operating Voltage Range	V_S		3.2		12	V
			±1.6		±6	
Quiescent Current / Amplifier	I_Q	V_S=±5V		1.7		mA
Power Supply Rejection Ratio	PSRR	V_S = ±5V to ±6V	60	80		dB
Dynamic Performance						
-3 dB Small-Signal Bandwidth	f_{-3dB}	G = +1		80		MHz
Slew Rate	SR	G = +1 , 2V Step		36		V/μs
Settling Time to 0.1%	t_S	G = +1 , 2V Step, C_L=10pF		125		ns
Noise Performance						
Voltage Noise Density	e_n	f=10kHz		18		nV/ √Hz

4.0 Application Notes

Driving Capacitive Loads

Driving large capacitive loads can cause stability problems for voltage feedback op amps. As the load capacitance increases, the feedback loop's phase margin decreases, and the closed loop bandwidth is reduced. This produces gain peaking in the frequency response, with overshoot and ringing in the step response. A unity gain buffer (G = +1) is the most sensitive to capacitive loads, but all gains show the same general behavior.

When driving large capacitive loads with these op amps (e.g., > 100 pF when G = +1), a small series resistor at the output (R_{ISO} in Figure 1) improves the feedback loop's phase margin (stability) by making the output load resistive at higher frequencies. It does not, however, improve the bandwidth.

To select R_{ISO}, check the frequency response peaking (or step response overshoot) on the bench. If the response is reasonable, you do not need R_{ISO}. Otherwise, start R_{ISO} at 1 kΩ and modify its value until the response is reasonable.

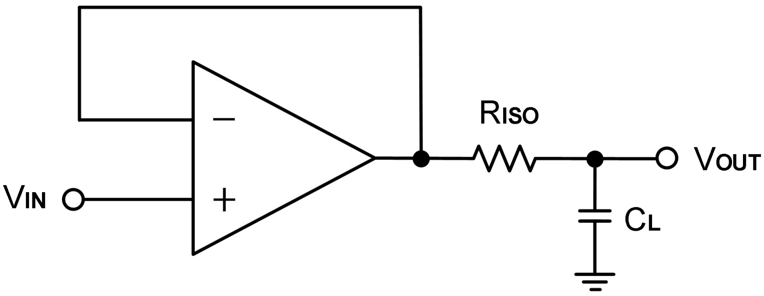


Figure 1. Indirectly Driving Heavy Capacitive Load

An improvement circuit is shown in Figure 2. It provides DC accuracy as well as AC stability. R_F provides the DC accuracy by connecting the inverting signal with the output, C_F and R_{ISO} serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to the amplifier's inverting input, thereby preserving phase margin in the overall feedback loop.

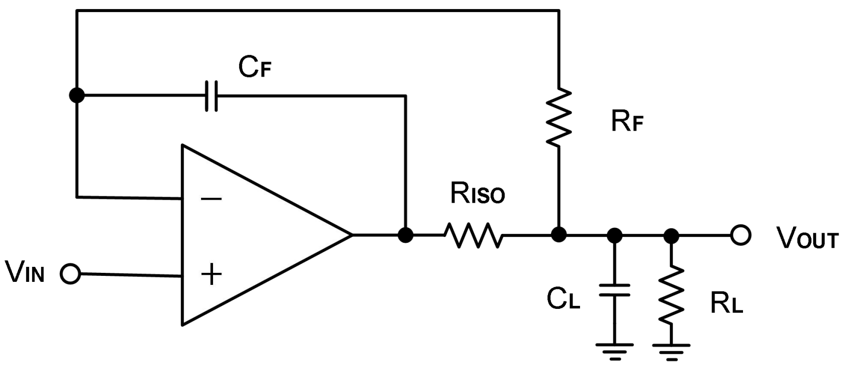


Figure 2. Indirectly Driving Heavy Capacitive Load with DC Accuracy

For non-inverting configuration, there are two others ways to increase the phase margin: (a) by increasing the amplifier's gain or (b) by placing a capacitor in parallel with the feedback resistor to counteract the parasitic capacitance associated with inverting node, as shown in Figure 3.

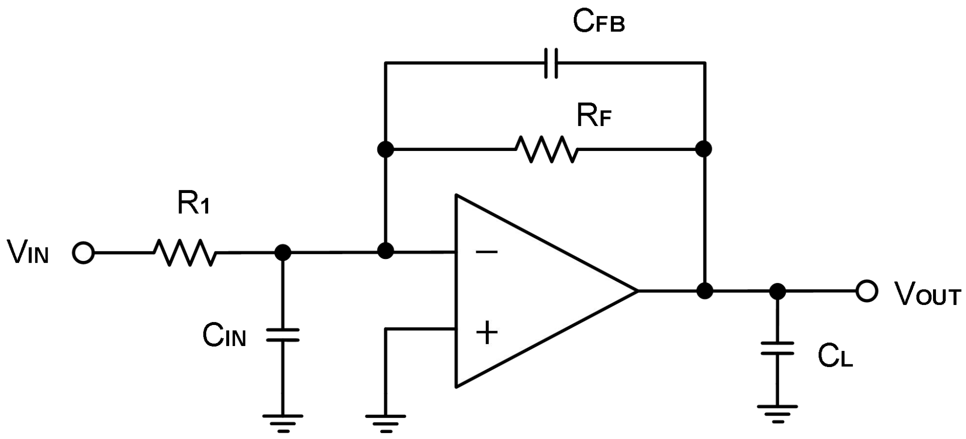


Figure 3. Adding a Feedback Capacitor in the Non-inverting Configuration

Power-Supply Bypassing and Layout

The COS8031/2/4 operates from a single +3.2V to +12V supply or dual ±1.6V to ±6V supplies. For single-supply operation, bypass the power supply +Vs with a 0.1μF ceramic capacitor which should be placed close to the +Vs pin. For dual-supply operation, both the +Vs and the -Vs supplies should be bypassed to ground with separate 0.1μF ceramic capacitors. 2.2μF tantalum capacitor can be added for better performance.

The length of the current path is directly proportional to the magnitude of parasitic inductances and thus the high frequency impedance of the path. High speed currents in an inductive ground return create an unwanted voltage noise. Broad ground plane areas will reduce the parasitic inductance. Thus a ground plane layer is important for high speed circuit design.

Typical Application Circuits

Differential Amplifier

The circuit shown in Figure 4 performs the differential function. If the resistors ratios are equal (R_4 / R_3 = R_2 / R_1), then $V_{OUT} = (V_{IP} – V_{IN}) \times R_2 / R_1 + V_{REF}$.

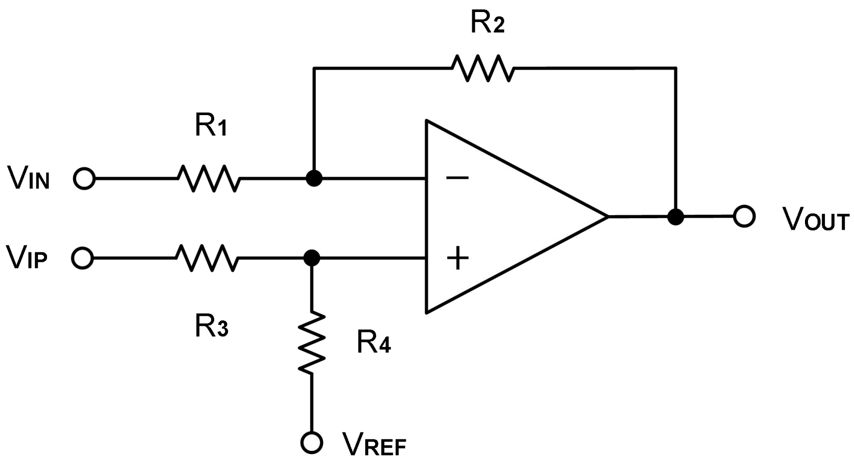


Figure 4. Differential Amplifier

Low Pass Active Filter

When receiving low-level signals, limiting the bandwidth of the incoming signals into the system is often required. The simplest way to establish this limited bandwidth is to place an RC filter at the noninverting terminal of the amplifier. If even more attenuation is needed, a multiple pole filter is required. The Sallen-Key filter can be used for this task, as Figure 5. For best results, the amplifier should have a bandwidth that is 8 to 10 times the filter frequency bandwidth. Failure to follow this guideline can result in reduction of phase margin. The large values of feedback resistors can couple with parasitic capacitance and cause undesired effects such as ringing or oscillation in high-speed amplifiers. Keep resistors value as low as possible and consistent with output loading consideration.

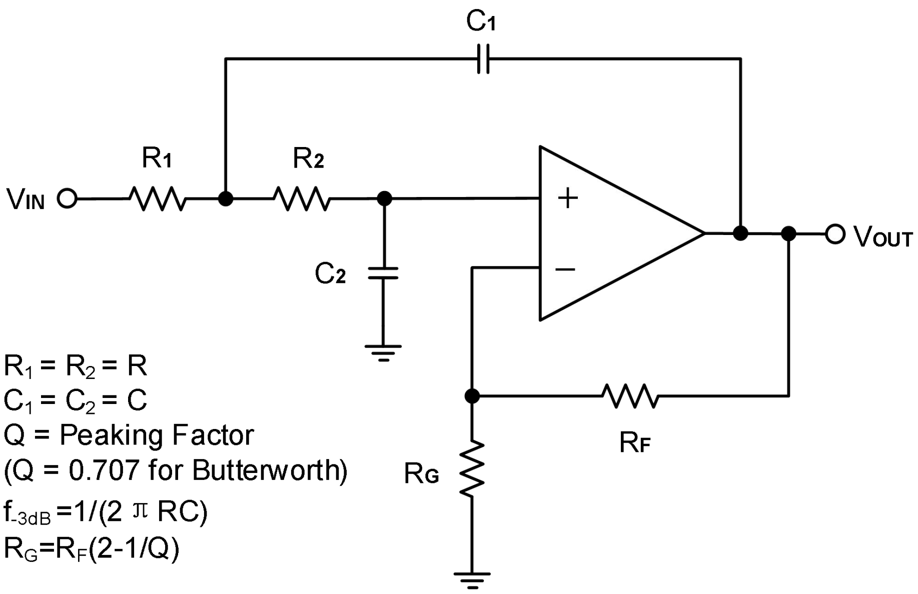
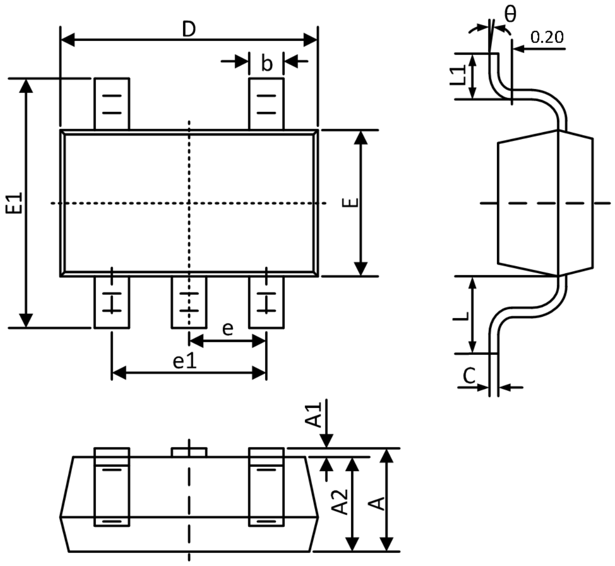


Figure 5. Two-Pole Low-Pass Sallen-Key Active Filter

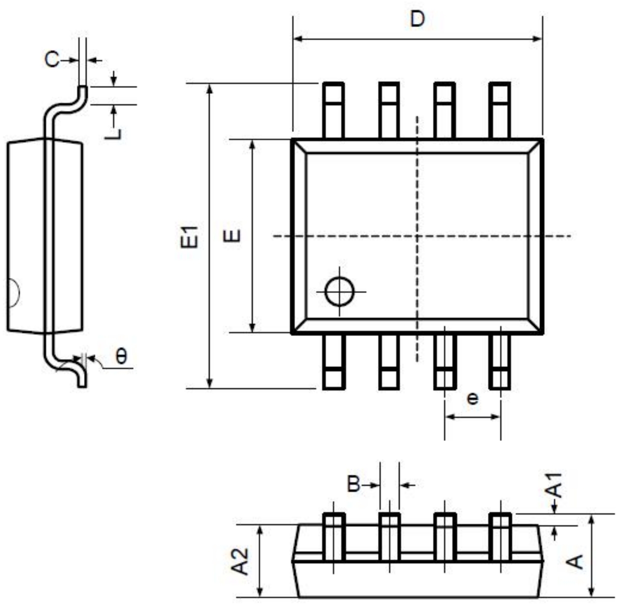
5. Package Information

5.1 SOT23-5 (Package Outline Dimensions)



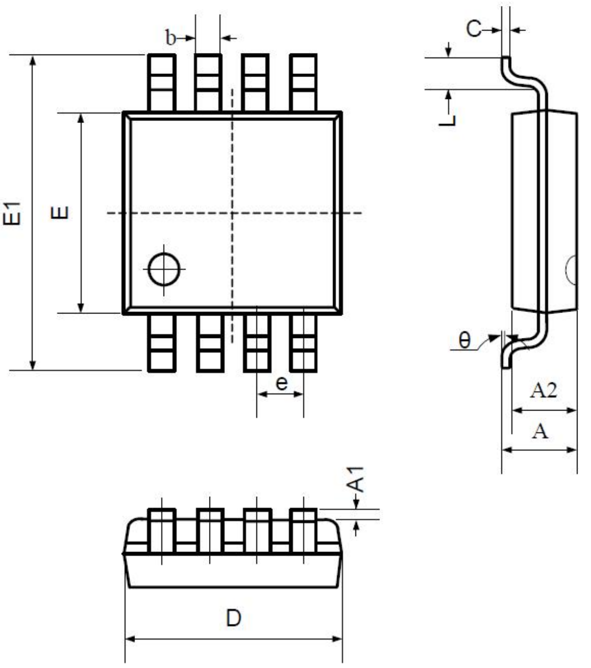
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

5.2 SOP8 (Package Outline Dimensions)



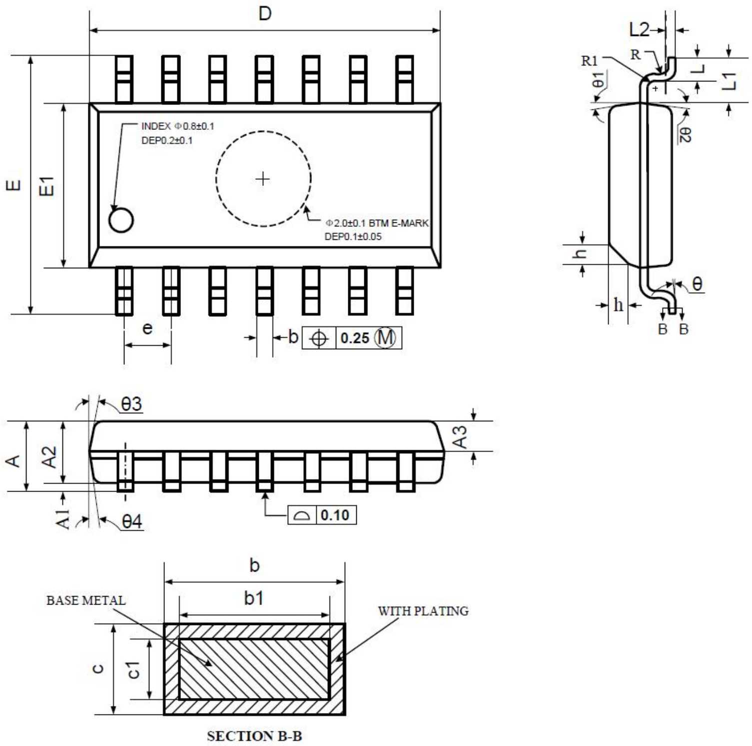
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

5.3 MSOP8 (Package Outline Dimensions)



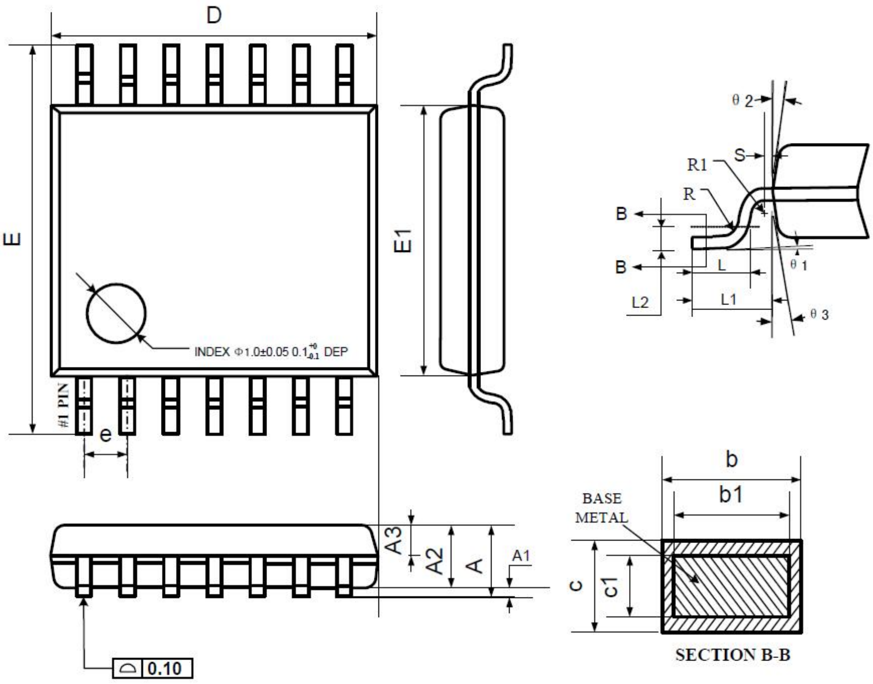
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.200	0.031	0.047
A1	0.000	0.200	0.000	0.008
A2	0.760	0.970	0.030	0.038
b	0.30 TYP		0.012 TYP	
c	0.15 TYP		0.006 TYP	
D	2.900	3.100	0.114	0.122
e	0.65 TYP		0.026 TYP	
E	2.900	3.100	0.114	0.122
E1	4.700	5.100	0.185	0.201
L	0.410	0.650	0.016	0.026
θ	0°	6°	0°	6°

5.4 SOP14 (Package Outline Dimensions)



Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36		0.49
b1	0.35	0.40	0.45
c	0.16		0.25
c1	0.15	0.20	0.25
D	8.53	8.63	8.73
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07		
R1	0.07		
h	0.30	0.40	0.50
θ	0°		8°
θ1	6°	8°	10°
θ2	6°	8°	10°
θ3	5°	7°	9°
θ4	5°	7°	9°

5.5 TSSOP14 (Package Outline Dimensions)



Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.34	0.44	0.54
b	0.20	—	0.28
b1	0.20	0.22	0.24
c	0.10	—	0.19
c1	0.10	0.13	0.15
D	4.86	4.96	5.06
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
L2	0.25 BSC		
R	0.09	—	—
R1	0.09	—	—
S	0.20	—	—
θ1	0°	—	8°
θ2	10°	12°	14°
θ3	10°	12°	14°

6. Related Parts

Part Number	Description
COS6042	24kHz, 0.5μA, Nano-Power Op Amps, 1.4V to 5.5V Supply
COS8032	170MHz, 6.1mA, High Speed Op Amps, 3.2V to 12V Supply
COS2172	10MHz, 1.2mA, RRIO Op Amps, 4.5 to 40V Supply
COS2333	350kHz, 18μA, Precision Op Amps, 1.8 to 5.5V Supply, Zero Drift, Vos<10μV
COS8552	1.5MHz, 55μA, Precision Op Amps, 1.8 to 5.5V Supply, Zero Drift, Vos<10μV
COS2388	9MHz, 570μA, Precision Op Amps, 1.8 to 5.5V Supply, Zero Drift, Vos<10μV
COS2227	10MHz, 1.3mA, Precision Op Amps, 4.5 to 36V Supply, Vos<50μV
COS2182	5MHz, 580μA, RRIO Precision Op Amps, 4.5 to 40V Supply, Vos<50μV
COS620	1.5MHz, 1.3mA, Instrumentation Amps, 4.5 to 36V Supply, Vos<50μV
COSINA333	150kHz, 65μA, Instrumentation Amps, 1.8 to 5.5V Supply, Vos<25μV