TLC2201, TLC2201A, TLC2201B
Advanced LinCMOS™ LOW-NOISE PRECISION OPERATIONAL AMPLIFIERS

NOTICE
SEE ORDER OF DATA FOR ERRATA INFORMATION

D3173, NOVEMBER 1988

T-79-08

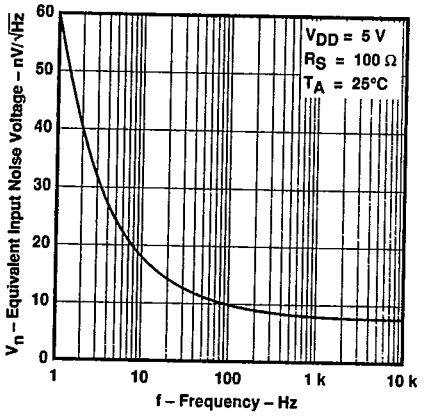
- **TLC2201B Is 100% Tested for Noise:**
  25 nV/√Hz Max at f = 10 Hz
  12 nV/√Hz Max at f = 1 kHz
- **Low Input Offset Voltage ... 200 μV Max**
- **Excellent Offset Voltage Stability with Temperature ... 0.5 μV/°C Typ**
- **Low Input Bias Current ... 1 pA Typ at T_A = 25°C**
- **Fully Specified for Both Single-Supply and Split-Supply Operation**
- **Common-Mode Input Voltage Range Includes the Negative Rail**

description

The TLC2201, TLC2201A, and TLC2201B are precision, low-noise operational amplifiers using Texas Instruments Advanced LinCMOS™ process. These devices combine the noise performance of the lowest-noise JFET amplifiers with the dc precision available previously only in bipolar amplifiers. The Advanced LinCMOS™ process uses silicon-gate technology to obtain input offset voltage stability with temperature and time that far exceeds that obtainable using metal-gate technology. In addition, this technology makes possible input impedance levels that meet or exceed levels offered by top-gate JFET and expensive dielectric-isolated devices.

The combination of excellent dc and noise performance with a common-mode input voltage range that includes the negative rail makes these devices an ideal choice for high-impedance, low-level signal conditioning applications in either single-supply or split-supply configurations.

TYPICAL EQUIVALENT INPUT NOISE VOLTAGE VS FREQUENCY



The device inputs and outputs are designed to withstand –100-mA surge currents without sustaining latchup. In addition, internal ESD protection circuits prevent functional failures at voltages up to 2000 V as tested under MIL-STD-883C, Method 3015.2; however, care should be exercised in handling these devices as exposure to ESD may result in degradation of the device parametric performance.

AVAILABLE OPTIONS

T_A	V_{IO} max AT 25°C	V_n max f = 10 Hz AT 25°C	V_n max f = 1 kHz AT 25°C	PACKAGE				
				SMALL-OUTLINE (D)	PLASTIC DIP (P)	CERAMIC DIP (JG)	CHIP CARRIER (FK)	METAL CAN (L)
0°C	200 μV	25 nV/√Hz	12 nV/√Hz	TLC2201BCD	TLC2201BCP	TLC2201BCJG	—	TLC2201BCL
to	200 μV	35 nV/√Hz	15 nV/√Hz	TLC2201ACD	TLC2201ACP	TLC2201ACJG	—	TLC2201ACL
70°C	500 μV	—	—	TLC2201CD	TLC2201CP	TLC2201CJG	—	TLC2201CL
– 40°C	200 μV	25 nV/√Hz	12 nV/√Hz	TLC2201BID	TLC2201BIP	TLC2201BIJG	—	TLC2201BIL
to	200 μV	35 nV/√Hz	15 nV/√Hz	TLC2201AID	TLC2201AIP	TLC2201AIJG	—	TLC2201AIL
85°C	500 μV	—	—	TLC2201ID	TLC2201IP	TLC2201IJG	—	TLC2201IL
– 55°C	200 μV	25 nV/√Hz	12 nV/√Hz	TLC2201BMD	TLC2201BMP	TLC2201BMJG	TLC2201BMFK	TLC2201BML
to	200 μV	35 nV/√Hz	15 nV/√Hz	TLC2201AMD	TLC2201AMP	TLC2201AMJG	TLC2201AMFK	TLC2201AML
125°C	500 μV	—	—	TLC2201MD	TLC2201MP	TLC2201MJG	TLC2201MFK	TLC2201ML

D packages are available taped-and-reeled. Add "R" suffix to device type when ordering (e.g., TLC2201BCDR).

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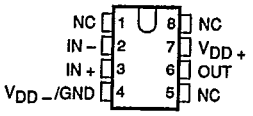
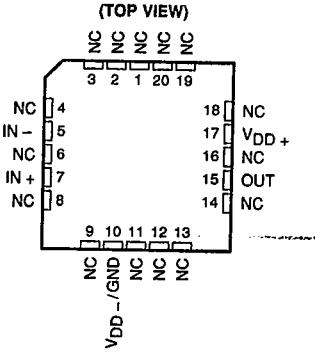
description (continued)

The M-suffix devices are characterized for operation over the full military temperature range of −55°C to 125°C. The I-suffix devices are characterized for operation from −40°C to 85°C. The C-suffix devices are characterized for operation from 0°C to 70°C.

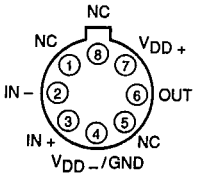
D, JG, or P PACKAGE
(TOP VIEW)



FK PACKAGE
(TOP VIEW)



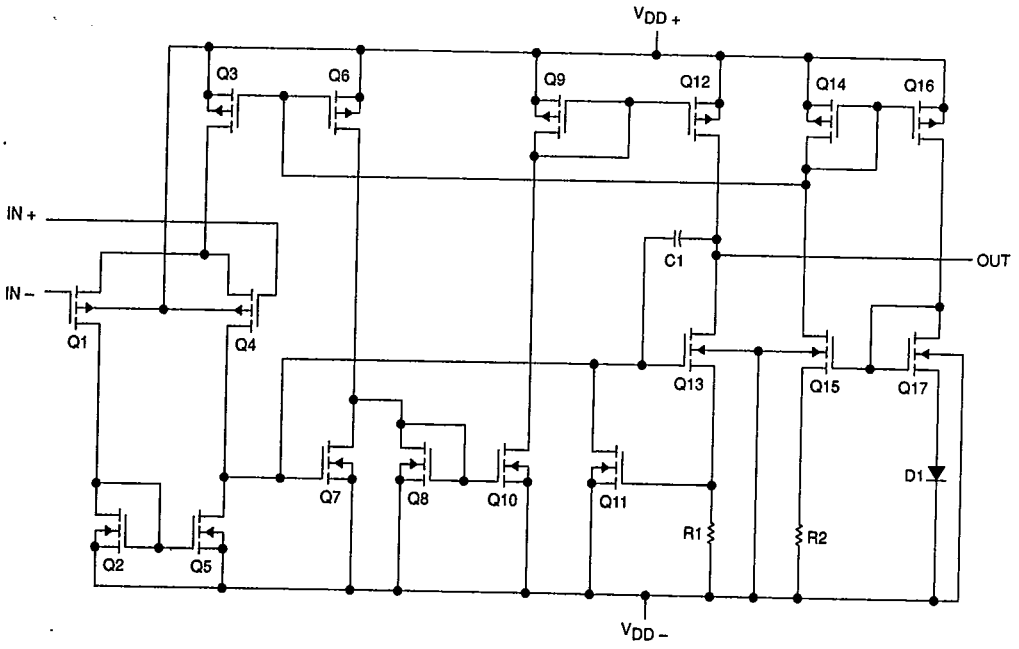
L PACKAGE
(TOP VIEW)



Pin 4 of the L package is in electrical contact with the case.

NC – No internal connection

equivalent schematic



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absolute maximum ratings over operating free-air temperature (unless otherwise noted)

Supply voltage, V_{DD+} (see Note 1) . . . . . 8 V
Supply voltage, V_{DD-} (see Note 1) . . . . . −8 V
Differential input voltage (see Note 2) . . . . . ±16 V
Input voltage range, V_I (any input, see Note 1) . . . . . ±8 V
Input current, I_I (each input) . . . . . ±5 mA
Output current, I_O . . . . . ±50 mA
Duration of short-circuit current at (or below) 25°C (see Note 3) . . . . . Unlimited
Continuous total dissipation . . . . . see Dissipation Rating Table
Operating free-air temperature, T_A: M-suffix . . . . . −55°C to 125°C
I-suffix . . . . . −40°C to 85°C
C-suffix . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C
Case temperature for 60 seconds: FK package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or P package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG or L package . . . . . 300°C

NOTES: 1. All voltage values, except differential voltages, are with respect to the midpoint between V_{DD+} and V_{DD-}.
2. Differential voltages are at the noninverting input with respect to the inverting input.
3. The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING	$T_A = 125°C$ POWER RATING
D	725 mW	5.8 mW/°C	464 mW	377 mW	145 mW
FK	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
JG	1050 mW	8.4 mW/°C	672 mW	546 mW	210 mW
L	650 mW	5.2 mW/°C	416 mW	338 mW	130 mW
P	1000 mW	8.0 mW/°C	640 mW	520 mW	200 mW

recommended operating conditions

	M-SUFFIX		I-SUFFIX		C-SUFFIX		UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	
Supply voltage, V_{DD}	±2.3	±8	±2.3	±8	±2.3	±8	V
Common-mode input voltage, V_{IC}	V_{DD-}	$V_{DD+}-2.3$	V_{DD-}	$V_{DD+}-2.3$	V_{DD-}	$V_{DD+}-2.3$	V
Operating free-air temperature, T_A	−55	125	−40	85	0	70	°C

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electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†			TLC2201M MIN	TLC2201M TYP	TLC2201M MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 0,	R_S = 50 Ω	25°C		100	500	µV
				Full range			700	
α_{VIO}	Temperature coefficient of input offset voltage			−55°C to 125°C		0.5		µV/°C
	Input offset voltage long-term drift (see Note 4)			25°C		0.001	0.005	µV/mo
I_{IO}	Input offset current			25°C		0.5		pA
				Full range			500	
I_{IB}	Input bias current			25°C		1		pA
				Full range			500	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		Full range	−5 to 2.7			V
V_{OM+}	Maximum positive peak output voltage swing	R_L = 10 kΩ		25°C	4.7	4.8		V
				Full range	4.7			
V_{OM-}	Maximum negative peak output voltage swing			25°C	−4.7	−4.9		V
				Full range	−4.7			
A_{VD}	Large-signal differential voltage amplification	V_O = ±4 V, R_L = 500 kΩ,		25°C	400	560		V/mV
				Full range	200			
		V_O = ±4 V, R_L = 10 kΩ		25°C	90	100		
				Full range	45			
CMRR	Common-mode rejection ratio	V_O = 0, V_{IC} = V_{ICR} min, R_S = 50 Ω		25°C	90	115		dB
				Full range	85			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}$ / ΔV_{IO})	$V_{DD\pm}$ = ±2.3 V to ±8 V		25°C	90	110		dB
				Full range	85			
I_{DD}	Supply current	V_O = 0,	No load	25°C		1.1	1.5	mA
				Full range			1.5	

operating characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201M MIN	TLC2201M TYP	TLC2201M MAX	UNIT
SR	Slew rate at unity gain	V_O = ±2.3 V, R_L = 10 kΩ, C_L = 100 pF	25°C	2	2.7		V/µs
			Full range	1.3			
V_n	Equivalent input noise voltage	f = 10 Hz	25°C		18		nV/√Hz
		f = 1 kHz	25°C		8		
V_{NPP}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5		µV
		f = 0.1 to 10 Hz	25°C		0.7		
I_n	Equivalent input noise current		25°C		0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.9		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		48°		

†Full range is −55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201AM			TLC2201BM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	25°C		80	200		80	200	µV
			Full range			400			400	
α_{VIO}	Temperature coefficient of input offset voltage		−55°C to 125°C		0.5			0.5		µV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005		0.001	0.005	µV/mo
I_{IO}	Input offset current		25°C		0.5			0.5		pA
			Full range			500			500	
I_{IB}	Input bias current		25°C		1			1		pA
			Full range			500			500	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	Full range	−5 to 2.7			−5 to 2.7			V
V_{OM+}	Maximum positive peak output voltage swing	R_L = 10 kΩ	25°C	4.7	4.8		4.7	4.8		V
			Full range	4.7			4.7			
V_{OM-}	Maximum negative peak output voltage swing		25°C	−4.7	−4.9		−4.7	−4.9		V
			Full range	−4.7			−4.7			
A_{VD}	Large-signal differential voltage amplification	V_O = ±4 V, R_L = 500 kΩ	25°C	400	560		400	560		V/mV
			Full range	200			200			
		V_O = ±4 V, R_L = 10 kΩ	25°C	90	100		90	100		
			Full range	45			45			
CMRR	Common-mode rejection ratio	V_O = 0, V_{IC} = V_{ICR} min, R_S = 50 Ω	25°C	90	115		90	115		dB
			Full range	85			85			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}$ / ΔV_{IO})	$V_{DD\pm}$ = ±2.3 V to ±8 V	25°C	90	110		90	110		dB
			Full range	85			85			
I_{DD}	Supply current	V_O = 0, No load	25°C		1.1	1.5		1.1	1.5	mA
			Full range			1.5			1.5	

operating characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201AM			TLC2201BM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	V_O = ±2.3 V, R_L = 10 kΩ, C_L = 100 pF	25°C	2	2.7		2	2.7		V/µs
			Full range	1.3			1.3			
V_n	Equivalent input noise voltage (see Note 5)	f = 10 Hz	25°C		18	35		18	25	nV/√Hz
		f = 1 kHz	25°C		8	15		8	12	
V_{NPP}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5			0.5		µV
		f = 0.1 to 10 Hz	25°C		0.7			0.7		
I_n	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.9			1.9		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		48°			48°		

†Full range is −55°C to 125°C.

NOTES: 4. Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

5. This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing on testing or nontesting of other parameters.

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electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201M MIN	TLC2201M TYP	TLC2201M MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	25°C		100	500	µV
			Full range			700	
α_{VIO}	Temperature coefficient of input offset voltage		– 55°C to 125°C		0.5		µV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005	µV/mo
I_{IO}	Input offset current		25°C		0.5		pA
			Full range			500	
I_{IB}	Input bias current		25°C		1		pA
			Full range			500	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	Full range	0 to 2.7			V
V_{OH}	Maximum high-level output voltage	R_L = 10 kΩ	25°C	4.7	4.8		V
			Full range	4.7			
V_{OL}	Maximum low-level output voltage	I_O = 0	25°C		0	50	mV
			Full range			50	
A_{VD}	Large-signal differential voltage amplification	V_O = 1 V to 4 V, R_L = 500 kΩ,	25°C	150	315		V/mV
			Full range	75			
		V_O = 1 V to 4 V, R_L = 10 kΩ	25°C	25	55		
			Full range	10			
CMRR	Common-mode rejection ratio	V_O = 0, V_{IC} = V_{ICR} min, R_S = 50 Ω	25°C	90	110		dB
			Full range	85			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD} \pm / \Delta V_{IO}$)	V_{DD} = 4.6 V to 16 V	25°C	90	110		dB
			Full range	85			
I_{DD}	Supply current	V_O = 2.5 V, No load	25°C		1	1.5	mA
			Full range			1.5	

operating characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201M MIN	TLC2201M TYP	TLC2201M MAX	UNIT
SR	Slew rate at unity gain	V_O = 0.5 V to 2.5 V, R_L = 10 kΩ, C_L = 100 pF	25°C	1.8	2.5		V/µs
			Full range	1.1			
V_n	Equivalent input noise voltage	f = 10 Hz	25°C		18		nV/√Hz
		f = 1 kHz	25°C		8		
V_{NPP}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5		µV
		f = 0.1 to 10 Hz	25°C		0.7		
I_n	Equivalent input noise current		25°C		0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.8		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		45°		

†Full range is – 55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201AM			TLC2201BM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	25°C		80	200		80	200	µV
			Full range			400			400	
α_{VIO}	Temperature coefficient of input offset voltage		– 55°C to 125°C		0.5			0.5		µV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005		0.001	0.005	µV/mo
I_{IO}	Input offset current		25°C		0.5			0.5		pA
			Full range			500			500	
I_{IB}	Input bias current		25°C		1			1		pA
			Full range			500			500	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	Full range	0 to 2.7			0 to 2.7			V
V_{OH}	Maximum high-level output voltage	R_L = 10 kΩ	25°C	4.7	4.8		4.7	4.8		V
			Full range	4.7			4.7			
V_{OL}	Maximum low-level output voltage	I_O = 0	25°C		0	50		0	50	mV
			Full range			50			50	
A_{VD}	Large-signal differential voltage amplification	V_O = 1 V to 4 V, R_L = 500 kΩ	25°C	150	315		150	315		V/mV
			Full range	75			75			
		V_O = 1 V to 4 V, R_L = 10 kΩ	25°C	25	55		25	55		
			Full range	10			10			
CMRR	Common-mode rejection ratio	V_O = 0, V_{IC} = V_{ICR} min, R_S = 50 Ω	25°C	90	110		90	110		dB
			Full range	85			85			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}$ / ΔV_{IO})	V_{DD} = 4.6 V to 16 V	25°C	90	110		90	110		dB
			Full range	85			85			
I_{DD}	Supply current	V_O = 2.5 V, No load	25°C		1	1.5		1	1.5	mA
			Full range			1.5			1.5	

operating characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201AM			TLC2201BM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	V_O = 0.5 V to 2.5 V, R_L = 10 kΩ, C_L = 100 pF	25°C	1.8	2.5		1.8	2.5		V/µs
			Full range	1.1			1.1			
V_n	Equivalent input noise voltage (see Note 5)	f = 10 Hz	25°C		18	35		18	25	nV/√Hz
		f = 1 kHz	25°C		8	15		8	12	
V_{NPP}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5			0.5		µV
		f = 0.1 to 10 Hz	25°C		0.7			0.7		
I_n	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.8			1.8		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		45°			45°		

†Full range is – 55°C to 125°C.

NOTES: 4. Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

5. This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing on testing or nontesting of other parameters.

electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201I MIN	TLC2201I TYP	TLC2201I MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	25°C		100	500	µV
			Full range			650	
α_{VIO}	Temperature coefficient of input offset voltage		−40°C to 85°C		0.5		µV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005	µV/mo
I_{IO}	Input offset current		25°C		0.5		pA
			Full range			150	
I_{IB}	Input bias current		25°C		1		pA
			Full range			150	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	Full range	−5 to 2.7			V
V_{OM+}	Maximum positive peak output voltage swing	R_L = 10 kΩ	25°C	4.7	4.8		V
			Full range	4.7			
V_{OM-}	Maximum negative peak output voltage swing		25°C	−4.7	−4.9		V
			Full range	−4.7			
A_{VD}	Large-signal differential voltage amplification	V_O = ±4 V, R_L = 500 kΩ,	25°C	400	560		V/mV
			Full range	250			
		V_O = ±4 V, R_L = 10 kΩ	25°C	90	100		
			Full range	65			
CMRR	Common-mode rejection ratio	V_O = 0, V_{IC} = V_{ICR} min, R_S = 50 Ω	25°C	90	115		dB
			Full range	85			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}$ / ΔV_{IO})	$V_{DD\pm}$ = ±2.3 V to ±8 V	25°C	90	110		dB
			Full range	85			
I_{DD}	Supply current	V_O = 0, No load	25°C		1.1	1.5	mA
			Full range			1.5	

operating characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201I MIN	TLC2201I TYP	TLC2201I MAX	UNIT
SR	Slew rate at unity gain	V_O = ±2.3 V, R_L = 10 kΩ, C_L = 100 pF	25°C	2	2.7		V/µs
			Full range	1.4			
V_n	Equivalent input noise voltage	f = 10 Hz	25°C		18		nV/√Hz
		f = 1 kHz	25°C		8		
V_{NPP}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5		µV
		f = 0.1 to 10 Hz	25°C		0.7		
I_n	Equivalent input noise current		25°C		0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.9		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		48°		

†Full range is −40°C to 85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201AI			TLC2201BI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	25°C		80	200		80	200	µV
			Full range			350			350	
α_{VIO}	Temperature coefficient of input offset voltage		−40°C to 85°C		0.5			0.5		µV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005		0.001	0.005	µV/mo
I_{IO}	Input offset current		25°C		0.5			0.5		pA
			Full range			150			150	
I_{IB}	Input bias current		25°C		1			1		pA
			Full range			150			150	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	Full range	−5 to 2.7			−5 to 2.7			V
V_{OM+}	Maximum positive peak output voltage swing	R_L = 10 kΩ	25°C	4.7	4.8		4.7	4.8		V
			Full range	4.7			4.7			
V_{OM-}	Maximum negative peak output voltage swing		25°C	−4.7	−4.9		−4.7	−4.9		V
			Full range	−4.7			−4.7			
A_{VD}	Large-signal differential voltage amplification	V_O = ±4 V, R_L = 500 kΩ	25°C	400	560		400	560		V/mV
			Full range	250			250			
		V_O = ±4 V, R_L = 10 kΩ	25°C	90	100		90	100		
			Full range	65			65			
CMRR	Common-mode rejection ratio	V_O = 0, V_{IC} = V_{ICR} min, R_S = 50 Ω	25°C	90	115		90	115		dB
			Full range	85			85			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}$ / ΔV_{IO})	$V_{DD\pm}$ = ±2.3 V to ±8 V	25°C	90	110		90	110		dB
			Full range	85			85			
I_{DD}	Supply current	V_O = 0, No load	25°C		1.1	1.5		1.1	1.5	mA
			Full range			1.5			1.5	

operating characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201AI			TLC2201BI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	V_O = ±2.3 V, R_L = 10 kΩ, C_L = 100 pF	25°C	2	2.7		2	2.7		V/µs
			Full range	1.4			1.4			
V_n	Equivalent input noise voltage (see Note 5)	f = 10 Hz	25°C		18	35		18	25	nV/√Hz
		f = 1 kHz	25°C		8	15		8	12	
V_{NPP}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5			0.5		µV
		f = 0.1 to 10 Hz	25°C		0.7			0.7		
I_n	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.9			1.9		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		48°			48°		

†Full range is −40°C to 85°C.

NOTES: 4. Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

5. This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing on testing or nontesting of other parameters.

electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201I MIN	TLC2201I TYP	TLC2201I MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	25°C		100	500	µV
			Full range			650	
α_{VIO}	Temperature coefficient of input offset voltage		−40°C to 85°C		0.5		µV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005	µV/mo
I_{IO}	Input offset current		25°C		0.5		pA
			Full range			150	
I_{IB}	Input bias current		25°C		1		pA
			Full range			150	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	Full range	0 to 2.7			V
V_{OH}	Maximum high-level output voltage	R_L = 10 kΩ	25°C	4.7	4.8		V
			Full range	4.7			
V_{OL}	Maximum low-level output voltage	I_O = 0	25°C		0	50	mV
			Full range			50	
A_{VD}	Large-signal differential voltage amplification	V_O = 1 V to 4 V, R_L = 500 kΩ,	25°C	150	315		V/mV
			Full range	100			
		V_O = 1 V to 4 V, R_L = 10 kΩ	25°C	25	55		
			Full range	15			
CMRR	Common-mode rejection ratio	V_O = 0, V_{IC} = V_{ICR} min, R_S = 50 Ω	25°C	90	110		dB
			Full range	85			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}$ / ΔV_{IO})	V_{DD} = 4.6 V to 16 V	25°C	90	110		dB
			Full range	85			
I_{DD}	Supply current	V_O = 2.5 V, No load	25°C		1	1.5	mA
			Full range			1.5	

operating characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201I MIN	TLC2201I TYP	TLC2201I MAX	UNIT
SR	Slew rate at unity gain	V_O = 0.5 V to 2.5 V, R_L = 10 kΩ, C_L = 100 pF	25°C	1.8	2.5		V/µs
			Full range	1.2			
V_n	Equivalent input noise voltage	f = 10 Hz	25°C		18		nV/√Hz
		f = 1 kHz	25°C		8		
V_{NPP}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5		µV
		f = 0.1 to 10 Hz	25°C		0.7		
I_n	Equivalent input noise current		25°C		0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.8		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		45°		

†Full range is −40°C to 85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201AI			TLC2201BI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	25°C		80	200		80	200	µV
			Full range			350			350	
α_{VIO}	Temperature coefficient of input offset voltage		−40°C to 85°C		0.5			0.5		µV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005		0.001	0.005	µV/mo
I_{IO}	Input offset current		25°C		0.5			0.5		pA
			Full range			150			150	
I_{IB}	Input bias current		25°C		1			1		pA
			Full range			150			150	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	Full range	0 to 2.7			0 to 2.7			V
V_{OH}	Maximum high-level output voltage	R_L = 10 kΩ	25°C	4.7	4.8		4.7	4.8		V
			Full range	4.7			4.7			
V_{OL}	Maximum low-level output voltage	I_O = 0	25°C		0	50		0	50	mV
			Full range			50			50	
A_{VD}	Large-signal differential voltage amplification	V_O = 1 V to 4 V, R_L = 500 kΩ	25°C	150	315		150	315		V/mV
			Full range	100			100			
		V_O = 1 V to 4 V, R_L = 10 kΩ	25°C	25	55		25	55		
			Full range	15			15			
CMRR	Common-mode rejection ratio	V_O = 0, V_{IC} = V_{ICR} min, R_S = 50 Ω	25°C	90	110		90	110		dB
			Full range	85			85			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD} \pm / \Delta V_{IO}$)	V_{DD} = 4.6 V to 16 V	25°C	90	110		90	110		dB
			Full range	85			85			
I_{DD}	Supply current	V_O = 2.5 V, No load	25°C		1	1.5		1	1.5	mA
			Full range			1.5			1.5	

operating characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201AI			TLC2201BI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	V_O = 0.5 V to 2.5 V, R_L = 10 kΩ, C_L = 100 pF	25°C	1.8	2.5		1.8	2.5		V/µs
			Full range	1.2			1.2			
V_n	Equivalent input noise voltage (see Note 5)	f = 10 Hz	25°C		18	35		18	25	nV/√Hz
		f = 1 kHz	25°C		8	15		8	12	
V_{NPP}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5			0.5		µV
		f = 0.1 to 10 Hz	25°C		0.7			0.7		
I_n	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.8			1.8		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		45°			45°		

†Full range is −40°C to 85°C.

NOTES: 4. Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

5. This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing on testing or nontesting of other parameters.

electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201C MIN	TLC2201C TYP	TLC2201C MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	25°C		100	500	µV
			Full range			600	
α_{VIO}	Temperature coefficient of input offset voltage		0°C to 70°C		0.5		µV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005	µV/mo
I_{IO}	Input offset current		25°C		0.5		pA
			Full range			100	
I_{IB}	Input bias current		25°C		1		pA
			Full range			100	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	Full range	−5 to 2.7			V
V_{OM+}	Maximum positive peak output voltage swing	R_L = 10 kΩ	25°C	4.7	4.8		V
			Full range	4.7			
V_{OM-}	Maximum negative peak output voltage swing		25°C	−4.7	−4.9		V
			Full range	−4.7			
A_{VD}	Large-signal differential voltage amplification	V_O = ±4 V, R_L = 500 kΩ,	25°C	400	560		V/mV
			Full range	300			
		V_O = ±4 V, R_L = 10 kΩ	25°C	90	100		
			Full range	70			
CMRR	Common-mode rejection ratio	V_O = 0, V_{IC} = V_{ICR} min, R_S = 50 Ω	25°C	90	115		dB
			Full range	85			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}$ / ΔV_{IO})	$V_{DD\pm}$ = ±2.3 V to ±8 V	25°C	90	110		dB
			Full range	85			
I_{DD}	Supply current	V_O = 0, No load	25°C		1.1	1.5	mA
			Full range			1.5	

operating characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201C MIN	TLC2201C TYP	TLC2201C MAX	UNIT
SR	Slew rate at unity gain	V_O = ±2.3 V, R_L = 10 kΩ, C_L = 100 pF	25°C	2	2.7		V/µs
			Full range	1.5			
V_n	Equivalent input noise voltage	f = 10 Hz	25°C		18		nV/√Hz
		f = 1 kHz	25°C		8		
V_{NPP}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5		µV
		f = 0.1 to 10 Hz	25°C		0.7		
I_n	Equivalent input noise current		25°C		0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.9		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		48°		

†Full range is 0°C to 70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201AC			TLC2201BC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	25°C		80	200		80	200	µV
			Full range			300			300	
α_{VIO}	Temperature coefficient of input offset voltage		0°C to 70°C		0.5			0.5		µV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005		0.001	0.005	µV/mo
I_{IO}	Input offset current		25°C		0.5			0.5		pA
			Full range			100			100	
I_{IB}	Input bias current		25°C		1			1		pA
			Full range			100			100	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	Full range	−5 to 2.7			−5 to 2.7			V
V_{OM+}	Maximum positive peak output voltage swing	R_L = 10 kΩ	25°C	4.7	4.8		4.7	4.8		V
			Full range	4.7			4.7			
V_{OM-}	Maximum negative peak output voltage swing		25°C	−4.7	−4.9		−4.7	−4.9		V
			Full range	−4.7			−4.7			
A_{VD}	Large-signal differential voltage amplification	V_O = ±4 V, R_L = 500 kΩ	25°C	400	560		400	560		V/mV
			Full range	300			300			
		V_O = ±4 V, R_L = 10 kΩ	25°C	90	100		90	100		
			Full range	70			70			
CMRR	Common-mode rejection ratio	V_O = 0, V_{IC} = V_{ICR} min, R_S = 50 Ω	25°C	90	115		90	115		dB
			Full range	85			85			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}$ / ΔV_{IO})	$V_{DD\pm}$ = ±2.3 V to ±8 V	25°C	90	110		90	110		dB
			Full range	85			85			
I_{DD}	Supply current	V_O = 0, No load	25°C		1.1	1.5		1.1	1.5	mA
			Full range			1.5			1.5	

operating characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201AC			TLC2201BC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	V_O = ±2.3 V, R_L = 10 kΩ, C_L = 100 pF	25°C	2	2.7		2	2.7		V/µs
			Full range	1.5			1.5			
V_n	Equivalent input noise voltage (see Note 5)	f = 10 Hz	25°C		18	35		18	25	nV/√Hz
		f = 1 kHz	25°C		8	15		8	12	
V_{NPP}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5			0.5		µV
		f = 0.1 to 10 Hz	25°C		0.7			0.7		
I_n	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.9			1.9		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		48°			48°		

†Full range is 0°C to 70°C.

NOTES: 4. Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

5. This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing on testing or nontesting of other parameters.

electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201C MIN	TLC2201C TYP	TLC2201C MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	25°C		100	500	µV
			Full range			600	
α_{VIO}	Temperature coefficient of input offset voltage		0°C to 70°C		0.5		µV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005	µV/mo
I_{IO}	Input offset current		25°C		0.5		pA
			Full range			100	
I_{IB}	Input bias current		25°C		1		pA
			Full range			100	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	Full range	0 to 2.7			V
V_{OH}	Maximum high-level output voltage	R_L = 10 kΩ	25°C	4.7	4.8		V
			Full range	4.7			
V_{OL}	Maximum low-level output voltage	I_O = 0	25°C		0	50	mV
			Full range			50	
A_{VD}	Large-signal differential voltage amplification	V_O = 1 V to 4 V, R_L = 500 kΩ,	25°C	150	315		V/mV
			Full range	100			
		V_O = 1 V to 4 V, R_L = 10 kΩ	25°C	25	55		
			Full range	15			
CMRR	Common-mode rejection ratio	V_O = 0, V_{IC} = V_{ICR} min, R_S = 50 Ω	25°C	90	110		dB
			Full range	85			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD} \pm / \Delta V_{IO}$)	V_{DD} = 4.6 V to 16 V	25°C	90	110		dB
			Full range	85			
I_{DD}	Supply current	V_O = 2.5 V, No load	25°C		1	1.5	mA
			Full range			1.5	

operating characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201C MIN	TLC2201C TYP	TLC2201C MAX	UNIT
SR	Slew rate at unity gain	V_O = 0.5 V to 2.5 V, R_L = 10 kΩ, C_L = 100 pF	25°C	1.8	2.5		V/µs
			Full range	1.3			
V_n	Equivalent input noise voltage	f = 10 Hz	25°C		18		nV/√Hz
		f = 1 kHz	25°C		8		
V_{NPP}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5		µV
		f = 0.1 to 10 Hz	25°C		0.7		
I_n	Equivalent input noise current		25°C		0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.8		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		45°		

†Full range is 0°C to 70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201AC			TLC2201BC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	25°C		80	200		80	200	μV
			Full range			300			300	
α_{VIO}	Temperature coefficient of input offset voltage		0°C to 70°C		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005		0.001	0.005	μV/mo
I_{IO}	Input offset current		25°C		0.5			0.5		pA
			Full range			100			100	
I_{IB}	Input bias current		25°C		1			1		pA
			Full range			100			100	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	Full range	0 to 2.7			0 to 2.7			V
V_{OH}	Maximum high-level output voltage	R_L = 10 kΩ	25°C	4.7	4.8		4.7	4.8		V
			Full range	4.7			4.7			
V_{OL}	Maximum low-level output voltage	I_O = 0	25°C		0	50		0	50	mV
			Full range			50			50	
A_{VD}	Large-signal differential voltage amplification	V_O = 1 V to 4 V, R_L = 500 kΩ	25°C	150	315		150	315		V/mV
			Full range	100			100			
		V_O = 1 V to 4 V, R_L = 10 kΩ	25°C	25	55		25	55		
			Full range	15			15			
CMRR	Common-mode rejection ratio	V_O = 0, V_{IC} = V_{ICR} min, R_S = 50 Ω	25°C	90	110		90	110		dB
			Full range	85			85			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}$ / ΔV_{IO})	V_{DD} = 4.6 V to 16 V	25°C	90	110		90	110		dB
			Full range	85			85			
I_{DD}	Supply current	V_O = 2.5 V, No load	25°C		1	1.5		1	1.5	mA
			Full range			1.5			1.5	

operating characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TLC2201AC			TLC2201BC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	V_O = 0.5 V to 2.5 V, R_L = 10 kΩ, C_L = 100 pF	25°C	1.8	2.5		1.8	2.5		V/μs
			Full range	1.3			1.3			
V_n	Equivalent input noise voltage (see Note 5)	f = 10 Hz	25°C		18	35		18	25	nV/√Hz
		f = 1 kHz	25°C		8	15		8	12	
V_{NPP}	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5			0.5		μV
		f = 0.1 to 10 Hz	25°C		0.7			0.7		
I_n	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.8			1.8		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		45°			45°		

†Full range is 0°C to 70°C.

NOTES: 4. Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

5. This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing on testing or nontesting of other parameters.

PARAMETER MEASUREMENT INFORMATION

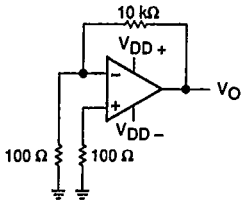
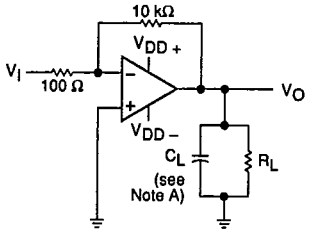
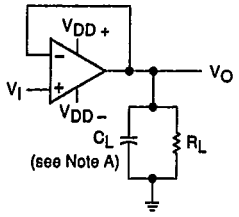


FIGURE 1. NOISE VOLTAGE TEST CIRCUIT



NOTE A: C_L includes fixture capacitance.

FIGURE 2. PHASE MARGIN TEST CIRCUIT



NOTE A: C_L includes fixture capacitance.

FIGURE 3. SLEW RATE TEST CIRCUIT

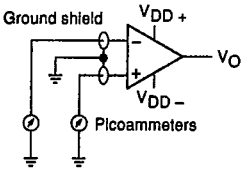


FIGURE 4. INPUT BIAS AND OFFSET CURRENT TEST CIRCUIT

typical values

Typical values as presented in this data sheet represent the median (50% point) of device parametric performance.

input bias and offset current

At the picoamp bias current level typical of the TLC2201, TLC2201A, and TLC2201B, accurate measurement of the bias current becomes difficult. Not only does this measurement require a picoammeter, but test socket leakages can easily exceed the actual device bias currents. To measure these small currents, Texas Instruments uses a two-step process. The socket leakage is measured using picoammeters with bias voltages applied but with no device in the socket. The device is then inserted in the socket and a second test measuring both the socket leakage and the device input bias current is performed. The two measurements are then subtracted algebraically to determine the bias current of the device.

noise

Texas Instruments offers automated production noise testing to meet individual applications requirements. Noise voltage at f = 10 Hz and f = 1 kHz is 100% tested on every TLC2201B device, while lot sample testing is performed on the TLC2201A. For other noise test requirements, please contact the factory.

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TYPICAL CHARACTERISTICS

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table of graphs

			FIGURE
V_{IO}	Input offset voltage	Distribution	5
I_{IB}	Input bias current	vs Common-mode voltage	6
		vs Temperature	7
CMRR	Common-mode rejection ratio	vs Frequency	8
V_{OM}	Maximum peak output voltage	vs Output current	9
		vs Temperature	10
V_{OPP}	Maximum peak-to-peak output voltage	vs Frequency	11
V_{OH}	High-level output voltage	vs Frequency	12
		vs Current	13
		vs Temperature	14
V_{OL}	Low-level output voltage	vs Output current	15
		vs Temperature	16
A_{VD}	Differential voltage amplification	vs Frequency	17
		vs Temperature	18
I_{OS}	Short-circuit output current	vs Supply voltage	19
		vs Temperature	20
I_{DD}	Supply current	vs Supply voltage	21
		vs Temperature	22
SR	Slew rate	vs Supply voltage	23
		vs Temperature	24
	Pulse response	Small-signal	25, 26
		Large-signal	27, 28
V_{NPP}	Peak-to-peak equivalent input noise voltage	0.1 to 1 Hz	29
		0.1 to 10 Hz	30
	Gain-bandwidth product	vs Supply voltage	31
		vs Temperature	32
ϕ_m	Phase margin	vs Supply voltage	33
		vs Temperature	34
	Phase shift	vs Frequency	17

TYPICAL CHARACTERISTICS†

DISTRIBUTION OF TLC2201
INPUT OFFSET VOLTAGE

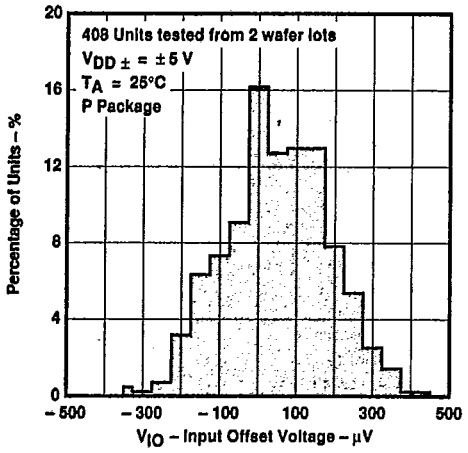

FIGURE 5

INPUT BIAS CURRENT
VS
COMMON-MODE INPUT VOLTAGE

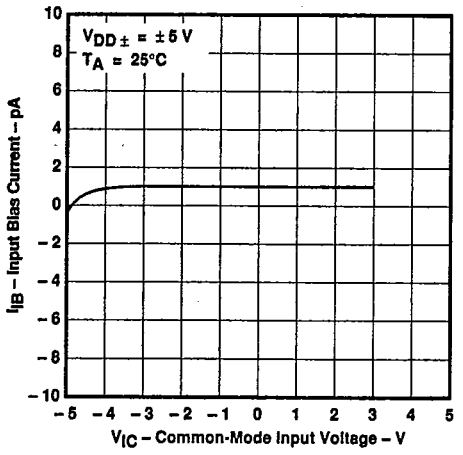

FIGURE 6

INPUT BIAS CURRENT
VS
FREE-AIR TEMPERATURE

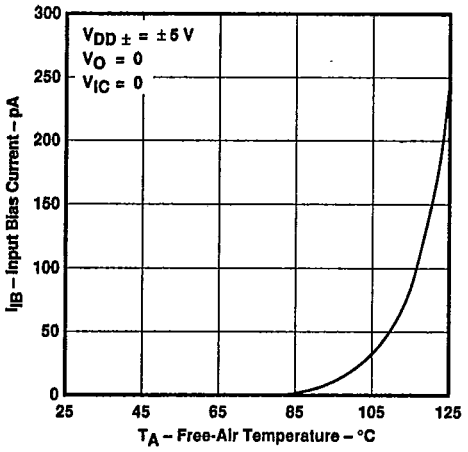

FIGURE 7

COMMON-MODE REJECTION RATIO
VS
FREQUENCY

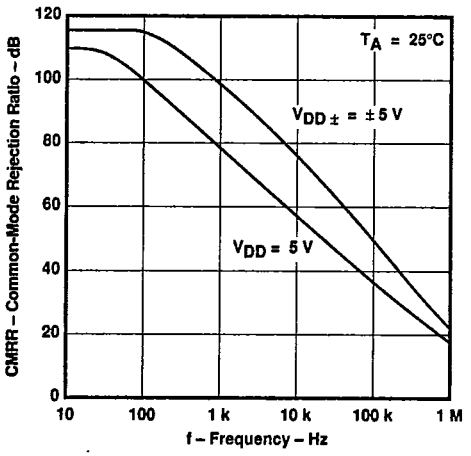

FIGURE 8

†Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

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TYPICAL CHARACTERISTICS†

MAXIMUM PEAK OUTPUT VOLTAGE
vs
OUTPUT CURRENT

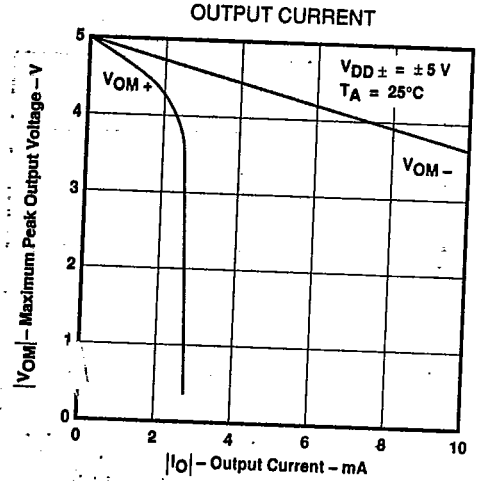

FIGURE 9

MAXIMUM PEAK OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

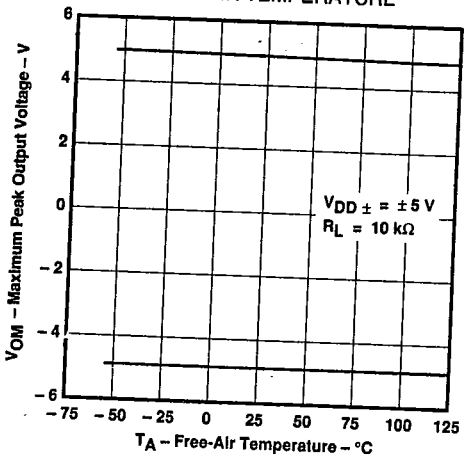

FIGURE 10

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE
vs
FREQUENCY

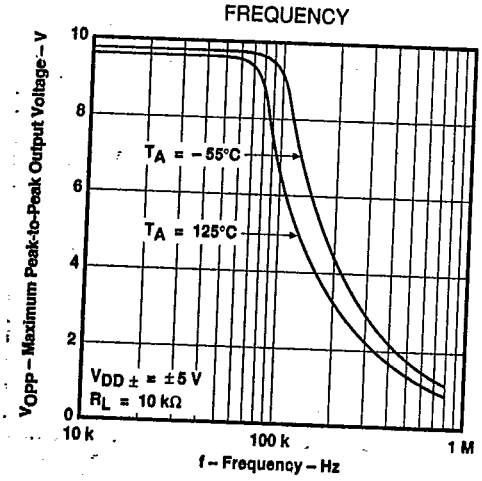

FIGURE 11

HIGH-LEVEL OUTPUT VOLTAGE
vs
FREQUENCY

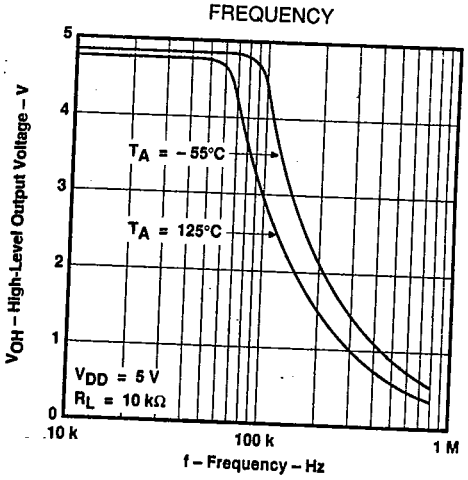

FIGURE 12

†Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

TYPICAL CHARACTERISTICS†

HIGH-LEVEL OUTPUT VOLTAGE
vs
HIGH-LEVEL OUTPUT CURRENT

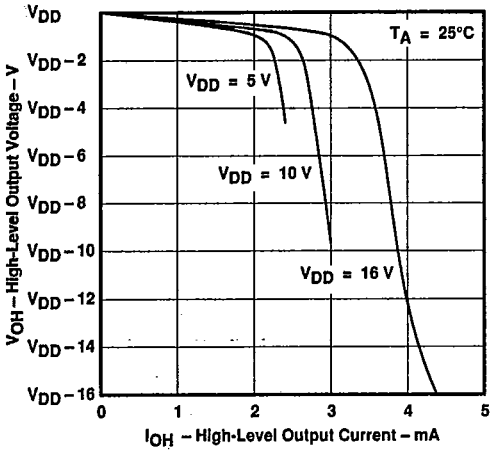

FIGURE 13

HIGH-LEVEL OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

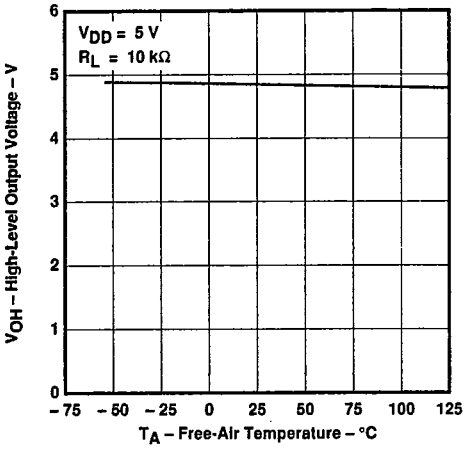

FIGURE 14

LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

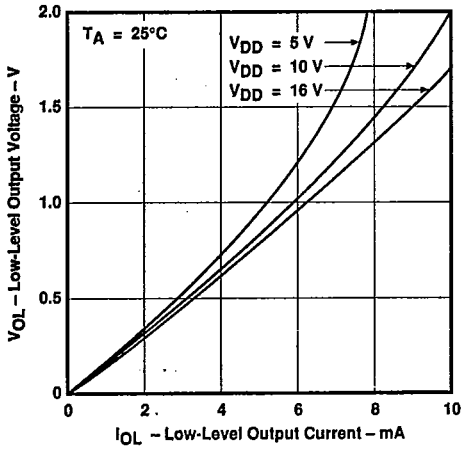

FIGURE 15

LOW-LEVEL OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

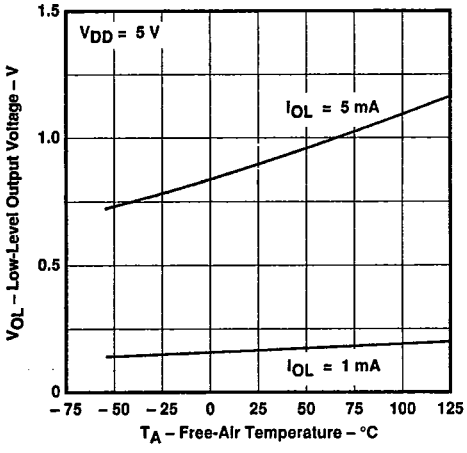

FIGURE 16

†Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

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TYPICAL CHARACTERISTICS†

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT
vs
FREQUENCY

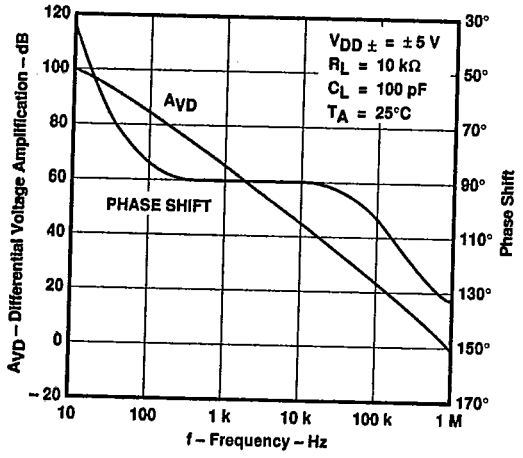

FIGURE 17

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION
vs
FREE-AIR TEMPERATURE

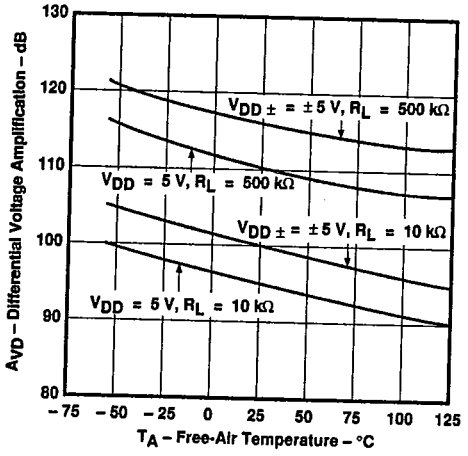

FIGURE 18

SHORT-CIRCUIT OUTPUT CURRENT
vs
SUPPLY VOLTAGE

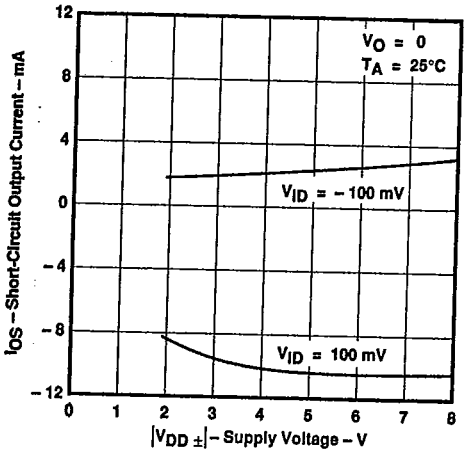

FIGURE 19

SHORT-CIRCUIT OUTPUT CURRENT
vs
FREE-AIR TEMPERATURE

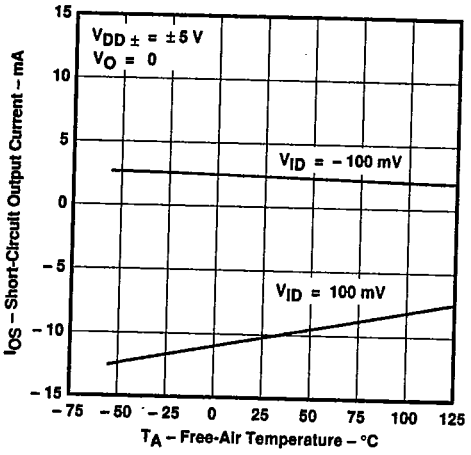

FIGURE 20

†Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

2 Operational Amplifiers

TLC2201, TLC2201A, TLC2201B
Advanced LinCMOS™ LOW-NOISE PRECISION OPERATIONAL AMPLIFIERS

TYPICAL CHARACTERISTICS†

SUPPLY CURRENT
vs
SUPPLY VOLTAGE

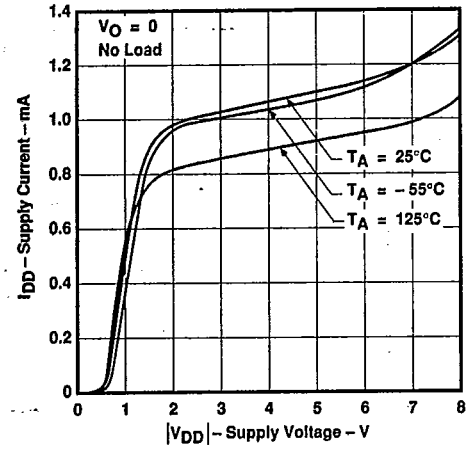

FIGURE 21

SUPPLY CURRENT
vs
FREE-AIR TEMPERATURE

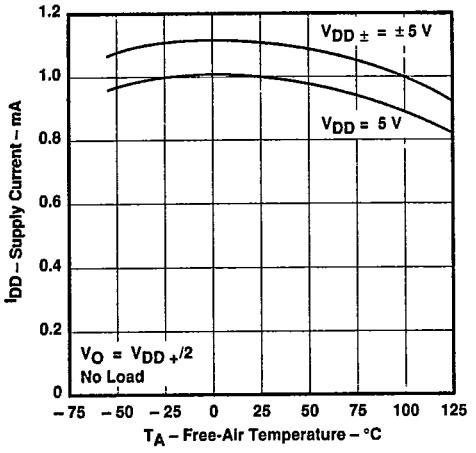

FIGURE 22

SLEW RATE
vs
SUPPLY VOLTAGE

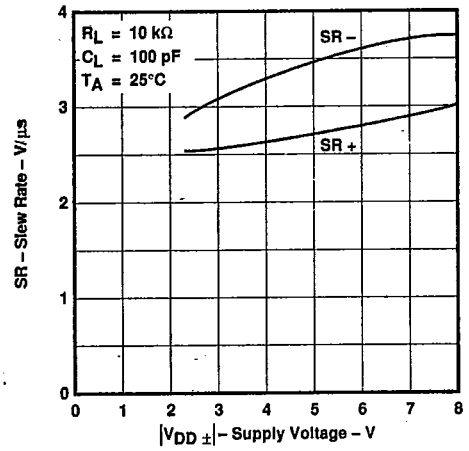

FIGURE 23

SLEW RATE
vs
FREE-AIR TEMPERATURE

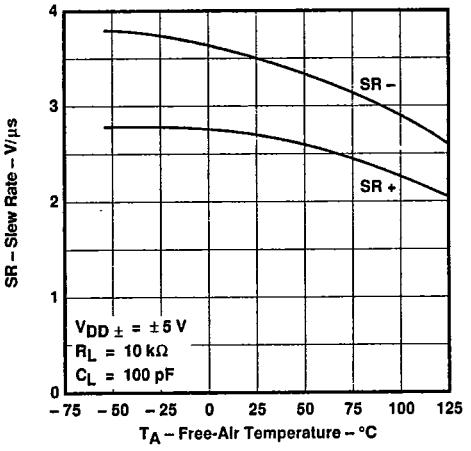

FIGURE 24

†Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

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TYPICAL CHARACTERISTICS

VOLTAGE-FOLLOWER
SMALL-SIGNAL
PULSE RESPONSE

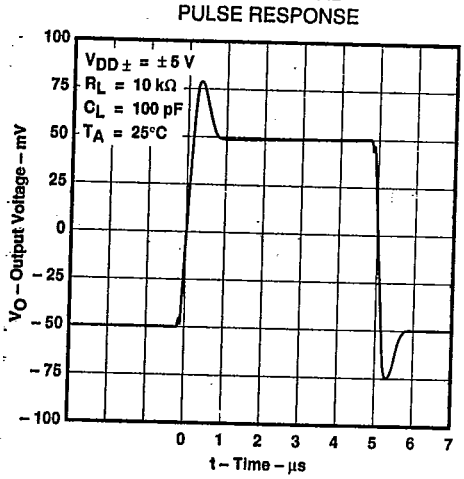

FIGURE 25

VOLTAGE-FOLLOWER
SMALL-SIGNAL
PULSE RESPONSE

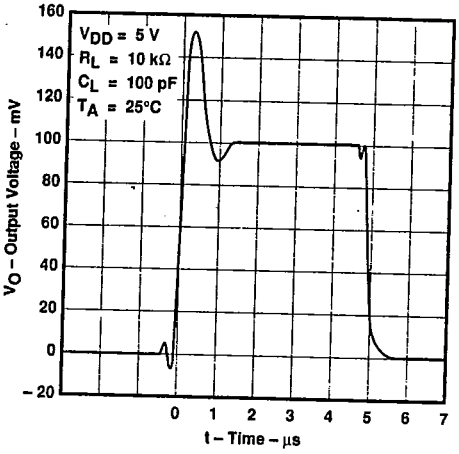

FIGURE 26

VOLTAGE-FOLLOWER
LARGE-SIGNAL
PULSE RESPONSE

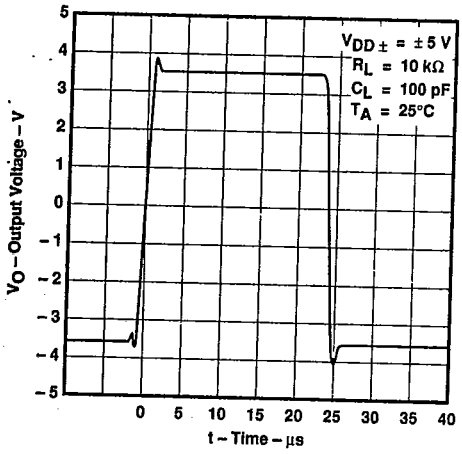

FIGURE 27

VOLTAGE-FOLLOWER
LARGE-SIGNAL
PULSE RESPONSE

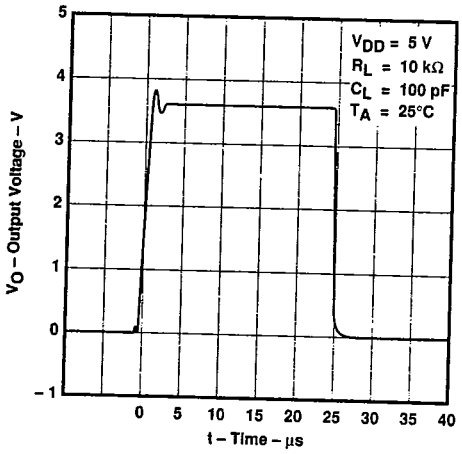

FIGURE 28

TYPICAL CHARACTERISTICS†

PEAK-TO-PEAK EQUIVALENT INPUT NOISE VOLTAGE 0.1 TO 1 Hz

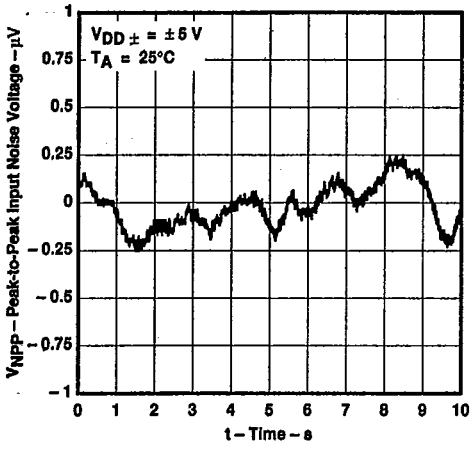

FIGURE 29

PEAK-TO-PEAK EQUIVALENT INPUT NOISE VOLTAGE 0.1 TO 10 Hz

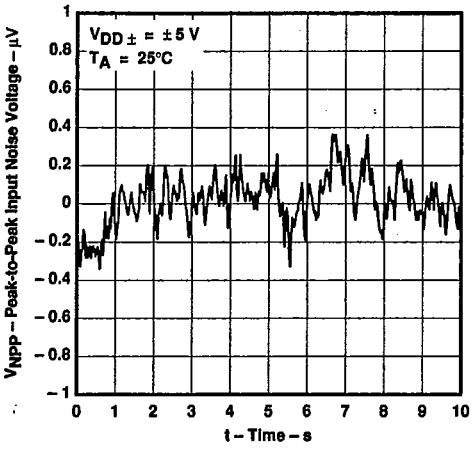

FIGURE 30

GAIN-BANDWIDTH PRODUCT VS SUPPLY VOLTAGE

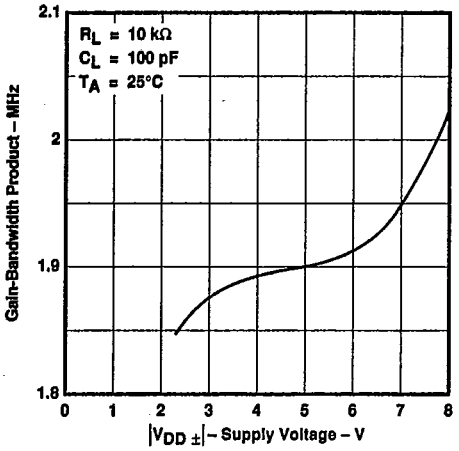

FIGURE 31

GAIN-BANDWIDTH PRODUCT VS FREE-AIR TEMPERATURE

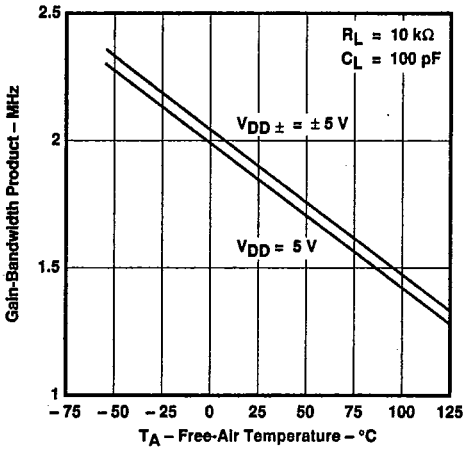

FIGURE 32

†Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

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TYPICAL CHARACTERISTICS†

PHASE MARGIN
vs
SUPPLY VOLTAGE

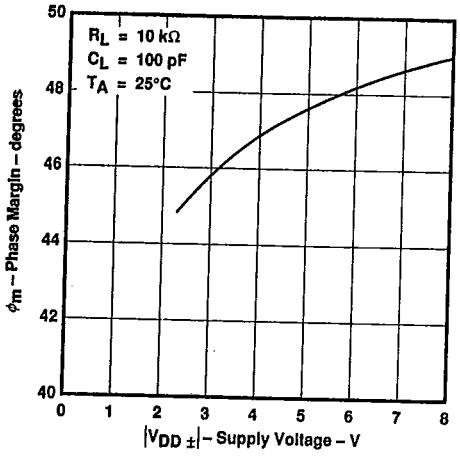

FIGURE 33

PHASE MARGIN
vs
FREE-AIR TEMPERATURE

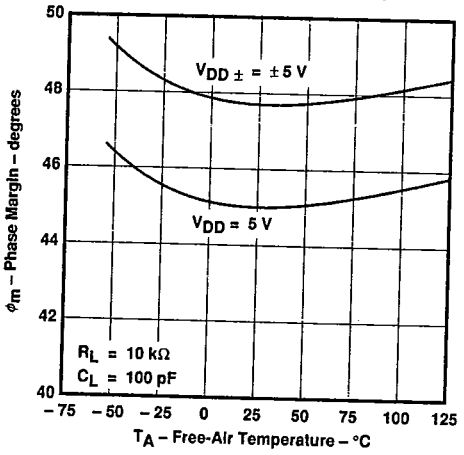

FIGURE 34

†Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

TYPICAL APPLICATION DATA

latchup avoidance

Because CMOS devices are susceptible to latchup due to their inherent parasitic thyristors, the TLC2201, TLC2201A, and TLC2201B inputs and outputs are designed to withstand –100-mA surge currents without sustaining latchup; however, techniques reducing the chance of latchup should be used whenever possible. Internal protection diodes should not be forward biased in normal operation. Applied input and output voltages should not exceed the supply voltage by more than 300 mV. Care should be exercised when using capacitive coupling on pulse generators. Supply transients should be shunted by the use of decoupling capacitors (0.1 µF typical) located across the supply rails as close to the device as possible.

electrostatic discharge protection

These devices use internal ESD protection circuits that prevent functional failures at voltages at or below 2000 V. Care should be exercised in handling these devices as exposure to ESD may result in degradation of the device parametric performance.