Low-Voltage Rail-to-Rail Output Operational Amplifie

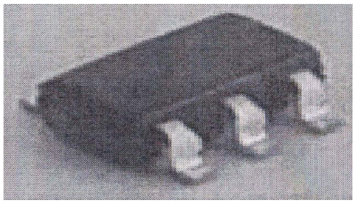
(compatible to LMV321)

Features

- 2.7-V and 5-V performance
- –40°C to +125°C operation
- No crossover distortion
- Low supply current
  - LMV321B: 330 μA (typical)
- Rail-to-rail output swing
- ESD protection exceeds JESD 22
  - 2000-V human-body model
  - 1000-V charged-device model

Applications

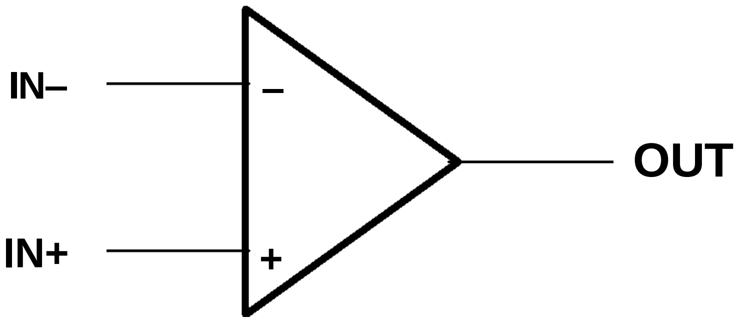
- Desktop PCs
- HVAC: heating, ventilating, and air conditioning
- Motor control: AC induction
- Netbooks
- Portable media players
- Power: telecom DC/DC module: digital
- Professional audio mixers
- Refrigerators
- Washing machines: high-end and low-end



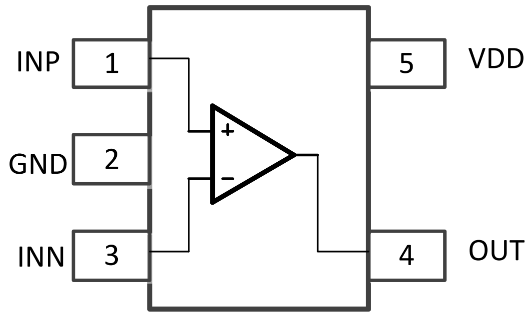
ORDERING INFORMATION

LMV321BRTZ SOT23-5

T_A = -40° to 125°C for all packages.



Pin Configuration and Functions



SOT23-5

Name	I/O	Analog/Digital	Description
INP	I	A	Non-Inverting Input of Amplifier. Voltage range of this pin can go from 0 to VDD.
GND	GROUND	GROUND	Ground pin. Connect to the most negative supply, ALL GND pads are connected on die.
INN	I	A	Inverting Input of Amplifier. This pin has same voltage range as INP.
OUT	O	A	Amplifier Output. The voltage range extends to within millivolts of each supply rail.
VDD	POWER	POWER	Power supply (5V) ,connect to positive voltage supply

Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) [1]

			MIN	MAX	UNIT
V_{CC}	Supply voltage[2]			5.5	V
V_{ID}	Differential input voltage[3]		–5.5	5.5	V
V_I	Input voltage (either input)		–0.2	5.7	V
	Duration of output short circuit (one amplifier) to ground[4]	At or below T_A = 25°C, V_{CC} ≤ 5.5 V	Unlimited		
T_J	Operating virtual junction temperature			150	°C
T_{stg}	Storage temperature		–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values (except differential voltages and V_{CC} specified for the measurement of I_{OS}) are with respect to the network GND.
(3) Differential voltages are at IN+ with respect to IN–.
(4) Short circuits from outputs to V_{CC} can cause excessive heating and eventual destruction.

ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins[1]	±2000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101, all pins[2]	±1000	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Electrical Characteristics: V_{CC}+ = 2.7 V

V_{CC+} = 2.7 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP[1]	MAX	UNIT
V_{IO}	Input offset voltage				1.7	7	mV
α_{VIO}	Average temperature coefficient of input offset voltage				5		µV/°C
I_{IB}	Input bias current				11	250	nA
I_{IO}	Input offset current				5	50	nA
CMRR	Common-mode rejection ratio	V_{CM} = 0 to 1.7 V		50	63		dB
k_{SVR}	Supply-voltage rejection ratio	V_{CC} = 2.7 V to 5 V, V_O = 1 V		50	60		dB
V_{ICR}	Common-mode input voltage range	CMRR ≥ 50 dB		0	–0.2		V
					1.9	1.7	
V_O	Output swing	R_L = 10 kΩ to 1.35 V	High level	V_{CC} – 100	V_{CC} – 10		mV
			Low level		60	180	
B_1	Unity-gain bandwidth	C_L = 200 pF			1.5		MHz
Φ_m	Phase margin				60		°
G_m	Gain margin				10		dB
V_n	Equivalent input noise voltage	f = 1 kHz			46		nV/√Hz
I_n	Equivalent input noise current	f = 1 kHz			0.17		pA/√Hz

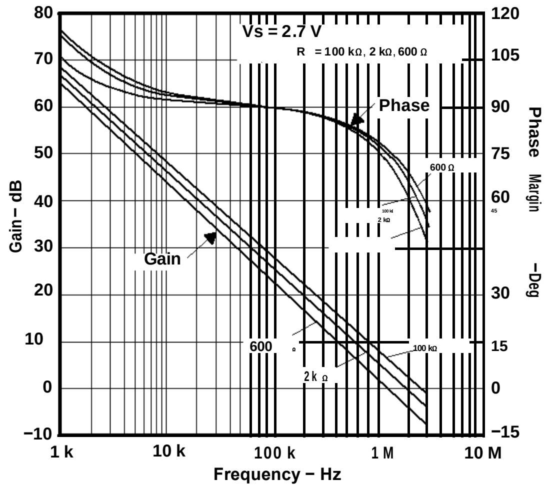
(1) Typical values represent the likely parametric nominal values determined at the time of characterization. Typical values depend on the application and configuration and may vary over time. Typical values are not ensured on production material.

Electrical Characteristics: V_{CC}+ = 5 V

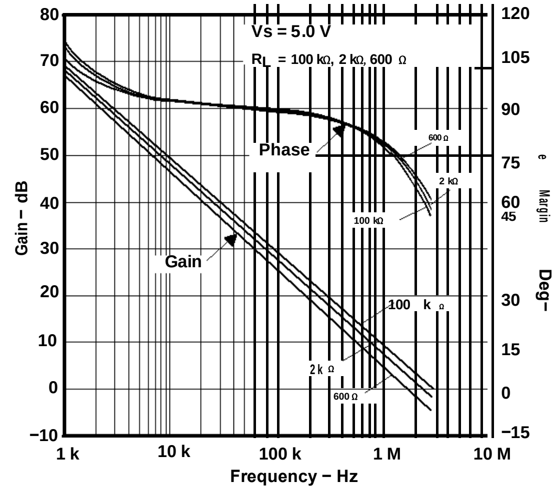
V_{CC+} = 5 V, at specified free-air temperature (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	MIN	TYP[(1)]	MAX	UNIT
V_{IO}	Input offset voltage	T_A = 25°C		1.7	3	mV
		T_A = –40°C to +125°C			7	
α_{VIO}	Average temperature coefficient of input offset voltage	T_A = 25°C		5		μV/°C
I_{IB}	Input bias current	T_A = 25°C		15	250[(2)]	nA
		T_A = –40°C to +125°C			500[(2)]	
I_{IO}	Input offset current	T_A = 25°C		5	50[(2)]	nA
		T_A = –40°C to +125°C			150[(2)]	
CMRR	Common-mode rejection ratio	V_{CM} = 0 to 4 V, T_A = 25°C	50	65		dB
k_{SVR}	Supply-voltage rejection ratio	V_{CC} = 2.7 V to 5 V, V_O = 1 V, V_{CM} = 1 V, T_A = 25°C	50	60		dB
V_{ICR}	Common-mode input voltage range	CMRR ≥ 50 dB, T_A = 25°C	0	–0.2		V
				4.2	4	
V_O	Output swing	R_L = 2 kΩ to 2.5 V, high level, T_A = 25°C	V_{CC} – 300	V_{CC} – 40		mV
		R_L = 2 kΩ to 2.5 V, high level, T_A = –40°C to +125°C	V_{CC} – 400[(2)]			
		T_A = 25°C, low level		120	300	
		T_A = –40°C to +125°C, low level			400[(2)]	
		R_L = 10 kΩ to 2.5 V, high level, T_A = 25°C	V_{CC} – 100	V_{CC} – 10		
		R_L = 10 kΩ to 2.5 V, high level, T_A = –40°C to +125°C	V_{CC} – 200[(2)]			
		T_A = 25°C, low level		65	180	
		T_A = –40°C to +125°C, low level			280[(2)]	
A_{VD}	Large-signal differential voltage gain	R_L = 2 kΩ, T_A = 25°C	15	100		V/mV
		R_L = 2 kΩ, T_A = –40°C to +125°C	10[(2)]			
I_{OS}	Output short-circuit current	Sourcing, V_O = 0 V, T_A = 25°C	5[(2)]	40		mA
		Sinking, V_O = 5 V, T_A = 25°C	10[(2)]	40		
B_1	Unity-gain bandwidth	C_L = 200 pF, T_A = 25°C		1.5		MHz
Φ_m	Phase margin	T_A = 25°C		60		°
G_m	Gain margin	T_A = 25°C		10		dB
V_n	Equivalent input noise voltage	f = 1 kHz, T_A = 25°C		39		nV/√Hz
I_n	Equivalent input noise current	f = 1 kHz, T_A = 25°C		0.21		pA/√Hz
SR	Slew rate	T_A = 25°C		1		V/μs

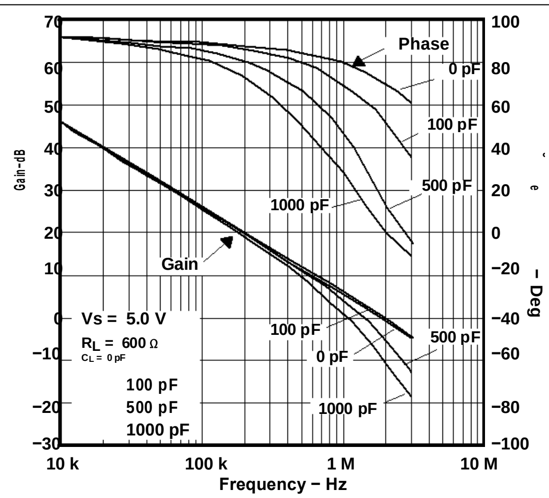
Typical Characteristics



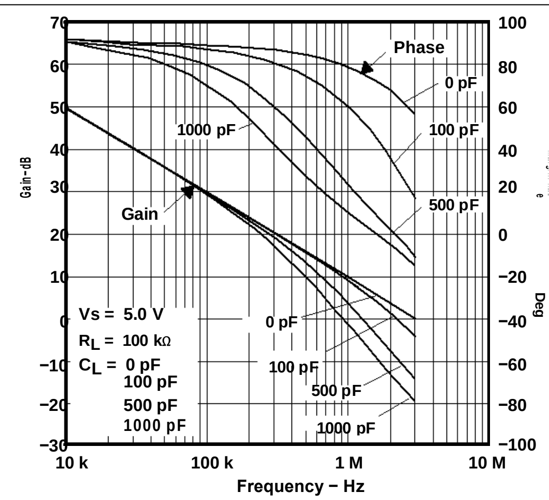
LMV321B Frequency Response vs Resistive Load



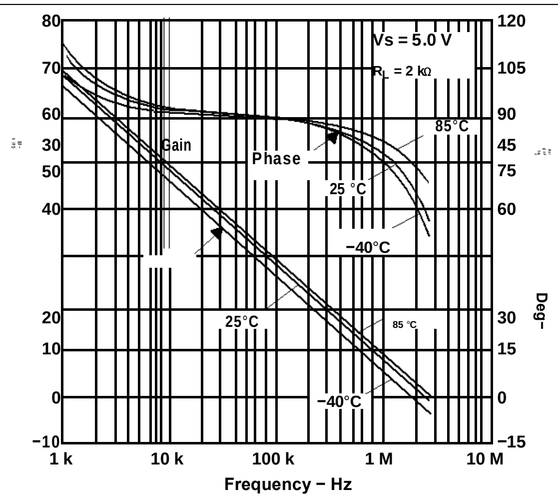
LMV321B Frequency Response vs Resistive Load



LMV321B Frequency Response vs Capacitive Load

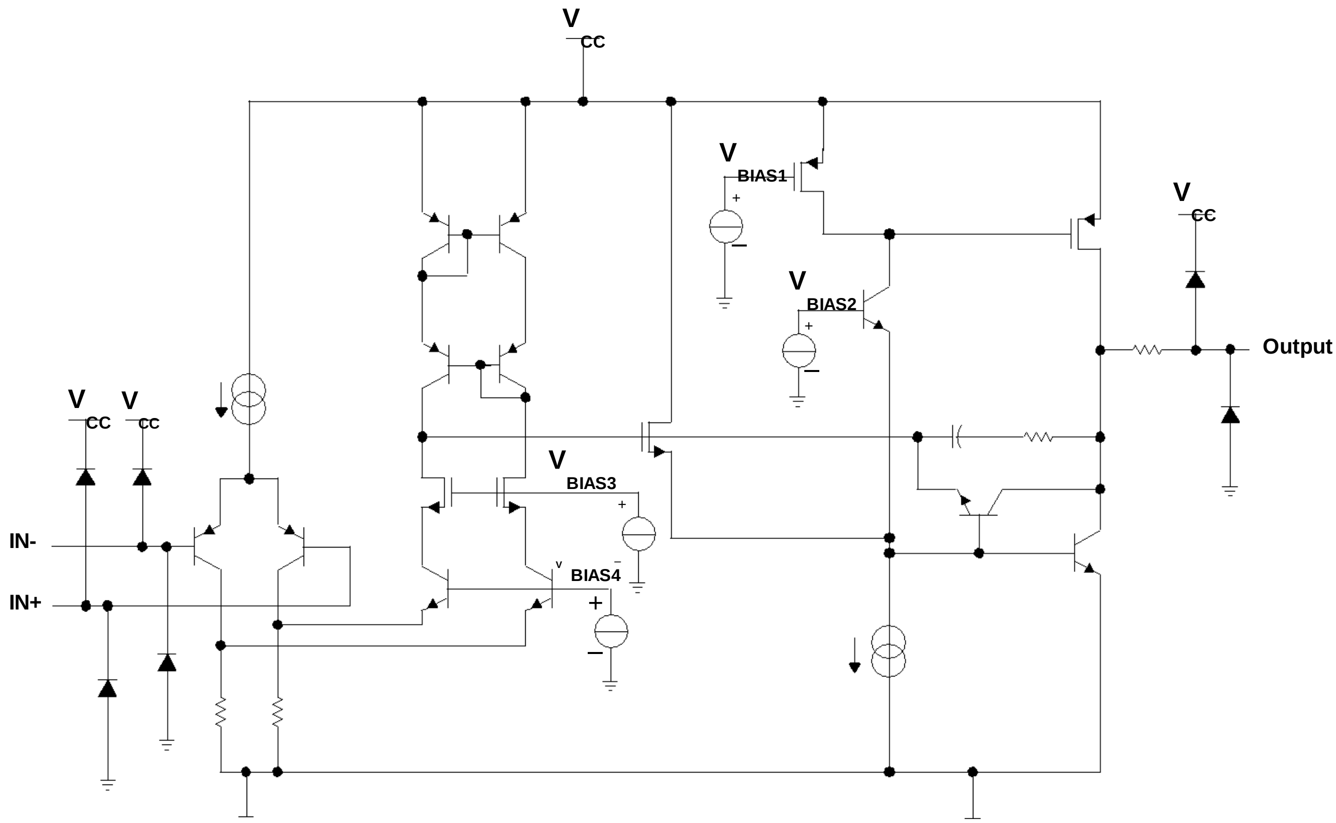


LMV321B Frequency Response vs Capacitive Load



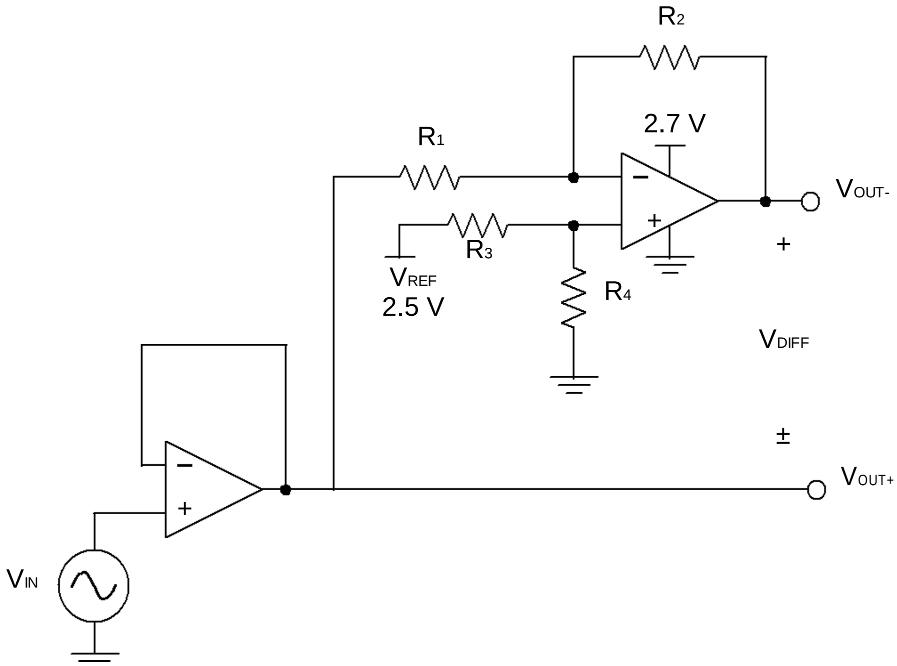
LMV321B Frequency Response vs Temperature

Functional Block Diagram

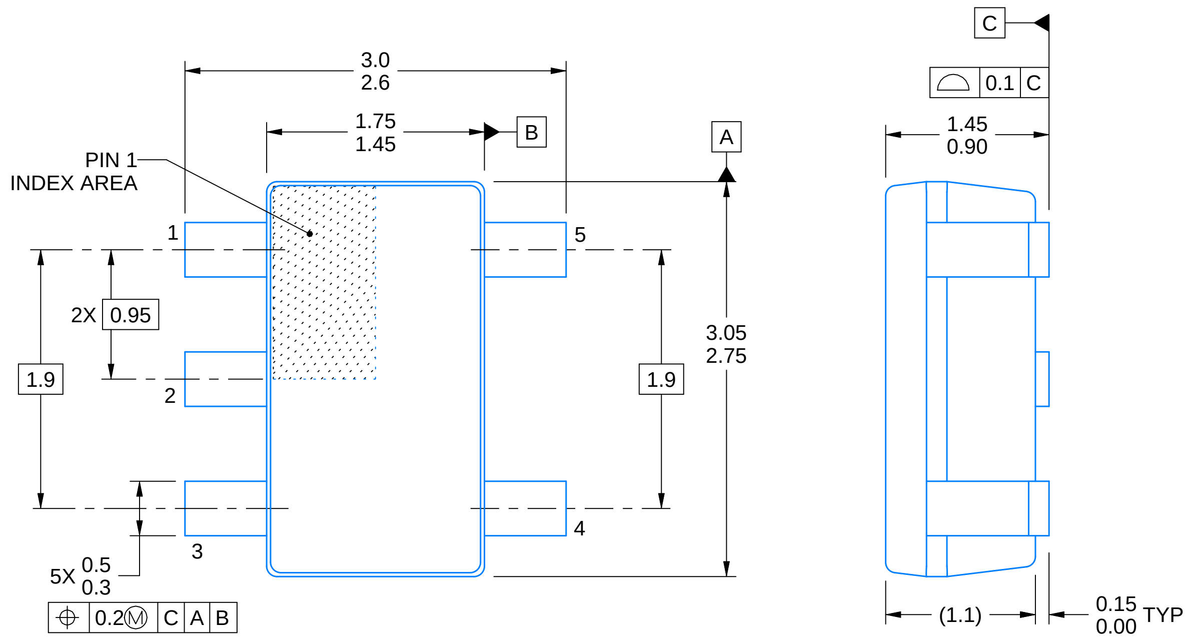


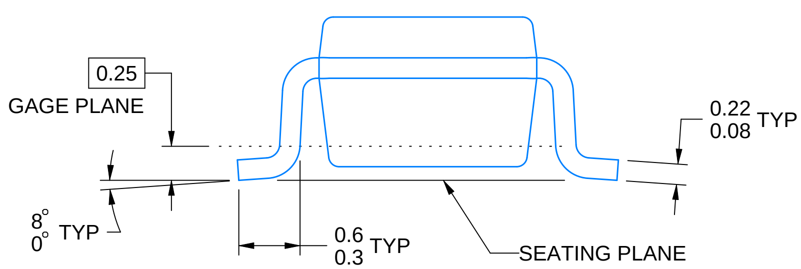
Typical Application

Some applications require differential signals. shows a simple circuit to convert a single-ended input of 0.5 to 2 V into differential output of ±1.5 V on a single 2.7-V supply. The output range is intentionally limited to maximize linearity. The circuit is composed of two amplifiers. One amplifier acts as a buffer and creates a voltage, V_{OUT+}. The second amplifier inverts the input and adds a reference voltage to generate $V_{OUT–}$. Both V_{OUT+} and $V_{OUT–}$ range from 0.5 to 2 V. The difference, V_{DIFF}, is the difference between V_{OUT+} and $V_{OUT–}$. The LMV358 was used to build this circuit.



Schematic for Single-Ended Input to Differential Output Conversion


3.0
2.6
1.75
1.45
B
A
PIN 1
INDEX AREA
1
2
3
4
5
2X 0.95
1.9
1.9
3.05
2.75
5X 0.5
0.3
0.2Ⓜ C A B
C
0.1 C
1.45
0.90
(1.1)
0.15
0.00
TYP


0.25
GAGE PLANE
8°
0°
TYP
0.6
0.3
TYP
SEATING PLANE
0.22
0.08
TYP