36V, 10MHz
Low-Noise Dual Operational Amplifiers

Features

- Operates on ±2.5V to ±18V Supplies
- Gain Bandwidth Product: 10MHz
- Power Bandwidth: 140kHz
- Slew Rate: 8V/μs
- Offset Voltage: 5mV (Max.)
- Quiescent Current: 2.8mA
- Output Drive Capability: 2kΩ, 10Vrms typ
- Extended Temperature Ranges From -40°C to +125°C
- Available in SOP-8/MSOP-8/DIP-8

Applications

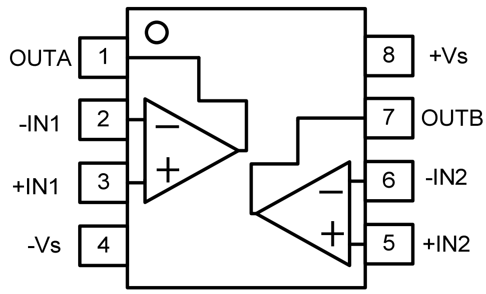
- Precision Instrumentation
- Professional Audio
- DAC Output Amplifier
- Active Filters
- Low Noise Amplifier Front End

General Description

The COS5532 are high performance, low noise operational amplifiers combining excellent dc and ac characteristics. They feature very low noise, high output-drive capability, high unity-gain and maximum-output-swing bandwidths, low distortion, high slew rate, and output short-circuit protection. These operational amplifiers are compensated internally for unity-gain operation and can operate from ±2.5 to ±18V dual power supplies or from +5V to +36V single supplies.

Pin Configuration

SOP-8/MSOP-8



Rev1.0

1. Product Specification

1.1 Absolute Maximum Ratings [1]

Parameter	Rating	Units
Power Supply: +Vs to -Vs	36	V
Differential Input Voltage Range	±30	V
Input Voltage (any input)	±15	V
Output Current	50	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.

1.2 Thermal Data

Parameter	Rating	Unit
Package Thermal Resistance	155 (SOP8) 206 (MSOP8) 125 (DIP8)	°C/W

1.3 Recommended Operating Conditions

Parameter	Rating	Unit
DC Supply Voltage	±2.5V ~ ±18V	V
Input common-mode voltage range	-Vs+2 ~ +Vs-2	V
Operating ambient temperature	-40 to +85	°C

1.4 Electrical Characteristics

(+V_S=+15V, -V_S=-15V, 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}			0.5	5	mV
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	-40 to 125°C		2		μV/°C
Input Bias Current	I_B			200	800	nA
Input Offset Current	I_{OS}			50	200	nA
Common-Mode Voltage Range	V_{CM}			±13		V
Common-Mode Rejection Ratio	CMRR	Rs⩽10kΩ	70	100		dB
Open-Loop Voltage Gain	AOL	R_L ≥ 10kΩ, V_O = ±10V	88	110		dB
		R_L ≥ 2kΩ, V_O = ±10V	82	94		dB
Output Characteristics						
Output Voltage Swing	$V_{O(PP)}$	R_L ≥2kΩ	±12	±13		V
Short-Circuit Current	I_{SC}			60		mA
Power Supply						
Operating Voltage Range			±2.5		±18	V
Power Supply Rejection Ratio	PSRR	Rs⩽10kΩ	80	110		dB
Quiescent Current / Amplifier	I_Q			2.8	3.5	mA
Dynamic Performance						
Gain Bandwidth Product	GBWP	C_L=100pF, R_L=2kΩ		10		MHz
Slew Rate	SR	C_L=100pF, R_L=2kΩ, Av=1		8.0		V/μs
Noise Performance						
Voltage Noise Density	e_n	f=1kHz		5.0		nV/√Hz

2.0 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.

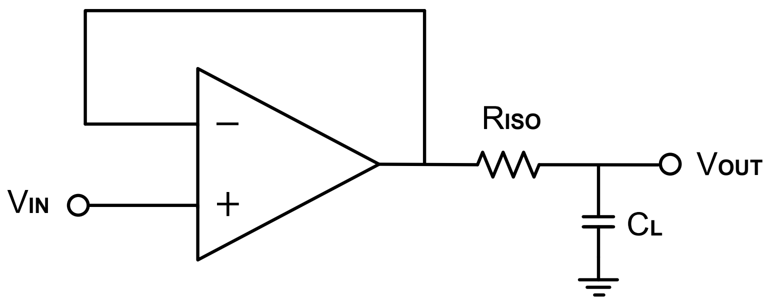


Figure 1. Indirectly Driving Heavy Capacitive Load

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.

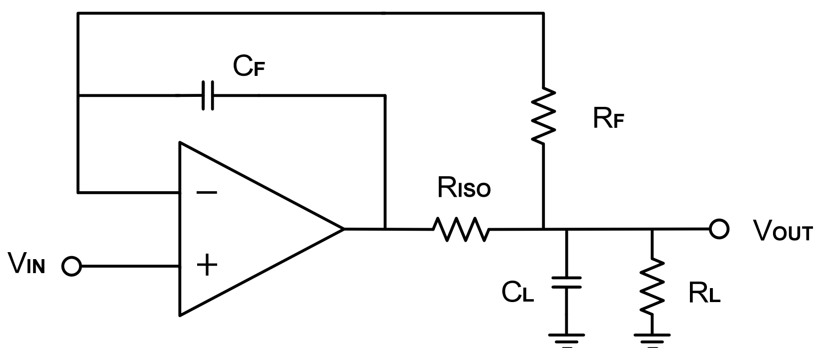


Figure 2. Indirectly Driving Heavy Capacitive Load with DC Accuracy

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.

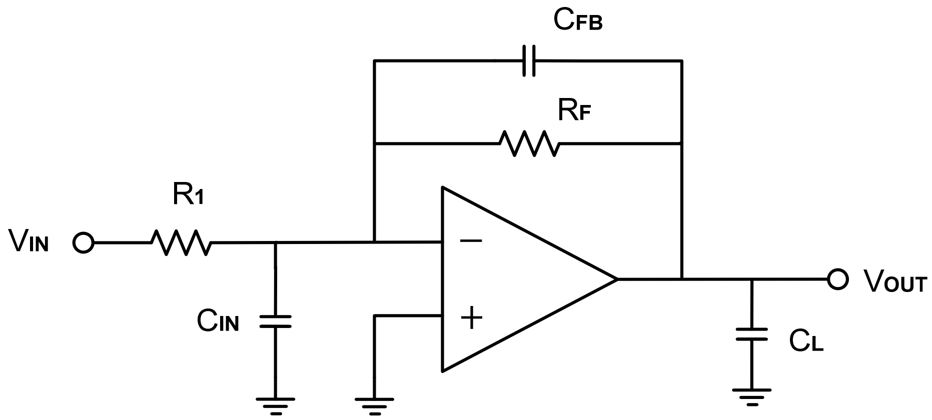


Figure 3. Adding a Feedback Capacitor in the Noninverting Configuration

Power-Supply Bypassing and Layout

The COS5532 operates from a single +5V to +36V supply or dual ±2.5V to ±18V 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 $V_{OUT} = (V_{IP} - V_{IN}) \times R_2 / R_1 + V_{REF}$.

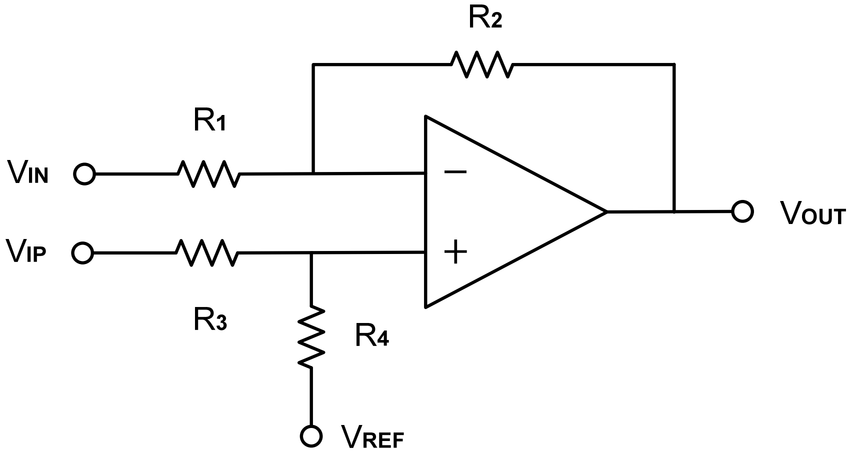
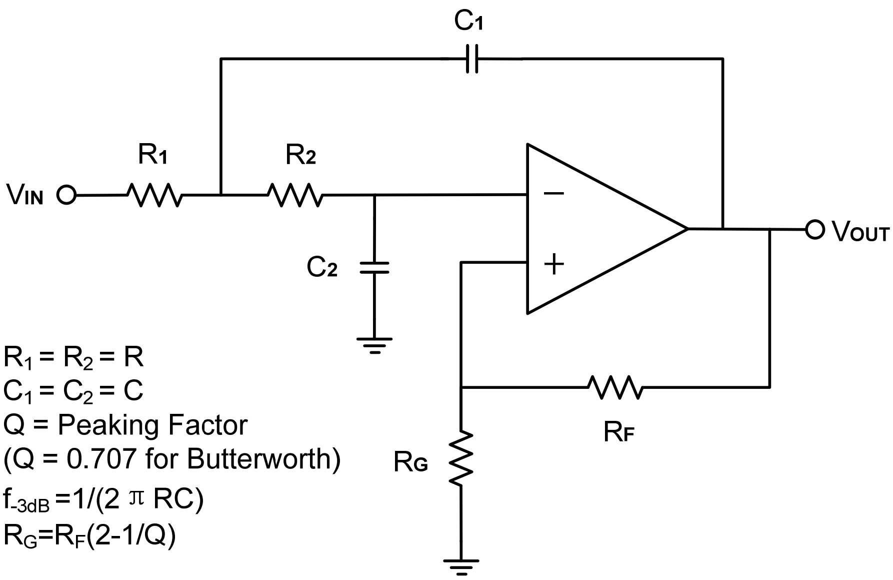


Figure 4. Differential Amplifier

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.

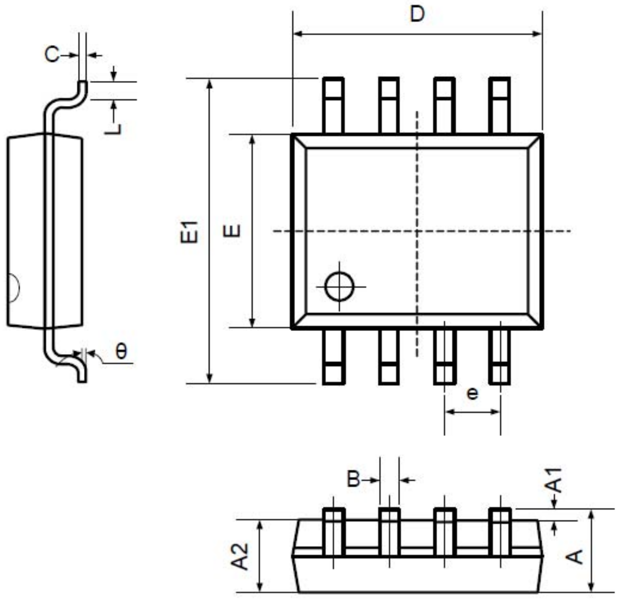


$R_1 = R_2 = R$
$C_1 = C_2 = C$
Q = Peaking Factor
(Q = 0.707 for Butterworth)
$f_{-3dB} = 1/(2\pi RC)$
$R_G = R_F(2-1/Q)$

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

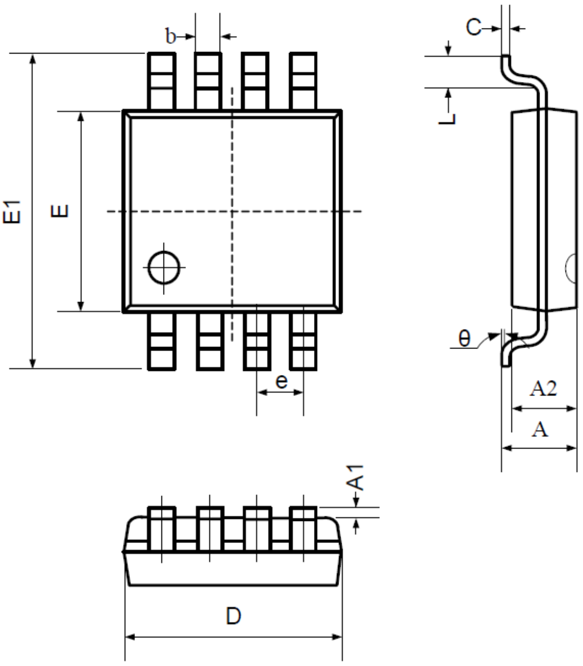
3. Package Information

3.1 SOP8 (Package Outline Dimensions)



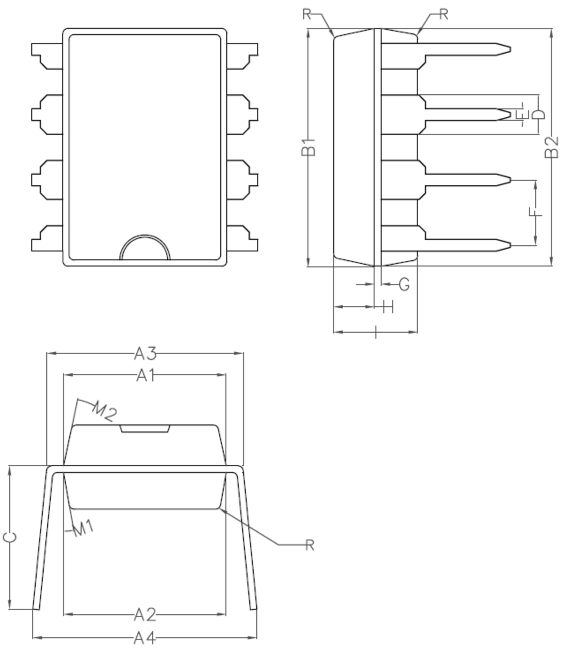
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP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

3.2 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°

3.3 DIP8 (Package Outline Dimensions)



Symbol	Min	Non	Max
A1	6.28	6.33	6.38
A2	6.33	6.38	6.43
A3	7.52	7.62	7.72
A4	7.80	8.40	9.00
B1	9.15	9.20	9.25
B2	9.20	9.25	9.30
C		5.57	
D		1.52	
E	0.43	0.45	0.47
F		2.54	
G		0.25	
H	1.54	1.59	1.64
I	3.22	3.27	3.32
R		0.20	
M1	9°	10°	11°
M2	11°	12°	13°

4. Package and Ordering Information

Model	Channel	Order Number	Package	Package Option	Marking Information
COS5532	2	COS5532SR	SOP-8	Tape and Reel, 3000	COS5532SR
		COS5532MR	MSOP-8	Tape and Reel, 3000	COS5532MR
		COS5532DR	DIP-8	Tape and Reel, 1500	COS5532DR
		COS5532DT	DIP-8	Tube, 50	COS5532DT

5. Related Parts

Part Number	Description
COS1177/2177/4177	36V high precision Op Amps, 5 to 36V Supply, Vos<50μV
COS1347/2347/4347	350kHz, 15μA, RRIO Op Amps, 1.8 to 5.5V Supply
COS6001/2/4	1.5MHz, 50μA, RRIO Op Amps, 1.8 to 5.5V Supply
COS721/2/4	10MHz, 650μA, RRIO Op Amps, 2.1 to 5.5V Supply
COS1333/2333/4333	0.35MHz, 18μA, RRIO Op Amps, 1.8 to 5.5V Supply, Zero Drift, Vos<20μV
COS8551/2/4	1.5MHz, 55μA, RRIO Op Amps, 1.8 to 5.5V Supply, Zero Drift, Vos<10μV