

Low Power Single Operational Amplifier

Features

- Large DC voltage gain:90dB
- Gain-bandwidth product: 1.1MHz
- Input Voltage Range:-0.1V ~ +5.6V with Vs=5.5V
- Low supply current:40μA(Typ.)
- Supply Voltage range:2.1V~5.6V
- Low offset voltage: ± 0.8 (TYP)
- Slew rate:0.6V/μs(TYP)
- Operating temperature range: -40°C ~ +85°C

Applications

- Active filter
- Electronic instrumentation
- General purpose low voltage
- Smoke detectors
- Battery-powered equipment

General Description

The LMV321IDBVR are low cost, rail-to-rail input and output voltage feedback amplifiers. 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. All are specified over the extended -40°C to +85°C, temperature range.

LMV321IDBVR provide 1.1MHz bandwidth at a low current consumption of 40μA per amplifier. Very low input bias currents of 10pA enable LMV321IDBVR to be used for integrators, photodiode amplifiers, and piezoelectric sensors. Rail-to-Rail input and output are useful to designers for buffering ASIC in single-supply systems.

Applications for this series of amplifiers include safety monitoring, portable equipment, battery and power supply control, and signal conditioning and interfacing for transducers in very low power systems.

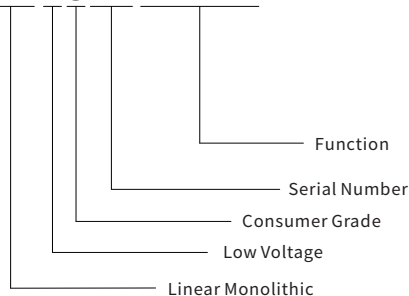
The LMV321IDBVR is available in the SOT-23-5L package.

Reference News

Marking: RC1+DC

Part Numbering

LMV321IDBVR



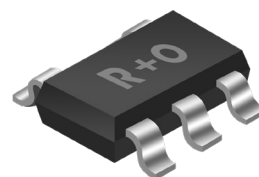
Supply Voltage

6V

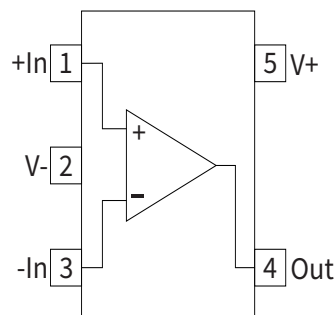
Offset Voltage

± 0.8 mV(Typ.)

SOT-23-5L



Pin Configuration



● Ordering Information

Order Number	Package	Package Code	Unit Weight(g)	Reel(pcs)	Box(pcs)	Carton(pcs)	Delivery Mode	MSL
LMV321IDBVR	SOT-23-5L	R1	0.0146	3000	30000	120000	7"	3

● Absolute Maximum Ratings ⁽¹⁾ ($T_A=25^{\circ}\text{C}$ Unless otherwise specified.)

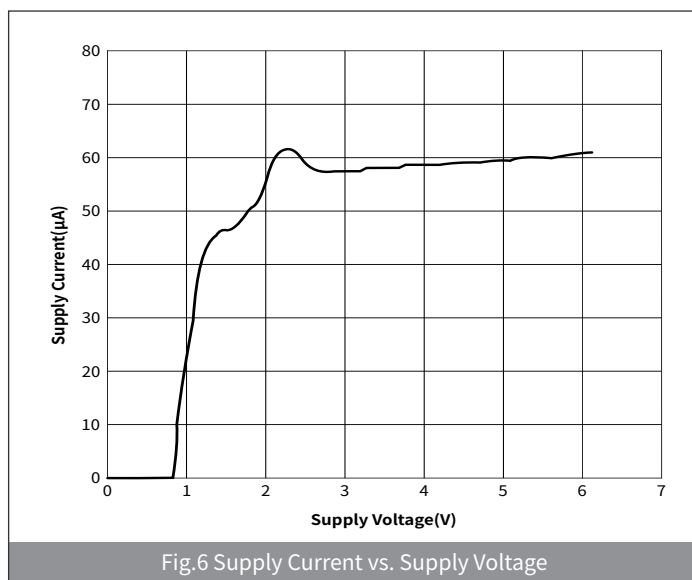
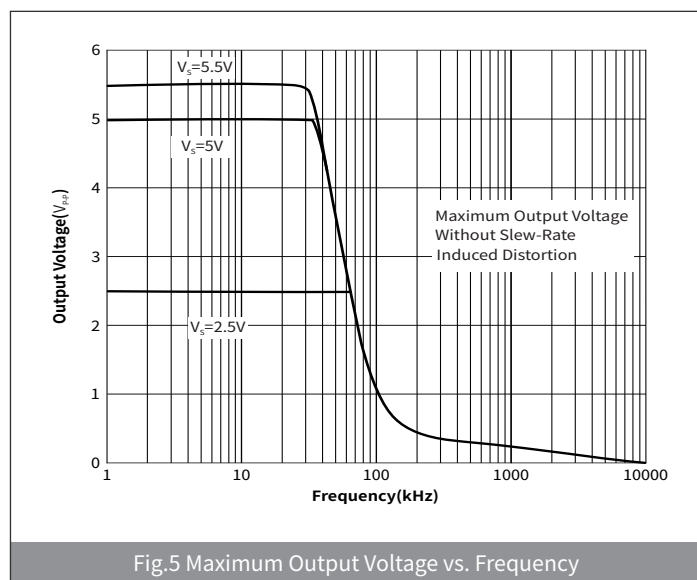
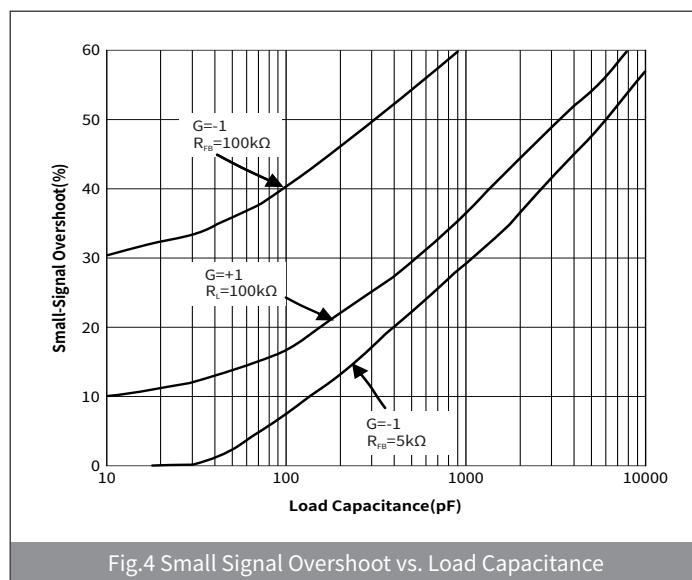
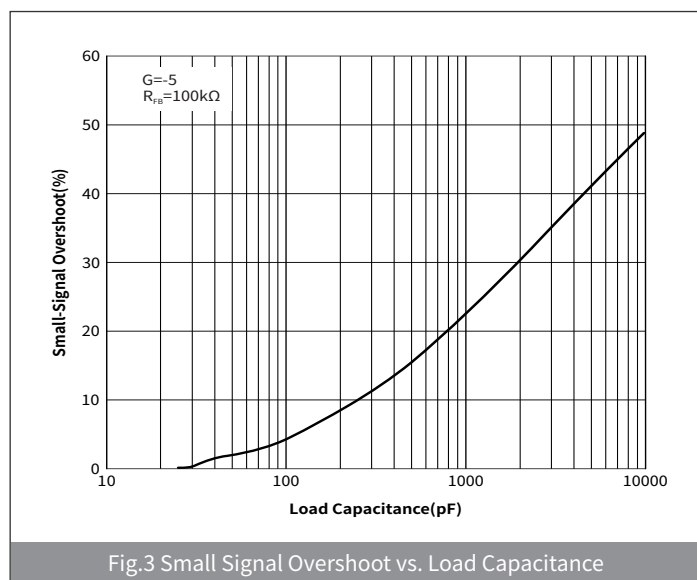
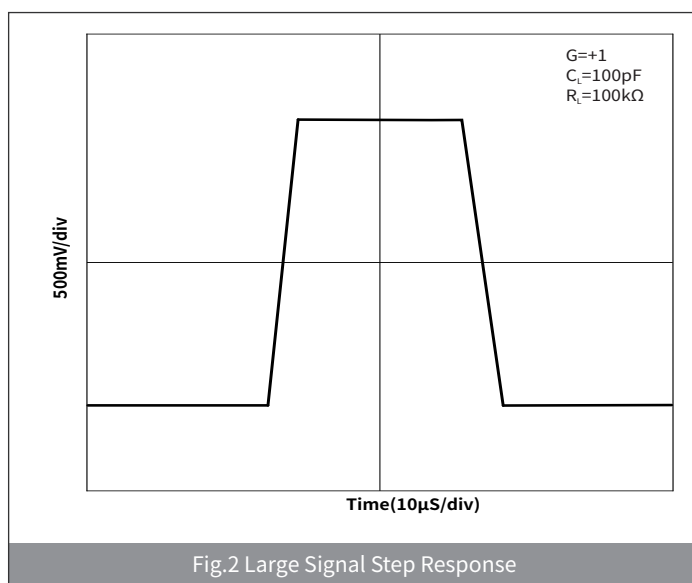
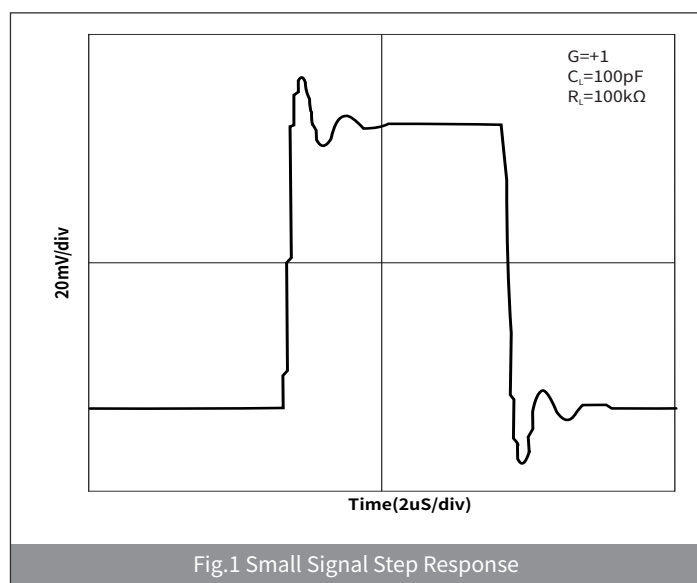
Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	6	V
All Input and Output Voltage	$V_{IN/OUT}$	$V_{-}-0.3$ to $V_{+}+0.3$	V
Junction Temperature	T_J	150	$^{\circ}\text{C}$
Operating Temperature Range	T_{OPR}	-40 to 85	$^{\circ}\text{C}$
Storage Temperature Range	T_{STG}	-65 to 150	$^{\circ}\text{C}$
Lead Temperature(Soldering,10s)	T_{LEAD}	260	$^{\circ}\text{C}$
Thermal Resistance to Ambient	$R_{\theta JA}$	190	$^{\circ}\text{C}/\text{W}$
ESD Rating(Human Body Model)	ESD(HBM)	4	kV
Machine Model ESD Protection	ESD(MM)	400	V

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

● **Electrical Characteristics** ($T_A=25^{\circ}\text{C}$, At $V_S=+5\text{V}$, $R_L=100\text{k}\Omega$ connected to $V_S/2$, and $V_{out}=V_S/2$. Unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
AC Specifications						
Gain-Bandwidth Product	GBW	--	--	1.1	--	MHz
Slew Rate	SR	G=+1.2V Output Step	--	0.6	--	V/μs
Settling Time to 0.1%	t _s	G=+1.2V Output Step	--	5.3	--	μs
Overload Recovery Time	--	V _{IN} *G=Vs	--	2.6	--	μs
Input Voltage Noise	e _N	f=1KHz	--	27	--	nV/ √ Hz
		f=10KHz	--	20	--	nV/ √ Hz
DC Characteristics						
Input Offset Voltage	V _{OS}	V _{CM} =V _S /2	--	±0.8	±5.0	mV
Input Bias Current	I _B	--	--	±10	--	pA
Input Offset Current	I _{OS}	--	--	±10	--	pA
Operating Voltage Rang	V _S	--	2.1	--	5.5	V
Power Supply Rejection Ratio	PSRR	V _S =2.5V to 5.5V,V _{CM} =+0.5V	60	82	--	dB
Quiescent Current per Amplifier	I _Q	--	--	40	--	μA
Large signal voltage gain	A _{VOL}	R _L =5kΩ, V ₀ =+0.1V to +4.9V	70	90	--	dB
		R _L =100kΩ, V ₀ =+0.035V to +4.965V	80	94	--	dB
Input Offset Voltage Drift	△ V _{OS} / △ T	--	--	2.7	--	μV/°C
Input Characteristics						
Common-mode Input Voltage Range	V _{CMR}	V _S =5.5V	-0.1	--	+5.6	V
Common Mode Rejection Ratio	CMRR	V _S =5.5V,V _{CM} =-0.1V to 4V	62	90	--	dB
		V _S =5.5V,V _{CM} =-0.1V to 5.6V	56	88	--	dB
Output Characteristics						
Output Source Current	I _{O+}	R _L =10Ω to V _S /2	60	84	--	mA
Output Sink Current	I _{O-}	R _L =10Ω to V _S /2	60	75	--	mA
Output voltage swing	V _{OH}	R _L =100kΩ	4.980	4.997	--	V
		R _L =10kΩ	4.970	4.992	--	V
	V _{OL}	R _L =100kΩ	--	5	20	mV
		R _L =10kΩ	--	10	30	mV

● **Typical Performance Characteristics**($T_A=25^{\circ}\text{C}$, $V_S=+5\text{V}$, and $R_L=100\text{k}\Omega$ connected to $V_S/2$, Unless otherwise specified.)



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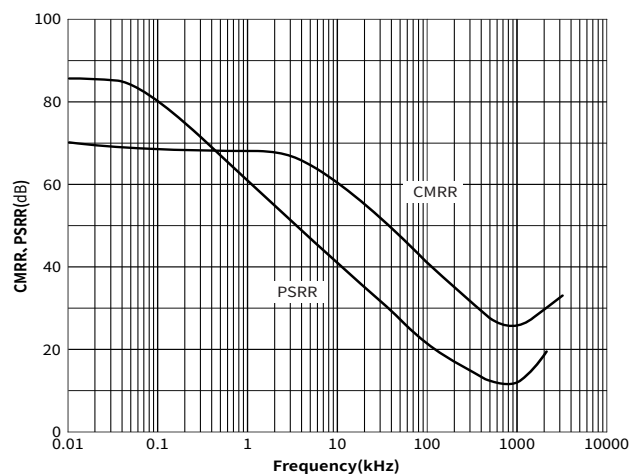


Fig.7 CMRR and PSRR vs. Frequency

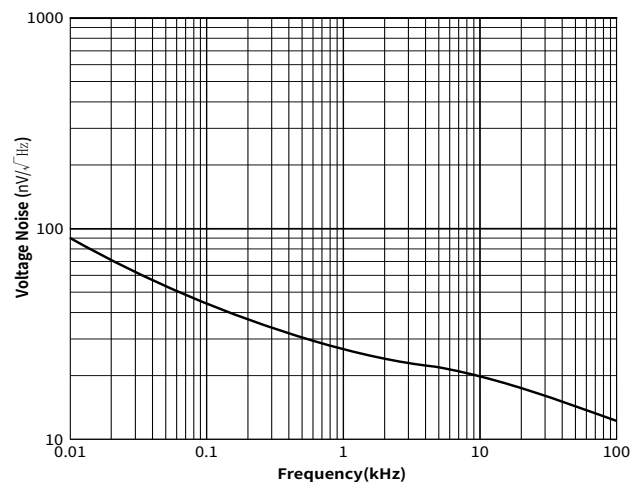


Fig.8 Input Voltage Noise Spectral Density vs. Frequency

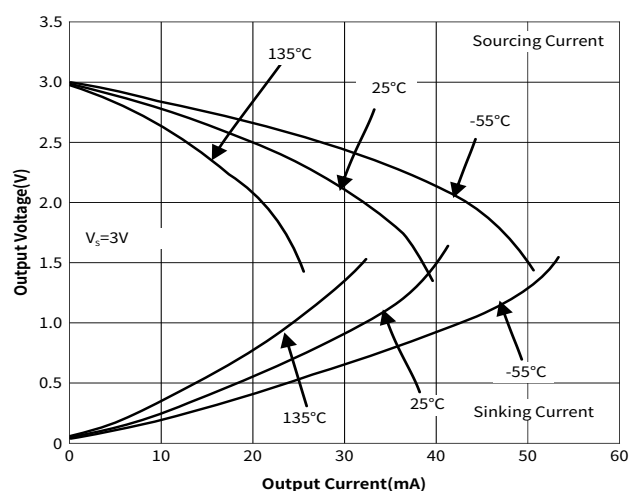


Fig.9 Output Voltage vs. Output Current

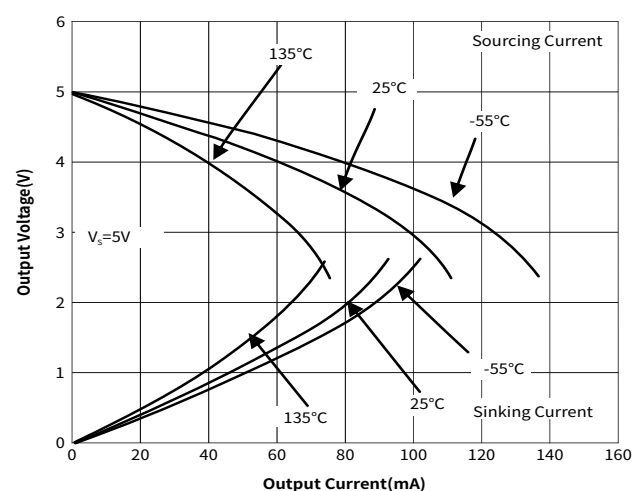


Fig.10 Output Voltage vs. Output Current

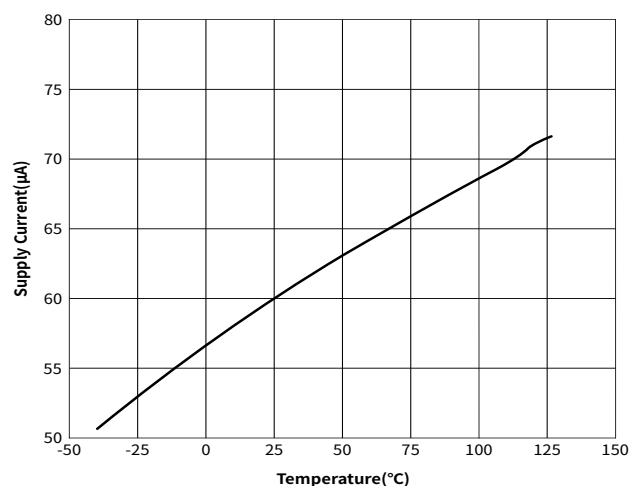


Fig.11 Supply Current vs. Temperature

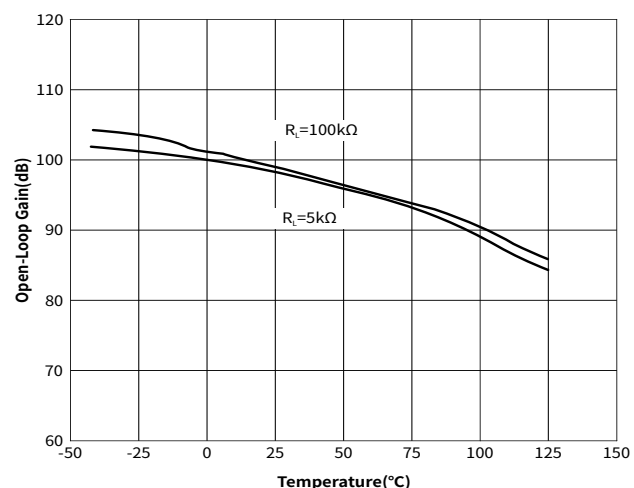
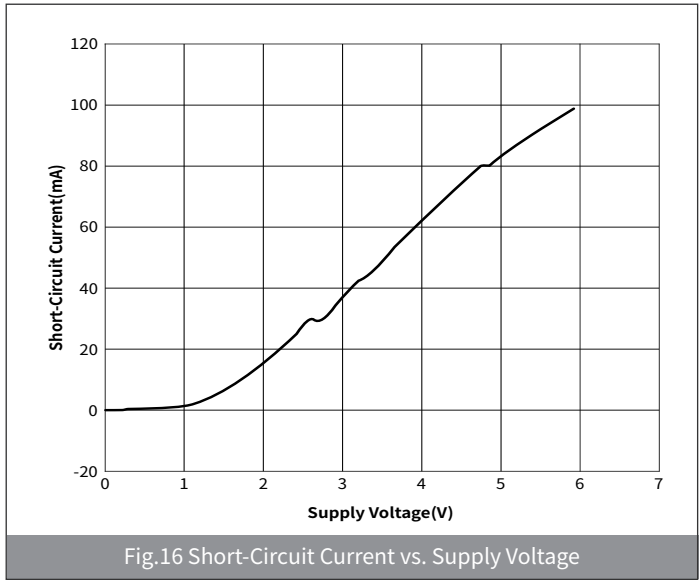
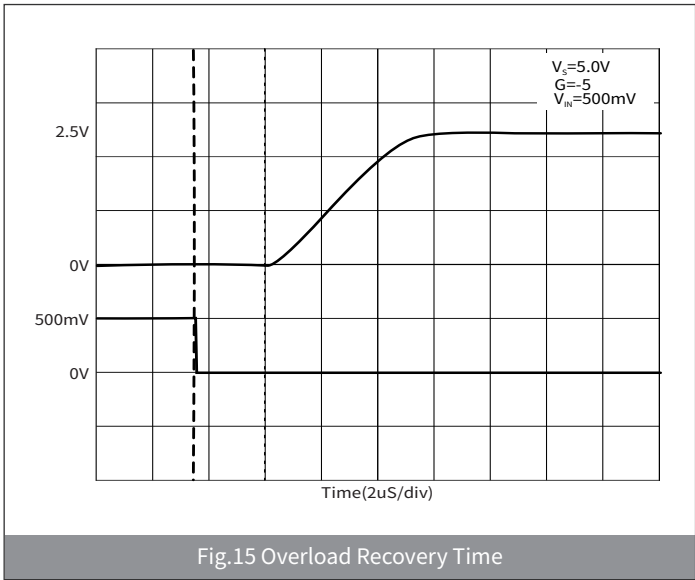
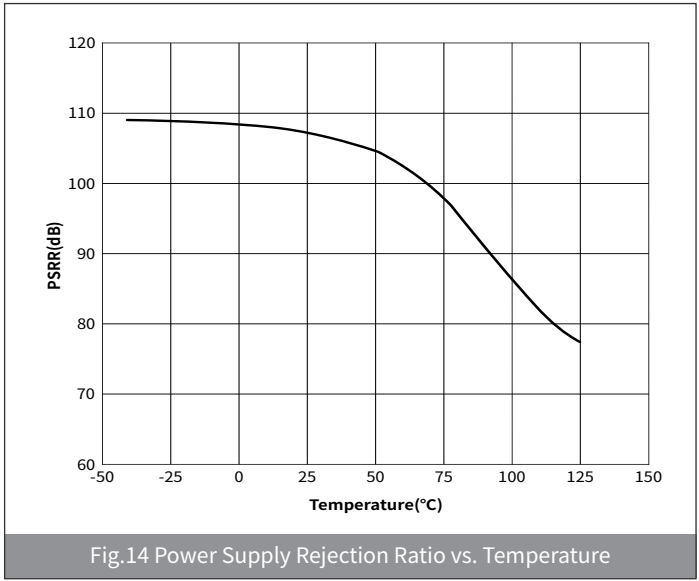
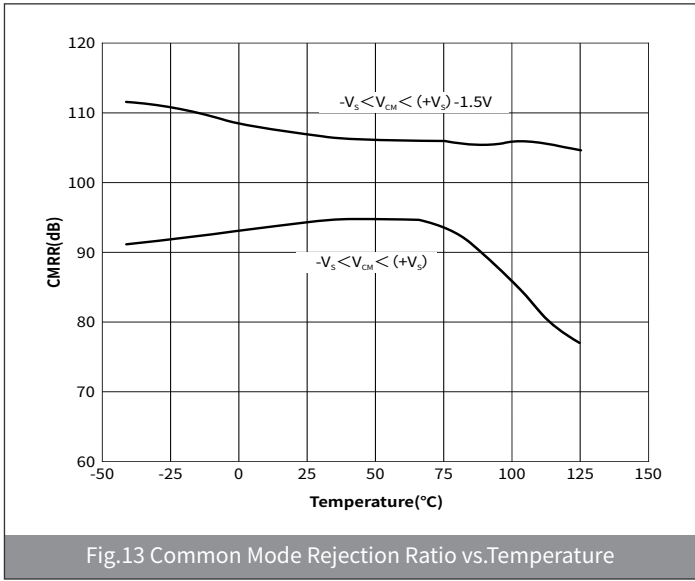


Fig.12 Open-Loop Gain vs. Temperature

● Typical Performance Characteristics($T_A=25^{\circ}\text{C}$, $V_S=+5\text{V}$, and $R_L=100\text{k}\Omega$ connected to $V_S/2$, Unless otherwise specified.)



● Application Note

Driving Capacitive Loads

The LMV321IDBVR can directly drive 250pF in unity-gain without oscillation. The unitygain follower(buffer) is the most sensitive configuration to capacitive loading. Direct capacitive loading reduces the phase margin of amplifiers & this results in ringing or even oscillation. Applications that require greater capacitive driving capability should use an isolation resistor between the output and the capacitive load like the circuit in Figure 3. The isolation resistor R_{ISO} and the load capacitor C_L form a zero to increase stability. The bigger the R_{ISO} resistor value, the more stable V_{OUT} will be. Note that this method results in a loss of gain accuracy because R_{ISO} forms a voltage divider with the R_{LOAD} .

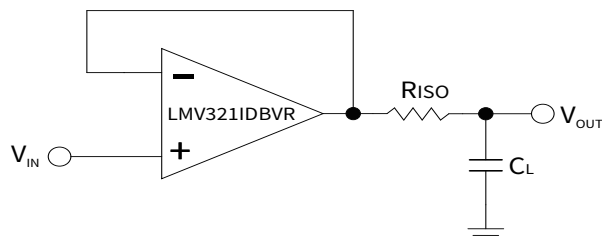


Figure 3, Indirectly Driving Heavy Capacitive Load

An improved circuit is shown in Figure 4. It provide DC accuracy as well as AC stability. R_F provides the DC accuracy by connecting the inverting input 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.

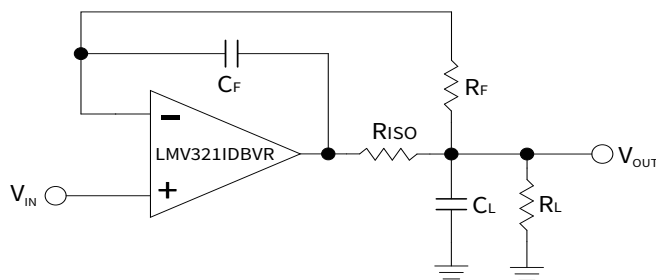


Figure 4, Indirectly Driving Heavy Capacitive Load with DC Accuracy

For non-buffer configuration. There are two other ways to increase the phase margin: (a) by increasing the amplifier's closed-loop gain or (b) by placing a capacitor in parallel with the feedback resistor to counteract the parasitic capacitance associated with inverting node.

Power-Supply Bypassing and Layout

The LMV321IDBVR can operate from either a single +2.1V to +5.5V supply or dual $\pm 1.05V$ to $\pm 2.75V$ supplies. For single-supply operation bypass the power supply +Vs with a 0.1 μF 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 μF ceramic capacitors. 2.2 μF tantalum capacitor can be added for better performance.

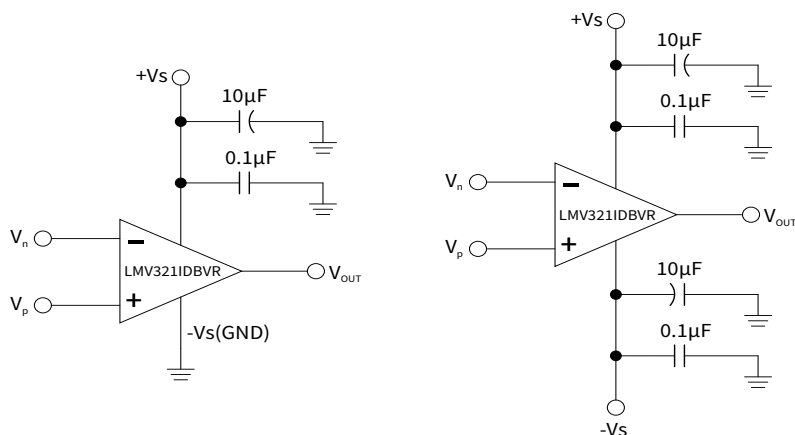


Figure 5, Amplifier with Bypass Capacitors

● Application Note

Differential Amplifier

The circuit shown in Figure 6 performs the difference function. If the resistor ratios are equal to $(R_4/R_3=R_2/R_1)$ then $V_{OUT}=(V_P-V_n) \times R_2/R_1+V_{REF}$.

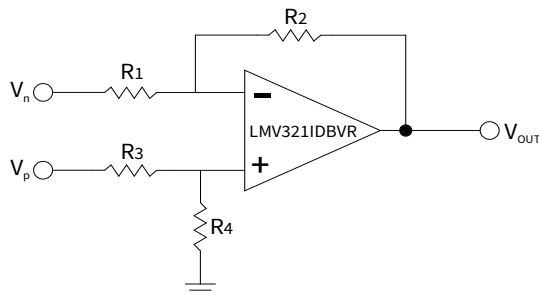


Figure 6, Differential Amplifier

Instrumentation Amplifier

The circuit in Figure 7 performs the same function as that in Figure 6 but with a high input impedance.

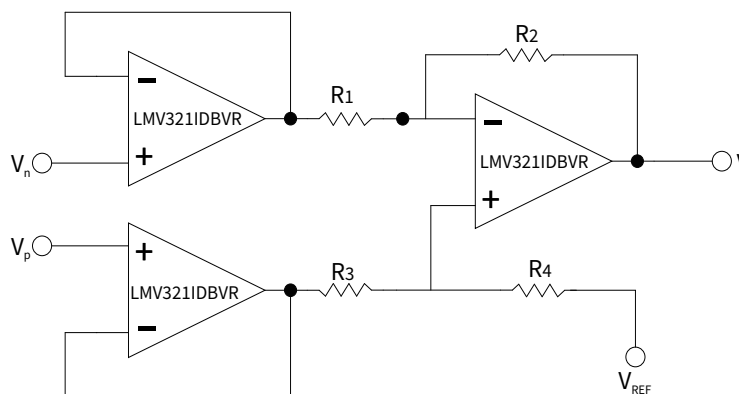


Figure 7, Instrumentation Amplifier

Low-Pass Active Filter

The low-pass filter shown in Figure 8 has a DC gain of $(-R_2/R_1)$ and the -3dB corner frequency is $1/2\pi R_2 C$. make sure the filter bandwidth 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 resistor values as low as possible and consistent with output loading consideration.

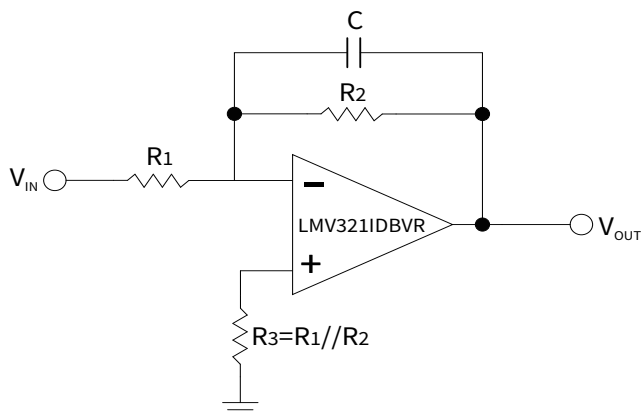


Figure 8, Low-Pass Active Filter

● Package Outline Dimensions (SOT-23-5L)

Symbol	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	1.05	1.25	0.041	0.049
A1	0	0.13	0.000	0.005
A2	1.05	1.15	0.041	0.045
b	0.3	0.5	0.012	0.020
c	0.10	0.2	0.004	0.008
D	2.82	3.02	0.111	0.119
E	1.50	1.70	0.059	0.067
E1	2.65	2.95	0.104	0.116
e	0.95 BSC		0.037BSC	
e1	1.90 BSC		0.075 BSC	
L	0.3	0.60	0.012	0.024
θ	0	8°	0	8°

● Suggested Pad Layout

Symbol	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
X	0.85	0.85	0.033	0.033
Y	0.90	1.10	0.035	0.043
M	0.85	1.05	0.033	0.041
M1	1.80	2.0	0.071	0.079
N	2.3	2.5	0.091	0.098