

36V, 10MHz LOW-NOISE DUAL OPERATIONAL AMPLIFIERS**Features**

- Operates on $\pm 2.5\text{V}$ to $\pm 18\text{V}$ Supplies
- Gain Bandwidth Product: 10MHz
- Power Bandwidth: 140kHz
- Slew Rate: $8\text{V}/\mu\text{s}$
- Offset Voltage: 5mV (Max.)
- Quiescent Current: 2.8mA
- Output Drive Capability: $2\text{k}\Omega$, 10Vrms typ
- Extended Temperature Ranges
From -40°C to $+125^\circ\text{C}$

Applications

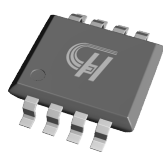
- Precision Instrumentation
- Professional Audio
- DAC Output Amplifier
- Active Filters
- Low Noise Amplifier Front End

General Description

The HCR5532 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 $\pm 18\text{V}$ dual power supplies or from $+5\text{V}$ to $+36\text{V}$ single supplies.

The HCR5532 is available in Green MSOP-8, SOIC-8 and DIP-8 package. It is specified over the extended -40°C to $+85^\circ\text{C}$ temperature range.



MSOP-8

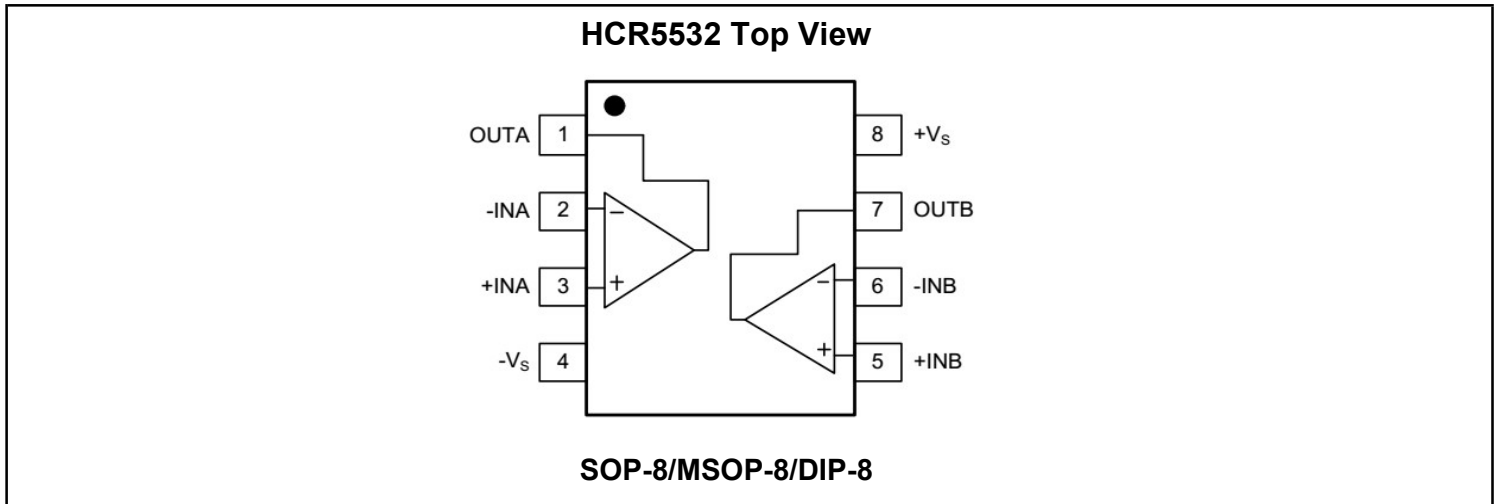


SOIC-8

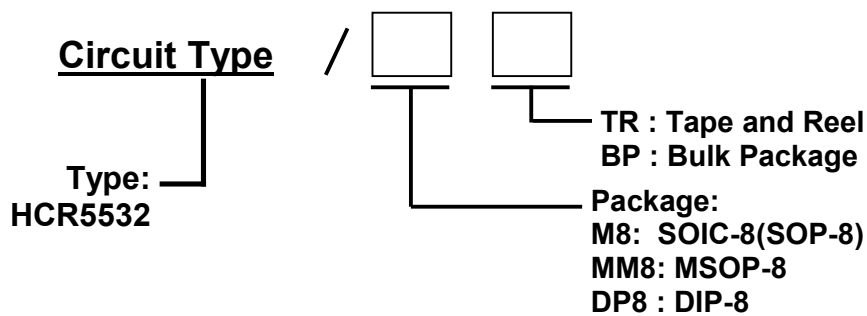


DIP-8

Figure 1. Package Type of HCR5532

36V, 10MHz LOW-NOISE DUAL OPERATIONAL AMPLIFIERS
Pin Configuration

Figure 2. Pin Configuration of HCR5532 (Top View)
Pin Function Table

Pin	Name	Function
3, 5	+IN A, +IN B	Non-inverting Inputs
2, 6	-IN A, -IN B	Inverting Inputs
8	+Vs	Positive Power Supply
4	-Vs	Negative Power Supply
1, 7	OUTA, OUTB	Outputs

Ordering Information

Ordering Code

Part Number	Marking ID ^{note1}	Temperature Range	Package	Package Type
HCR5532/M8TR	HCR5532XX	-40°C to +85°C	SOIC-8 (SOP-8)	4000pcs/TR
HCR5532/MS8TR	HCR5532XX	-40°C to +85°C	MSOP-8	4000pcs/TR
HCR5532/DP8BP	HCR5532DXX	-40°C to +85°C	DIP-8	1200pcs/BP

Note 1. the "XX" is date code.

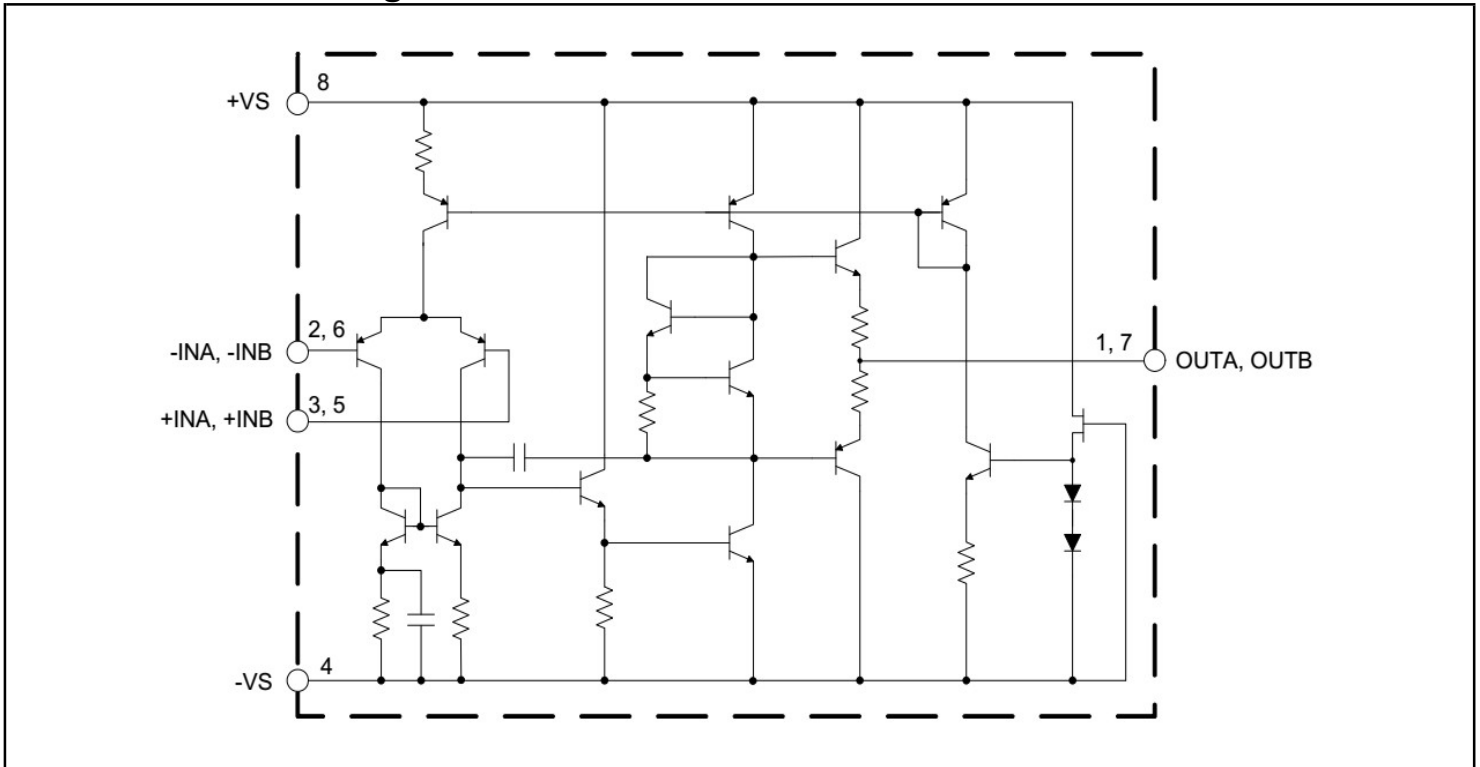
36V, 10MHz LOW-NOISE DUAL OPERATIONAL AMPLIFIERS
Functional Block Diagram


Figure 3. Pin Configuration of HCR5532 (Top View)

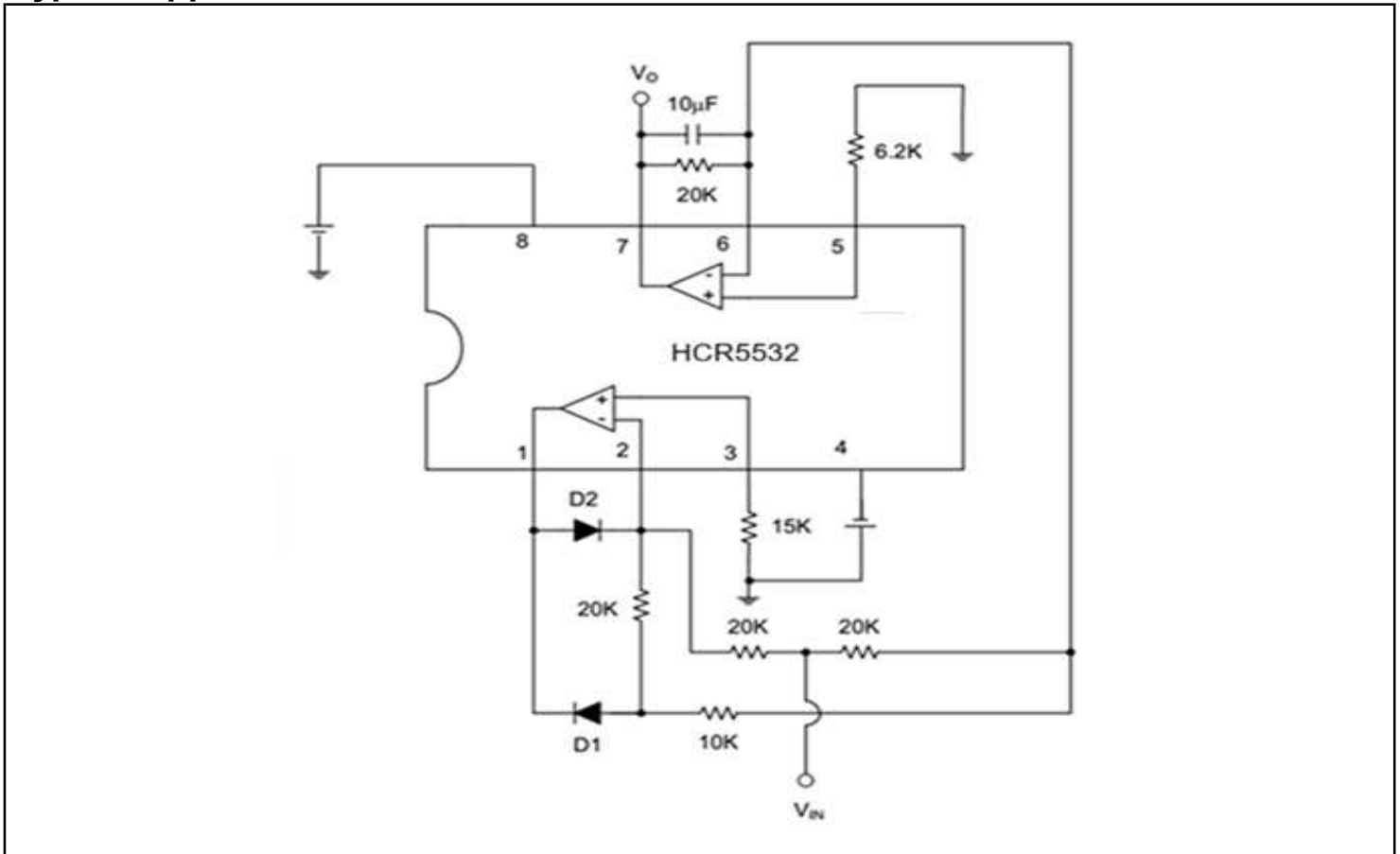
Typical Applications


Figure 4. Application of HCR5532 in an AC/DC Converter

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Absolute Maximum Ratings ^{Note 2}

Parameter		Symbol	Value	Unit
Supply Voltage, +Vs to -Vs		V+	+20	V
		V-	-20	
Input Voltage, VIN		VIN	±15	V
Differential Input Voltage		VDF	±30	V
Power Dissipation @TA=+25°C	MSOP-8	PD	400	mW
	SOP-8		500	mW
	DIP-8		800	mW
Package Thermal Resistance	MSOP-8	RQJA	206	'C/W
	SOP-8		155	'C/W
	DIP-8		125	'C/W
Storage Temperature Range		TSTORAGE	-65 to 150	'C
Operating Temperature Range ^{note 2}		TOPERATING	-40 to 85	'C
Junction Temperature		TJ	150	'C
Lead Temperature (Soldering, 10s)		TLEAD	260	'C
ESD Susceptibility		HBM	2000	V

Note 2: Stresses above those listed under "Maximum Ratings" may cause permanent damage to the device.

This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
DC Supply Voltage V+ to V-	V+, V-	±2.5	±18	V
Input Common-mode Voltage Range	V+, V-	-Vs+2	+Vs-2	V
Operating Temperature Range	Ta	-40	+85	'C

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Electrical Characteristics

(Operating Conditions: +Vs=+15V, -Vs=-15V, RL=10KΩ to VS/2, Unless Otherwise Specified.)

Parameter	Symbol	Conditions	Min	Type	Max	Unit
Input Characteristics						
Input Offset Voltage	Vos		-	0.5	5.0	mV
Input Offset Voltage Drift	$\Delta V_{os}/\Delta T$	-40°C to +125°C	-	2	-	uV/°C
Input Bias Current	IB	VCM=0V	-	200	800	nA
Input Offset Current	Ios	VCM=0V	-	50	200	nA
Common-Mode Voltage Range	VCM		±12	±13	-	V
Common Mode Rejection Ratio	CMRR	VCM=0V to VCC-1.5V, RS≤10KΩ	70	100	-	dB
Open-Loop Voltage Gain	AOL	RL≥10KΩ, Vo=±10V	88	110	-	dB
		RL≥2KΩ, Vo=±10V	82	94	-	dB
Output Characteristics						
Output Voltage Swing	VO(PP)	RL≥2KΩ	±12	±13	-	V
Short-Circuit Current	ISC		-	60	-	mA
Power Supply						
Output Voltage Range	VAV		±2.5	-	±18	V
Power Supply Rejection Ratio	PSRR	RS≤10KΩ	80	110	-	dB
Quiescent Current / Amplifier	Iq		-	2.8	3.5	mA
Dynamic Performance						
Gain Bandwidth Product	GBWP	CL=100pF, RL=2KΩ	-	15	-	MHz
Slew Rate	SR	CL=100pF, RL=2KΩ, Av=1	-	9.0	-	V/uS
Noise Performance						
Voltage Noise Density	en	f=1KHz	-	5.0	-	uV √Hz

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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 (RISO 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 RISO, check the frequency response peaking (or step r

response is reasonable, you do not need RISO.

Otherwise, start RISO at 1 k Ω and modify its value until the response is reasonable.

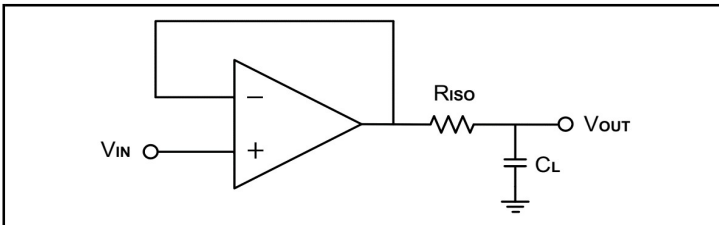


Figure 5. Indirectly Driving Heavy Capacitive Load

An improvement circuit is shown in Figure 2. It provides DC accuracy as well as AC stability. RF provides the DC accuracy by connecting the inverting signal with the output, CF and RISO 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.

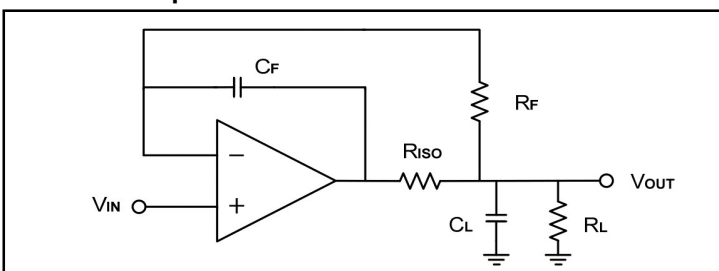


Figure 6. Indirectly Driving Heavy Capacitive Load with DC Accuracy

Driving Capacitive Loads(Con.)

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 7.

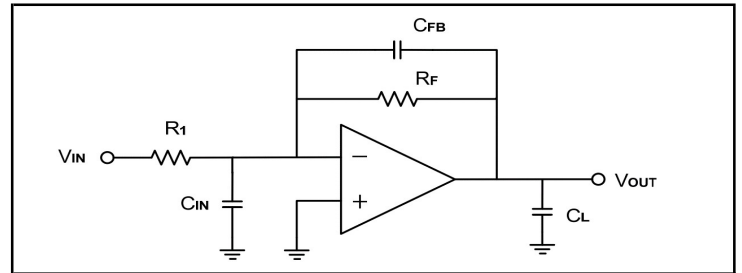


Figure 7. Adding a Feedback Capacitor in the Noninverting Configuration

Power-Supply Bypassing and Layout

The HCR5532 operates from a single +5V to +36V supply or dual ± 2.5 V to ± 18 V supplies. For single-supply operation, bypass the power supply +Vs with a 0.1 μ F 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 0.1 μ F ceramic capacitors. 2.2 μ F 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.

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Typical Application Circuits

Differential Amplifier

The circuit shown in Figure 4 performs the differential function. If the resistors ratios are equal

$(R4/R3 = R2/R1),$

then $V_{OUT}=(V_{IP}-V_{IN}) \times R2/R1+V_{REF}.$

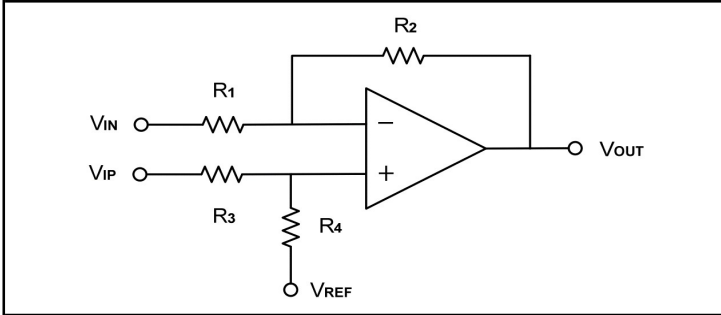


Figure 8. Differential Amplifier

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

Low Pass Active Filter(Con.)

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.

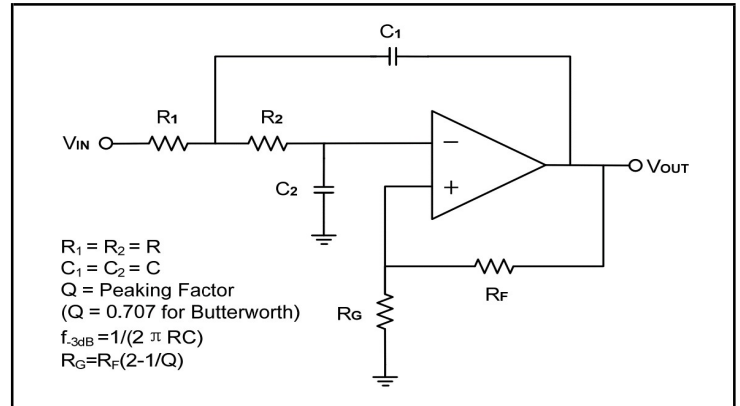
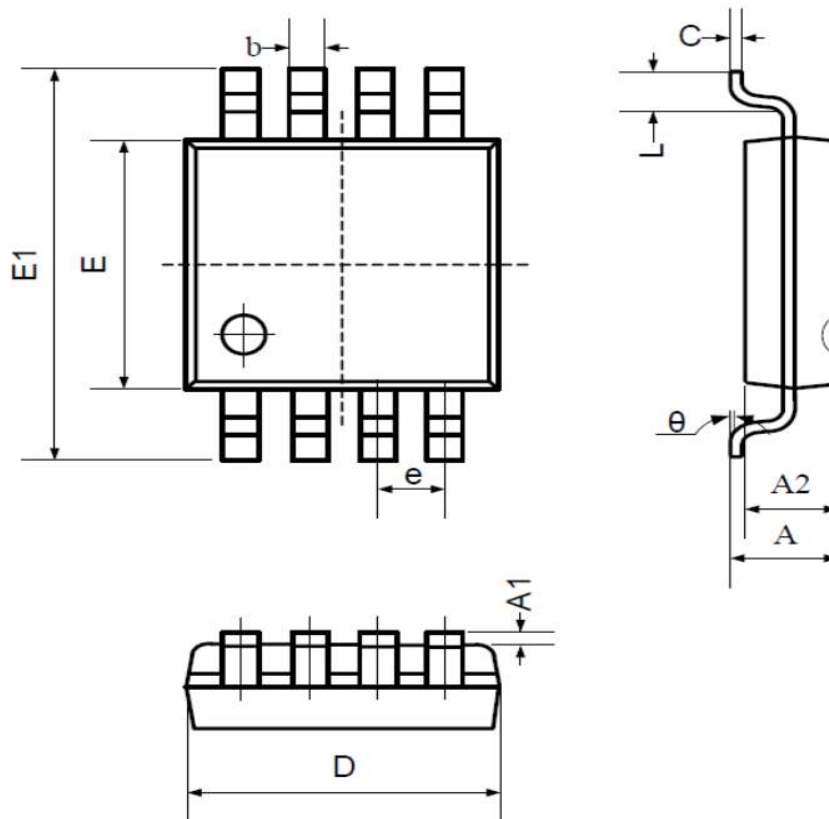
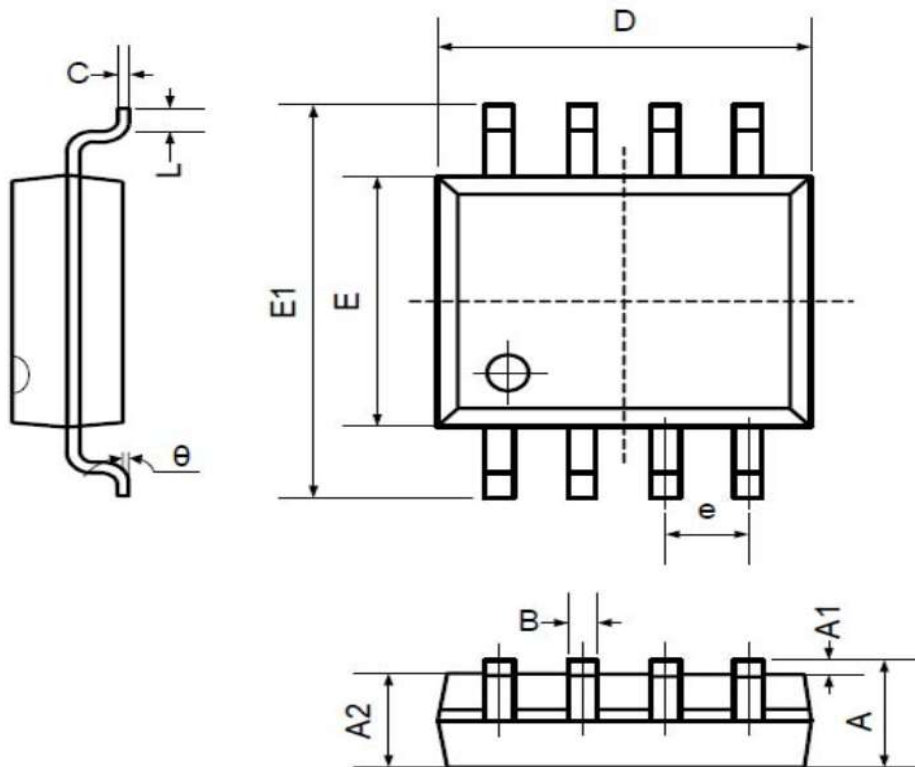


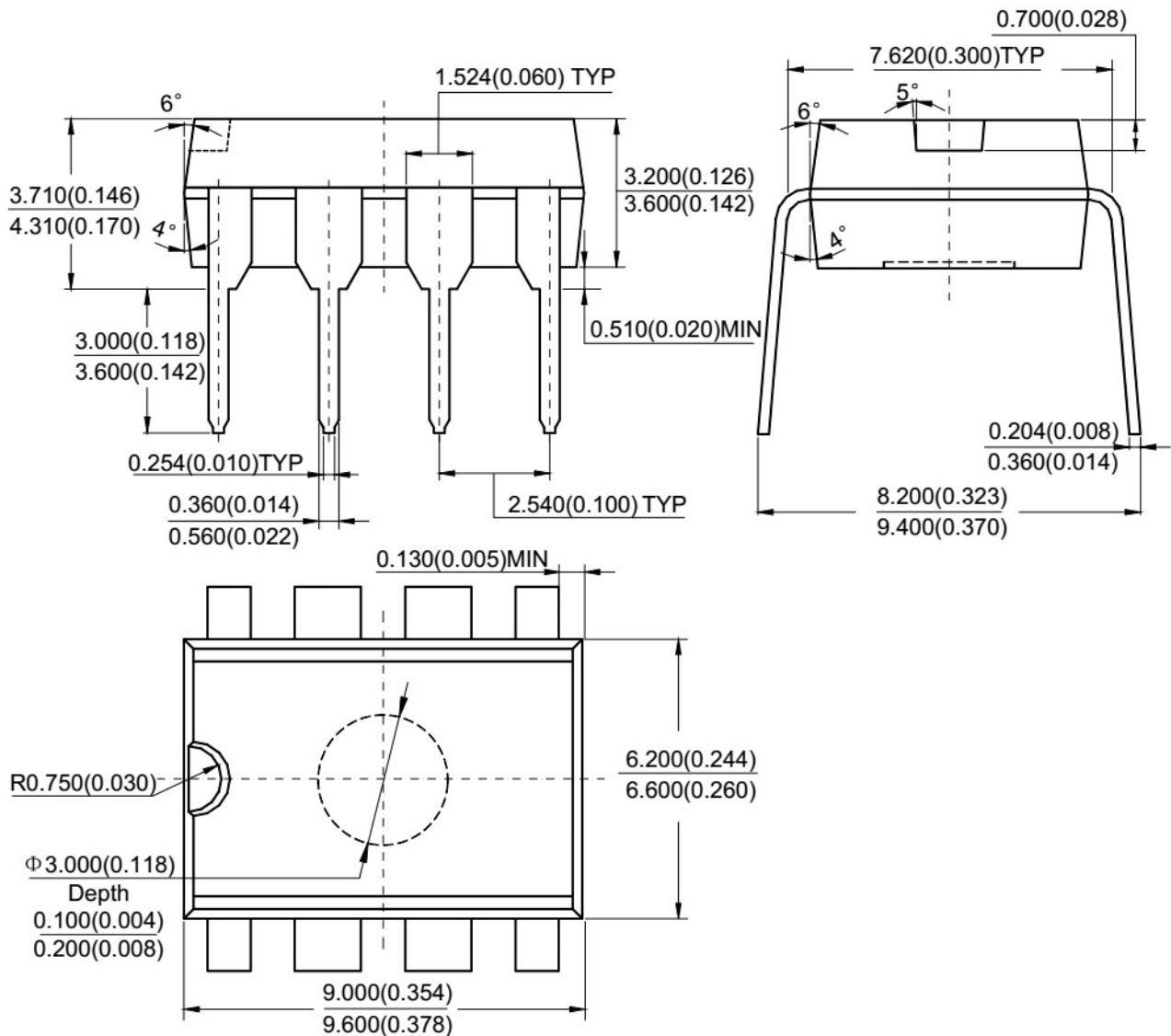
Figure 9. Two-Pole Low-Pass Sallen-Key Active Filter

Mechanical Dimensions
MS8 : MSOP8 Package
Unit: mm (inch)


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°

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Mechanical Dimensions (Con.)
M8 : SOIC-8(SOP-8) Package
Unit: mm (inch)


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°

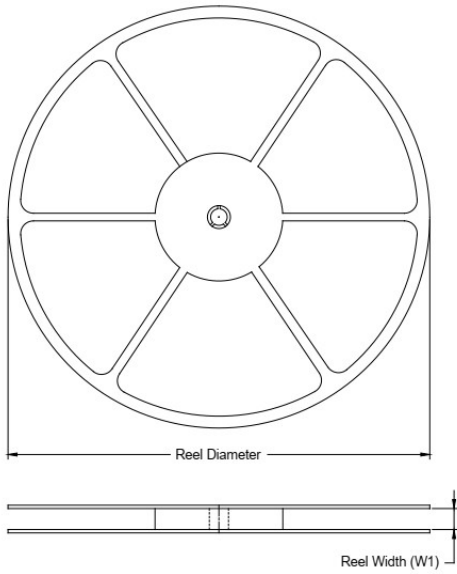
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Mechanical Dimensions (Con.)
DP8 : DIP-8
Unit: mm (inch)


Note: Eject hole, oriented hole and mold mark is optional.

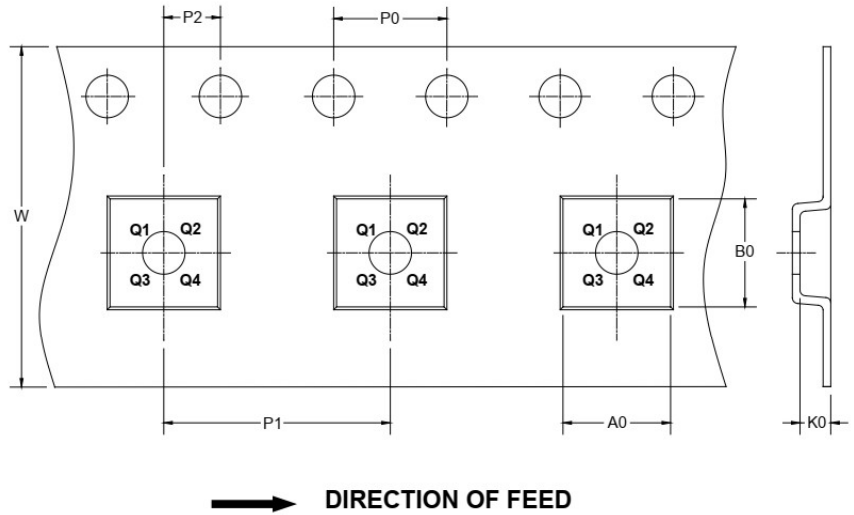
36V, 10MHz LOW-NOISE DUAL OPERATIONAL AMPLIFIERS

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

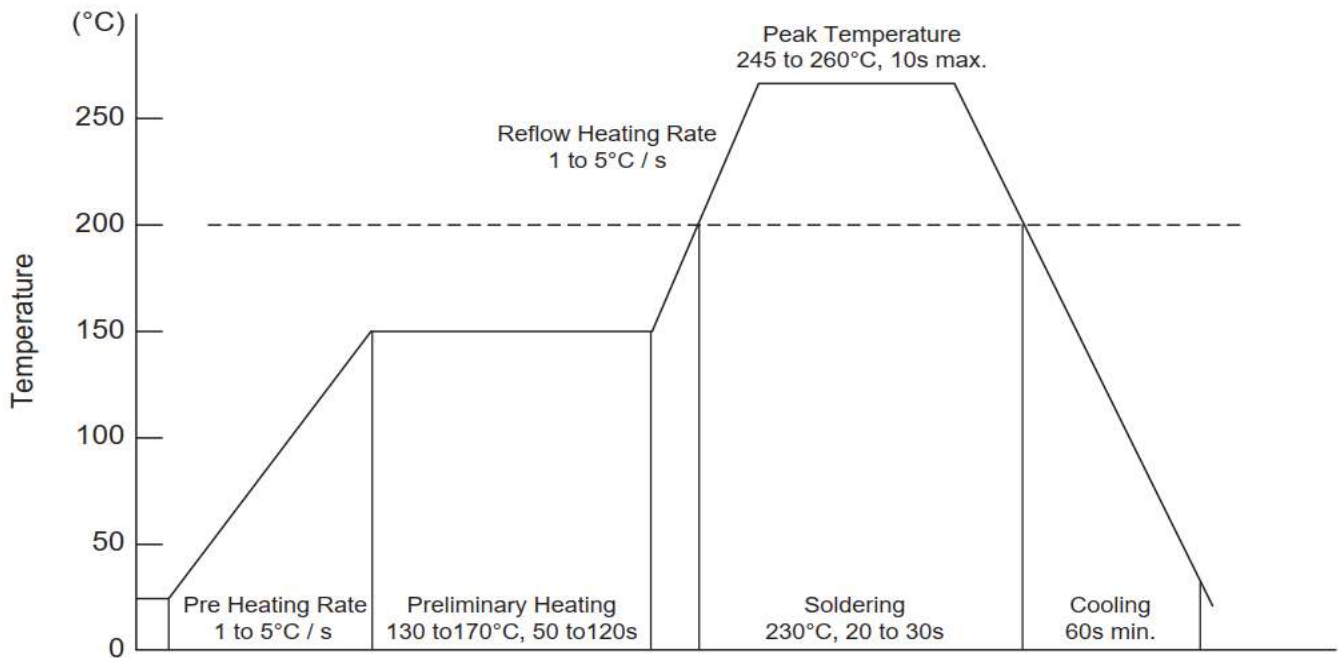
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOIC-8	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1
MSOP-8	13"	12.4	5.20	3.30	1.50	4.0	8.0	2.0	12.0	Q1

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Conditions of Soldering and Storage

• Recommended condition of reflow soldering



Recommended peak temperature is over 245°C, if peak temperature is below 245°C, you may adjust the following parameters:

- * Time length of peak temperature (longer)
- * Time length of soldering (longer)
- * Thickness of solder paste (thicker)

• Conditions of hand soldering

- * Temperature : 300°C
- * Time : 3s max
- * Times : one time

• Storage conditions

- * Temperature
5 to 40°C
- * Humidity
30 to 80% RH
- * Recommended period
One year after manufacturing