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

Applications

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

General Description

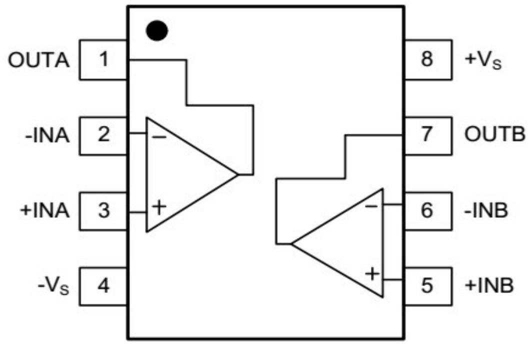
The HCRM5532 are high performance, low noise operational amplifiers combining excellent dc and ac characteristics. They feature very low noise, high output-drive capability, high unity-gain and maximum-output-swing bandwidths, low distortion, high slew rate, and output short-circuit protection. These 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.

The HCRM5532 is available in Green MSOP-8, SOIC-8 and DIP-8 package. It is specified over the extended -40'C to +85'C temperature range.

Figure 1. Package Type of HCRM5532

Pin Configuration

HCRM5532 Top View



SOP-8/MSOP-8/DIP-8

Figure 2. Pin Configuration of HCRM5532 (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

Circuit Type / ☐ ☐

Type:
HCRM5532

TR : Tape and Reel
BP : Bulk Package

Package:
M8: SOIC-8(SOP-8)
MS8: MSOP-8
DP8 : DIP-8

Ordering Code

Part Number	Marking ID note1	Temperature Range	Package	Package Type
HCRM5532/M8TR	HCRM5532XX	-40'C to +85'C	SOIC-8 (SOP-8)	4000pcs/TR
HCRM5532/MS8TR	HCRM5532XX	-40'C to +85'C	MSOP-8	4000pcs/TR
HCRM5532/DP8BP	HCRM5532XX	-40'C to +85'C	DIP-8	1200pcs/BP

Note 1. the "XX" is date code.

Functional Block Diagram

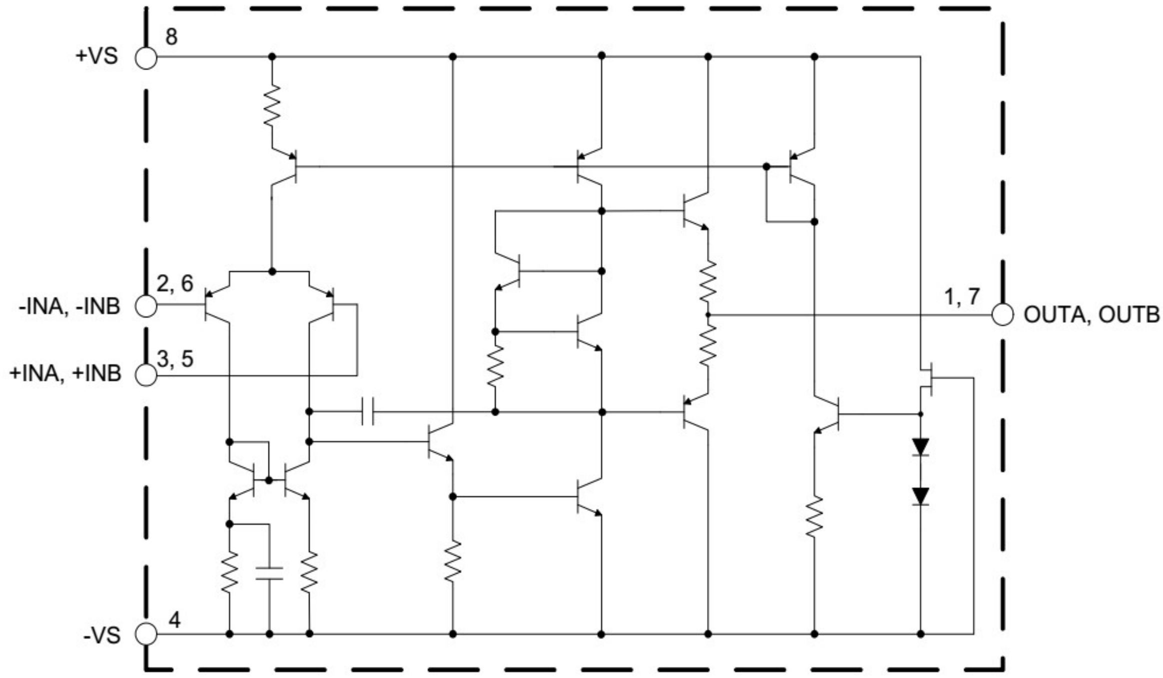


Figure 3. Pin Configuration of HCRM5532 (Top View)

Typical Applications

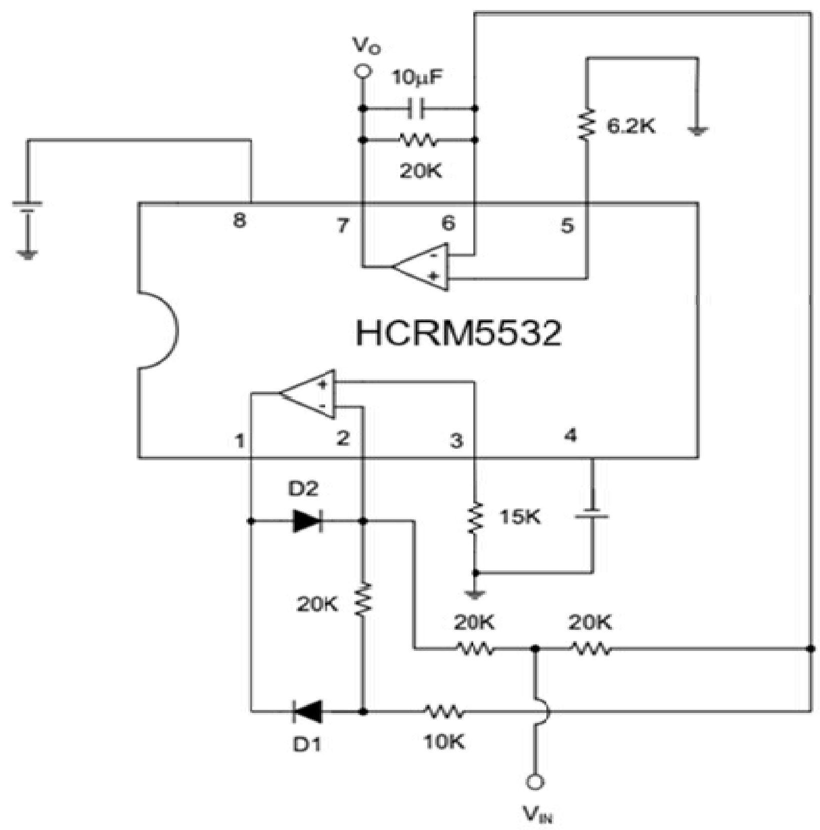


Figure 4. Application of HCRM5532 in an AC/DC Converter

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

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	V_{OS}		-	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	I_B	V_{CM}=0V	-	200	800	nA
Input Offset Current	I_{OS}	V_{CM}=0V	-	50	200	nA
Common-Mode Voltage Range	V_{CM}		±12	±13	-	V
Common Mode Rejection Ratio	CMRR	V_{CM}=0V to V_{CC}-1.5V, R_S<=10KΩ	70	100	-	dB
Open-Loop Voltage Gain	A_{OL}	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						
Output Voltage Range	V_{AV}		±2.5	-	±18	V
Power Supply Rejection Ratio	PSRR	R_S<=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, A_V=1	-	8.0	-	V/uS
Noise Performance						
Voltage Noise Density	e_n	f=1KHz	-	5.0	-	uV√Hz

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 kΩ and modify its value until the response is reasonable.

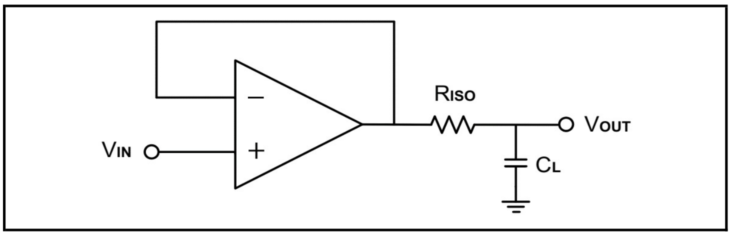


Figure 5. Indirectly Driving Heavy Capacitive Load

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.

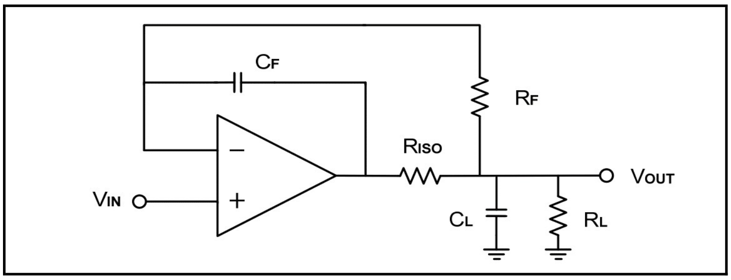


Figure 6. Indirectly Driving Heavy Capacitive Load with DC Accuracy

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.

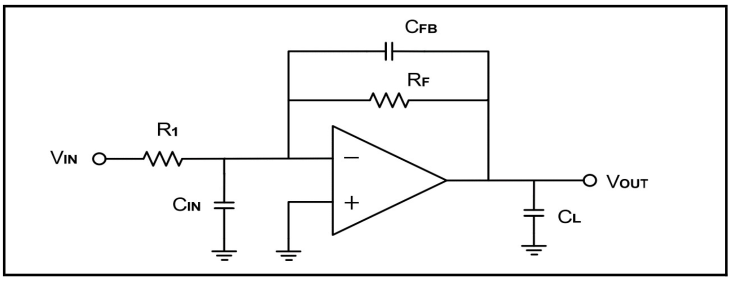


Figure 7. Adding a Feedback Capacitor in the Noninverting Configuration

Power-Supply Bypassing and Layout

The HCRM5532 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 (R4/R3 = R2/R1), then VOUT=(VIP–VIN) × R2/R1+VREF.

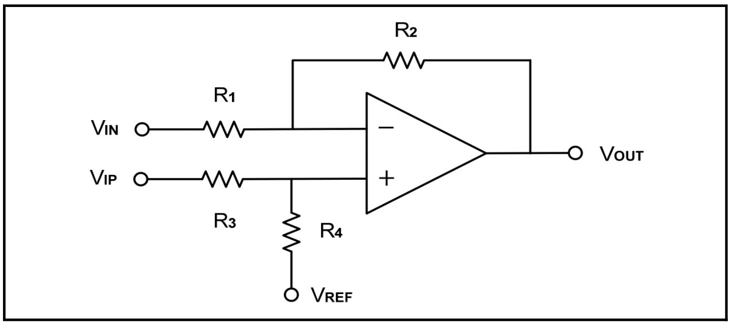


Figure 8. Differential Amplifier

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.

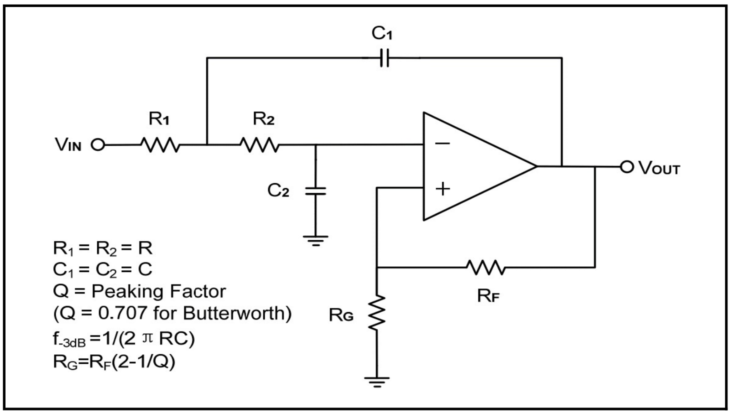
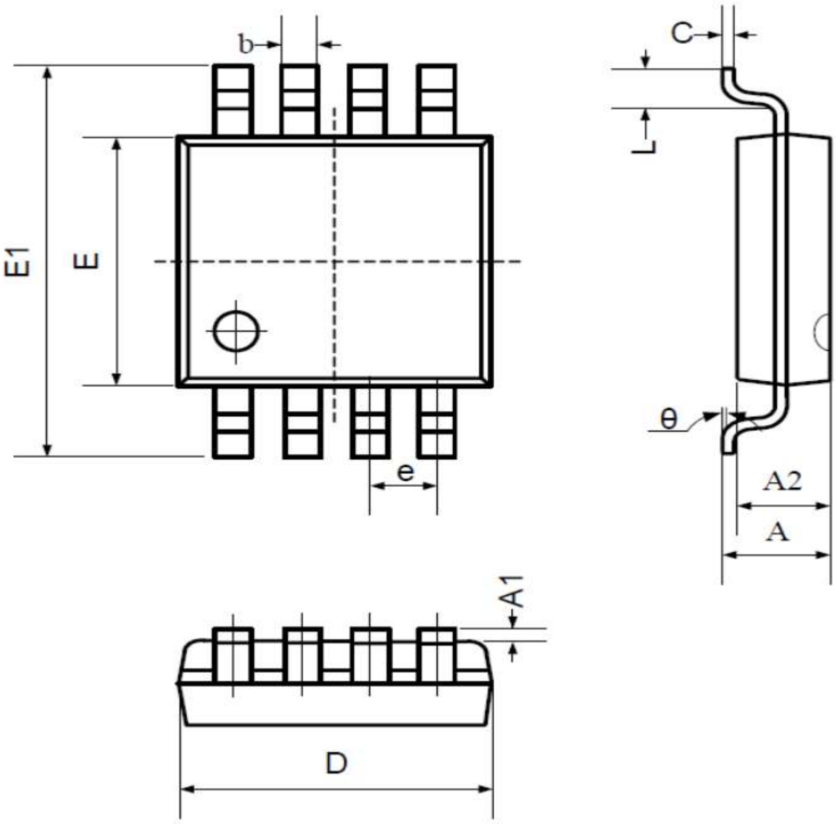


Figure 9. Two-Pole Low-Pass Sallen-Key Active Filter

Mechanical Dimensions

MS8 : MSOP8 **Unit: mm (inch)**

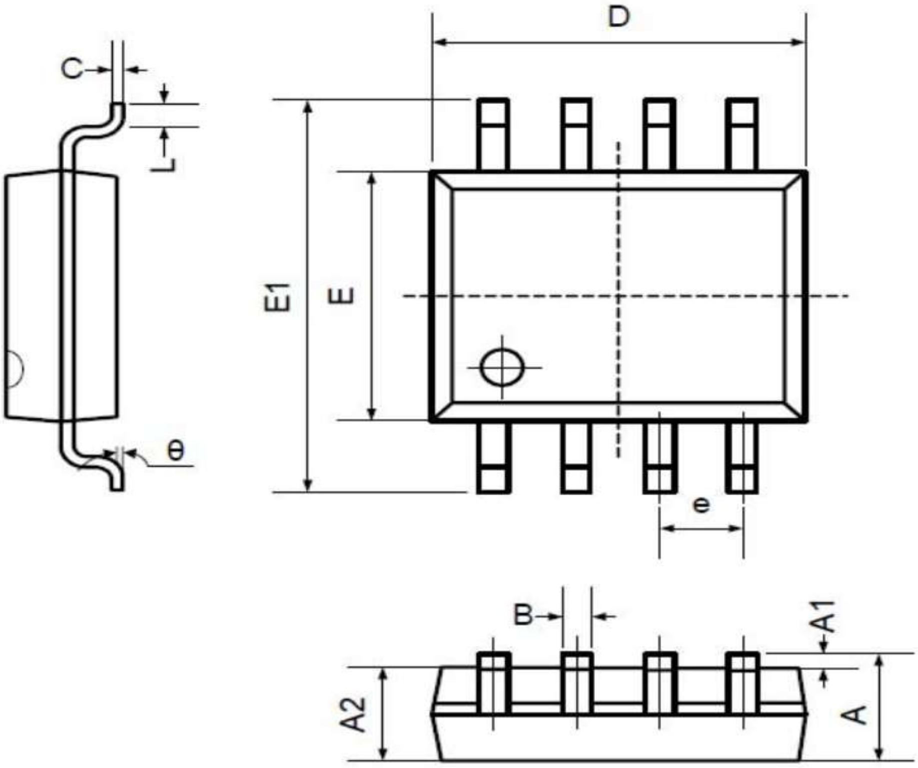


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.200	0.031	0.047
A1	0.000	0.200	0.000	0.008
A2	0.760	0.970	0.030	0.038
b	0.30 TYP		0.012 TYP	
c	0.15 TYP		0.006 TYP	
D	2.900	3.100	0.114	0.122
e	0.65 TYP		0.026 TYP	
E	2.900	3.100	0.114	0.122
E1	4.700	5.100	0.185	0.201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

Mechanical Dimensions (Con.)

M8 : SOIC-8(SOP-8)

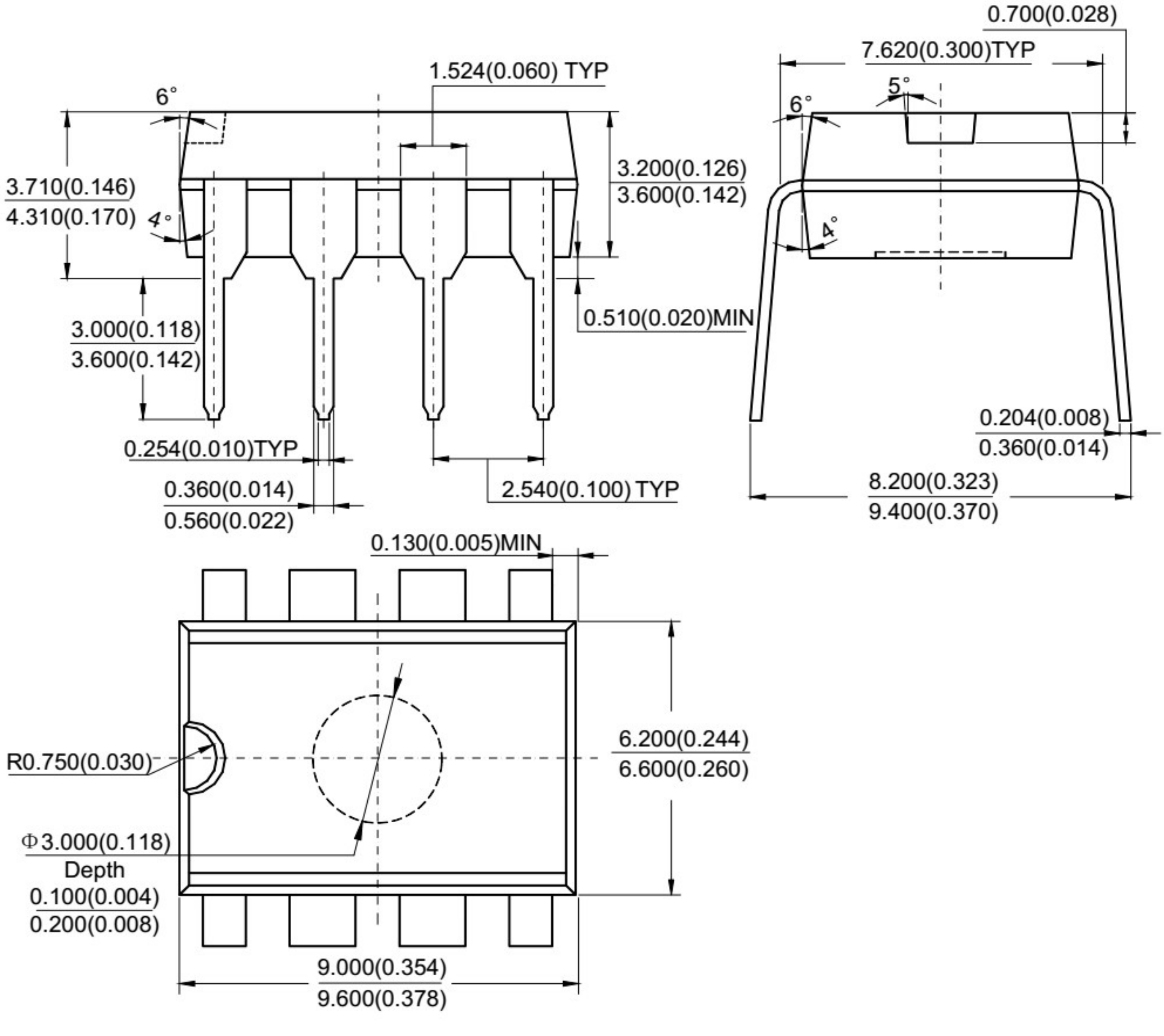
Unit: mm (inch)



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°

Mechanical Dimensions (Con.)

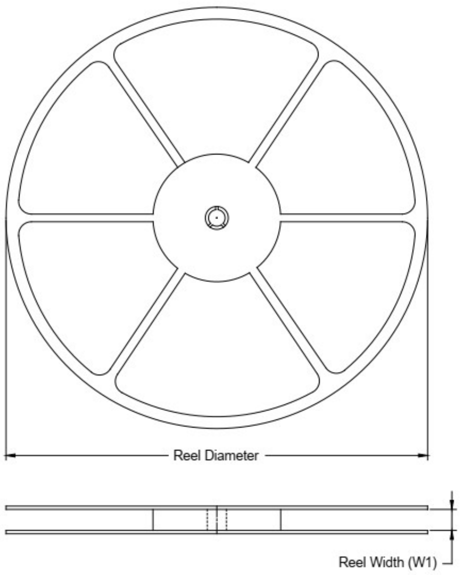
DP8 : DIP-8 **Unit: mm (inch)**



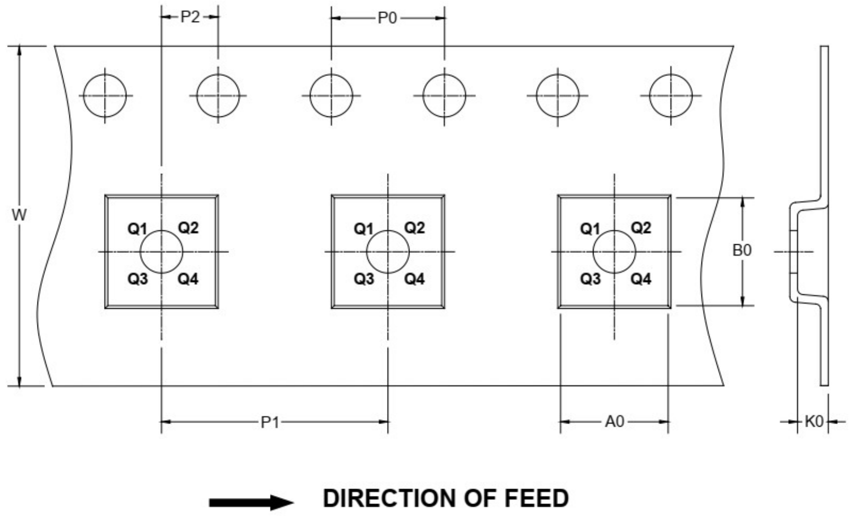
Note: Eject hole, oriented hole and mold mark is optional.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS

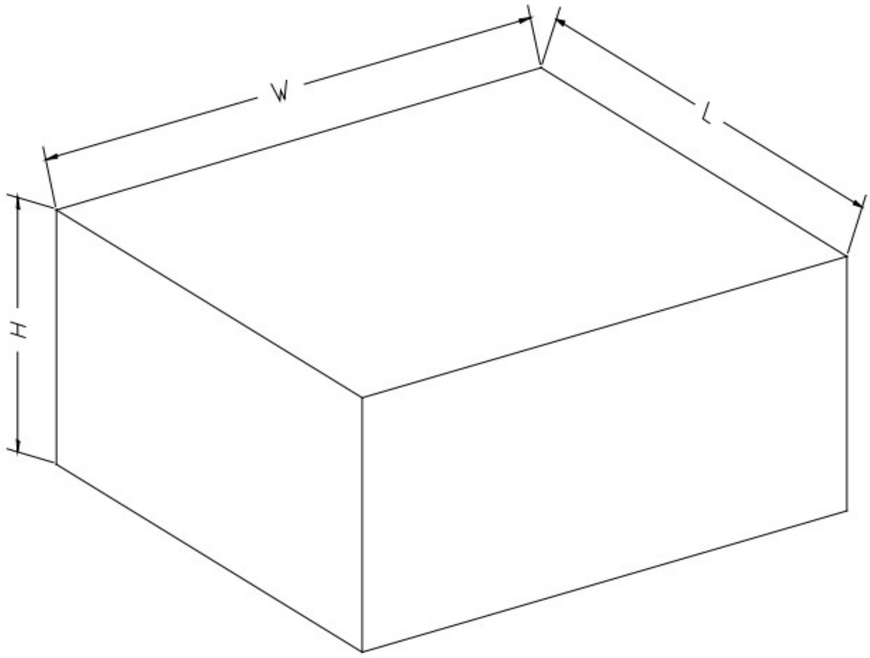


NOTE: The picture is only for reference. Please make the object as the standard.

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

CARTON BOX DIMENSIONS



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

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
13″	386	280	370	5