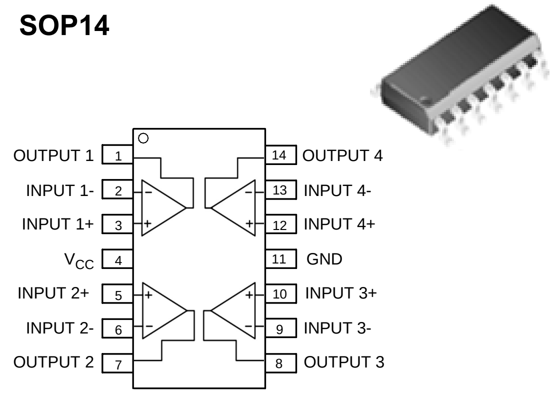
1.1MHz, 45μA, Rail-to-Rail I/O CMOS Operational Amplifiers

LMV324

DESCRIPTION

The LMV324(quad) are rail- to- rail input and output voltage feedback amplifiers offering low cost. They have a wide input common-mode voltage range and output voltage swing, and take the minimum operating supply voltage down to 2.1V.The maximum recommended supply voltage is 5.5V. temperature range.

The LMV324 provide 1.1MHz bandwidth at a low current consumption of 45μA per amplifier. Very low input bias currents of 10pA enable LMV324 to be used for integrators, photodiode amplifiers, and piezoelectric sensors. Rail-to-rail inputs and outputs are useful to designers buffering ASIC in single-supply systems. Applications for the series amplifiers include safety monitoring , portable equipment, battery and power supply control, and signal conditioning and interfacing for transducers in very low power systems.



Applications

- ASIC Input or Output Amplifier
- Sensor Interface
- Piezo Electric Transducer Amplifier
- Medical Instrumentation
- Mobile Communication
- Audio Output
- Portable Systems
- Smoke Detectors
- Notebook PC
- PCMCIA Cards
- Battery – Powered Equipment
- DSP Interface

Features

- Low Cost
- Rail- to- Rail Input and Output 0.8mV Typical VOS
- Unity Gain Stable
- Gain Bandwidth Product: 1.1MHz
- Very Low Input Bias Currents:10pA
- Operates on 2.1V to 5.5V Supplies
- Input Voltage Range: - 0.1V to +5.6V with VS = 5.5V
- Low Supply Current: < 70μA/Amplifier
- Small Packaging：LMV324 Available in SOP14

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V+ to V-..7.5V
Common-Mode Input Voltage.. ($-V_S$) - 0.5V to ($+V_S$) + 0.5V
Storage Temperature Range....................... ....–50℃ to +150℃
Junction Temperature...150℃
Operating Temperature Range..................... ……………………-40℃ to +85℃
Lead Temperature Range (Soldering 10 sec).............................260℃

ELECTRICAL CHARACTERISTICS

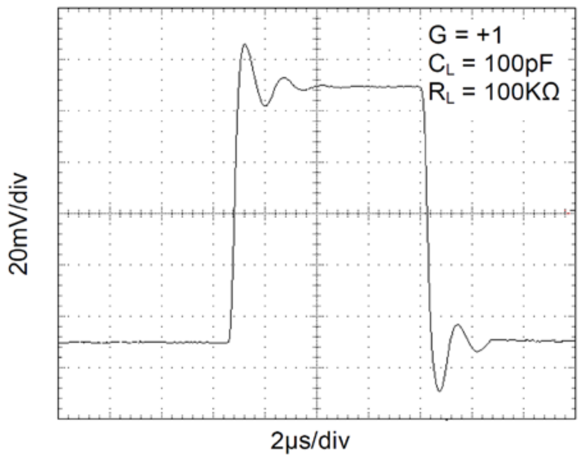
(At T_A=25℃, RL = 100KΩ connected to Vs/2, and VOUT = Vs/2, V_S=+5V,unless otherwise noted.)

PARAMETER	CONDITIONS	LMV324			
		TYP	MIN/MAX OVER TEMPERATURE		
				UNITS	MIN/ MAX
INPUT HARACTERISTICS					
Input Offset Voltage (V_{OS})		±0.8	±5	mV	MAX
Input Bias Current (I_B)		10		pA	TYP
Input Offset Current (I_{OS})		10		pA	TYP
Common-Mode Voltage Range (V_{CM})	VS=5.5V	-0.1to+5.6		V	TYP
Common-Mode Rejection Ratio (CMRR)	VS=5.5V, VCM=-0.1V to 4V	70	62	dB	MIN
	VS= 5.5V, VCM=-0.1V to 5.6V	68	56	dB	MIN
Open-Loop Voltage Gain (A_{OL})	RL= 5KΩ ,Vo=0.1V to 4.9V	80	70	dB	MIN
	RL=100KΩ,Vo=0.035V to 4.965V	84	80	dB	MIN
OUTPUT CHARACTERISTICS					
Output Voltage Swing from Rail	RL = 100KΩ	0.008		V	TYP
	RL = 10KΩ	0.08		V	TYP
Output Current (I_{OUT})		30	18	mA	MIN
POWER SUPPLY					
Operating Voltage Range			2.1	V	MIN
			5.5	V	MAX
Power Supply Rejection Ratio (PSRR)	Vs =+2.5V to + 5.5V VCM= (-VS) + 0.5V	82	60	dB	MIN
Quiescent Current / Amplifier (IQ)	IOUT = 0	45	75	µA	MAX
DYNAMIC PERFORMANCE					
Gain-Bandwidth Product (GBP)	CL= 100pF	1.1		MHz	TYP
Slew Rate (SR)	G = +1, 2V Output Step	0.5		V/µs	TYP
NOISE PERFORMANCE					
Voltage Noise Density (en)	f = 1kHz	27		n$\sqrt{Hz}$	TYP
	f = 10kHz	20		n$\sqrt{Hz}$	TYP

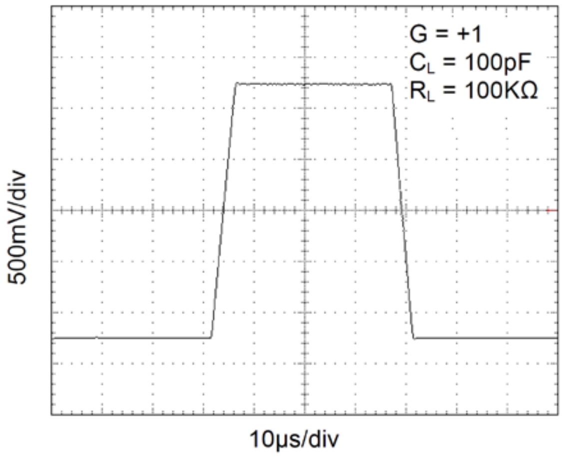
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_S = +5V, and R_L = 100KΩ connected to Vs/2, unless otherwise noted.

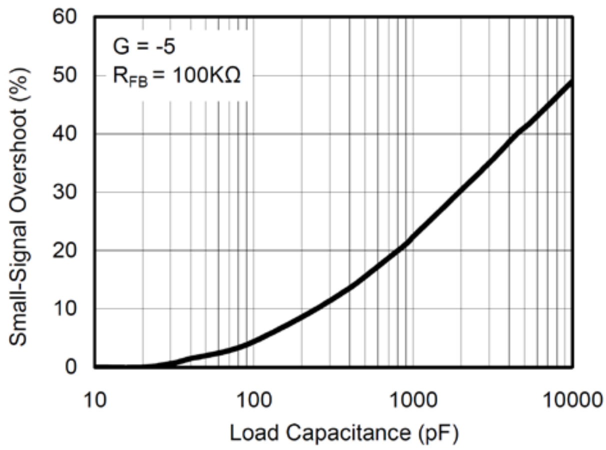
Small-Signal Step Response



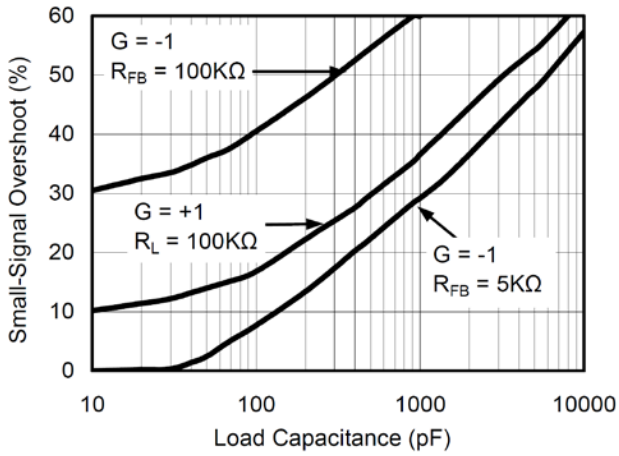
Large-Signal Step Response



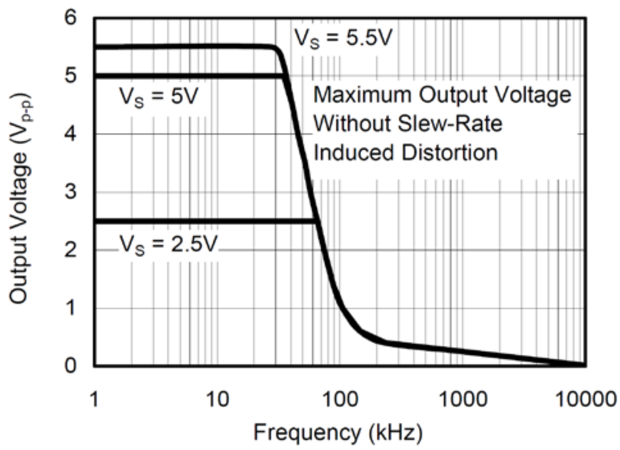
Small-Signal Overshoot vs. Load Capacitance



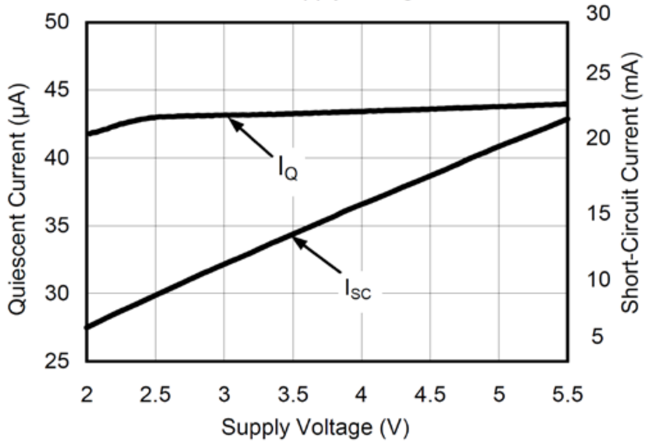
Small-Signal Overshoot vs. Load Capacitance

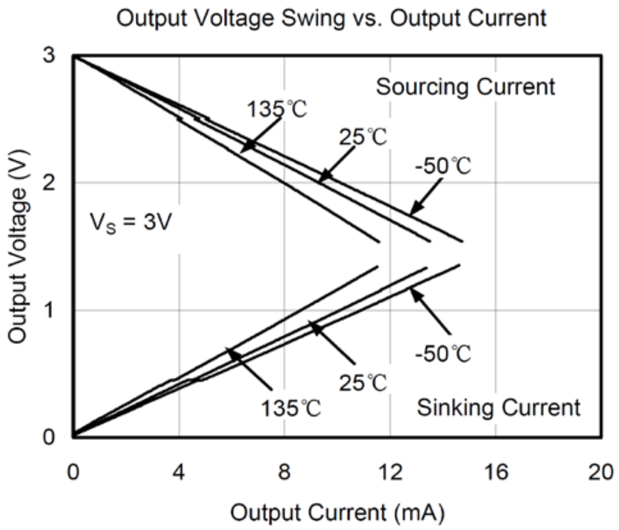


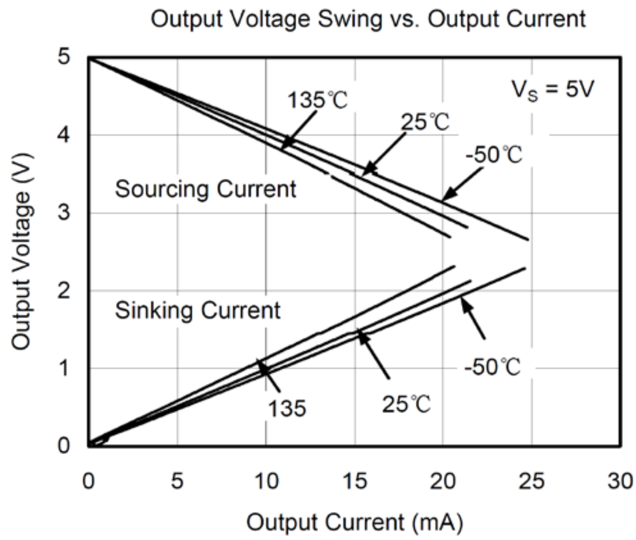
Maximum Output Voltage vs. Frequency



Quiescent and Short-Circuit Current vs. Supply Voltage

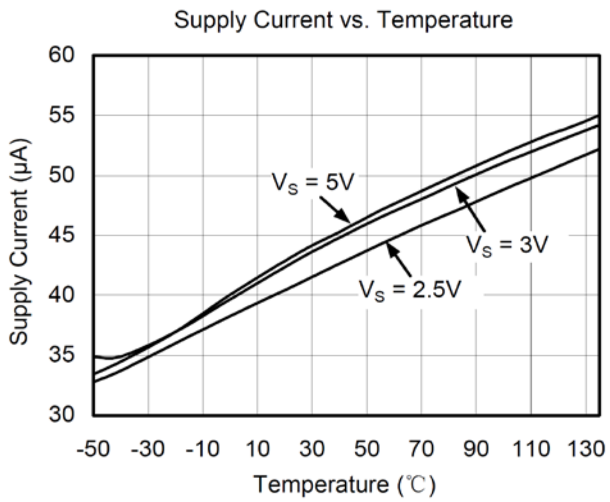


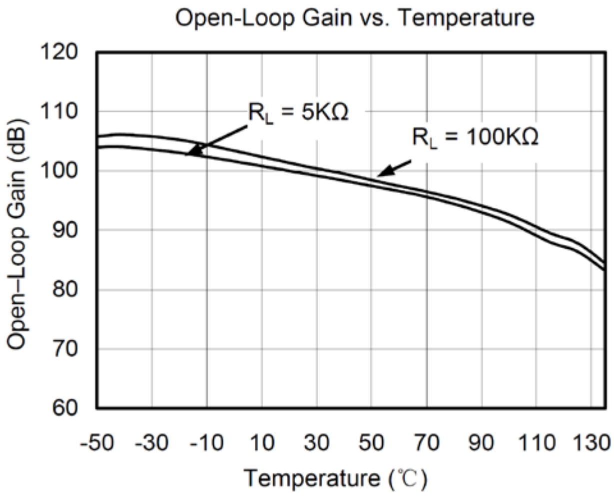


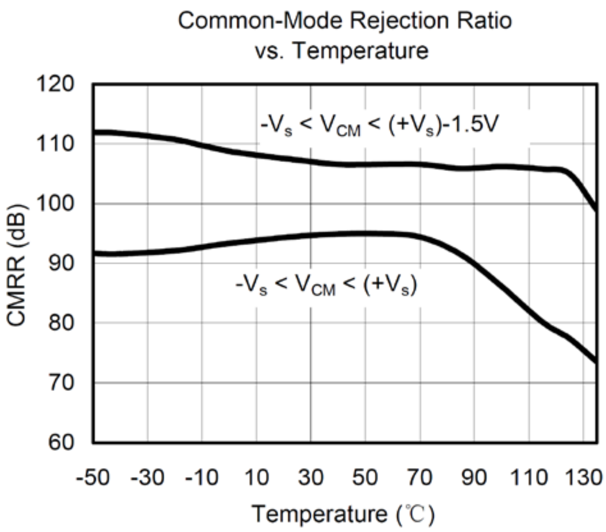


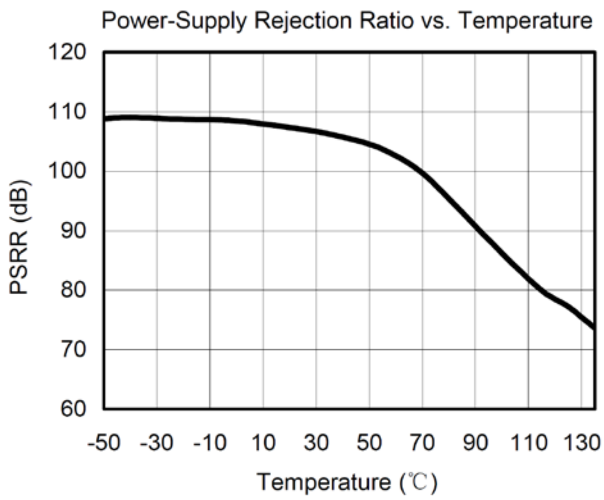
TYPICAL PERFORMANCE CHARACTERISTICS

At TA = +25℃, VS = +5V, and RL = 100KΩ connected to Vs/2, unless otherwise noted.









APPLICATION NOTES

Driving Capacitive Loads

The LMV324 can directly drive 250pF in unity-gain without oscillation. The unity-gain follower (buffer) is the most sensitive configuration to capacitive loading. Direct capacitive loading reduces the phase margin of amplifiers and this results in ringing or even oscillation.Applications that require greater capacitive drive capability should use an isolation resistor between the output and the capacitive load like the circuit in Figure 1. The isolation resistor RISO and the load capacitor CL form a zero to increase stability. The bigger the R_{ISO} resistor value, the more stable VOUT will be. Note that this method results in a loss of gain accuracy because R_{ISO} forms a voltage divider with the R_{LOAD}.

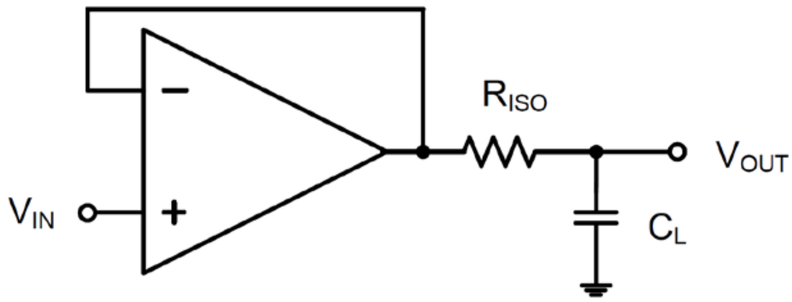


Figure 1. Indirectly Driving Heavy Capacitive Load

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.

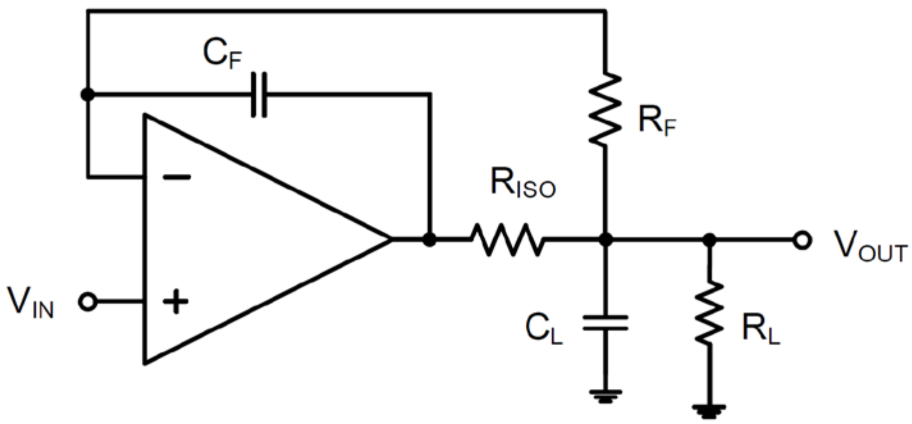


Figure 2. Indirectly Driving Heavy Capacitive Load with DC Accuracy

For no-buffer 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.

Typical Application

Power-Supply Bypassing and Layout

The LMV324 family operates from either a single +2.5V to +5.5V supply or dual ±1.25V to ±2.75V supplies. For single-supply operation, bypass the power supply VDD with a 0.1μF ceramic capacitor which should be placed close to the VDD pin. For dual-supply operation, both the VDD and the VSS supplies should be bypassed to ground with separate 0.1μF ceramic capacitors. 2.2μF tantalum capacitor can be added for better performance.

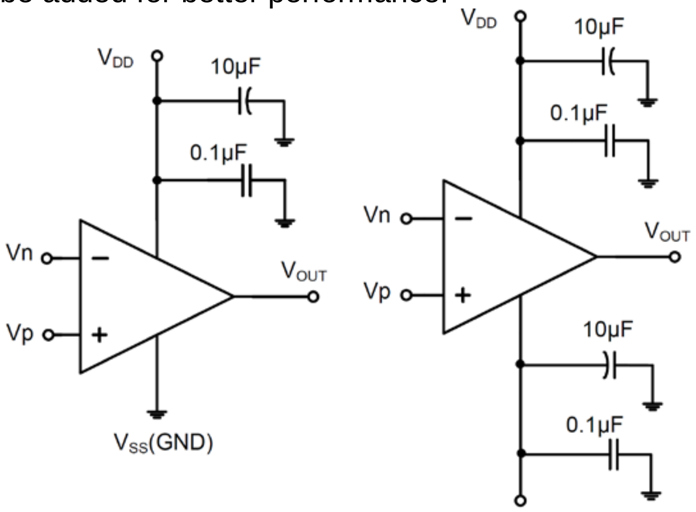


Figure 3. Amplifier with Bypass Capacitors

TYPICAL APPLICATION CIRCUITS

Differential Amplifier

The circuit shown in Figure 4 performs the difference function. If the resistors ratios are equal (R4 / R3 = R2 / R1), then VOUT = (Vp – Vn) × R2 / R1 + VREF.

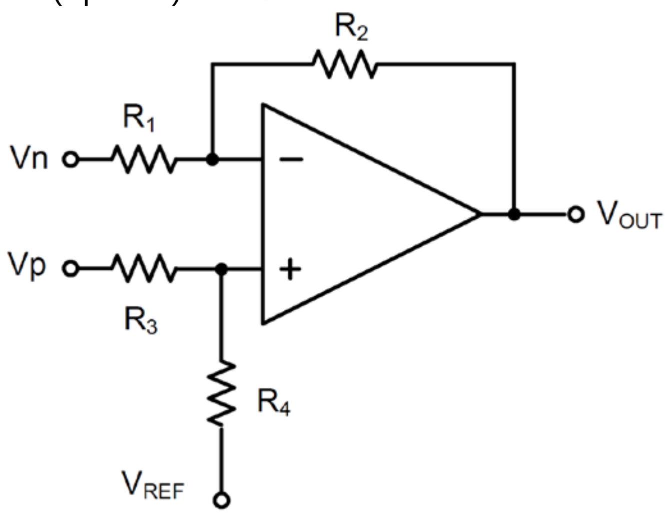


Figure 4. Differential Amplifier

Instrumentation Amplifier

The circuit in Figure 5 performs the same function as that in Figure 4 but with the high input impedance.

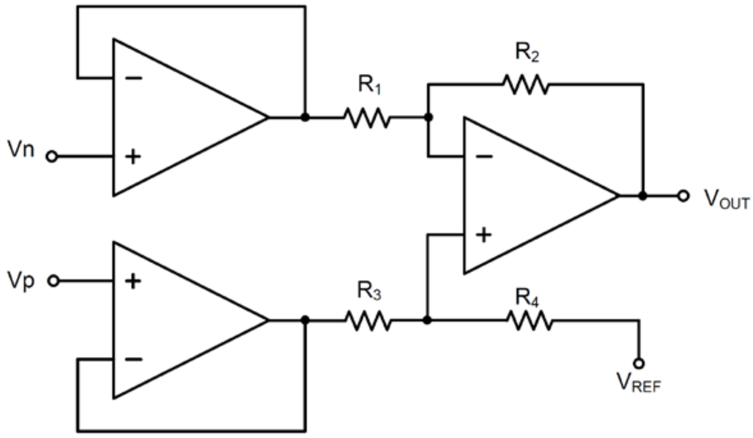


Figure 5. Instrumentation Amplifier

Low Pass Active Filter

The low pass filter shown in Figure 6 has a DC gain of (-R2 / R1) and the –3dB corner frequency is 1/2πR2C. Make sure the filter is within the bandwidth of the amplifier. 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.

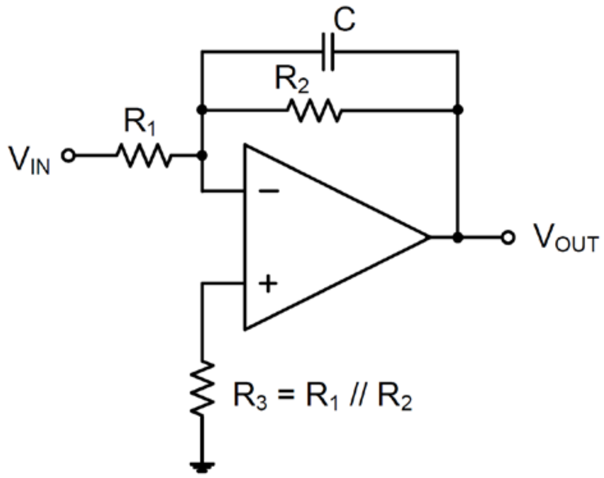
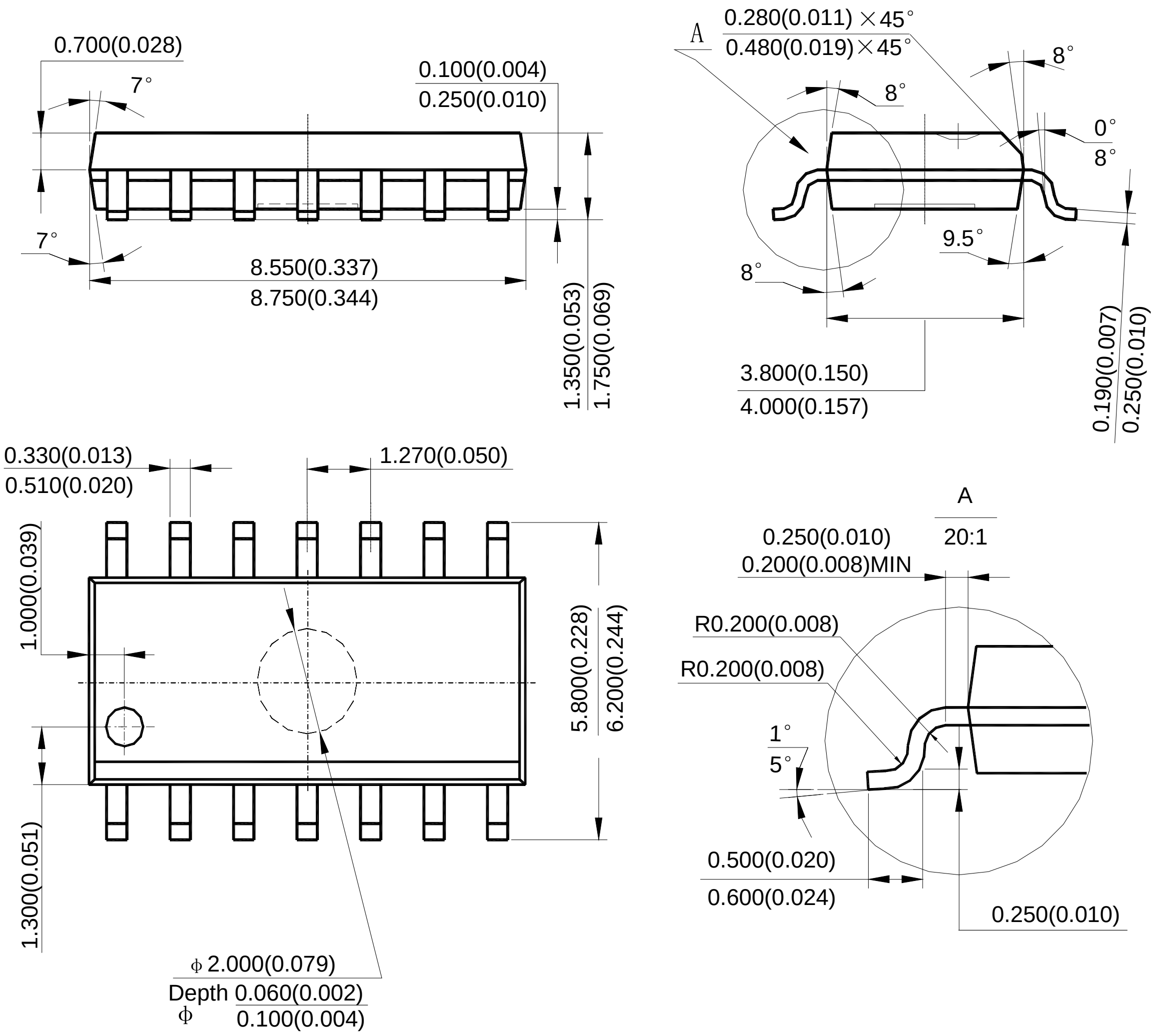


Figure 6. Low Pass Active Filter

Unit: mm(inch)



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