1.8V to 7.0V, 10MHz, RRIO
Low Power Operational Amplifiers

Features

- Operates on 1.8V ~ 7.0V Supplies
- Input Offset voltage: ±2mV(max)
- Low Quiescent Current: 725μA
- Gain Bandwidth Product: 10MHz
- Slew Rate: 8.5V/μs
- Rail-to-Rail Input and Output (RRIO)
- Unity Gain Stable
- No Phase Reversal
- Extended Temperature Ranges
  From -40°C to +125°C
- Small Packaging
  COS9061 available in SOT23-5
  COS9061S available in SOT23-6
  COS9062 available in SOP8/MSOP8
  COS9062S available in MSOP10
  COS9064 available in SOP14/TSSOP14

Applications

- Battery or Solar Powered Systems
- Portable Equipment
- Sensor Conditioning
- Analog Active Filters
- White Goods
- Smoke/Gas/Environment Sensors

Rev1.0

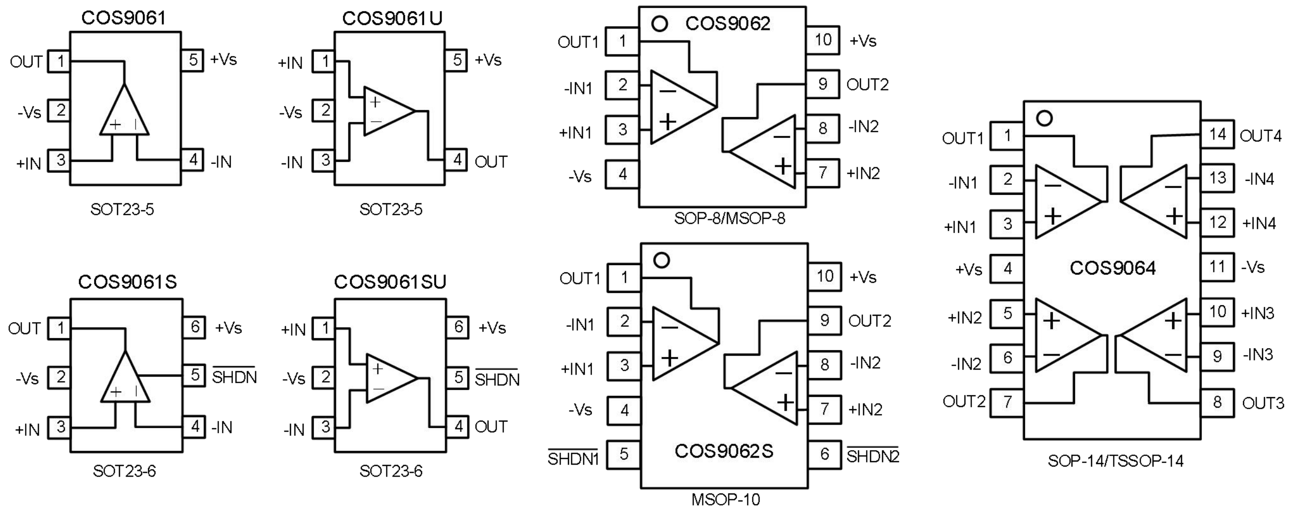
General Description

The COS9061 (single), COS9062 (dual) and COS9064 (quad) are micro-power, rail-to-rail input and output amplifiers operated on 1.8V to 7.0V supplies. Despite their low quiescent current, the COS906x family provides excellent overall performance and versatility. They have both rail-to-rail input and output range. The output voltage swing extends to within 10mV of each rail, providing the maximum output dynamic range with excellent overdrive recovery.

COS906x family is unity gain stable and has a gain bandwidth product of 10MHz (typical). They provide high CMRR and PRSS performance and can operate from a single supply voltage as low as 1.8V.

The COS906xS devices include a shutdown mode (COS9061S, and COS9062S) that allow the amplifiers to switch off into standby mode with typical current consumption less than 5 μA. These features make the COS906x family well suited for single-supply, battery-powered applications. They can be used as plus-in replacements for many commercially available op-amps to reduce power and improve input/output range and performance.

1. Pin Configuration and Functions



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.
$\overline{\text{SHDN}}$	Shutdown	High: enable op-amp; Low: disable op-amp

2. Product Specification

2.1 Absolute Maximum Ratings [1]

Parameter	Rating	Units
Power Supply: +Vs to -Vs	7.5	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.

2.2 Thermal Data

Parameter	Rating	Unit
Package Thermal Resistance	190 (SOT23-5) 206 (MSOP8) 155 (SOP8) 105 (TSSOP14) 82 (SOP14)	°C/W

2.3 Recommended Operating Conditions

Parameter	Rating	Unit
DC Supply Voltage	1.8V ~ 7V	V
Input common-mode voltage range	-Vs ~ +Vs	V
Operating ambient temperature	-40 to +85	°C

2.4 Electrical Characteristics

(+V_S=+5V, -V_S=0, V_{CM}=V_S/2, T_A=+25°C, R_L=10kΩ to V_S/2, unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Characteristics						
Input Offset Voltage	V_{OS}	COS906xA		±0.4	±2	mV
		COS906xB			±5	
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	-40 to 125°C		±0.6		μV/°C
Input Bias Current	IB			±2.5		pA
Input Offset Current	I_{OS}			±2.5		pA
Common-Mode Voltage Range	V_{CM}	V_S = 5.5V	-0.1		5.6	V
Common-Mode Rejection Ratio	CMRR	V_{CM} =0.1V to 4.9V		125		dB
Open-Loop Voltage Gain	AOL	V_O=0.2V to 4.8V		120		dB
Output Characteristics						
Output Voltage Swing from Rail		R_L=100kΩ		1		mV
		R_L=10kΩ		8		mV
		R_L=2kΩ		40		mV
Short-Circuit Current	I_{SR}	Sourcing		21		mA
	I_{SK}	Sinking		22		mA
Power Supply						
Operating Voltage Range			1.8		7.0	V
Power Supply Rejection Ratio	PSRR	V_S = +1.8V to +5.5V	80	100		dB
Quiescent Current / Amplifier	I_Q	I_O = 0 mA		725		μA
		Shutdown mode			5	μA
Dynamic Performance						
Gain Bandwidth Product	GBWP	G=+1		10		MHz
Slew Rate	SR	G = +1 , 2V Output Step		8.5		V/μs
Noise Performance						
Voltage Noise Density	e_n	f=1kHz		12		nV/ √Hz

3.0 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.

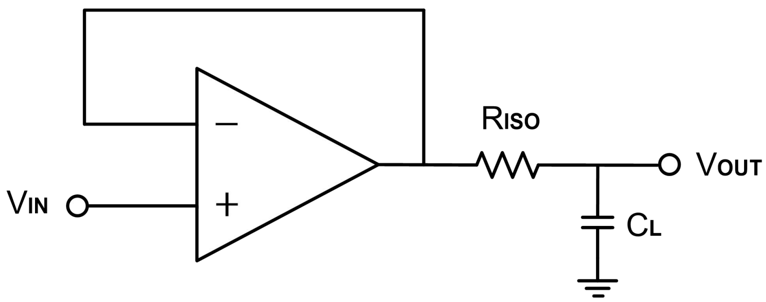


Figure 1. Indirectly Driving Heavy Capacitive Load

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.

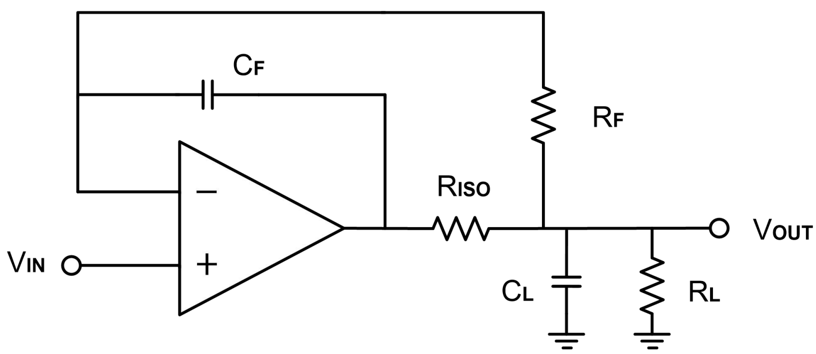


Figure 2. Indirectly Driving Heavy Capacitive Load with DC Accuracy

For noninverting 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.

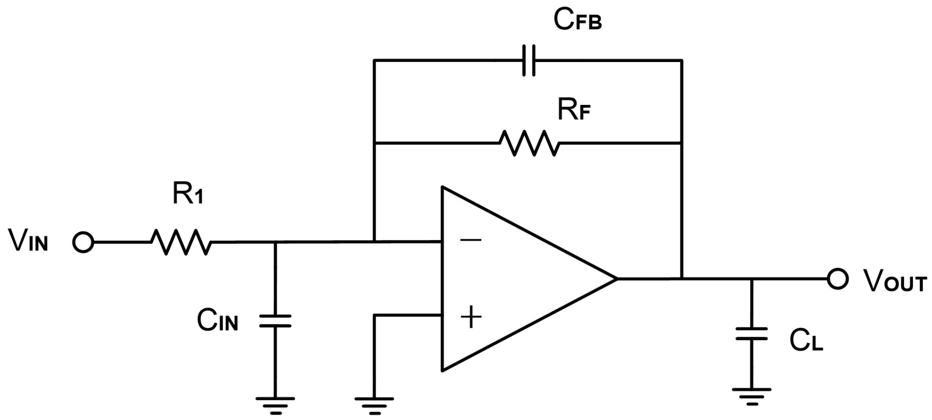


Figure 3. Adding a Feedback Capacitor in the Noninverting Configuration

Power-Supply Bypassing and Layout

The COS9061/2/4 operates from a single +1.8V to +5.5V supply or dual ±0.9V to ±2.75V 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 $V_{OUT} = (V_{IP} – V_{IN}) \times R_2 / R_1 + V_{REF}$.

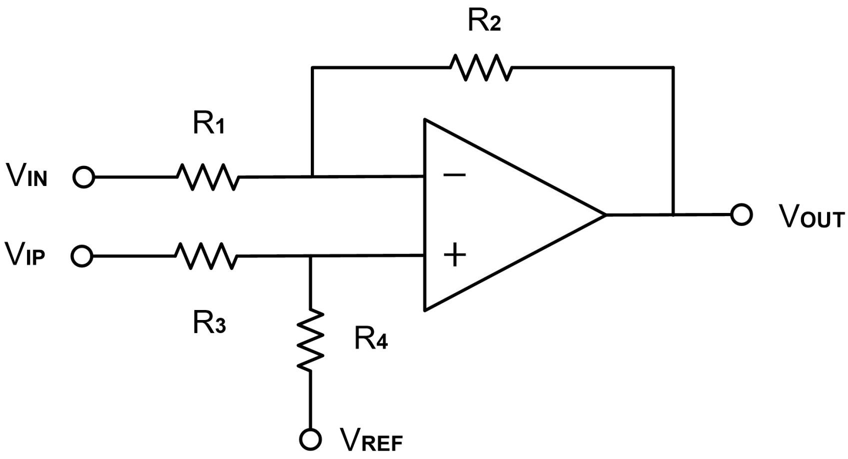


Figure 4. Differential Amplifier

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.

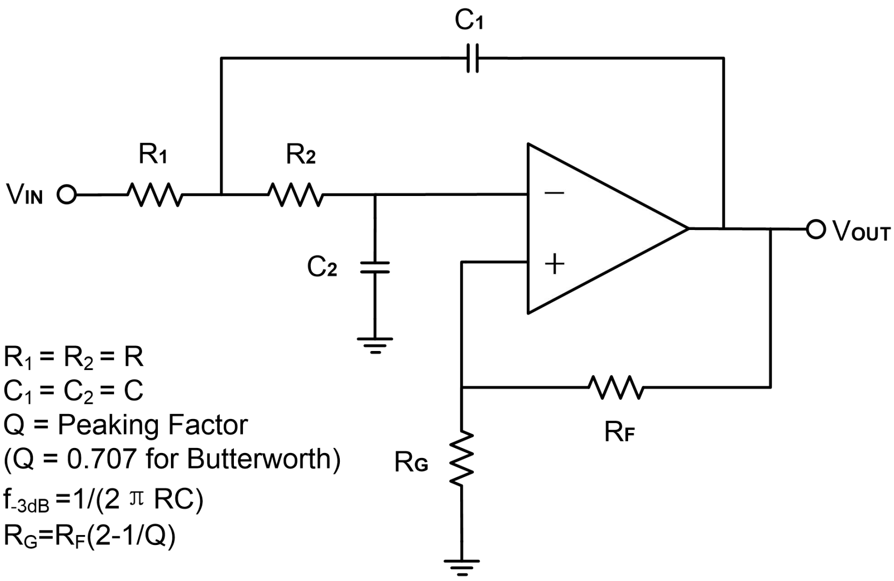
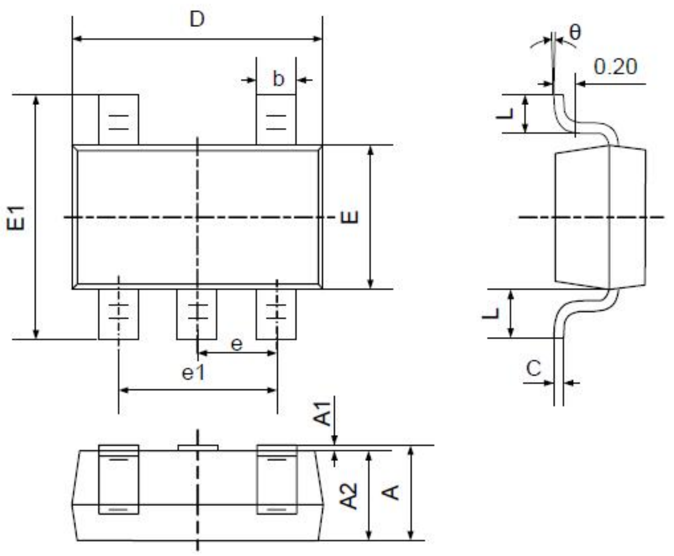


Figure 5. Two-Pole Low-Pass Sallen-Key Active Filter

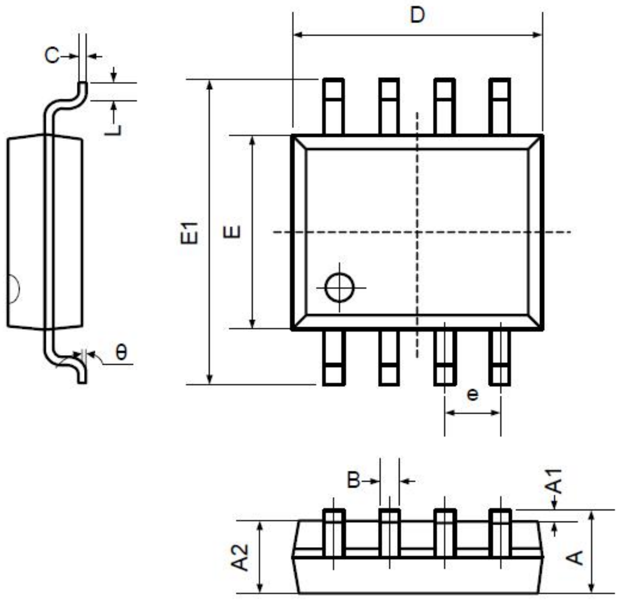
4. Package Information

4.1 SOT23-5 (Package Outline Dimensions)



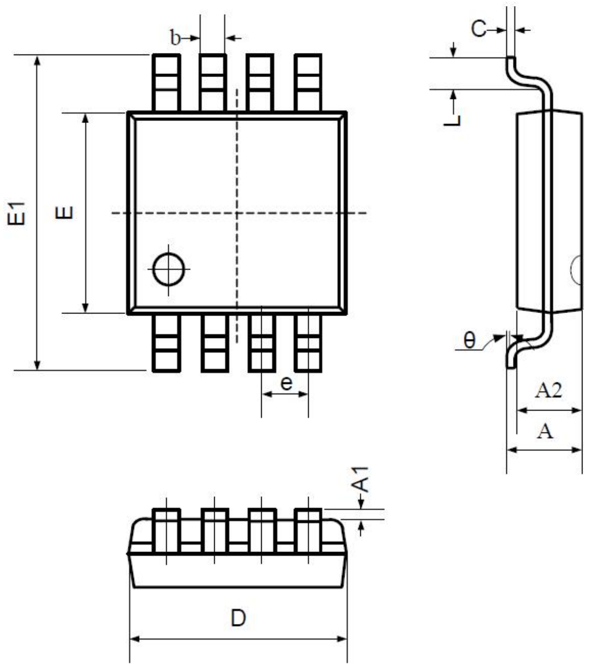
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
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°

4.2 SOP8 (Package Outline Dimensions)



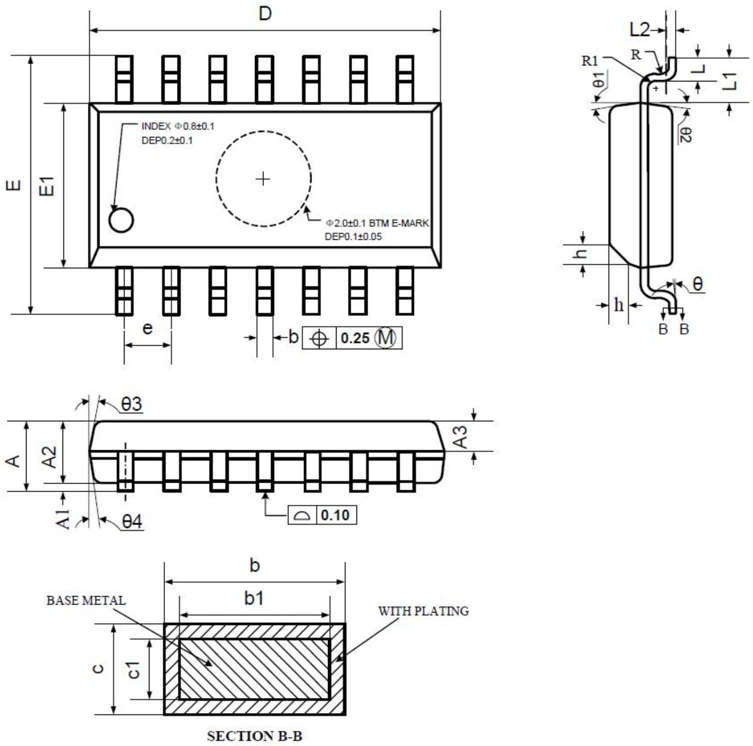
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP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

4.3 MSOP8 (Package Outline Dimensions)



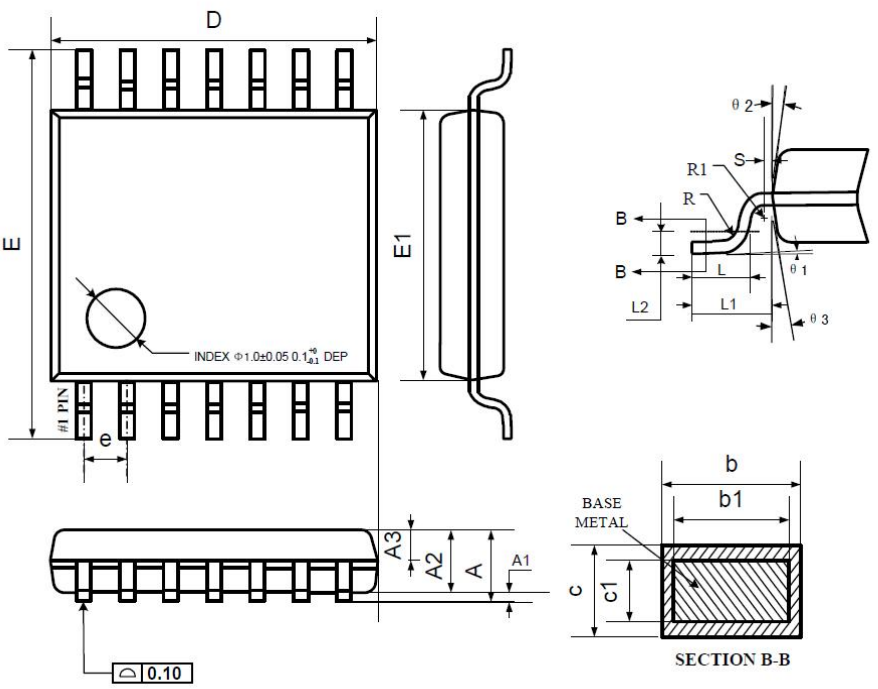
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.200	0.031	0.047
A1	0.000	0.200	0.000	0.008
A2	0.760	0.970	0.030	0.038
b	0.30 TYP		0.012 TYP	
c	0.15 TYP		0.006 TYP	
D	2.900	3.100	0.114	0.122
e	0.65 TYP		0.026 TYP	
E	2.900	3.100	0.114	0.122
E1	4.700	5.100	0.185	0.201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

4.4 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°

4.5 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°

5. Order Information

Model	Channel	Order Number	Package	Package Option	Marking Information
COS9061	1	COS9061TR	SOT23-5	Tape and Reel, 3000	C9061
		COS9061TRU	SOT23-5	Tape and Reel, 3000	C9061U
COS9061S		COS9061STR	SOT23-6	Tape and Reel, 3000	C9061S
		COS9061STRU	SOT23-6	Tape and Reel, 3000	C9061SU
COS9062	2	COS9062SR	SOP-8	Tape and Reel, 3000	COS9062
		COS9062MR	MSOP-8	Tape and Reel, 3000	COS9062
COS9062S		COS9062SMRA	MSOP-10	Tape and Reel, 3000	COS9062S
		COS9062SMRB	MSOP-10	Tape and Reel, 3000	COS9062S
COS9064	4	COS9064SR	SOP-14	Tape and Reel, 3000	COS9064
		COS9064TR	TSSOP-14	Tape and Reel, 3000	COS9064

单击下面可查看定价，库存，交付和生命周期等信息

[>>COSINE(科山芯创)]